2024 CMS Winter Meeting

PROGRAMME

Réunion d'hiver 2024 de la SMC

November 29 - December 2
29 novembre - 2 décembre

Richmond, BC

Canadian Mathematical Society
Société mathématique du Canada

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Merci

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CRM CENTRE DE RECHERCHES MATHÉMATIQUES

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Sheraton Vancouver Airport Hotel (Friday | vendredi) | Kwantlen Polytechnic University

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8:00 - 19:30 - Registration | Inscription	7:30 - 18:00 - Registration | Inscription 8:30 - 16:30 - Poster Session Affiches 10:00 - 16:30 - Exhibits | Expositions	7:30 - 18:00 - Registration | Inscription 8:30 - 16:30 - Poster Session Affiches 10:00 - 16:30 - Exhibits | Expositions	7:30 - 18:00 - Registration | Inscription
9:00 – 12:00 CMS Mini-Courses | Mini-cours de la SMC	8:00 – 10:30 Scientific Sessions Sessions Scientifiques	8:00 – 10:30 Scientific Sessions Sessions Scientifiques	8:00 – 10:30 Scientific Sessions Sessions Scientifiques
	10:30 – 11:00 Break | Pause	10:30 – 11:00 Break | Pause	10:30 – 11:00 Break | Pause
12:30 – 17:30 CMS Board of Directors Meeting | Réunion du Conseil d'administration SMC	11:00 – 12:00 Florence Glanfield Education Plenary Lecture Conférence sur l'éducation	11:00 – 12:00 Steven Rayan Plenary Lecture Conférence plénière	11:00 – 12:00 Trevor Wooley Plenary Lecture Conférence plénière
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	12:15 - 13:30 Townhall with Dr. Marc Fortin *(VP, Research Grants and Scholarships Directorate)*		
	13:30 – 14:30 André Boileau Adrien Pouliot Prize Lecture | Conférence de Prix Adrien Pouliot	13:30 – 14:30 Michael Groechenig Coxeter-James Prize Lecture | Conférence de Prix Coxeter-James	13:30 – 14:30 **David Urbanik** Doctoral Prize Lecture| Conférence de Prix de doctorat
	14:30 – 15:00 Break | Pause ARTS 241 Foyer	14:30 – 15:00 Break | Pause ARTS 241 Foyer	14:30 – 15:00 Break | Pause ARTS 241 Foyer
17:45 – 19:00 Opening Remarks and Public Lecture **Mark Lewis (Victoria)** Conférence publique	15:00 – 18:00 Scientific Sessions Sessions Scientifiques	15:00 – 18:00 Scientific Sessions Sessions Scientifiques	15:00 – 18:00 Scientific Sessions Sessions Scientifiques
19:00 – 20:00 Welcome Reception | Réception	19:00 – 22:00 Reception and Awards Banquet Réception et Banquet de prix *Sheraton*		
20:00 – 22:00 Student Social | Soirée étudiante			

FRIDAY | VENDREDI (1/1)

#	ROOM SALLE	FRIDAY | VENDREDI AM	FRIDAY | VENDREDI PM
1	Westminster 1 (Sheraton)	Mini Course | Mini-cours : “Mathematical Modelling of Traffic Flow”	Mini Course | Mini-cours : “Continuous Optimization”
2	Westminster 2 & 3 (Sheraton)	Student Writing Workshop Atelier d’écriture des étudiants	Mini Course | Mini-cours : “Logic/Set Theory”

SATURDAY | SAMEDI (1/2)

#	ROOM | SALLE	SATURDAY | SAMEDI AM	SATURDAY | SAMEDI PM
1	Westminster 1 (Sheraton)	Descriptive Set Theory Théorie descriptive des ensembles	
2	Westminster 2/3 (Sheraton)	Computational aspects of arithmetic geometry and analytic number theory Aspects informatiques de la géométrie arithmétique et de la théorie analytique des nombres	
3	WSOD 4900	Determination and Resilience in Mathematics | Détermination et résilience en mathématiques	
4	R 1380	Algebraic Graph Theory 1 and 2 | Théorie algébrique des graphes 1 et 2	
5	R 1690	Variational Analysis: Theory and Applications | Analyse variationnelle : Théorie et applications	
6	R 1780	Algebraic Geometry | Géométrie algébrique	
7	R 2005		Desciptive Set Theory Théorie descriptive des ensembles
8	R 2060	Graph Coloring, Minors, and Hypergraphs | Coloration des graphes, mineurs et hypergraphes	
9	R 2125	Finite Fields and Applications Champs finis et applications Théorie descriptive des ensembles, logique continue et applications	
10	R 2150	Automorphic forms and number theory | Formes automorphes et théorie des nombres	
11	R 2300	Mathematics of Machine Learning | Mathématiques de l'apprentissage automatique	
12	R 2435	Recent Advances in Differential Equations and Applications Progrès récents dans le domaine des équations différentielles et de leurs applications	
13	R 2500		The Mathematics of Mathematics Education Les mathématiques de l'enseignement des mathématiques
14	R 2510		Mathematics in Business Modelling Les mathématiques dans la modélisation des entreprises

SATURDAY | SAMEDI (2/2)

#	ROOM | SALLE	SATURDAY | SAMEDI AM	SATURDAY | SAMEDI PM
15	R 2525		Operator Theory, Function Theory, and Geometry: Connections to Corona Problems and Geometric Analysis | Théorie des opérateurs, théorie des fonctions et géométrie : Connexions avec les problèmes de couronne et l'analyse géométrique
16	R 2620		Interplay between Discrete Geometry, Convexity, and Combinatorics Interaction entre la géométrie discrète, la convexité et la combinatoire
17	R 2630	Arithmetic Aspects of Galois Representations Aspects arithmétiques des représentations de Galois	
18	R 2725	From single to collective cell migration: A geometric multi-physics bulk-surface PDE approach De la migration cellulaire unique à la migration cellulaire collective : Une approche géométrique multi-physique de l'EDP de surface et de volume	
19	R 2800	Automorphic Forms of Galois Representations Formes automorphes des représentations de Galois	
20	R 3080	Harmonic Analysis and Geometric Measure Theory Analyse harmonique et théorie des mesures géométriques	
21	R 3625	Automorphic forms and representations | Formes automorphes et représentations	
22	WSOD 1950	Cayley Graphs | Graphes de Cayley	
23	WSOD 1960	Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory | Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres	
24	WSOD 2920	Geometric Analysis and PDE | Analyse géométrique et EDP	
25	WSOD 2930	Asymptotic Geometric Analysis | Analyse géométrique asymptotique	
26	WSOD 2960	Recent Progress of Stochastic Analysis and Related Fields Progrès récents de l'analyse stochastique et des domaines connexes	

SUNDAY | DIMANCHE (1/3)

#	ROOM | SALLE	SUNDAY | DIMANCHE AM	SUNDAY | DIMANCHE PM
1	WSOD 4900	Embedding Ethics in Mathematics | Intégrer l'éthique dans les mathématiques	
2	R 1380	Algebraic Graph Theory 1 and 2 | Théorie algébrique des graphes 1 et 2	
3	R 1690	Geometric quantization for young people | Quantification géométrique pour les jeunes	
4	R 1780	Incidence Problems in Analysis | Problèmes d'incidence dans l'analyse	
5	R 2005	Descriptive Set Theory | Théorie descriptive des ensembles	
6	R 2060	Applications of Dynamical Systems in Biology Applications des systèmes dynamiques en biologie	
7	R 2125	Finite Fields and Applications Champs finis et applications | Théorie descriptive des ensembles, logique continue et applications	
8	R 2150	Automorphic forms and number theory Formes automorphes et représentations	
9	R 2155	Student Research Session | Session de recherche des étudiants	
10	R 2170	Computational aspects of arithmetic geometry and analytic number theory Aspects informatiques de la géométrie arithmétique et de la théorie analytique des nombres	
11	R 2225	The Theory of Pursuit-Evasion Games | Théorie des jeux de poursuite et d'invasion	
12	R 2300	Mathematics of Machine Learning | Mathématiques de l'apprentissage automatique	
13	R 2435	Recent Advances in Differential Equations and Applications | Progrès récents dans le domaine des équations différentielles et de leurs applications	Graph Structure and Algorithms Structure des graphes et algorithmes

SUNDAY | DIMANCHE (2/3)

#	ROOM | SALLE	SUNDAY | DIMANCHE AM	SUNDAY | DIMANCHE PM
14	R 2500	Scalable learning analytics and feedback tools for large undergraduate classrooms Outils évolutifs d'analyse de l'apprentissage et de retour d'information pour les grandes classes de premier cycle universitaire	The Mathematics of Mathematics Education | Les mathématiques de l'enseignement des mathématiques
15	R 2505	Modeling, Analysis, and Computation of Variational Problems Modélisation, analyse et calcul des problèmes variationnels	
16	R 2510	Mathematics in Business Modelling Les mathématiques dans la modélisation des entreprises	
17	R 2515	Discrete Probability | Probabilité discrète	
18	R 2520	Combinatorial Designs | Designs combinatoires	
19	R 2525	Operator Theory, Function Theory, and Geometry: Connections to Corona Problems and Geometric Analysis | Théorie des opérateurs, théorie des fonctions et géométrie : Connexions avec les problèmes de couronne et l'analyse géométrique	
20	R 2530	Continuous Optimization – Algorithms, Applications, and Analysis Optimisation continue - Algorithmes, applications et analyse	
21	R 2540	Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations | Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires	
22	R 2550 A&B	Emerging Frontiers in Number Theory: Insights from early career researchers | Frontières émergentes en théorie des nombres : réflexions de chercheurs en début de carrière	
23	R 2590	Structure-Preserving Discretizations and their Applications Discrétisations préservant la structure et leurs applications	
24	R 2620	Interplay between Discrete Geometry, Convexity, and Combinatorics Interaction entre la géométrie discrète, la convexité et la combinatoire	
25	R 2630	Arithmetic Aspects of Galois Representations Aspects arithmétiques des représentations de Galois	

SUNDAY | DIMANCHE (3/3)

#	ROOM | SALLE	SUNDAY | DIMANCHE AM	SUNDAY | DIMANCHE PM
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27	R 2800	Automorphic Forms of Galois Representations Formes automorphes des représentations de Galois	
28	R 3080	Harmonic Analysis and Geometric Measure Theory Analyse harmonique et théorie des mesures géométriques	
29	R 3625	Automorphic forms and representations | Formes automorphes et représentations	
30	WSOD 1950	Optimization, Control Dynamics, and stochastics: Interplay and Applications Optimisation, contrôle, dynamique et stochastique : interaction et applications	
31	WSOD 1960	Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres	
32	WSOD 2920	Geometric Analysis and PDE | Analyse géométrique et EDP	
33	WSOD 2930	Asymptotic Geometric Analysis | Analyse géométrique asymptotique	
34	WSOD 2960	Recent Progress of Stochastic Analysis and Related Fields | Progrès récents de l'analyse stochastique et des domaines connexes	

MONDAY | LUNDI

#	ROOM | SALLE	MONDAY | LUNDI AM	MONDAY | LUNDI PM
2	R 1380	Algebraic Graph Theory 1 and 2 Théorie algébrique des graphes 1 et 2	
3	R 1690	Geometric quantization for young people | Quantification géométrique pour les jeunes	
4	R 1780	Incidence Problems in Analysis Problèmes d'incidence dans l'analyse	
5	R 2435	Graph Structure and Algorithms | Structure des graphes et algorithmes	
6	R 2530	Continuous Optimization – Algorithms, Applications, and Analysis Optimisation continue - Algorithmes, applications et analyse	
7	R 2540	Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations | Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires	
8	R 2550 A&B	Emerging Frontiers in Number Theory: Insights from early career researchers Frontières émergentes en théorie des nombres : réflexions de chercheurs en début de carrière	
9	R 3080	Harmonic Analysis and Geometric Measure Theory | Analyse harmonique et théorie des mesures géométriques	

PRESIDENT'S WELCOME LETTER

Dear Participants,

It is my pleasure to welcome you to Vancouver for the 2024 CMS Winter Meeting, hosted by Kwantlen Polytechnic University and the Faculty of Science at UBC. This meeting represents a unique opportunity for mathematical exchange, collaboration and advancement through a rich program of presentations, lectures, and discussions. Under the guidance of our scientific directors, Julia Gordon (UBC), Melissa Huggan (Vancouver Island University), and Weiran Sun (Simon Fraser University), as well as the scientific organizing committee, the conference will feature 36 sessions and three mini-courses.

The conference will kick off on Friday, November 29, with a public lecture by Mark Lewis (University of Victoria). Plenary talks will be delivered by Florence Glanfield (University of Alberta), Steven Rayan (University of Saskatchewan), and Trevor Wooley (Purdue University). Highlights of the program include a student poster session and a series of prize lectures.

During Saturday's banquet, we will celebrate notable achievements in mathematics with the presentation of the Society's awards. This winter, André Boileau (UQAM) will be honored with the Adrien Pouliot Award, Peter Taylor (Queen's University) with the Graham Wright Award, Michael Groechenig (University of Toronto) with the Coxeter-James Award, David Urbanik (IHES) with the Blair Spearman Doctoral Prize, as well as David E.V. Rose and Logan Tatham (both of University of North Carolina), Michiya Mori (University of Tokyo), and Peter Šemrl (University of Ljubljana) with the G. de B. Robinson Award. The winners of the student poster session will also be announced and celebrated during the banquet.

Organizing an event of this scale requires the dedication of many. I extend my deepest gratitude to the scientific directors, session organizers, speakers, volunteers, and CMS staff, as well as to our host institutions. Special thanks go to our generous sponsors: the Atlantic Association for Research in the Mathematical Sciences (AARMS), the Centre de recherches mathématiques (CRM), Fields Institute, Pacific Institute for the Mathematical Sciences (PIMS), Mitacs, the City of Richmond, Simon Fraser University, and the UBC Department of Mathematics.

I hope you find this meeting to be a valuable and inspiring experience. Whether you are here to present your research, network with peers, or engage with the broader mathematical community, this gathering is an opportunity to explore new ideas and make lasting connections. If you are not yet a member of the Canadian Mathematical Society, I encourage you to visit the registration desk to learn more about how you can get involved with the Society's activities throughout the year.

Best wishes for a productive and enjoyable meeting,

Barbara Csima
President, Canadian Mathematical Society

LETTRE DE BIENVENUE DE LA PRÉSIDENTE

Chers participants,

J'ai le plaisir de vous accueillir à Vancouver pour la réunion d'hiver 2024 de la SMC, accueillie par l'Université polytechnique Kwantlen et la Faculté des sciences de l'UBC. Cette réunion représente une occasion unique d'échange, de collaboration et de progrès en mathématiques grâce à un riche programme de présentations, de conférences et de discussions. Sous la direction de nos directrices scientifiques, Julia Gordon (UBC), Melissa Huggan (Vancouver Island University) et Weiran Sun (Simon Fraser University), ainsi que du comité d'organisation scientifique, la conférence comportera 36 sessions et trois mini-cours.

La conférence débutera le vendredi 29 novembre par une conférence publique de Mark Lewis (Université de Victoria). Florence Glanfield (Université de l'Alberta), Steven Rayan (Université de la Saskatchewan) et Trevor Wooley (Université de Purdue) prononceront des allocutions en séance plénière. Les points saillants du programme comprennent une séance par affiches pour les étudiants et une série de conférences de prix.

Au cours du banquet du samedi, nous célébrerons les réalisations notables en mathématiques en remettant les prix de la Société. Cet hiver, André Boileau (UQAM) recevra le prix Adrien Pouliot, Peter Taylor (Queen's University) le prix Graham Wright, Michael Groechenig (University of Toronto) le prix Coxeter-James, David Urbanik (IHES) le prix de doctorat Blair Spearman, tandis que David E. V. Rose et Logan Tatham (tous deux de l'université de Caroline du Nord), Michiya Mori (université de Tokyo) et Peter Šemrl (université de Ljubljana) recevront le prix G. de B. Robinson. Les lauréats de la session d'affiches des étudiants seront également annoncés et célébrés lors du banquet.

L'organisation d'un événement de cette envergure nécessite le dévouement de nombreuses personnes. Je tiens à exprimer ma profonde gratitude aux directrices et directeurs scientifiques, aux organisateurs de sessions, aux conférenciers, aux bénévoles et au personnel de la SMC, ainsi qu'à nos institutions d'accueil. Je remercie tout particulièrement nos généreux commanditaires : l'Association atlantique pour la recherche en sciences mathématiques (AARMS), le Centre de recherches mathématiques (CRM), le Fields Institute, le Pacific Institute for the Mathematical Sciences (PIMS), Mitacs, la ville de Richmond, l'Université Simon Fraser et le département de mathématiques de l'Université de la Colombie-Britannique (UBC).

J'espère que cette réunion sera pour vous une expérience enrichissante et inspirante. Que vous soyez ici pour présenter votre recherche, établir un réseau avec vos pairs ou vous engager avec la communauté mathématique au sens large, ce rassemblement est l'occasion d'explorer de nouvelles idées et de nouer des liens durables. Si vous n'êtes pas encore membre de la Société mathématique du Canada, je vous encourage à vous rendre au bureau d'inscription pour en savoir plus sur la façon dont vous pouvez participer aux activités de la Société tout au long de l'année.

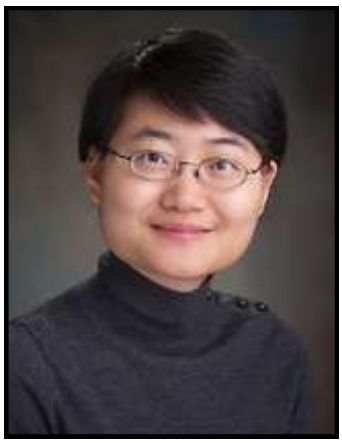
Meilleurs vœux pour une réunion productive et agréable,

Barbara Csima
Présidente, Société mathématique du Canada

SCIENTIFIC DIRECTORS' WELCOME LETTER

Julia Gordon
University of British Columbia

Melissa Huggan
Vancouver Island University



Weiran Sun
Simon Fraser University

Welcome to the 2024 Canadian Mathematical Society (CMS) Winter meeting! We are delighted to welcome you to Richmond, BC—a vibrant, multicultural coastal city known for its scenic beauty. Our sincere gratitude goes to Kwantlen Polytechnic University for graciously hosting the meeting on their campus, and to the Musqueam, Katzie, Semiahmoo, Tsawwassen, Qayqayt, Kwikwetlem, and the Kwantlen First Nation, which gifted its name to this university, for hosting us all on their unceded lands.

This gathering offers a wonderful opportunity to connect with colleagues and collaborators, meet with students, teachers, and industry professionals, and anyone who calls mathematics their passion.

We begin the meeting with a Mitacs Public lecture by Professor Mark Lewis (University of Victoria), followed by a reception. Over the next three days three plenary and three prize lectures are bound to inspire. This year we have a record number of 40 parallel sessions, scientific and education, for everyone to enjoy over the course of the meeting. They encompass a rich and stimulating spectrum of classical and emerging topics, including algebraic geometry, number theory, analysis, discrete mathematics, differential equations, stochastic analysis, numerical computation, mathematical biology, mathematical machine learning and mathematics of business models. We hope many will also join us for the Townhall with NSERC on Saturday, as well as celebrate the prize speakers at the reception and awards banquet on Saturday evening.

The CMS student committee has planned several exciting opportunities for students to participate in the meeting. A writing workshop is being hosted to kick-off the meeting on Friday morning, and in the evening a student social will be taking place. Over Saturday and Sunday, there will be an AARMS-CMS poster session and a student research session on Sunday – come out and support student researchers!

We would like to pass along a heartfelt thank you to the scientific organizing committee (Jason Bramburger, Andrijana Burazin, Clifton Cunningham, Karen Gunderson, Alia Hamieh, Jessica Lin, Joshua Zahl), the scientific and education session organizers, and mini-course hosts. Collective efforts from everyone went into planning this event and we are truly grateful for everyone's hard work. A special thank you to the CMS staff who worked very hard behind the scenes to make these events possible and an immense thank you to our sponsors for supporting the meeting.

We thank you for attending and wish you a fantastic time!

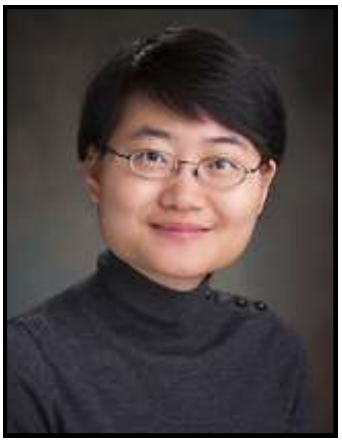
The Scientific Directors

Julia Gordon (University of British Columbia)
Melissa Huggan (Vancouver Island University)
Weiran Sun (Simon Fraser University)

LETTRE DE BIENVENUE DES DIRECTRICES SCIENTIFIQUES

Julia Gordon
University of British Columbia

Melissa Huggan
Vancouver Island University



Weiran Sun
Simon Fraser University

Bienvenue à la réunion d'hiver 2024 de la Société mathématique du Canada (SMC) ! Nous sommes ravies de vous accueillir à Richmond, en Colombie-Britannique, une ville côtière dynamique et multiculturelle reconnue pour la beauté de ses paysages. Nous remercions sincèrement l'Université polytechnique Kwantlen d'avoir gracieusement accueilli la réunion sur son campus, ainsi que les Musqueam, Katzie, Semiahmoo, Tsawwassen, Qayqayt, Kwikwetlem et la Première nation Kwantlen, qui a donné son nom à cette université, de nous accueillir sur leurs terres non cédées.

Ce rassemblement offre une merveilleuse occasion de nouer des liens avec des collègues et des collaborateurs, de rencontrer des étudiants, des enseignants et des professionnels de l'industrie, ainsi que tous ceux qui appellent les mathématiques leur passion.

Nous commençons la réunion par une conférence publique Mitacs donnée par le professeur Mark Lewis (Université de Victoria), suivie d'une réception. Au cours des trois jours suivants, trois conférences plénières et trois conférences de prix ne manqueront pas d'inspirer les participants. Cette année, nous avons un nombre record de 40 sessions parallèles, scientifiques et d'éducation, dont tout le monde pourra profiter au cours de la réunion. Elles englobent un éventail riche et stimulant de sujets classiques et émergents, notamment la géométrie algébrique, la théorie des nombres, l'analyse, les mathématiques discrètes, les équations différentielles, l'analyse stochastique, le calcul numérique, la biologie mathématique, l'apprentissage automatique des mathématiques et les mathématiques des modèles d'entreprise. Nous espérons que vous serez nombreux à vous joindre à nous pour la séance de discussion ouverte avec le CRSNG le samedi, et à fêter les lauréats lors de la réception et du banquet de remise des prix le samedi soir.

Le comité des étudiants de la SMC a prévu plusieurs occasions passionnantes pour les étudiants qui participeront à la réunion. Un atelier d'écriture sera organisé pour lancer la réunion le vendredi matin, et dans la soirée, une soirée étudiante aura lieu. Samedi et dimanche, il y aura une session d'affiches de l'AARMS-SMC et une session de recherche pour les étudiants le dimanche - venez soutenir les étudiants chercheurs !

Nous tenons à remercier chaleureusement le comité d'organisation scientifique (Jason Bramburger, Andrijana Burazin, Clifton Cunningham, Karen Gunderson, Alia Hamieh, Jessica Lin, Joshua Zahl), les organisateurs des sessions scientifiques et d'éducation, ainsi que les hôtes des mini-cours. Les efforts collectifs de chacun ont permis de planifier cet événement et nous sommes vraiment reconnaissants pour le travail acharné de tous. Nous remercions tout particulièrement le personnel de la SMC qui a travaillé d'arrache-pied dans les coulisses pour rendre ces événements possibles et nous remercions infiniment nos commanditaires pour le soutien qu'ils ont apporté à la réunion.

Nous vous remercions de votre participation et vous souhaitons de passer un excellent moment !

Les directrices scientifiques

Julia Gordon (University of British Columbia)
Melissa Huggan (Vancouver Island University)
Weiran Sun (Simon Fraser University)

THE SCIENTIFIC ORGANIZING COMMITTEE
LE COMITÉ SCIENTIFIQUE ORGANISATEUR

Jason Bramburger
Concordia University

Andrijana Burazin
U of T Mississauga
Education Representative
Représentante de l'éducation

Clifton Cunningham
University of Calgary

Karen Gunderson
University of Manitoba

Alia Hamieh
UNBC

Jessica Lin
McGill University

Joshua Zahl
UBC

Thank you!
Merci !

Canadian Mathematical Society
Société mathématique du Canada

CLASS OF FELLOWS 2024
COHORTE 2024 DES FELLOWS

Congratulations

to the 2024 CMS Class of Fellows

Dr. Sue Ann Campbell

Dr. Edward Doolittle

Dr. Robert Jerrard

Dr. Yael Karshon

Félicitations

à la cohorte 2024 des Fellows de la SMC

2024 COXETER-JAMES PRIZE

The CMS is pleased to announce that Dr. Michael Groechenig (University of Toronto) has been named the recipient of the 2024 Coxeter-James Prize for his outstanding contributions to arithmetic and algebraic geometry.

Dr. Groechenig obtained his BSc in Mathematics from ETH Zurich (2009) and his PhD in Mathematics at the University of Oxford in 2013. In 2018, he transitioned to the University of Toronto where he worked as an Assistant Professor until 2023, when he was promoted to Associate Professor (with tenure).

Dr. Groechenig's fields of interest include algebraic and arithmetic geometry, moduli spaces of Higgs bundles and flat connections, p-adic integration, and K-theory.

In his second paper titled "Hilbert schemes as moduli of Higgs bundles and local systems", Dr. Groechenig employed advanced geometric methods, primarily drawing on derived categories of sheaves and occasionally delving into more intricate aspects of derived algebraic geometry. Through these sophisticated techniques, he successfully validated the elegant conjectures put forth by Boalch, which had been inspired, in part, by the prior insights of mathematical physicists Gorsky, Nekrasov, and Rubtsov.

In a collaborative publication (with Wyss and Ziegler) on p-adic integration, Dr. Groechenig substantiated a conjecture proposed by Hausel and Thaddeus. This conjecture posited an equivalence of stringy Hodge numbers between two separate moduli spaces.

The higher K-groups represent crucial invariants within the realm of cohomological assertions, yet they persist as enigmatic entities, proving challenging to grasp explicitly or generate specific elements. Nevertheless, Dr. Groechenig, together with Braunling, has recently accomplished a significant milestone by demonstrating the existence of non-torsion classes. This achievement marks a pivotal initial stride toward understanding these objects.

Dr. Groechenig's most notable achievement to date involves his collaborative work with Esnault (2020) on rigid local systems. In their groundbreaking contribution, they substantiate a consequence of Simpson's conjecture, demonstrating that irreducible cohomologically rigid connections on a smooth projective variety are integral. Additionally, they extend Grothendieck's p-curvature conjecture by proving new cases. What sets their approach apart is the striking methodology employed – despite the conjecture residing solely within the realm of complex geometry, they navigate through arithmetic to establish its validity. Impressively, their results have garnered recognition from experts and have already found other significant applications.

In addition to the aforementioned contributions, Dr. Groechenig has (co-) authored over 20 publications, establishing an extensive portfolio of high-impact achievements and fundamental outcomes. Moreover, he has garnered recognition through various grants and fellowships, including a Marie Sklodowska-Curie individual fellowship, an NSERC Discovery Grant, and an Alfred P. Sloan fellowship.

In summary, Dr. Groechenig emerges as a dynamic and brilliant early-career mathematician, whose innovative ideas exert a profound influence across a broad spectrum of mathematical domains. The CMS is proud to award him the 2024 Coxeter-James Prize and eagerly anticipates witnessing the evolution of his career in the coming years.

PRIX COXETER-JAMES 2024

La SMC a le plaisir d'annoncer que le Dr. Michael Groechenig (Université de Toronto) a été nommé lauréat du prix Coxeter-James 2024 pour ses contributions exceptionnelles à l'arithmétique et à la géométrie algébrique.

Le Dr. Groechenig a obtenu son BSc en mathématiques à l'ETH Zurich (2009) et son doctorat en mathématiques à l'Université d'Oxford en 2013. En 2018, il est passé à l'Université de Toronto où il a travaillé en tant que professeur adjoint jusqu'en 2023, date à laquelle il a été promu professeur agrégé (avec permanence).

Les domaines d'intérêt du Dr. Groechenig comprennent la géométrie algébrique et arithmétique, les espaces de modules des fibrés de Higgs et des connexions sans torsion, l'intégration p-adique et la K-théorie.

Dans son deuxième article intitulé « Hilbert schemes as moduli of Higgs bundles and local systems », le Dr. Groechenig a utilisé des méthodes géométriques avancées, en s'appuyant principalement sur les catégories dérivées de faisceaux et en plongeant occasionnellement dans des aspects plus complexes de la géométrie algébrique dérivée. Grâce à ces techniques sophistiquées, il a réussi à valider les élégantes conjectures avancées par Boalch, qui avaient été inspirées, en partie, par les idées antérieures des physiciens mathématiciens Gorsky, Nekrasov et Rubtsov.

Dans une publication en collaboration (avec Wyss et Ziegler) sur l'intégration p-adique, le Dr. Groechenig a étayé une conjecture proposée par Hausel et Thaddeus. Cette conjecture postulait une équivalence des nombres de Hodge filiformes entre deux espaces de modules distincts.

Les groupes K supérieurs représentent des invariants cruciaux dans le domaine des assertions cohomologiques, mais ils restent des entités énigmatiques, difficiles à appréhender explicitement ou à générer des éléments spécifiques. Néanmoins, le Dr. Groechenig, en collaboration avec Braunling, a récemment franchi une étape importante en démontrant l'existence de classes sans torsion. Cette avancée marque un premier pas décisif vers la compréhension de ces objets.

La réalisation la plus remarquable du Dr. Groechenig à ce jour est son travail en collaboration avec Esnault (2020) sur les systèmes locaux rigides. Dans leur contribution révolutionnaire, ils justifient une conséquence de la conjecture de Simpson, démontrant que les connexions irréductibles cohomologiquement rigides sur une variété projective lisse sont intégrales. De plus, ils étendent la conjecture de Grothendieck sur la p-courbure en prouvant de nouveaux cas. Ce qui distingue leur approche, c'est la méthodologie frappante qu'ils emploient – bien que la conjecture relève uniquement du domaine de la géométrie complexe, ils naviguent à travers l'arithmétique pour établir sa validité. De manière impressionnante, leurs résultats ont été reconnus par des experts et ont déjà trouvé d'autres applications significatives.

En plus des contributions susmentionnées, le Dr. Groechenig a (co-)rédigé plus de 20 publications, établissant ainsi un vaste portefeuille de réalisations à fort impact et de résultats fondamentaux. En outre, il a été récompensé par diverses subventions et bourses, notamment une bourse individuelle Marie Sklodowska-Curie, une subvention à la découverte du CRSNG et une bourse Alfred P. Sloan.

En résumé, le Dr. Groechenig émerge comme un mathématicien dynamique et talentueux en début de carrière, dont les idées novatrices exercent une profonde influence sur un large éventail de domaines mathématiques. La SMC est fière de lui décerner le prix Coxeter-James 2024 et attend avec impatience d'être témoin de l'évolution de sa carrière dans les années à venir.

2024 BLAIR SPEARMAN DOCTORAL PRIZE

The CMS is pleased to announce that Dr. David Urbanik (Institut des Hautes Études Scientifiques) has been named the 2024 CMS Blair Spearman Doctoral Prize recipient. This prize was inaugurated to recognize outstanding performance by a doctoral student who graduated from a Canadian university.

Dr. Urbanik earned his PhD in Mathematics at the University of Toronto under the supervision of Dr. Jacob Tsimerman, who regards Urbanik as “the strongest graduate student [he has] had”. Dr. Urbanik’s research builds upon recent groundbreaking advancements in Hodge theory, infused with a distinctive arithmetic perspective. This approach has yielded fascinating results on algebraic cycles within the realm of arithmetic geometry, showcased both in his thesis and in his other publications.

Dr. Urbanik’s thesis work successfully establishes a new and direct pathway from complex analysis to arithmetic over finite fields. His thesis proves a finiteness result on arithmetic cycles over finite fields, demonstrating uniformity across primes—a feat deemed unattainable until recently.

The central theorem of Dr. Urbanik’s thesis is connected to a significant recent result of Baldi-Klingler-Ullmo. In their work, they establish that for polarized variations of Hodge structures with level of at least 3, the union of all positive-dimensional components of the Noether-Lefschetz locus—specifically, the locus of complex points in the base containing Hodge classes unable to be lifted to the geometric generic fiber—is not Zariski-dense.

Dr. Urbanik proves a modified version of this theorem (with an additional monodromy assumption) that extends to an arithmetic base *S*. For example, under similar conditions, if S is a finite type scheme over Z, Urbanik demonstrates that there exists only a finite number of primes p for which there is a positive-dimensional subscheme of the reduction *Sp* of *S* modulo *p*, over which X exhibits a family of algebraic cycles unable to be lifted to the generic fiber of X over *S*. In a more general context, Urbanik proves the non-Zariski density of the union of those components *C* within the locus in *S* where additional algebraic cycles emerge, with *C* having positive dimension over a prime.

During his graduate studies, Dr. Urbanik demonstrated remarkable productivity, evidenced by numerous published papers. For instance, in a paper published in Journal of Differential Geometry, Dr. Urbanik delves into the question of whether images of period maps can be defined over number fields, culminating in an elegant finding: when S is smooth and S’ is replaced by its normalization, everything is indeed defined over number fields. Urbanik employs a sophisticated approach, amalgamating pivotal results such as Ax-Schanuel for variations of Hodge structures and the algebraicity of period map images, alongside ingenious constructions on algebraic groups. His strategy combines the fact that Shimura varieties are defined over a number field together with the same fact for certain equivalence relations defined by local lifts of the period map to the period domain. Central to this paper, as in Urbanik’s thesis, is the utilization of jet bundles, showcasing their efficacy in a variety of contexts.

In summary, Dr. Urbanik’s thesis represents a significant breakthrough in a challenging yet crucial domain. The methodologies forged within his thesis, as well as across his other contributions, are poised to yield numerous significant applications within the realm of arithmetic Hodge theory. The CMS is proud to award Dr. David Urbanik with the 2024 Blair Spearman Doctoral Prize.

PRIX DOCTORAL BLAIR SPEARMAN 2024

La SMC a le plaisir d'annoncer que le Dr David Urbanik (Institut des Hautes Études Scientifiques) a été nommé lauréat du prix de doctorat Blair Spearman de la SMC pour 2024. Ce prix a été inauguré pour reconnaître la performance exceptionnelle d'un doctorant diplômé d'une université canadienne.

Le Dr Urbanik a obtenu son doctorat en mathématiques à l'Université de Toronto sous la supervision du Dr Jacob Tsimerman. Les recherches du Dr Urbanik s'appuient sur les récentes avancées révolutionnaires de la théorie de Hodge, imprégnées d'une perspective arithmétique distinctive. Cette approche a donné lieu à des résultats fascinants sur les cycles algébriques dans le domaine de la géométrie arithmétique, présentés à la fois dans sa thèse et dans ses autres publications.

Le travail de thèse du Dr Urbanik établit avec succès une nouvelle voie directe de l'analyse complexe à l'arithmétique sur les corps finis. Sa thèse prouve un résultat de finitude sur les cycles arithmétiques sur les corps finis, démontrant l'uniformité à travers les nombres premiers – un exploit considéré comme inaccessible jusqu'à récemment.

Le théorème central de la thèse du Dr Urbanik est lié à un important résultat récent de Baldi-Klingler-Ullmo. Dans leur travail, ils établissent que pour les variations polarisées des structures de Hodge avec un niveau d'au moins 3, l'union de toutes les composantes de dimension positive du lieu de Noether-Lefschetz – plus précisément, le lieu des points complexes dans la base contenant des classes de Hodge incapables d'être élevées à la fibre géométrique générique – n'est pas Zariski-dense.

Le Dr Urbanik prouve une version modifiée de ce théorème (avec une hypothèse de monodromie supplémentaire) qui s'étend à une base arithmétique *S*. Par exemple, dans des conditions similaires, si S est un schéma de type fini sur Z, le Dr Urbanik démontre qu'il n'existe qu'un nombre fini de nombres premiers p pour lesquels il existe un sous-schéma de dimension positive de la réduction *Sp* de *S* modulo *p*, sur lequel X présente une famille de cycles algébriques incapables d'être élevés à la fibre générique de X sur *S*. Dans un contexte plus général, Urbanik prouve la densité non-Zariski de l'union des composantes *C* à l'intérieur du lieu dans *S* où des cycles algébriques supplémentaires émergent, avec *C* ayant une dimension positive sur un nombre premier.

Au cours de ses études supérieures, le Dr Urbanik a fait preuve d'une productivité remarquable. Par exemple, dans un article publié dans le *Journal of Differential Geometry*, le Dr Urbanik se penche sur la question de savoir si les images des cartes périodiques peuvent être définies sur des corps de nombres, et aboutit à une conclusion élégante : lorsque S est lisse et que S' est remplacé par sa normalisation, tout est en effet défini sur des corps de nombres. Urbanik utilise une approche sophistiquée, amalgamant des résultats essentiels tels que Ax-Schanuel pour les variations des structures de Hodge et l'algébricité des images des cartes périodiques, ainsi que des constructions ingénieuses sur les groupes algébriques. Sa stratégie combine le fait que les variétés de Shimura sont définies sur un corps de nombres avec le même fait pour certaines relations d'équivalence définies par des levées locales de la carte de période sur le domaine de période. Au centre de cet article, comme dans la thèse d'Urbanik, se trouve l'utilisation des faisceaux de jets, dont l'efficacité est démontrée dans une variété de contextes.

En résumé, la thèse du Dr Urbanik représente une avancée significative dans un domaine difficile mais crucial. Les méthodologies élaborées dans le cadre de sa thèse, ainsi que ses autres contributions, sont susceptibles de déboucher sur de nombreuses applications significatives dans le domaine de la théorie arithmétique de Hodge. La SMC est fière de décerner au Dr David Urbanik le prix de doctorat Blair Spearman 2024.

2024 GRAHAM WRIGHT AWARD

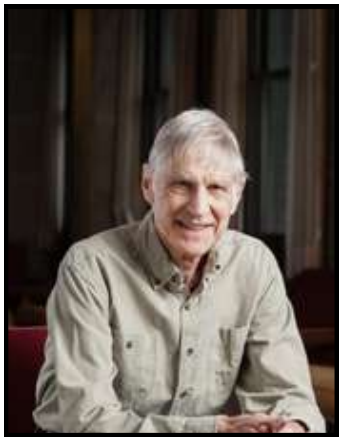
The CMS is pleased to announce that Dr. Peter Taylor (Queen's University) has been named the recipient of the 2024 Graham Wright Award for Distinguished Service. This award was inaugurated to recognize individuals who have made sustained and significant contributions to the Canadian mathematical community and, in particular, to the Canadian Mathematical Society.

Dr. Taylor obtained his B.A. and M.A. from Queen's University, before completing his Ph.D. at Harvard in 1969. He has primarily worked at Queen's University, holding diverse roles such as Professor, Teaching Fellow, and Department Head. He is currently a Professor of Mathematics and Statistics at Queen's University, where he also holds cross appointments in the Department of Biology and in the Faculty of Education. Beyond his teaching responsibilities, Dr. Taylor has mentored numerous graduate students and post-doctoral fellows and contributed to various university and professional committees. He has been an active member of the CMS since 1973 and has secured research grants from NSERC, KNAER, The Fields Institute, and SSHRC, among others. His commitment to research is evident through editorial roles held since 1990 and a prolific publication record in refereed journals.

As mentioned above, Dr. Taylor has made significant contributions to the CMS over the past five decades, participating in various committees and attending numerous meetings. He also serves as a leader for Education Sessions at CMS Meetings, offering guidance and coordination. Beyond his involvement with the CMS, Dr. Taylor plays a pivotal role in math education across Canada. He helped establish the Canadian Mathematics Education Study Group (CMESG), the Canadian Math Ed Forum (CMEF), and the Ontario Association for Mathematics Education (OAME) and was instrumental in initiating math education initiatives at the Fields Institute. These organizations collectively address teaching from kindergarten to graduate studies, forging essential ties for the CMS. Dr. Taylor has done path-breaking work on the school mathematics curriculum, particularly at the high school level. Recognizing that the key to successful implementation of a curriculum is to have qualified teachers, he has developed highly effective professional development seminars and workshops for elementary and high school teachers. His approach to curriculum and teacher education is informed by innovative concepts such as structure, beauty, design, construction, algorithms, and coding, to mention a few.

In summary, Dr. Taylor's illustrious career, spanning from his leadership within the CMS, to his instrumental role in shaping math education initiatives nationwide, underscores his enduring commitment to fostering excellence in all mathematical aspects. The CMS is proud to acknowledge Dr. Taylor's remarkable achievements, thanks him for all his years of service thus far, and looks forward to continuing collaboration with him.

PRIX GRAHAM WRIGHT 2024



La SMC a le plaisir d'annoncer que le Dr Peter Taylor (Université Queen's) a été nommé lauréat du Prix Graham Wright 2024 pour service méritoire. Ce prix a été inauguré pour reconnaître les personnes qui ont apporté une contribution soutenue et importante à la communauté mathématique canadienne et, en particulier, à la Société mathématique du Canada.

Le Dr Taylor a obtenu son B.A. et son M.A. à l'université Queen's, avant de compléter son doctorat à Harvard en 1969. Il a principalement travaillé à l'université Queen's, où il a occupé divers postes tels que professeur, chargé de cours et chef de département. Il est actuellement professeur de mathématiques et de statistiques à l'université Queen's, où il occupe également des fonctions conjointes au département de biologie et à la faculté d'éducation. Outre ses responsabilités en matière d'enseignement, le Dr Taylor a encadré de nombreux étudiants diplômés et boursiers postdoctoraux et a participé à divers comités universitaires et professionnels. Il est un membre actif de la SMC depuis 1973 et a obtenu des subventions de recherche du CRSNG, du KNAER, du Fields Institute et du CRSH, entre autres. Son engagement dans la recherche se manifeste par les rôles éditoriaux qu'il occupe depuis 1990 et par un nombre prolifique de publications dans des revues arbitrées.

Comme indiqué ci-dessus, le Dr Taylor a apporté une contribution importante à la SMC au cours des cinq dernières décennies, en participant à divers comités et en assistant à de nombreuses réunions. Il joue également un rôle prépondérant dans les sessions sur l'éducation lors des réunions de la SMC, en offrant des conseils et de la coordination. Au-delà de son engagement au sein de la SMC, le Dr Taylor joue un rôle essentiel dans l'enseignement des mathématiques au Canada. Il a contribué à la création du Groupe d'étude canadien sur l'enseignement des mathématiques (GECEM), du Forum canadien sur l'enseignement des mathématiques (FCEM) et de l'Association ontarienne pour l'enseignement des mathématiques (AEM), et a joué un rôle déterminant dans le lancement d'initiatives en matière d'enseignement des mathématiques à l'Institut Fields. Ces organisations traitent collectivement de l'enseignement de la maternelle aux études supérieures, forgeant ainsi des liens essentiels pour la SMC. Le Dr Taylor a réalisé des travaux novateurs sur les programmes scolaires de mathématiques, en particulier au niveau du secondaire. Conscient que la clé de la réussite de la mise en œuvre d'un programme d'études réside dans la qualification des enseignants, il a mis au point des séminaires et des ateliers de développement professionnel très efficaces à l'intention des enseignants du primaire et du secondaire. Son approche des programmes et de la formation des enseignants s'appuie sur des concepts novateurs tels que la structure, la beauté, la conception, la construction, les algorithmes et le codage, pour n'en citer que quelques-uns.

En résumé, l'illustre carrière du Dr Taylor, qui s'étend de son leadership au sein de la SMC à son rôle déterminant dans l'élaboration d'initiatives en matière d'enseignement des mathématiques à l'échelle nationale, souligne son engagement permanent à promouvoir l'excellence dans tous les aspects des mathématiques. La SMC est fière de reconnaître les réalisations remarquables du Dr Taylor, le remercie pour toutes les années de service qu'il a passées jusqu'à présent et se réjouit de poursuivre sa collaboration avec lui.

2024 ADRIEN POULIOT AWARD

The CMS is pleased to announce that Dr. André Boileau (UQAM) is the recipient of the 2024 Adrien Pouliot Award in recognition of his outstanding contribution to mathematics education.

Dr. André Boileau obtained his PhD in mathematics, with a specialization in mathematical logic, from the Université de Montréal in 1977. He subsequently joined the Department of Mathematics at UQAM, where he contributed to the didactic section. As a full professor, he designed and taught nearly 50 different courses in mathematics teacher training programs. Dr. Boileau retired in 2013.

Throughout his career, Dr. Boileau has distinguished himself by his creativity and innovative spirit. In 1983, with the help of his colleague Jean-Baptiste Lapalme, he designed from the ground up courses for the Certificat d'Informatique Appliquée à l'Enseignement (CIAE) (Certificate in Computer Science Applied to Teaching). Aimed at high school math and science teachers, this certificate was designed to train computer science teachers and promote the integration of computer science applications in Quebec schools. Later, during a Quebec government reform, mathematics teachers were required to take additional disciplinary training, either in computer science or in the physical sciences. At UQAM, Dr. Boileau was put in charge of the computer science option of this new BESmaths program, comprising ten computer science courses of 3 credits each. In 2002, the Quebec government rescinded its decision to provide bi-disciplinary training for high school math teachers. Dr. Boileau designed, structured and supervised the MAT1812, MAT3812 and MAT4812 courses to compensate for the removal of the computer science option from the program. Finally, UQAM's mathematics teacher training program also owes credit to Dr. Boileau for the design of MAT2700, MAT2005, MAT3005 and MAT3106, courses designed to maximize students' learning both in terms of their training and their relationship with mathematics.

Dr. Boileau has also made a significant contribution to research, as evidenced by his numerous publications on the use of technology in mathematics teaching. He has also been and continues to be a regular speaker at conferences organized by the GRMS (*Groupe des responsables de la mathématique au secondaire*) and the AMQ (*Association mathématique du Québec*).

Today, Dr. Boileau remains deeply committed to exploring the possibilities offered by computers in mathematics education. He continues to design and develop powerful tools that he shares on his website, such as the P5Visuel interface he created. This "block" programming environment also facilitates the transition to more "classical" programming, and integrates features for web programming, dynamic geometry, turtle geometry and symbolic calculation.

In summary, Dr. Boileau is passionately committed to the teaching of mathematics, particularly through the integration of technology. The originality of his contributions and his influence on many teachers throughout his career make him a pillar of mathematics didactics in Quebec and across Canada. The CMS is proud to present him with the 2024 Adrien Pouliot Award.

PRIX ADRIEN POULIOT 2024

La SMC a le plaisir d'annoncer que le Dr André Boileau (UQAM) est le lauréat du prix Adrien Pouliot 2024 en reconnaissance de sa contribution exceptionnelle à l'enseignement des mathématiques.

Le Dr André Boileau a obtenu son doctorat en mathématiques, avec une spécialisation en logique mathématique, à l'Université de Montréal en 1977. Par la suite, il a rejoint le Département de mathématiques de l'UQAM, où il a contribué à la section didactique. En tant que professeur titulaire, il a conçu et dispensé près de 50 cours différents dans le cadre des programmes de formation des enseignants de mathématiques. Le Dr Boileau est à la retraite depuis 2013.

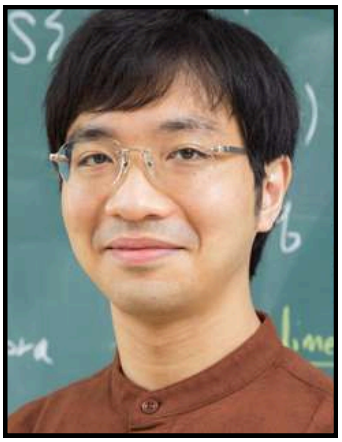
Au cours de sa carrière, le Dr Boileau s'est démarqué par sa créativité et son esprit novateur. En 1983, avec l'aide de son collègue Jean-Baptiste Lapalme, il a conçu de toutes pièces les cours du Certificat d'Informatique Appliquée à l'Enseignement (CIAE). Destiné aux enseignants de mathématiques et de sciences au secondaire, ce certificat visait à former des professeurs d'informatique et à promouvoir l'intégration des applications pédagogiques de l'informatique dans les écoles québécoises. Plus tard, lors d'une réforme du gouvernement québécois, les enseignants de mathématiques ont été obligés de suivre une formation disciplinaire supplémentaire, soit en informatique, soit en sciences physiques. À l'UQAM, le Dr Boileau a été chargé de l'option informatique de ce nouveau programme BESmaths, comprenant dix cours d'informatique de 3 crédits chacun. En 2002, le gouvernement du Québec a annulé sa décision d'une formation bi-disciplinaire pour les enseignants de mathématiques au secondaire. Le Dr Boileau a alors conçu, structuré et supervisé les cours MAT1812, MAT3812 et MAT4812 pour pallier la suppression de l'option informatique du programme. Finalement, le programme de formation en enseignement des mathématiques de l'UQAM doit également au Dr Boileau la conception des cours MAT2700, MAT2005, MAT3005 et MAT3106, conçus pour maximiser l'apprentissage des étudiants tant sur le plan de leur formation que sur celui de leur relation avec les mathématiques.

Le Dr Boileau a également apporté une contribution significative à la recherche, comme en témoignent ses nombreuses publications sur l'utilisation des technologies dans l'enseignement des mathématiques. Par ailleurs, il a toujours été et continue d'être un intervenant régulier aux congrès du GRMS (Groupe des responsables de la mathématique au secondaire) ainsi qu'à ceux de l'AMQ (Association mathématique du Québec).

Le Dr Boileau reste aujourd'hui très engagé dans l'exploration des possibilités offertes par l'informatique dans l'enseignement des mathématiques. Il continue à concevoir et développer des outils performants qu'il partage sur son site Web, tels que l'interface P5Visuel qu'il a créée. Cet environnement de programmation « par blocs » facilite également la transition vers la programmation plus « classique » et intègre des fonctionnalités pour la programmation web, la géométrie dynamique, la géométrie de la tortue et le calcul symbolique.

En résumé, le Dr Boileau se consacre passionnément à l'enseignement des mathématiques, notamment à travers l'intégration des technologies. L'originalité de ses contributions et son influence sur de nombreux enseignants tout au long de sa carrière font de lui un pilier de la didactique des mathématiques au Québec et à travers le Canada. La SMC est fière de lui décerner le prix Adrien Pouliot 2024.

2024 G. DE B. ROBINSON AWARD



Dr. Michiya Mori

Dr. Peter Šemrl

Dr. David E. V. Rose

Dr. Logan Tatham

The CMS is pleased to announce Dr. Michiya Mori (The University of Tokyo) & Dr. Peter Šemrl (University of Ljubljana), as well as Dr. David E. V. Rose & Dr. Logan Tatham (both University of North Carolina) as the joint recipients of the 2024 G. de B. Robinson Award. This award was inaugurated to recognize the publication of excellent papers in the Canadian Journal of Mathematics (CJM) and the Canadian Mathematical Bulletin (CMB) and to encourage the submission of the highest quality papers to these journals.

Dr. Mori and Dr. Šemrl are receiving this award for their paper "**Loewner's theorem for maps on operator domains**" published in the Canadian Journal of Mathematics (75:3 [2023], pp 912–944).

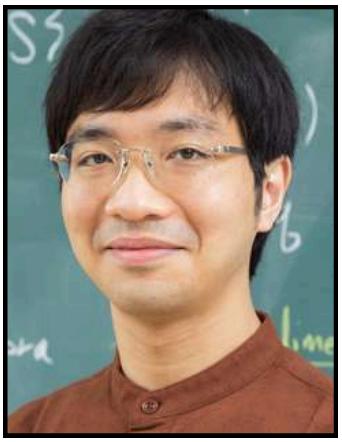
This paper presents a significant advancement in understanding the structure of local order isomorphisms in operator theory, particularly through its novel variation of Loewner's theorem. By considering variations of Loewner's classic results in the case of operator domains, specifically characterizing local order isomorphisms as restrictions of biholomorphic automorphisms within the generalized upper half-plane, this work offers a fascinating perspective on the interaction between operator theory and complex analysis. The theorems formulated, especially Theorem 1.1, adapt them to a modern framework that could significantly influence future research in mathematical physics and quantum theory. This paper's ability to bridge these foundational concepts illustrates its originality and timely contribution to the field.

Dr. Rose and Dr. Tatham are receiving this award for their paper "**On webs in quantum type C**" published in the Canadian Journal of Mathematics (74:3 [2022], pp 793–832).

The paper, which combines elements of representation theory, category theory, and low-dimensional topology, seeks to give a diagrammatic presentation of the representation category of the quantized enveloping algebra associated to the symplectic group of rank 3. The authors define a full, essentially surjective functor from their diagrammatic web category to the representation category and conjecture that this functor is also full. The work leads to a new approach to the associated quantum link invariant, similar to the Kauffman bracket description of the Jones polynomial.

The CMS is proud to present the 2024 G. de B. Robinson Award to Dr. Mori, Dr. Šemrl, Dr. Rose and Dr. Tatham, to whom it sends its warmest congratulations.

PRIX G. DE B. ROBINSON 2024



Dr. Michiya Mori

Dr. Peter Šemrl

Dr. David E. V. Rose

Dr. Logan Tatham

La SMC a le plaisir d'annoncer que le Dr Michiya Mori (The University of Tokyo) & le Dr Peter Šemrl (University of Ljubljana), ainsi que le Dr David E. V. Rose & le Dr Logan Tatham (tous deux de l'University of North Carolina) sont les lauréats conjoints du prix G. de B. Robinson 2024. Ce prix a été créé pour reconnaître la publication d'excellents articles dans le Journal canadien de mathématiques (JCM) et le Bulletin canadien de mathématiques (BCM) et pour encourager la soumission d'articles de la plus haute qualité à ces revues.

Les **Dr Mori et Šemrl** reçoivent ce prix pour leur article « **Loewner's theorem for maps on operator domains** » publié dans la Revue canadienne de mathématiques (75:3 [2023], pp 912-944).

Cet article présente une avancée significative dans la compréhension de la structure des isomorphismes d'ordre local dans la théorie des opérateurs, en particulier grâce à sa nouvelle variation du théorème de Loewner. En considérant les variations des résultats classiques de Loewner dans le cas des domaines d'opérateurs, en particulier en caractérisant les isomorphismes d'ordre local comme des restrictions d'automorphismes biholomorphes dans le demi-plan supérieur généralisé, ce travail offre une perspective fascinante sur l'interaction entre la théorie des opérateurs et l'analyse complexe. Les théorèmes formulés, en particulier le théorème 1.1, les adaptent à un cadre moderne qui pourrait influencer de manière significative la recherche future en physique mathématique et en théorie quantique. La capacité de ce document à faire le lien entre ces concepts fondamentaux illustre son originalité et sa contribution opportune au domaine.

Les **Dr Rose et Tatham** reçoivent ce prix pour leur article « **On webs in quantum type C** » publié dans le Journal canadien de mathématiques (74:3 [2022], pp 793-832).

L'article, qui combine des éléments de la théorie des représentations, de la théorie des catégories et de la topologie de basse dimension, cherche à donner une présentation diagrammatique de la catégorie de représentation de l'algèbre enveloppante quantifiée associée au groupe symplectique de rang 3. Les auteurs définissent un foncteur complet, essentiellement surjectif, de leur catégorie de toile diagrammatique à la catégorie de représentation et conjecturent que ce foncteur est également complet. Ce travail conduit à une nouvelle approche de l'invariant de lien quantique associé, similaire à la description du polynôme de Jones par le bracket de Kauffman.

La SMC est fière de présenter le prix G. de B. Robinson 2024 aux Dr Mori, Dr Šemrl, Dr Rose et Dr Tatham, à qui elle adresse ses plus chaleureuses félicitations.

List of Abbreviations
Liste des abbréviations

AGalois	Arithmetic Aspects of Galois Representations Aspects arithmétiques des représentations de Galois
AlgAppA	Continuous Optimization – Algorithms, Applications, and Analysis Continuous Optimization – Algorithms, Applications, and Analysis
AlgGeo	Algebraic Geometry Géométrie algébrique
AsymGeo	Asymptotic Geometric Analysis Analyse géométrique asymptotique
AutoNT	Automorphic forms and number theory Formes automorphes et théorie des nombres
AutoRep	Automorphic forms and representations Formes automorphes et représentations
BusOpti	Mathematics in Business Modeling, Optimization, Risk, and Decision Making Mathematics in Business Modeling, Optimization, Risk, and Decision Making
CAargeo	Computational aspects of arithmetic geometry and analytic number theory Computational aspects of arithmetic geometry and analytic number theory
CaylGra	Cayley Graphs Graphes de Cayley
CellMig	From single to collective cell migration: A geometric multi-physics bulk-surface PDE approach From single to collective cell migration: A geometric multi-physics bulk-surface PDE approach
CombDes	Combinatorial Designs Conceptions combinatoires
DesSetT	Descriptive Set Theory, Continuous Logic, and Applications Descriptive Set Theory, Continuous Logic, and Applications
DisProb	Discrete Probability Discrete Probability
DynSyst	Applications of Dynamical Systems in Biology Applications des systèmes dynamiques en biologie
EdPlen	Education Plenary Conférence plénière sur l'éducation
EmbEthi	Embedding Ethics In Mathematics Embedding Ethics In Mathematics
FinFiel	Finite Fields and Applications Finite Fields and Applications
GeAnPDE	Geometric Analysis and PDE Geometric Analysis and PDE
GeoQuan	Geometric quantization for young people Geometric quantization for young people
GraStAl	Graph Structure and Algorithms Graph Structure and Algorithms
GraTheo	Graph Coloring, Minors, and Hypergraphs (previously Graph Theory) Graph Coloring, Minors, and Hypergraphs (previously Graph Theory)
GregMar	Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres
HarAnaG	Harmonic Analysis and Geometric Measure Theory Harmonic Analysis and Geometric Measure Theory
IncProb	Incidence Problems in Analysis Incidence Problems in Analysis
IntDisG	Interplay between Discrete Geometry, Convexity, and Combinatorics Interplay between Discrete Geometry, Convexity, and Combinatorics
MachLea	Mathematics of Machine Learning Mathematics of Machine Learning

MACVarP	Modeling, Analysis, and Computation of Variational Problems
	Modeling, Analysis, and Computation of Variational Problems
Mitacs	Public Mitacs Lecture
	Conférence publique Mitacs
NumTheo	Emerging Frontiers in Number Theory: Insights from Early-Career Researchers
	Emerging Frontiers in Number Theory: Insights from Early-Career Researchers
OptConD	Optimization, control, dynamics and stochastics: interplay and applications
	Optimization, control, dynamics and stochastics: interplay and applications
OpTheo	Operator Theory, Function Theory, and Geometry: Connections to Corona Problems and Geometric Analysis
	Operator Theory, Function Theory, and Geometry: Connections to Corona Problems and Geometric Analysis
Plen	Plenary Lectures
	Conférences plénières
Poster	AARMS-CMS Student Poster Session
	Présentations par affiches des étudiants - AARMS-SMC
PurEvG	The Theory of Pursuit-Evasion Games
	The Theory of Pursuit-Evasion Games
PzAPA	Adrien Pouliot Award
	Prix Adrien-Pouliot
PzCJ	Coxeter-James Prize
	Prix Coxeter-James
PzDoc	Blair Spearman Doctoral Prize
	Prix de doctorat Blair Spearman
ReAdvDE	Recent Advances in Differential Equations and Applications
	Recent Advances in Differential Equations and Applications
ReProSt	Recent Progress of Stochastic Analysis and Related Fields
	Recent Progress of Stochastic Analysis and Related Fields
SPDiscr	Structure-Preserving Discretizations and their Applications
	Structure-Preserving Discretizations and their Applications
StudRes	Student Research Session
	Student Research Session
SymAlgS	Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations
	Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires
VarAna	Variational Analysis: Theory and Applications
	Variational Analysis: Theory and Applications
AlgGrT1	Algebraic Graph Theory I
	Théorie algébrique des graphes I
AlgGrT2	Algebraic Graph Theory II
	Théorie algébrique des graphes II
MathEd1	Scalable learning analytics and feedback tools for large undergraduate classrooms
	Scalable learning analytics and feedback tools for large undergraduate classrooms
MathEd2	The Mathematics of Mathematics Education
	The Mathematics of Mathematics Education
MathEd3	Determination and Resilience in Mathematics
	Determination and Resilience in Mathematics

Schedule for Business Meetings
Horaire pour Séances de travail

Friday November 29	**vendredi 29 novembre**
12:30 - 17:30	CMS Board of Directors Meeting / Réunion du Conseil d'administration SMC, Minoru D, Sheraton

Saturday November 30	**samedi 30 novembre**
8:00 - 13:00	Student Committee / Comité des étudiants, R 1805
9:00 - 12:00	Publications Committee / Comité des publications, R1320

Schedule for Related Activities
Horaire pour Activités sociales

Friday November 29 — vendredi 29 novembre

9:00 - 12:00	Student Writing Workshop / Atelier d'écriture, Westminster 3, Sheraton
17:45 - 18:00	Opening and Welcome / Ouverture et bienvenue, Minoru A-B, Sheraton
19:00 - 20:00	Welcome Reception / Réception de bienvenue, Minoru Foyer, Sheraton
20:00 - 22:00	Student Social / Soirée étudiante, Harold's Restaurant, Sheraton

Saturday November 30 — samedi 30 novembre

9:30 - 11:00	AARMS-CMS Student Poster Session / Session de présentation par affiches pour étudiants AARMS-SMC, KPU - WSOD Entrance
10:30 - 11:00	Break / Pause, KPU - WSOD Entrance
14:30 - 15:00	Break / Pause, KPU - WSOD Entrance
19:00 - 21:30	Awards Banquet / Banquet de prix, Minoru A, Sheraton

Sunday December 1 — dimanche 1er décembre

10:30 - 11:00	Break / Pause, KPU - WSOD Entrance
14:30 - 15:00	Break / Pause, KPU - WSOD Entrance

Monday December 2 — lundi 2 décembre

10:30 - 11:00	Break / Pause, KPU - WSOD Entrance
14:30 - 15:00	Break / Pause, KPU - WSOD Entrance

Schedule
Horaire

Friday November 29	**vendredi 29 novembre**
9:00 - 12:00	Student Writing Workshop / Atelier d'écriture, Westminster 3, Sheraton
17:45 - 18:00	Opening and Welcome / Ouverture et bienvenue, Minoru A-B, Sheraton
18:00 - 19:00	Mark Lewis (University of Victoria), *One equation helps solve three paradoxes in the spatial ecology of predators and prey*, Mitacs (p. 45), Minoru A-B, Sheraton
19:00 - 20:00	Welcome Reception / Réception de bienvenue, Minoru Foyer, Sheraton
20:00 - 22:00	Student Social / Soirée étudiante, Harold's Restaurant, Sheraton

Saturday November 30 — samedi 30 novembre

8:00 - 8:30 Angel Cruz (University of British Columbia), *Fourier Dimension and Trasnlation-Invariant Linear Equations*, HarAnaG (p. 156), R 3080

8:00 - 8:30 Penny Haxell (Waterloo), *A bounded diameter strengthening of Kőnig's Theorem*, GraTheo (p. 147), R 2060

8:00 - 8:30 Damir Kinzebulatov (Université Laval), *Singular SDEs with critical and super-critical drifts*, ReProSt (p. 196), R 2960

8:00 - 8:30 Kunquan Lan (Toronto Metropolitan University), *Have the classical Riemann-Liouville fractional integrals been fully understood before ?*, ReAdvDE (p. 192), R 2435

8:00 - 8:30 Lucia Moura (University of Ottawa), *New families of strength-3 covering arrays using LFSR sequences*, FinFiel (p. 129), R 2125

8:00 - 8:30 Fabian Spill (Birmingham), *Cellular and Subcellular Geometry and Mechanics as Determinants of Cell Migration*, CellMig (p. 135), R 2725

8:30 - 9:00 Ryan Bushling (University of Washington), *An Integral Identity with Applications to Convex Sets*, HarAnaG (p. 156), R 3080

8:30 - 9:00 Yuming Chen (Wilfrid Laurier University), *An algebraic approach to determining negative (semi-)definiteness in applying the Lyapunov direct method*, ReAdvDE (p. 192), R 2435

8:30 - 9:00 Davide Cusseddu (Lisbon), *A bulk–surface modelling framework for cell polarisation*, CellMig (p. 132), R 2725

8:30 - 9:00 Neranga Fernando (College of the Holy Cross), *Idempotents and Tripotents in Quandle Rings*, FinFiel (p. 126), R 2125

8:30 - 9:00 Brian Forrest (Waterloo), *It's ok to be wrong ! ! ! Really !*, MathEd3 (p. 112), WSOD 4900

8:30 - 9:00 Andrew Lane (UVic), *Proper Rainbow Saturation for Trees*, GraTheo (p. 147), R 2060

8:30 - 9:00 Rahul Parhi (University of California San Diego), *Deep Learning Meets Sparse Regularization*, MachLea (p. 177), R 2300

8:30 - 9:00 Amarpreet Rattan (SFU), *Centrality of star factorizations*, CaylGra (p. 85), WSOD 1950

8:30 - 9:00 Mathias Sonnleitner (University of Alberta), *Strange shadows of ℓ_p-balls*, AsymGeo (p. 74), WSOD 2930

8:30 - 9:00 Daniel Vallieres (California State University Chico), *Iwasawa theory for branched $\mathbb{Z}_p$-towers of finite graphs*, AGalois (p. 72), R 2630

8:30 - 9:00 Luc Vinet (Université de Montréal), *Spin systems on q-hypercubes and the connection to dual polar graphs*, AlgGrT2 (p. 58), R 1380

8:30 - 9:00 Te-Chun Wang (University of Victoria), *Asymptotics and the sub-limit at L^2-criticality of higher moments for the SHE in dimension $d \geq 3$*, ReProSt (p. 198), R 2960

8:30 - 9:00 Welcome, GregMar (p. 91), WSOD 1960

8:30 - 9:00 Sasha Zotine (McMaster University), *Kawaguchi-Silverman for Projective Bundles on Elliptic Curves*, AlgGeo (p. 51), R 1780

8:30 - 9:10 James Steele (University of Calgary), *Between equivariant and constructible Yoneda algebras in the p-adic local Langlands correspondence*, AutoRep (p. 82), R 3625

9:00 - 9:30 Andrii Arman (University of Manitoba), *Bodies of constant width that have small volume*, AsymGeo (p. 73), WSOD 2930

9:00 - 9:30 Soffía Árnadóttir (Universidade Federal de Minas Gerais (Brazil)), *Cayley incidence graphs*, CaylGra (p. 84), WSOD 1950

9:00 - 9:30 Cindy Blois and Pam Sargent (University of Toronto), *Building Resilience in a Community of Learners*, MathEd3 (p. 111), WSOD 4900

9:00 - 9:30 Break, HarAnaG (p. 155), R 3080

9:00 - 9:30 Susan Cooper (University of Manitoba), *Viewing Codes Through the Lens of Fat Points*, AlgGeo (p. 49), R 1780

9:00 - 9:30 Kim Tuan Do (UCLA), *Euler systems over imaginary quadratic and biquadratic fields*, AGalois (p. 70), R 2630

9:00 - 9:30 Hermann Eberl (University of Guelph), *A spatio-temporal model of blossom blight*, ReAdvDE (p. 192), R 2435

9:00 - 9:30 Nathan Grieve (Acadia University), *On Schmidt's Subspace Theorem, Vojta's height inequalities and algebraic points in projective varieties: selected recent progres*, CAargeo (p. 98), Westminster 2-3, Sheraton

9:00 - 9:30	Emily Heath (Cal Poly Pomona), *Proper Rainbow Saturation for Cliques*, GraTheo (p. 147), R 2060
9:00 - 9:30	Kodjo Raphael Madou (McGill University), *Recent advances in non-local operators: singular SDEs and heat kernel bounds*, ReProSt (p. 197), R 2960
9:00 - 9:30	Kimball Martin (University of Oklahoma), *Distributions of root numbers and Fourier coefficients of modular forms*, AutoNT (p. 77), R 2800
9:00 - 9:30	Sergii Myroshnychenko (University of Fraser Valley), *Centroid of a convex body can be rarely the centroid of its sections*, GeAnPDE (p. 140), WSOD 2920
9:00 - 9:30	Paul Pollack (University of Georgia), *Counting primes with a given primitive root, uniformly*, GregMar (p. 90), WSOD 1960
9:00 - 9:30	Sarobidy Razafimahatratra (Fields Institute), *The intersection density of transitive groups of degree $3p$*, AlgGrT1 (p. 54), R 1380
9:00 - 9:30	Steven Ruuth (SFU), *A Closest Point Method for PDEs on Manifolds with Interior Boundary Conditions for Geometry Processing*, CellMig (p. 135), R 2725
9:00 - 9:30	Shambhavi Singh (Waterloo), *Analysis of Chambolle-Pock through the lens of duality*, VarAna (p. 215), R 1690
9:00 - 9:30	Ozgur Yilmaz (University of British Columbia), *Generative compressed sensing with Fourier measurements*, MachLea (p. 178), R 2300
9:00 - 9:30	Chi Hoi (Kyle) Yip (Georgia Institute of Technology), *Extensions of Carlitz-McConnel theorem on permutations over finite fields*, FinFiel (p. 130), R 2125
9:00 - 9:30	Clement Yung (Toronto), *An alternative proof of the Mathias-Silver theorem using the Kastanas game*, DesSetT (p. 110), Westminster 1, Sheraton
9:20 - 9:40	Jacob Stockton (University of British Columbia), *A derived Hecke algebra*, AutoRep (p. 82), R 3625
9:30 - 11:00	AARMS-CMS Student Poster Session / Session de présentation par affiches pour étudiants AARMS-SMC, KPU - WSOD Entrance
9:30 - 10:00	Amir Akbary (University of Lethbridge), *Dual pairs of eta quotients*, AutoNT (p. 76), R 2800
9:30 - 10:00	Ricardo Baptista (California Institute of Technology), *Dynamics and Memorization Behaviour of Score-Based Diffusion Models*, MachLea (p. 173), R 2300
9:30 - 10:00	Qi Deng (York University), *Modeling the Interaction of Cytotoxic T-lymphocytes and Oncolytic Viruses in a Tumor Microenvironment*, ReAdvDE (p. 192), R 2435
9:30 - 10:00	Lucile Devin (LMPA Université du Littoral Côte d'Opale), *Polynomial races with big ties*, GregMar (p. 88), WSOD 1960
9:30 - 10:00	Payman Eskandari (Winnipeg), *On the unipotent parts of the Hodge and Tate conjectures*, AGalois (p. 70), R 2630
9:30 - 10:00	Ailana Fraser (University of British Columbia), *Minimal surfaces in higher codimension*, GeAnPDE (p. 137), WSOD 2920
9:30 - 10:00	Yuan Gao (UBCO), *On a result by Baillon, Bruck, and Reich*, VarAna (p. 214), R 1690
9:30 - 10:00	Kalle Karu (UBC), *Anisotropy in Stanley-Reisner rings*, AlgGeo (p. 49), R 1780
9:30 - 10:00	Kirill Kashkan (University of Toronto), *Dense Forests With Low Visibility*, AsymGeo (p. 74), WSOD 2930
9:30 - 10:00	Shuxing Li (University of Delaware), *On the Nonexistence of Generalized Bent Functions*, FinFiel (p. 128), R 2125
9:30 - 10:00	Ben Moore (ISTA), *On powers of sparse graphs*, GraTheo (p. 148), R 2060
9:30 - 10:00	Raghu Pantangi (University of Regina), *Perfect State Transfer in Cayley and double coset graphs related to linear groups in two dimensions.*, CaylGra (p. 85), WSOD 1950
9:30 - 10:00	Jinniao Qiu (University of Calgary), *Viscosity solutions of a class of second-order Hamilton-Jacobi-Bellman Equations in the Wasserstein Space*, ReProSt (p. 197), R 2960
9:30 - 10:00	Diana Skrzydlo (Waterloo), *Resilience Through Reflection*, MathEd3 (p. 112), WSOD 4900
9:30 - 10:00	Igancio Uriarte-Turo (University of Toronto), *Two weight norm inequalities for singular and fractional integral operators in $\mathbb{R}^n$*, HarAnaG (p. 159), R 3080
9:30 - 10:00	Allison Wang (Carnegie Mellon), *Complexity of codes for Ramsey positive sets*, DesSetT (p. 109), Westminster 1, Sheraton
9:30 - 10:00	Michael Ward (UBC), *Pattern Forming Systems Coupling Linear Bulk Diffusion to Dynamically Active Membranes or Cells*, CellMig (p. 136), R 2725

9:30 - 10:00	Asif Zaman (University of Toronto), *Explicit Deuring-Heilbronn phenomenon for Dirichlet L-functions*, CAargeo (p. 100), Westminster 2-3, Sheraton
9:30 - 11:00	Adriana-Stefania Ciupeanu, Tanjima Akhter (Universities of Manitoba and Alberta), *Preventing HPV-Induced Cervical Cancer in Alberta, Canada: A Mathematical Modeling study*, Poster (p. 217), KPU - WSOD Entrance
9:30 - 11:00	Kye Emond (Simon Fraser University), *Existence and Uniqueness for a System of a Solid in a Lorentz Gas*, Poster (p. 217), KPU - WSOD Entrance
9:30 - 11:00	James Houle (University of Waterloo), *Schäffer's Conjecture and the Modular Method*, Poster (p. 217), KPU - WSOD Entrance
9:30 - 11:00	Rex Li (Carleton University Math Enrichment Centre), *Optimal Trajectories in Variable Speed Environments with Line Constraints*, Poster (p. 218), KPU - WSOD Entrance
9:30 - 11:00	Haggai Liu (Simon Fraser University), *Moduli Spaces of Weighted Stable Curves and their Fundamental Groups*, Poster (p. 218), KPU - WSOD Entrance
9:30 - 11:00	Kiara McDonald (University of Victoria), *Broadcast Independence in Split Graphs*, Poster (p. 218), KPU - WSOD Entrance
9:30 - 11:00	Elise Mozzaffari (Kwantlen Polytechnic University), *A Procedure for Obtaining a $(2 + c)$-Regular Graph from a Given Cycle Graph*, Poster (p. 219), KPU - WSOD Entrance
9:30 - 11:00	Prangya Parida (University of Ottawa), *Cover-free families on graphs*, Poster (p. 219), KPU - WSOD Entrance
9:50 - 10:30	Rachel Ollivier (University of British Columbia), *Rigid dualizing complexes for affine Hecke algebras.*, AutoRep (p. 81), R 3625
10:00 - 10:30	Raul Alonso (UC Santa Barbara), *An anticyclotomic Euler system for Hilbert cuspforms over a real quadratic field*, AGalois (p. 69), R 2630
10:00 - 10:30	Lindsay Daniels (UBC), *Building resilience through self-affirmation and reflection exercises*, MathEd3 (p. 112), WSOD 4900
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10:00 - 10:30	Thedore Kolokolnikov (Dalhousie University), *Maximizing network connectivity subject to resource constraints*, AlgGrT1 (p. 53), R 1380
10:00 - 10:30	Samuel Lanthaler (California Institute of Technology), *Generative AI for the statistical computation of fluids*, MachLea (p. 175), R 2300
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10:00 - 10:30	Isabella Negrini (University of Toronto), *Modular generating series for rigid cocycles*, AutoNT (p. 78), R 2800
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10:00 - 10:30	Sharon Robins (Simon Fraser University), *Versal Deformations of Smooth Complete Toric Varieties*, AlgGeo (p. 51), R 1780
10:00 - 10:30	Pablo Shmerkin (University of British Columbia), *Restricted projections and self-similar sets*, HarAnaG (p. 158), R 3080
10:00 - 10:30	Ila Varma (University of Toronto), *Counting number fields and predicting asymptotics*, CAargeo (p. 100), Westminster 2-3, Sheraton
10:00 - 10:30	Veatriki Eleni Vritsiou (University of Alberta), *Illuminating certain high-dimensional 1-unconditional convex bodies*, AsymGeo (p. 75), WSOD 2930
10:00 - 10:30	Ziyuan Wang (UBCO), *Level proximal subdifferential, variational convexity, and beyond.*, VarAna (p. 215), R 1690
10:00 - 10:30	Michael Wolman (Caltech), *Invariant uniformization*, DesSetT (p. 110), Westminster 1, Sheraton
10:00 - 10:30	Harmony Zhan (Worcester Polytechnic Institute), *Limiting behavior of coined quantum walks with marked vertices*, AlgGrT2 (p. 58), R 1380
10:00 - 10:30	Xiaohong Zhang (Université de Montréal), *Signed or oriented Cayley graphs with nice spectrum*, CaylGra (p. 86), WSOD 1950

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13:30 - 14:30	Dr. André Boileau (UQAM), *Les hauts et les bas d'un prof de maths*, PzAPA (p. 47), WSOD 4900
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15:00 - 15:30	Rebecca Carter (Queen's University), *Mathematical Inquiry with Concurrent Education Students*, MathEd2 (p. 207), R 2500
15:00 - 15:30	Wuyang Chen (Simon Fraser University), *Towards Data-Efficient and OOD Generalization of Scientific Machine Learning Models*, MachLea (p. 174), R 2300
15:00 - 15:30	Alexander Clow (SFU), *A Map Colour Theorem for Oriented Colouring*, GraTheo (p. 146), R 2060
15:00 - 15:30	Danielle Cox (MSVU), *Reflective Practices & Interpreting Student Errors*, MathEd3 (p. 111), WSOD 4900
15:00 - 15:30	Julie Desjardins (University of Toronto), *Trisections of Low Genus on Del Pezzo Surfaces of Degree 1*, CAargeo (p. 98), Westminster 2-3, Sheraton
15:00 - 15:30	Christoph Frei (University of Alberta), *Bayesian Clustering for Portfolio Credit Risk*, BusOpti (p. 170), R 2510
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15:00 - 15:30	Vishesh Jain (University of Illinois), *Entangled states are typically incomparable*, AsymGeo (p. 73), WSOD 2930
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15:00 - 15:30	Bojan Mohar (Simon Fraser University), *Square energy of graphs*, AlgGrT1 (p. 54), R 1380
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15:00 - 15:30	Samuel Murray (McGill), *Borel Fractional Perfect Matchings in Quasitransitive Amenable Graphs*, DesSetT (p. 108), R 2005
15:00 - 15:30	Sujatha Ramdorai (UBC), *Iwasawa theory over anticyclotomic extensions*, AGalois (p. 71), R 2630
15:00 - 15:30	Egon Schulte (Northeastern University), *Skeletal polyhedra, complexes, and their classification by symmetry*, IntDisG (p. 167), R 2620
15:00 - 15:30	Shahaboddin Shaabani (Concordia University), *The Operator Norm of Paraproducts on Bi-parameter Hardy Spaces*, HarAnaG (p. 158), R 3080
15:00 - 15:30	Lee Troupe (Mercer University), *The number of subgroups of the multiplicative group*, GregMar (p. 90), WSOD 1960
15:00 - 15:30	Henry Wolkowicz (Waterloo), *Regularized Nonsmooth Newton Algorithms for Best Approximation with Applications*, VarAna (p. 215), R 1690
15:00 - 15:40	Ila Varma (University of Toronto), *Geometry of numbers in the cusp*, AutoRep (p. 82), R 3625
15:30 - 16:00	Ahmet Alacaoglu (UBCV), *Revisiting Inexact Fixed-Point Iterations for Min-Max Problems: Stochasticity and Structured Nonconvexity*, VarAna (p. 214), R 1690
15:30 - 16:00	Leah Wrenn Berman (University of Alaska Fairbanks), *Infinite classes of movable* (n_4) *configurations using Poncelet polygons*, IntDisG (p. 164), R 2620
15:30 - 16:00	Ilia Binder (University of Toronto), *Conformal Dimension of Planar fractals.*, OpTheo (p. 183), R 2525
15:30 - 16:00	Imin Chen (Simon Fraser University), *Improved constants for Serre's open image theorem*, CAargeo (p. 98), Westminster 2-3, Sheraton
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15:30 - 16:00 Alex Cohen (Massachusetts Institute of Technology), *Lower bounds for incidences*, HarAnaG (p. 156), R 3080

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15:30 - 16:00 Sarah Dijols (University of British Columbia), *Parabolically induced representations of p-adic G2 distinguished by SO4*, AutoNT (p. 77), R 2800

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15:30 - 16:00 Kumar Hitesh (Simon Fraser University), *Combinations of first and second eigenvalue of trees*, AlgGrT1 (p. 53), R 1380

15:30 - 16:00 Slim Ibrahim (University of Victoria), *Persistence of vorticity concentration in the two-point vortex system of the 2D Euler equations*, GeAnPDE (p. 138), WSOD 2920

15:30 - 16:00 Thedore Kolokolnikov (Dalhousie), *Stripe patterns for Gierer-Meinhard model in thin domains*, CellMig (p. 133), R 2725

15:30 - 16:00 Heejong Lee (Purdue), *Recent advances on the Serre weight conjectures*, AGalois (p. 71), R 2630

15:30 - 16:00 Petr Lisonek (Simon Fraser University), *On a new class of Hadamard matrices*, FinFiel (p. 128), R 2125

15:30 - 16:00 Joshua Nevin (UOttawa), *Distant 2-Colored Components on Embeddings*, GraTheo (p. 148), R 2060

15:30 - 16:00 Lucas Teyssier (Univeristy of British Columbia), ReProSt (p. 198), R 2960

15:30 - 16:00 Spencer Unger (Toronto), *Equidecomposition and discrepancy*, DesSetT (p. 109), R 2005

15:30 - 16:00 Olga Vasilyeva (Memorial University of Newfoundland, Grenfell Campus), *Steady states and evolution of dispersal in river networks*, ReAdvDE (p. 193), R 2435

15:30 - 16:00 Gabriel Verret (University of Auckland), *Density of quotient orders in groups and applications to locally-transitive graphs*, CaylGra (p. 85), WSOD 1950

15:30 - 16:00 Sudan Xing (University of Arkansas), *On the s-Gaussian Measure in* $\mathbb{R}^n$, AsymGeo (p. 75), WSOD 2930

15:50 - 16:30 Alex Hazeltine (University of Michigan), *The local theta correspondence and functoriality*, AutoRep (p. 81), R 3625

16:00 - 16:30 Arturo Arellano Arias (McGill University), *A shape theorem for the convex hull of* d*-dimensional branching Brownian motion in periodic environments.*, ReProSt (p. 195), R 2960

16:00 - 16:30 Break, HarAnaG (p. 155), R 3080

16:00 - 16:30 Yixin Chen (Simon Fraser University), *Two-torsion in Brauer groups of hyperelliptic fibered surface*, CAargeo (p. 98), Westminster 2-3, Sheraton

16:00 - 16:30 Susan Cooper (University of Manitoba), *A Little Support Goes A Long Way - An EDI Journey*, GregMar (p. 88), WSOD 1960

16:00 - 16:30 Kenza Guenda (University of Victoria and University of Science and Technology Houari Boumediene), *Code-based cryptography*, FinFiel (p. 127), R 2125

16:00 - 16:30 Stephen Gustafson (University of British Columbia), *Two-solitons with logarithmic separation for 1D NLS with repulsive delta potential*, GeAnPDE (p. 138), WSOD 2920

16:00 - 16:30 David Holloway (British Columbia Institute of Technology), *What makes cotyledon numbers so variable in conifers ?*, CellMig (p. 133), R 2725

16:00 - 16:30 Jeannette Janssen (Dalhousie), *Orthogonal Colourings of Random Geometric Graphs*, GraTheo (p. 147), R 2060

16:00 - 16:30 Jennifer Johnson-Leung (University of Idaho), *Index lowering operators on Jacobi forms and stable Klingen theory*, AutoNT (p. 77), R 2800

16:00 - 16:30 Dan Krause (University of Saskatchewan), *On Assigning Meanings in Mathematics Education*, MathEd2 (p. 208), R 2500

16:00 - 16:30 Alexander Melnikov (University of Alberta), *On dual problem of imperfect hedging with life insurance applications*, BusOpti (p. 171), R 2510

16:00 - 16:30 Ahmad Mokhtar (Simon Fraser University), *Connectedness of Fano schemes of matrices of bounded rank*, AlgGeo (p. 50), R 1780

16:00 - 16:30 Wenlong Mou (University of Toronto), *Continuous-time reinforcement learning: blessings of elliptic structures and high-order approximations*, MachLea (p. 176), R 2300

16:00 - 16:30 Serhii Myroshnychenko (University of the Fraser Valley), *Stability of simplex slicing*, AsymGeo (p. 74), WSOD 2930

16:00 - 16:30 Bo Peng (McGill), *Generalized Oxtoby systems and hyperfiniteness*, DesSetT (p. 109), R 2005

16:00 - 16:30 Primoz Potocnik (University of Ljubljana (Slovenia)), *Extended Census of Cubic Cayley Graphs*, CaylGra (p. 85), WSOD 1950

16:00 - 16:30 Shivaram Pragada (Simon Fraser University), *Bollobas-Nikiforov conjecture and triangle counting*, AlgGrT1 (p. 54), R 1380

16:00 - 16:30 Peikai Qi (MSU), *An analogue of Greenberg pseudo-null conjecture for CM fields*, AGalois (p. 71), R 2630

16:00 - 16:30 Asmita Sodhi (Victoria), *Ms. Frizzle Teaches Calculus*, MathEd3 (p. 113), WSOD 4900

16:00 - 16:30 Krystal Taylor (Ohio State), *Efficient Coverings of Fractal sets by curves*, OpTheo (p. 185), R 2525

16:00 - 16:30 Xianfu Wang (UBCO), *On Bauschke-Bendit-Moursi modulus of averagedness and classifications of averaged nonexpansive operators*, VarAna (p. 215), R 1690

16:00 - 16:30 Gordon Williams (University of Alaska Fairbanks), *On Prisms of Polytopes*, IntDisG (p. 168), R 2620

16:00 - 16:30 Gail Wolkowicz (McMaster University), *Decay Consistent Models of Growth, Competition, and Predation*, ReAdvDE (p. 193), R 2435

16:30 - 17:00 Jupiter Algorta (UBC), CellMig (p. 131), R 2725

16:30 - 17:00 Paige Bright (University of British Columbia), *A Continuum Erdős–Beck Theorem*, HarAnaG (p. 155), R 3080

16:30 - 17:00 Alex Brudnyi (University of Calgary), *Runge-Type Approximation Theorem for Banach-valued H^∞ Functions on a Polydisk*, OpTheo (p. 184), R 2525

16:30 - 17:00 Jeremy Chiu (Langara), *What inhibits resilience, and what can we do about it ?*, MathEd3 (p. 111), WSOD 4900

16:30 - 17:00 Ted Dobson (University of Primorska (Slovenia)), *$\mathbb{Z}_p \times \mathbb{Z}_p$ is a BCI-group*, CaylGra (p. 84), WSOD 1950

16:30 - 17:00 Allen Herman (University of Regina), *Parameters of quotient-polynomial graphs*, AlgGrT1 (p. 52), R 1380

16:30 - 17:00 Saraí Hernández-Torres (National Autonomous University of Mexico), *Minkowski content of the scaling limit of 3D loop-erased random walk*, ReProSt (p. 196), R 2960

16:30 - 17:00 Chi-Yun Hsu (Santa Clara), *p-adic companion forms for Yoshida lifts*, AGalois (p. 70), R 2630

16:30 - 17:00 Cody Hyndman (Concordia University), *Generative Ornstein-Uhlenbeck Markets via Geometric Deep Learning*, BusOpti (p. 170), R 2510

16:30 - 17:00 Matilde Lalin (Université de Montréal), *Variances of prime independent multiplicative functions over function fields*, GregMar (p. 89), WSOD 1960

16:30 - 17:00 Malors Espinosa Lara (University of Toronto), AutoNT (p. 77), R 2800

16:30 - 17:00 Haggai Liu (Simon Fraser University), *Moduli Spaces of Weighted Stable Curves and their Fundamental Groups*, AlgGeo (p. 50), R 1780

16:30 - 17:00 Philip Loewen (UBCV), *Sensitivity Analysis for the Linear Quadratic Regulator*, VarAna (p. 214), R 1690

16:30 - 17:00 Wes Maciejewski (Red Deer Polytechnic), *Teaching Mathematical Practice*, MathEd2 (p. 209), R 2500

16:30 - 17:00 Jose Palacios (University of Toronto), *Linearized dynamic stability for vortices of Ginzburg-Landau evolutions*, GeAnPDE (p. 140), WSOD 2920

16:30 - 17:00 Antoine Poulin (McGill University), *Borel quasi-trees are treeable*, DesSetT (p. 109), R 2005

16:30 - 17:00 Jozsef Solymosi (UBC), *A sparse removal lemma for pentagons*, GraTheo (p. 148), R 2060

16:30 - 17:00 Alina Stancu (Concordia University), *An asymmetric flow with many symmetric solutions*, AsymGeo (p. 75), WSOD 2930

16:30 - 17:00 Hugo Teixeira (Carleton University), *The functional graph of $f(X) = (cX^q + aX)(X^q - X)^{n-1}$ over quadratic extensions of finite fields*, FinFiel (p. 130), R 2125

16:30 - 17:00 Sharan Vaswani (Simon Fraser University), *Global Convergence of Softmax Policy Gradient for Stochastic Bandits*, MachLea (p. 177), R 2300

16:30 - 17:00 Colin Weir (Tutte Institute for Mathematics and Computing), *On the distribution of a-numbers of hyperelliptic curves.*, CAargeo (p. 100), Westminster 2-3, Sheraton

16:30 - 17:00 Kexue Zhang (Queen's University), *Input-to-State Stability in Terms of Two Measures*, ReAdvDE (p. 194), R 2435

16:40 - 17:00 Jose Cruz (University of Calgary), *On the Fourier transform and Vogan's perspective on the Local Langlands Correspondence*, AutoRep (p. 80), R 3625

17:00 - 17:30 Liljana Babinkostova (Boise State University), CAargeo (p. 98), Westminster 2-3, Sheraton

17:00 - 17:30 Ludovick Bouthat (Université Laval), *Exploring Hadamard multipliers on weighted Dirichlet spaces through L-matrices*, OpTheo (p. 184), R 2525

17:00 - 17:30 Elena Braverman (University of Calgary), *On logistic models incorporating various diffusion strategies with and without harvesting*, ReAdvDE (p. 191), R 2435

17:00 - 17:30 Silvia Fernandez (California State University), *Bounding Sylvester's four-point constant and the rectilinear crossing number of the complete graph*, IntDisG (p. 165), R 2620

17:00 - 17:30 Gleb Glebov (Simon Fraser University), *The Non-Uniqueness of Decimal Representations and the Modified Long Division*, MathEd2 (p. 208), R 2500

17:00 - 17:30 Nick Harvey (University of British Columbia), *When Online Learning Meets Stochastic Calculus*, MachLea (p. 175), R 2300

17:00 - 17:30 Hassan Khodaiemehr (The University of British Columbia), *Quantum Bosonic Codes and Finite Fields*, FinFiel (p. 128), R 2125

17:00 - 17:30 Arnab Kundu (University of Toronto), *Motivic cohomology in mixed-characteristic*, AlgGeo (p. 50), R 1780

17:00 - 17:30 Chenkuan Li (Brandon University), *The analytical solution to the multi-term time-fractional diffusion-wave equation*, GeAnPDE (p. 138), WSOD 2920

17:00 - 17:30 Jinting Liang (UBC), *Log-concavity and log-convexity via distributive lattices*, AlgGrT1 (p. 54), R 1380

17:00 - 17:30 Yu-Ru Liu (University of Waterloo), *Equidistribution of Polynomial Sequences in Function Fields*, GregMar (p. 89), WSOD 1960

17:00 - 17:30 Mathav Murugan (University of British Columbia), *Heat kernel for reflected diffusion and extension property on uniform domains*, ReProSt (p. 197), R 2960

17:00 - 17:30 Tam Nguyen (UBC), *Residually isomorphic modular forms and BDP p-adic L-functions*, AGalois (p. 71), R 2630

17:00 - 17:30 Joanna Niezen (SFU), *Assignment Resubmission and Resilience*, MathEd3 (p. 112), WSOD 4900

17:00 - 17:30 David Saunders (University of Waterloo), *Generalized Optimal Transport Problems in Finance*, BusOpti (p. 171), R 2510

17:00 - 17:30 Fengwei Yang (UBC), *Combining image analysis and cell migration model for whole cell tracking*, CellMig (p. 136), R 2725

17:00 - 17:30 Josh Zahl (University of British Columbia), *curve tangencies and maximal functions*, HarAnaG (p. 159), R 3080

17:00 - 17:30 Shasha Zheng (Comenius University in Bratislava (Slovakia)), *Asymptotic proportion of graphical regular representations among Cayley graphs*, CaylGra (p. 86), WSOD 1950

17:10 - 17:50 Chi-Heng Lo (Purdue University), *On local Arthur packets and unitary dual of classical groups*, AutoRep (p. 81), R 3625

17:30 - 18:00 Meet for Group Dinner, HarAnaG (p. 157), R 3080

17:30 - 18:00 Chunyi Gai (UNBC), *An Asymptotic Analysis of Spike Self-Replication and Spike Nucleation of Reaction-Diffusion Patterns on Growing 1-D Domains*, CellMig (p. 132), R 2725

17:30 - 18:00 Ilmari Kangasniemi (University of Cincinnati), *On the theory of quasiregular values*, GeAnPDE (p. 138), WSOD 2920

17:30 - 18:00 Judy Larsen (UFV), MathEd3 (p. 112), WSOD 4900

17:30 - 18:00 Jake Levinson (Université de Montréal), *Limits in tropical compactifications and tropical psi classes*, AlgGeo (p. 50), R 1780

17:30 - 18:00 Shuwen Lou (Loyola University of Chicago), ReProSt (p. 197), R 2960

17:30 - 18:00 Ami Mamolo (Ontario Tech University), *Mathematics in society – what is on the horizon ?*, MathEd2 (p. 209), R 2500

17:30 - 18:00 Maria Pereyra (New Mexico), OpTheo (p. 185), R 2525

17:30 - 18:00 Renate Scheidler (University of Calgary), *Solving norm equations in global function fields using compact representations*, CAargeo (p. 100), Westminster 2-3, Sheraton

17:30 - 18:00	Tamon Stephen (Simon Fraser University), *Hypergraph Transversal Pairs Near the Fredman-Khachiyan Bound*, IntDisG (p. 167), R 2620
17:30 - 18:00	David Thomson (Tutte Institute for Mathematics and Computing), FinFiel (p. 130), R 2125
17:30 - 18:00	Ila Varma (University of Toronto), *The number of D_4-fields ordered by Artin conductor*, AGalois (p. 72), R 2630
17:30 - 18:00	Andrew Warren (University of British Columbia), *Estimation of one-dimensional structures from noisy empirical observation*, MachLea (p. 178), R 2300
17:30 - 18:00	Asif Zaman (University of Toronto), *Improving the trivial bound for class group torsion*, GregMar (p. 91), WSOD 1960
19:00 - 21:30	Awards Banquet / Banquet de prix, Minoru A, Sheraton

Sunday December 1 — dimanche 1er décembre

8:00 - 8:30 Carmen Bruni (University of Waterloo), *On the Ethics of Social Computing for Computer Science Majors*, EmbEthi (p. 118), WSOD 4900

8:00 - 8:30 Brian Camley (Johns Hopkins University), *Controlling Cell Exploration and Oscillation Using Deposited Footprints*, CellMig (p. 132), R 2725

8:00 - 8:30 Qi Deng (York University), *Uncovering the impact of infection routes on within-host MPXV dynamics: insights from a mathematical modeling study*, DynSyst (p. 60), R2060

8:00 - 8:30 Jacob Denson (University of Wisconsin–Madison), *A Characterization of Boundedness For Multipliers of Spherical Harmonic Expansions*, HarAnaG (p. 157), R 3080

8:00 - 8:30 Ferenc Fodor (University of Szeged), *Stability of mean width inequalities*, IntDisG (p. 166), R 2620

8:00 - 8:30 Yaozhong Hu (University of Alberta), ReProSt (p. 196), R 2960

8:00 - 8:30 Melissa Huggan (Vancouver Island University), *Cops and Attacking Robbers: A Shift in Power*, PurEvG (p. 212), R 2225

8:00 - 8:30 Amy Hurford (Memorial University), *Optimal control strategies for community and traveler isolation under resource constraints*, OptConD (p. 187), WSOD 1950

8:00 - 8:30 Bo Li (University of California San Diego), *The Legendre-Transformed Poisson-Boltzmann Electrostatics*, MACVarP (p. 181), R 2505

8:00 - 8:30 Ariane Masuda (New York City College of Technology/The City University of New York), *Involutions over finite fields*, FinFiel (p. 128), R 2125

8:00 - 8:30 Alex McDonald (Kennesaw State University), *Prescribed projections and efficient coverings of sets by curves*, IncProb (p. 162), R 1780

8:00 - 8:30 David Pike (Memorial), *2-Block-Intersection Graphs of Twofold Triple Systems*, CombDes (p. 95), R 2520

8:00 - 8:30 Jaxon Shumaker (University of Oregon), *Classifying monogenic quartic orders*, NumTheo (p. 124), R 2550 A&B

8:00 - 8:40 Kristaps Balodis (University of Calgary), *The Status and Consequences of the p-adic Kazhdan-Lusztig Hypothesis*, AutoRep (p. 80), R 3625

8:30 - 9:00 Belal Abuelnasr (Waterloo), *Effects of Diabetes on Renal Calcium Homeostasis*, DynSyst (p. 59), R2060

8:30 - 9:00 Jean-François Bégin (Simon Fraser University), *Benefit volatility-targeting strategies in lifetime pension pools*, BusOpti (p. 169), R 2510

8:30 - 9:00 Alex Cohen (MIT), *Branching structure in phase space*, IncProb (p. 161), R 1780

8:30 - 9:00 Pavel Coupek (MSU), *Heights of modular forms and Eisenstein congruences*, AGalois (p. 70), R 2630

8:30 - 9:00 Lindsey Daniels (University of British Columbia), *Utilizing text analytics, data visualizations, and regression to inform teaching and feedback in large enrollment courses*, MathEd1 (p. 199), R 2500

8:30 - 9:00 Rebecca DeLand (University of Colorado Boulder), *Limiting Density of Elliptic Divisibility Sequences*, NumTheo (p. 122), R 2550 A&B

8:30 - 9:00 Sean Douglas (University of British Columbia), *Chain Rule For Weighted Triebel-Lizorkin Spaces*, HarAnaG (p. 157), R 3080

8:30 - 9:00 Chunyi Gai (University of Northern British Columbia), *Pattern Formation and Spike Dynamics in the Presence of Noise*, SPDiscr (p. 202), R 2590

8:30 - 9:00 Matt Hayat (Georgia State University), *Integrating Ethics into Mathematics and Statistics Education*, EmbEthi (p. 118), WSOD 4900

8:30 - 9:00 Theodore Kolokolnikov (Dalhousie University), *Agent-based models: examples from from bacterial aggregation and epidemic models*, MACVarP (p. 180), R 2505

8:30 - 9:00 Esther Lamken (unaffiliated), *Duplicated Steiner triple systems with self-orthogonal near resolutions*, CombDes (p. 95), R 2520

8:30 - 9:00 Shawn McAdam (University of Saskatchewan), SymAlgS (p. 66), R 2540

8:30 - 9:00 Todd Mullen (University of Prince Edward Island), *An Empowered Robber*, PurEvG (p. 212), R 2225

8:30 - 9:00 Ali Fele Paranj, *Generation and Evolution of Vascular Netowrks*, CellMig (p. 134), R 2725

8:30 - 9:00 Welington Santos (University of Wisconsin-Stout), *Codes for Secure Distributed Matrix Multiplication*, FinFiel (p. 129), R 2125

8:30 - 9:00 Zachary Selk (Queen's University), *Rough Paths above Weierstrass Functions*, ReProSt (p. 197), R 2960

8:30 - 9:00 Owen Sharpe (Waterloo), StudRes (p. 205), R 2155

8:30 - 9:00 Thomás Spier (University of Waterloo), *Efficient reconstruction of the characteristic polynomial*, AlgGrT1 (p. 55), R 1380

8:30 - 9:00 Christos Thrampoulidis (University of British Columbia), *Implicit Geometry of Next-token Prediction: From Language Sparsity Patterns to Model Representations*, MachLea (p. 177), R 2300

8:30 - 9:00 Peter van Hintum (Institute of Advanced Studies), *Discrete Brunn-Minkowski theory*, IntDisG (p. 168), R 2620

8:30 - 9:00 Xiong Wang (Johns Hopkins University), OptConD (p. 189), WSOD 1950

8:30 - 9:00 Yuanxi Yue (Memorial University of Newfoundland), *Traveling wavefronts for the Belousov-Zhabotinsky system with non-local delayed interaction*, ReAdvDE (p. 194), R 2435

8:30 - 9:30 Yu-Tung (Tony) Yau (University of Michigan), *Berezin-Toeplitz quantization in real polarizations*, GeoQuan (p. 144), R 1690

8:50 - 9:10 Wong Tian An (University of Michigan), *Towards a notion of mesoscopy*, AutoRep (p. 79), R 3625

9:00 - 9:30 Raquel Barreira (Polytechnic University of Setúbal and CMAFcIO), *The evolving surface finite element method as a tool for solving PDEs on continuously evolving domains*, CellMig (p. 131), R 2725

9:00 - 9:30 Break, HarAnaG (p. 155), R 3080

9:00 - 9:30 Andrea Burgess (UNB), *Colourings of Kirkman triple systems*, CombDes (p. 93), R 2520

9:00 - 9:30 Samantha-Jo Caetano (University of Toronto), *Teaching Ethics in the Era of Data*, EmbEthi (p. 118), WSOD 4900

9:00 - 9:30 Adithya Chakravarthy (Toronto), *The Iwasawa μ-invariants of elliptic curves over the rational numbers*, AGalois (p. 69), R 2630

9:00 - 9:30 Aden Chan (University of British Columbia), *A framework for utilizing online grading software to deliver efficient assessment and feedback to students*, MathEd1 (p. 199), R 2500

9:00 - 9:30 Linh Dinh (Dalhousie), StudRes (p. 205), R 2155

9:00 - 9:30 Mahboobeh (Mary) Hosseinyazdi (Kwantlen Polytechnic University), *The solution set of a system of max-min-product fuzzy relational inequalities*, BusOpti (p. 170), R 2510

9:00 - 9:30 Fatemezahra Janbazi (University of Toronto), *Boundedness of average rank of elliptic curves ordered by the coefficients*, NumTheo (p. 123), R 2550 A&B

9:00 - 9:30 Sookyung Joo (Old Dominion University), *stability of nematic state in periodically modulated nematic phases*, MACVarP (p. 180), R 2505

9:00 - 9:30 Lord Kavi (University of Ottawa), *Towards Haemers Laplacian Toughness Conjecture*, AlgGrT1 (p. 53), R 1380

9:00 - 9:30 Damir Kinzebulatov (Université Laval), *Feller generators with singular drifts in the critical range*, OpTheo (p. 184), R 2525

9:00 - 9:30 Brock Klippenstein (University of Manitoba), *Fast Analytical-Numerical Hybrid Methods for Solving the Cosmic Ray Fokker-Planck Equation*, ReProSt (p. 196), R 2960

9:00 - 9:30 Matilde Lalin (Université de Montréal), *Arithmetic constants for symplectic variances of the divisor function*, CAargeo (p. 99), R 2170

9:00 - 9:30 Zsolt Lángi (Budapest University of Technology and Economics), *Steiner symmetrization on the sphere*, IntDisG (p. 167), R 2620

9:00 - 9:30 Mathias Lecuyer (University of British Columbia), *Adaptive Randomized Smoothing: Certified Adversarial Robustness for Multi-Step Defences*, MachLea (p. 176), R 2300

9:00 - 9:30 Meagan Mann (Queen's University), *A Data-Centric Approach to Cops and Robbers*, PurEvG (p. 212), R 2225

9:00 - 9:30 Yuveshen Mooroogen (UBC), *A large-scale variant of the Erdos similarity conjecture*, IncProb (p. 163), R 1780

9:00 - 9:30 Rehana Naz (Lahore School of Economics), *Lie symmetries, closed-form solutions, and conservation laws*, SymAlgS (p. 66), R 2540

9:00 - 9:30 Yuzhe Qin (UBC), *A second-order accurate numerical scheme for the Poisson-Nernst-Planck-Navier-Stokes (PNPNS) system*, SPDiscr (p. 202), R 2590

9:00 - 9:30 Pouria Ramazi (Brock University), *Towards Optimizing Vaccine Uptake Through Tailored Communication Strategies*, OptConD (p. 189), WSOD 1950

9:00 - 9:30 Cristian Rios (University of Calgary), *Continuity of solutions to infinite degenerate elliptic equations in the plane*, GeAnPDE (p. 140), WSOD 2920

9:00 - 9:30	Zhisheng Shuai (University of Central Florida, USA), *Impact of Incidence Functions on Epidemiological Model Dynamics: Mass Action vs. Standard Incidence*, ReAdvDE (p. 193), R 2435
9:00 - 9:30	Bianca Sosnovski (Queensborough Community College/The City University of New York), *Applications of Finite Fields in Cayley Hash Functions*, FinFiel (p. 130), R 2125
9:00 - 9:30	Adam Stinchcombe (Toronto), *A mathematical model for the role of dopamine-D2 self-regulation in the production of ultradian rhythms*, DynSyst (p. 62), R2060
9:00 - 9:30	Naomi Tanabe (Bowdoin College), *Subconvexity for L-functions of Hilbert modular forms*, AutoNT (p. 78), R 2800
9:00 - 9:30	Chi Hoi Yip (Georgia Tech), *Counting powerfree-like numbers*, GregMar (p. 91), WSOD 1960
9:00 - 9:30	Andy Zucker (Waterloo), *Topological groups with tractable minimal dynamics*, DesSetT (p. 110), R 2005
9:20 - 9:40	Serine Bairakji (University of Ottawa), *Lost in Levis: The Case of the Missing Middle*, AutoRep (p. 80), R 3625
9:30 - 10:00	Heinz Bauschke (UBC Okanagan), *On the Bredies-Chenchene-Lorenz-Naldi algorithm*, AlgAppA (p. 103), R 2530
9:30 - 10:00	Khalil Besrour (University of Ottawa), *Modular Solutions to Modular Differential Equations*, AutoNT (p. 77), R 2800
9:30 - 10:00	Sue Ann Campbell (University of Waterloo), *Time Delays, Symmetry and Hopf Bifurcation in Oscillator Networks*, ReAdvDE (p. 192), R 2435
9:30 - 10:00	Raphael Clouatre (Manitoba), *Joint spectra and annihilators in multivariate operator theory*, OpTheo (p. 184), R 2525
9:30 - 10:00	Cecile Dartyge (Institut Élie Cartan de Lorraine), *Exponential sums and reducible polynomials.*, GregMar (p. 88), WSOD 1960
9:30 - 10:00	Alexey Glazyrin (University of Texas Rio Grande Valley), *Illuminating constant width bodies*, IntDisG (p. 166), R 2620
9:30 - 10:00	Michel Grundland (CRM, Université de Montréal), SymAlgS (p. 65), R 2540
9:30 - 10:00	Nathan Heisz (McMaster University), *Densities of Bounded Primes in Hypergeometric Series*, NumTheo (p. 123), R 2550 A&B
9:30 - 10:00	Miranda Holmes-Cerfon (University of British Columbia), *Programmable assembly: inverse design of materials from discrete components*, MachLea (p. 175), R 2300
9:30 - 10:00	Thomas Hughes (University of Bath), *Stochastic PDEs with the compact support property: the stable noise regime*, ReProSt (p. 196), R 2960
9:30 - 10:00	Masomeh Jamshid-Nejad (Kwantlen Polytechnic University), *The Impact of Excel-Based Instruction on Business Students' Understanding of the Normal Distribution in Statistics*, BusOpti (p. 171), R 2510
9:30 - 10:00	Victor Juma (UBC), *Diffusion-driven dynamics in bistable reaction-diffusion systems: Beyond Turing Instabilities*, CellMig (p. 133), R 2725
9:30 - 10:00	Josh Lau (Toronto), *Algebro-topological invariants of co-existentially closed continua*, DesSetT (p. 108), R 2005
9:30 - 10:00	Simone Maletto (UBC), *Congruences of special values of the symmetric square L-function*, AGalois (p. 71), R 2630
9:30 - 10:00	Kenneth G. Monks (University of Scranton), *Proof Verification with Lurch*, MathEd1 (p. 200), R 2500
9:30 - 10:00	Joy Morris (University of Lethbridge), *Cop numbers of generalised Petersen graphs*, PurEvG (p. 212), R 2225
9:30 - 10:00	Minghao Pan (Caltech), *Dimension jump at the uniqueness threshold for percolation in $\infty + d$ dimensions*, DisProb (p. 115), R 2515
9:30 - 10:00	Guanying Peng (Worceser Polytechnic Institute), *A regularizing property of the 2D Eikonal equation*, MAC-VarP (p. 182), R 2505
9:30 - 10:00	Scott Rodney (Cape Breton University), *Existence, Boundedness, and Regularity - an overview of some recent results in Partial Differential Equations*, GeAnPDE (p. 140), WSOD 2920
9:30 - 10:00	Siddharth Sabharwal (Texas A&M University), *Population Size in Stochastic Ecological Dynamics*, Opt-ConD (p. 189), WSOD 1950
9:30 - 10:00	Marion Scheepers (Boise State University), *Fine structure of real quadratic integer rings*, CAargeo (p. 100), R 2170

9:30 - 10:00 Spandan Sengupta (Toront/Krembil), *Using a Population Rate Model of the CA1 Hippocampus to examine cell-type specific contributions to theta-gamma coupled rhythms*, DynSyst (p. 62), R2060

9:30 - 10:00 Raani K. S. Senthil (Indian Institute of Science Education and Research)), *Distribution of distances in quasi-regular sets*, IncProb (p. 163), R 1780

9:30 - 10:00 Kianoosh Shokri (Ottawa), *A construction of strength-4 covering arrays using three k-caps in $PG(3, q)$*, CombDes (p. 96), R 2520

9:30 - 10:00 Jozsef Solymosi (The University of British Columbia), *On the Thue-Vinogradov Lemma*, FinFiel (p. 130), R 2125

9:30 - 10:00 Kim Sooyeong (University of Guelph), *Perfect state transfer in a graph and its line graph*, AlgGrT1 (p. 55), R 1380

9:30 - 10:00 Mayya Tokman (UC Merced), *Exponential integration and applications*, SPDiscr (p. 203), R 2590

9:30 - 10:00 Rodolfo Torres (University of Calafornia Riverside), *EXTRAPOLATION OF COMPACTNESS FOR CERTAIN PSEUDODIFFERENTIAL OPERATORS*, HarAnaG (p. 159), R 3080

9:30 - 10:00 Scott Wesley (Dalhousie), StudRes (p. 206), R 2155

9:30 - 10:00 Vicki Zhang (University of Toronto), *Taking Stock: Eight Years of Embedded Ethics at UofT's Actuarial Science Program*, EmbEthi (p. 119), WSOD 4900

9:30 - 10:30 Ethan Ross (University of Toronto), *Quantization of Symplectic Stratified Spaces*, GeoQuan (p. 143), R 1690

9:50 - 10:30 Miao (Pam) Gu (University of Michigan), *On Triple Product L-functions*, AutoRep (p. 81), R 3625

10:00 - 10:30 Tanjima Akhter & Adriana-Stefania Ciupeanu (University of Alberta, University of Manitoba), StudRes (p. 205), R 2155

10:00 - 10:30 Dan Barake (McMaster University), *Characters in p-adic Vertex Operator Algebras*, NumTheo (p. 122), R 2550 A&B

10:00 - 10:30 Benjamin Bloem-Reddy (University of British Columbia), *Causal Inference with Cocycles*, MachLea (p. 174), R 2300

10:00 - 10:30 Hannah Cairns (McGill), *Cooperative motion in higher dimensions*, DisProb (p. 114), R 2515

10:00 - 10:30 Gyivan Lopez Campos (Instituto de Matemáticas, Universidad Nacional Autónoma de México), *0/1-Borsuk problem on matroids*, IntDisG (p. 165), R 2620

10:00 - 10:30 Matt Coles and Kelly Paton (University of British Columbia), *Student experience of group work in a large first-year calculus course: measuring, facilitating, improving*, MathEd1 (p. 199), R 2500

10:00 - 10:30 Daniel Fiorilli (CNRS Université Paris-Saclay), *Biases and variances in the distribution of primes*, GregMar (p. 88), WSOD 1960

10:00 - 10:30 Eric Foxall (University of British Columbia Okanagan), *Optimal control of ribosome population for gene expression under periodic nutrient intake*, OptConD (p. 187), WSOD 1950

10:00 - 10:30 Michael Friedlander (UBC), *Density Estimation from Moments*, AlgAppA (p. 104), R 2530

10:00 - 10:30 Judith Koeller (University of Waterloo), *Experiences teaching About Ethics in Math via Peace Studies*, EmbEthi (p. 118), WSOD 4900

10:00 - 10:30 Izabella Łaba (University of British Columbia), *A short survey of integer tilings*, HarAnaG (p. 157), R 3080

10:00 - 10:30 Alice Lacaze-Masmonteil (Ottawa), *Completing the solution of the directed Oberwolfach problem with two tables*, CombDes (p. 94), R 2520

10:00 - 10:30 Rossitza Marinova (Concordia University of Edmonton), *Variational Approach for Computing Solitary-Wave Solutions*, MACVarP (p. 181), R 2505

10:00 - 10:30 Brett Nasserden (University of Western Ontario), *Some Explicit Computations on Toric Vector Bundles with Applications to Arithmetic Dynamics*, CAargeo (p. 99), R 2170

10:00 - 10:30 Tori Noquez (Saint Mary's College of California), *Fractals as Final Coalgebras in Various Categories of Metric Spaces*, DesSetT (p. 108), R 2005

10:00 - 10:30 Daniel Panario (Carleton University), *Stable binomials over finite fields*, FinFiel (p. 129), R 2125

10:00 - 10:30 Merlin Pelz (UMN), *Synchronized Memory-Dependent Intracellular Oscillations in Compartmental-Reaction Diffusion Systems*, DynSyst (p. 62), R2060

10:00 - 10:30 Amanda Porter (University of Victoria), *Hyperopic Cops and Robbers: Cops with Vision Problems*, PurEvG (p. 213), R 2225

10:00 - 10:30 Mehdi Salimi (Kwantlen Polytechnic University), *Decision-Making Strategies for Pursuers with Speed and Energy Constraints in a Pursuit-Evasion Differential Game*, BusOpti (p. 171), R 2510

10:00 - 10:30	Eric Sawyer (McMaster), *Probabilistic and Deterministic Fourier Extension*, OpTheo (p. 185), R 2525
10:00 - 10:30	Alexey Shevyakov (University of Saskatchewan), *Exact Internal Waves in a Two-Fluid System*, SymAlgS (p. 66), R 2540
10:00 - 10:30	Lucas Villagra Torcomian (Simon Fraser University), *The modular method for Generalized Fermat equations*, AutoNT (p. 78), R 2800
10:00 - 10:30	Ignacio Uriarte-Tuero (University of Toronto), *Muckenhoupt Ap weights, BMO, distance functions and related problems*, GeAnPDE (p. 141), WSOD 2920
10:00 - 10:30	Andy Wan (UC Merced), *Minimal ℓ^2 Norm Discrete Multiplier Method*, SPDiscr (p. 203), R 2590
10:00 - 10:30	Xiaowen Zhou (Concordia University), *Speeds of coming down from infinity for Λ-Fleming-Viot supports*, ReProSt (p. 198), R 2960
10:30 - 11:00	Break / Pause, KPU - WSOD Entrance
11:00 - 12:00	Steve Rayan (University of Saskatchewan), *A Snapshot of Mathematics in the Second Quantum Revolution*, Plen (p. 46), R 2550 A&B
13:30 - 14:30	Michael Groechenig (University of Toronto), *Applications of finite and p-adic fields to complex algebraic geometry*, PzCJ (p. 48), R 2550 A&B
14:30 - 15:00	Break / Pause, KPU - WSOD Entrance
15:00 - 15:30	Jan Arulseelan (McMaster), *Computability in Continuous Logic with Applications to Operator Algebras*, DesSetT (p. 107), R 2005
15:00 - 15:30	Rylo Ashmore (Memorial University of Newfoundland), *Herding logical cats with Rabin's Theorem*, PurEvG (p. 211), R 2225
15:00 - 15:30	Khalil Besrour (Ottawa), StudRes (p. 205), R 2155
15:00 - 15:30	George Bluman (University of British Columbia), *Use of the symmetry-based method to construct non-invertible mappings*, SymAlgS (p. 65), R 2540
15:00 - 15:30	Vrushali Bokil (Oregon State), *Structure Preserving Discretizations for Magnetohydrodynamics*, SPDiscr (p. 201), R 2590
15:00 - 15:30	Dan Brown and Maura Grossman (University of Waterloo), *Teaching computer ethics by focusing on discrimination and surveillance: takeaways from an online teaching experiment*, EmbEthi (p. 117), WSOD 4900
15:00 - 15:30	Sue Ann Campbell (Waterloo), *Distributed Time Delay and Synchronization in a Neural Mass Model*, DynSyst (p. 59), R2060
15:00 - 15:30	Edward Doolittle (First Nations University), MathEd2 (p. 208), R 2500
15:00 - 15:30	Andrey Feuerverger (University of Toronto), *Statistics in Number Theory???*, GregMar (p. 88), WSOD 1960
15:00 - 15:30	Alexey Garber (University of Texas Rio Grande Valley), *On spheres with k points inside*, IntDisG (p. 166), R 2620
15:00 - 15:30	Samprit Ghosh (University of Calgary), *Certain Polytopes associated to Algebraic integer conjugates*, NumTheo (p. 123), R 2550 A&B
15:00 - 15:30	Chris Godsil (University of Waterloo), *Continuous quantum walks on locally finite graphs.*, AlgGrT2 (p. 57), R 1380
15:00 - 15:30	Kesav Krishnan (U. Victoria), *Local Convergence of Integer Valued Lipschitz Functions on Trees*, DisProb (p. 114), R 2515
15:00 - 15:30	Izabella Łaba (UBC), *Incidence questions in p-adic geometry*, IncProb (p. 162), R 1780
15:00 - 15:30	Dave McKinnon (University of Waterloo), *How do rational points cluster on wonderful varieties?*, CAargeo (p. 99), R 2170
15:00 - 15:30	Ben Moore (Institute of Science and Technology, Austria), *Orientations of Highly Edge Connected Graphs*, GraStAl (p. 152), R 2435
15:00 - 15:30	Dominique Orban (Ecole Polytechnique), *Complexity of trust-region methods in the presence of unbounded Hessian approximations*, AlgAppA (p. 105), R 2530
15:00 - 15:30	Hansol Park (Dalhousie University), *Emergent behavior of mathematical models on manifolds*, MACVarP (p. 181), R 2505
15:00 - 15:30	Clement Soubrier (UBC), *Experimental analysis of M. smegmatis morphological feature dynamics and modelling using reaction-diffusion systems.*, CellMig (p. 135), R 2725

15:00 - 15:30 Doug Stinson (Waterloo), *Recent results on near-factorizations of groups*, CombDes (p. 96), R 2520
15:00 - 15:30 Danica Sutherland (University of British Columbia), *Expander Graphs and Low-Distortion Embeddings for Learning on Graphs*, MachLea (p. 177), R 2300
15:00 - 15:30 William Verreault (Toronto), *The Cesàro Operator on local Dirichlet spaces*, OpTheo (p. 185), R 2525
15:00 - 15:30 Alexia Yavicoli (University of British Columbia), *The Erdős similarity problem for non-small Cantor sets*, HarAnaG (p. 159), R 3080
15:00 - 15:30 Kexue Zhang (Queen's University), *Impulsive Synchronization of Complex Networks: an Event-Triggered Pinning Algorithm*, OptConD (p. 190), WSOD 1950
15:00 - 15:40 Yanze Chen (University of Alberta), *Eisenstein series on metaplectic covers and multiple Dirichlet series*, AutoRep (p. 80), R 3625
15:00 - 16:00 Reebhu Bhattacharyya (University of Michigan), *Isotropic States on Kähler Manifolds*, GeoQuan (p. 142), R 1690

15:30 - 16:00 Shabnam Akhtari (Penn State), *Index Form Equations and Monogenized Orders in Quartic Number Fields*, CAargeo (p. 97), R 2170
15:30 - 16:00 Rachael Alvir (Waterloo), *Scott Complexity and Torsion Abelian Groups*, DesSetT (p. 107), R 2005
15:30 - 16:00 Nic Banks (University of Waterloo), *Galois Theory and Computation of Intersective Polynomials*, NumTheo (p. 122), R 2550 A&B
15:30 - 16:00 John Bowman (University of Alberta), *Conservative, Symplectic, and Exponential Integrators*, SPDiscr (p. 201), R 2590
15:30 - 16:00 Maritza Branker (Niagara University), *Viewing our students as ambassadors of our discipline: a new approach to the mathematics senior seminar.*, EmbEthi (p. 117), WSOD 4900
15:30 - 16:00 Paige Bright (UBC), *Dual Furstenberg Sets*, IncProb (p. 161), R 1780
15:30 - 16:00 Anouk Brose (University of California), *Computing Lattice Diameters of Lattice Polygons*, IntDisG (p. 165), R 2620
15:30 - 16:00 Emily Casey (University of Washington), *Anisotropic singular integrals and rectifiability*, HarAnaG (p. 156), R 3080
15:30 - 16:00 Egan Chernoff (University of Saskatchewan), *Popularizing the Mathematics of Mathematics Education*, MathEd2 (p. 207), R 2500
15:30 - 16:00 Stephen Choi (Simon Fraser University), *Polynomials whose reducibility is related to the Goldbach conjecture*, GregMar (p. 87), WSOD 1960
15:30 - 16:00 Kelsey Gasior (Notre Dame), *The Impact of Dynamical System Nondimensionalization on Sensitivity Analysis when Modeling the Epithelial Mesenchymal Transition*, DynSyst (p. 61), R2060
15:30 - 16:00 Ke Li (Simon Fraser University), *Rethinking Regression: Insights from Machine Learning*, MachLea (p. 176), R 2300
15:30 - 16:00 Zhaosong Lu (University of Minnesota), *Variance-reduced first-order methods for stochastic optimization with deterministic constraints*, AlgAppA (p. 105), R 2530
15:30 - 16:00 Trent Marbach (TMU), CombDes (p. 95), R 2520
15:30 - 16:00 Hermie Monterde (University of Manitoba), *New results in vertex sedentariness*, AlgGrT2 (p. 57), R 1380
15:30 - 16:00 Kathryn Nurse (Simon Fraser University), *Nowhere-zero flows and group connectivity - an intermediate step*, GraStAl (p. 153), R 2435
15:30 - 16:00 Pierre Olivier (UQTR), OpTheo (p. 185), R 2525
15:30 - 16:00 Merlin Pelz (Minnesota), *Symmetry-Breaking in Compartmental-Reaction Diffusion Systems with Comparable Diffusivities*, CellMig (p. 134), R 2725
15:30 - 16:00 Jiniao Qiu (University of Calgary), *A particle consensus approach to solving nonconvex-nonconcave min-max problems*, OptConD (p. 188), WSOD 1950
15:30 - 16:00 Lily Reeves (Caltech), *Phase Transitions of Ballistic Annihilation*, DisProb (p. 115), R 2515
15:30 - 16:00 Aaron Tronsgard (University of Toronto), StudRes (p. 206), R 2155
15:30 - 16:00 Beatrice-Helen Vritsiou (University of Alberta), *On a Blaschke-Santaló-type inequality for projections of (non-symmetric) convex bodies, and some applications*, GeAnPDE (p. 141), WSOD 2920
15:30 - 16:00 Boting Yang (University of Regina), *Constrained Graph Searching on Trees*, PurEvG (p. 213), R 2225
15:30 - 16:00 Zuhal Kucukarslan Yuzbasi (University of British Columbia), *New non-invertible mappings of Schrödinger equations to free particle equations*, SymAlgS (p. 67), R 2540

15:30 - 16:00	Zhichun Zhai (MacEwan University), *A nonlinear equation induced by fractional $p-$convexity*, MACVarP (p. 182), R 2505
15:50 - 16:10	Danielle Wang (Berkely), *Twisted GGP conjecture in the unramified case*, AutoRep (p. 83), R 3625
16:00 - 16:30	Break, HarAnaG (p. 155), R 3080
16:00 - 16:30	Benjamin Cameron (University of PEI), *Vertex-critical graphs in co-gem-free graphs*, GraStAl (p. 150), R 2435
16:00 - 16:30	Jose Cruz and Fatemeh Jalalvand (University of Calgary), *Geometric Properties of Log Unit Lattices*, NumTheo (p. 122), R 2550 A&B
16:00 - 16:30	Ying Cui (UC Berkeley), *Variational Theory and Algorithms for a Class of Asymptotically Approachable Nonconvex Problems*, AlgAppA (p. 103), R 2530
16:00 - 16:30	Katharine Faulkner (UBC), *Modelling Glucose Regulation: Lipotoxicity and the Progression to Type 2 Diabetes*, DynSyst (p. 61), R2060
16:00 - 16:30	David Feder (University of Calgary), *Hard-core bosons on lattices as the symmetric power of cycle graphs*, AlgGrT2 (p. 56), R 1380
16:00 - 16:30	Miao Gu (University of Michigan), *Factorization tests arising from counting modular forms and automorphic representations*, GregMar (p. 89), WSOD 1960
16:00 - 16:30	Kevin Hare (University of Waterloo), *Non-expansive matrix number systems with bases similar to certain Jordan blocks*, CAargeo (p. 99), R 2170
16:00 - 16:30	Antonio Torres Hernandez (University of California), *Counting Vertices on Hyperplane Slices of Polytopes*, IntDisG (p. 166), R 2620
16:00 - 16:30	Jonathan Jedwab (SFU), *Additive triples in groups of odd prime order*, CombDes (p. 94), R 2520
16:00 - 16:30	Christopher Karpinski (McGill), *Hyperfiniteness of boundary actions of small cancellation groups*, DesSetT (p. 108), R 2005
16:00 - 16:30	Matthew Koban (University of Toronto), *Bundle representations of double quivers*, GeoQuan (p. 143), R 1690
16:00 - 16:30	Caleb Marshall (UBC), *Pinned Dot Product Set Estimates*, IncProb (p. 162), R 1780
16:00 - 16:30	Daniel de la Riva Massaad (UBC), *Voter Model stability with respect to conservative noises*, DisProb (p. 115), R 2515
16:00 - 16:30	Tyler Meadows (Queen's University), *Optimizing biomass production in bioreactors*, OptConD (p. 188), WSOD 1950
16:00 - 16:30	Pearson W. Miller (USCD), CellMig (p. 134), R 2725
16:00 - 16:30	Nilima Nigam (Simon Fraser), *Structure-preservation and the Steklov eigenfunctions*, SPDiscr (p. 202), R 2590
16:00 - 16:30	Alan Pasos (Simon Fraser University), *Coping with Coercion in Logic*, MathEd2 (p. 209), R 2500
16:00 - 16:30	Lindsay Poirier (Smith College), *Data Ethnography: Cultivating Reflexive Sensibilities through the Cultural Analysis*, EmbEthi (p. 119), WSOD 4900
16:00 - 16:30	Asiyeh Sanaei (Kwantlen Polytechnic University), *Damage Number of Small Graphs*, PurEvG (p. 213), R 2225
16:00 - 16:30	Subhankar Sil (University of British Columbia), *Non-invertible mappings relating linear PDEs to corresponding nonlinear PDEs through symmetry-based method*, SymAlgS (p. 67), R 2540
16:00 - 16:30	Matt Spragge (Simon Fraser University), StudRes (p. 205), R 2155
16:00 - 16:30	Chong Wang (Washington and Lee Univeristy), *Core Shells, Double Bubbles, and Lens Clusters in Ternary Nonlocal Isoperimetric Problems*, MACVarP (p. 182), R 2505
16:00 - 16:30	Yiming Xu (University of Kentucky), *Statistical Ranking with Dynamic Covariates*, MachLea (p. 178), R 2300
16:00 - 16:30	Joshua Zahl (University of British Columbia), *A survey of the Kakeya problem*, GeAnPDE (p. 141), WSOD 2920
16:00 - 16:30	Nina Zorboska (Manitoba), *Hankel measures and Hankel type operators on weighted Dirichlet spaces*, OpTheo (p. 186), R 2525
16:20 - 16:40	Fatma Cicek (UNBC), *Moments of Rankin-Selberg Convolution L-functions Near the Central Point*, AutoRep (p. 80), R 3625
16:30 - 17:00	Stephen Anco (Brock University), *Hidden symmetry groups in classical mechanics and beyond*, SymAlgS (p. 64), R 2540

16:30 - 17:00 Michael Astwood (Manitoba), *The Kepler Problem on Pseudo-Riemannian Surfaces*, StudRes (p. 205), R 2155

16:30 - 17:00 Alex Clow (Simon Fraser University), *Eternal Distance-k Domination in Trees*, PurEvG (p. 211), R 2225

16:30 - 17:00 Eric Cytrynbaum (UBC), *Spatiotemporal patterning in reptile tooth replacement*, DynSyst (p. 60), R2060

16:30 - 17:00 Jack Hughes (UBC), *Travelling waves and wave pinning (polarity): Switching between random and directional cell motility*, CellMig (p. 133), R 2725

16:30 - 17:00 Jiajin Li (UBC), *Unveiling Spurious Stationarity and Hardness Results for Bregman Proximal-Type Algorithms*, AlgAppA (p. 104), R 2530

16:30 - 17:00 Shuxing Li (Delaware), *Intersection Distributions and Related Steiner Systems*, CombDes (p. 95), R 2520

16:30 - 17:00 Yucheng Liu (UBC), *The torus plateau for the high-dimensional Ising model*, DisProb (p. 115), R 2515

16:30 - 17:00 Xin Yang Lu (Lakehead University), *Geometry of minima in co-polymer models*, MACVarP (p. 181), R 2505

16:30 - 17:00 Abbas Maarefparvar (University of Lethbridge), *An Application of Terada's Principal Ideal Theorem*, NumTheo (p. 124), R 2550 A&B

16:30 - 17:00 Amita Malik (Penn State University), *Zeros of derivatives of L-functions attached to Maass forms*, GregMar (p. 90), WSOD 1960

16:30 - 17:00 Caleb Marshall (University of British Columbia), *The Size of Spanning Sets of Lines for Fractal Subsets of* $\mathbb{R}^n$, GeAnPDE (p. 139), WSOD 2920

16:30 - 17:00 Nathalie Moon (University of Toronto), *Embracing Uncertainty: Weaving Ethics into Statistics Education*, EmbEthi (p. 119), WSOD 4900

16:30 - 17:00 Nhu Nguyen (University of Rhode Island), *Stochastic Approximation and Applications*, OptConD (p. 188), WSOD 1950

16:30 - 17:00 Ben Seamone (Dawson College), *Ramsey numbers of signed graphs*, GraStAl (p. 153), R 2435

16:30 - 17:00 Forte Shinko (Berkeley), *Hyperfiniteness of graphs of slow intermediate growth*, DesSetT (p. 109), R 2005

16:30 - 17:00 Donald M. Stull (University of Chicago), *Exceptional sets for orthogonal directions*, IncProb (p. 163), R 1780

16:30 - 17:00 Peter Taylor (Queen's University), *Discrete Optimization for school and university*, MathEd2 (p. 209), R 2500

16:30 - 17:00 Seth Taylor (McGill), *A functional discretization of the coadjoint action on the diffeomorphism group*, SPDiscr (p. 203), R 2590

16:30 - 17:00 Zhichun Zhai (MacEwan University), *Stengthened Fractional Sobolev Inequalities and Geometric Inequalities*, OpTheo (p. 186), R 2525

16:30 - 17:00 Xiaohong Zhang (Université de Montréal), *Real state transfer*, AlgGrT2 (p. 58), R 1380

16:30 - 17:00 Junjie Zhu (University of British Columbia), *Hausdorff dimension and quadratic Roth*, HarAnaG (p. 160), R 3080

16:30 - 17:30 Hyunmoon Kim (University of Toronto), *Stratification of families of representations of the Heisenberg Lie algebra*, GeoQuan (p. 143), R 1690

16:50 - 17:10 Manish M. Patnaik (University of Alberta), AutoRep (p. 82), R 3625

17:00 - 17:30 Masoomeh Akbari (Ottawa), *The Generalized Honeymoon Oberwolfach Problem with one large table of size 2m*, CombDes (p. 93), R 2520

17:00 - 17:30 Johannes Bäumler (UCLA), *The truncation problem for long-range percolation*, DisProb (p. 114), R 2515

17:00 - 17:30 Nicolas Doyon (Laval), *Using the Finite Element method to solve the Poisson Nernst-Planck equations in neural structures*, DynSyst (p. 60), R2060

17:00 - 17:30 Kostya Druzhkov (University of Saskatchewan), SymAlgS (p. 65), R 2540

17:00 - 17:30 Jacob B. Fiedler (University of Wisconsin - Madison), *Universal sets for pinned distances*, IncProb (p. 161), R 1780

17:00 - 17:30 Stephen Finbow (St. Francis Xavier University), PurEvG (p. 212), R 2225

17:00 - 17:30 Angèle Foley (Wilfrid Laurier University), *When is a graph e-positive ?*, GraStAl (p. 152), R 2435

17:00 - 17:30 Himanshu Gupta (University of Regina), *Minimum number of distinct eigenvalues of Johnson and Hamming graphs*, AlgGrT1 (p. 52), R 1380

17:00 - 17:30 Illya Ivanov (University of Calgary), *Counting C-polyhedra facets*, IntDisG (p. 167), R 2620

17:00 - 17:30 Brett Nasserden (McMaster University), *Some Progress on Fulton's Local-Global Question*, NumTheo (p. 124), R 2550 A&B

17:00 - 17:30	Siddharth Sabharwal (Texas A&M University), *Existence and Asymptotics of Nonlinear Helmholtz Eigenfunctions*, GeAnPDE (p. 141), WSOD 2920
17:00 - 17:30	Zhongwei Shen (University of Alberta), *WKB Approximation of Quasi-stationary Distributions with Applications*, OptConD (p. 189), WSOD 1950
17:00 - 17:30	Reginald Simpson (UBC), *The Density and Distribution of Cyclic Groups in the Invariant Factor Decomposition of the Multiplicative Group*, GregMar (p. 90), WSOD 1960
17:00 - 17:30	Krystal Taylor (Ohio State University), *Projections and Favard length in a nonlinear setting*, HarAnaG (p. 158), R 3080
17:00 - 17:30	Nia Tzvetkova and Nahid Walji (UBC), *Incorporating student-perspective resources into a proofs course*, MathEd2 (p. 210), R 2500
17:00 - 17:30	Daniel Venn (Simon Fraser), *Meshfree Integration Techniques for Scattered Data on Curves and Surfaces*, SPDiscr (p. 203), R 2590
17:00 - 17:30	Mahishanka Withanachchi (University of Calgary), *Vanishing Cohomology and the Corona Problem for the Algebra of Bounded Holomorphic Functions on the Polydisk*, OpTheo (p. 186), R 2525
17:00 - 17:30	Alp Yurtsever (Umea University), *Block Coordinate DC Programming*, AlgAppA (p. 106), R 2530
17:00 - 18:00	Talkback/roundtable session (open to all), *Talkback/roundtable discussion*, EmbEthi (p. 119), WSOD 4900
17:20 - 17:40	Lior Silberman (University of British Columbia), *Arithmetic Quantum Unique Ergodicity on Hyperbolic spaces*, AutoRep (p. 82), R 3625
17:30 - 18:00	Bodan Arsovski (IAS), HarAnaG (p. 154), R 3080
17:30 - 18:00	Kristaps Balodis (University of Calgary), *L-functions, representation theory, and geometry.*, NumTheo (p. 121), R 2550 A&B
17:30 - 18:00	Discussion, GeoQuan (p. **??**), R 1690
17:30 - 18:00	Federico Firoozi (University of Calgary), *Counting lattice paths with respect to a linear boundary of rational slope*, IntDisG (p. 165), R 2620
17:30 - 18:00	Robert Fraser (Wichita State University), *A Framework for constructing large sets without configurations*, IncProb (p. 162), R 1780
17:30 - 18:00	Donglin Han (University of Alberta), *Retrospective estimation of proportion of total infections of COVID-19 during the first wave in Alberta*, DynSyst (p. 61), R2060
17:30 - 18:00	Siqi Wei (Saskatchewan), *Operator-splitting methods for qualitative property preservation of production-destruction systems*, SPDiscr (p. 204), R 2590
17:30 - 18:00	Trevor Wooley (Purdue University), *Smooth values of polynomials and superirreducibility*, GregMar (p. 91), WSOD 1960
17:30 - 18:00	Yang Yang (University of Calgary), *Infinite dimensional optimal control differential systems with randomness and path-dependence*, OptConD (p. 189), WSOD 1950
17:30 - 18:00	Rina Zazkis (Simon Fraser University), *Mathematical Incidents and resulting research*, MathEd2 (p. 210), R 2500

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8:00 - 8:30	James Cumberbatch (Purdue University), NumTheo (p. 122), R 2550 A&B
8:00 - 8:30	Mahdieh Moghadam (Brock University), SymAlgS (p. 66), R 2540
8:30 - 9:00	Ada Chan (York University), *Pair-state transfer in distance regular graphs*, AlgGrT2 (p. 56), R 1380
8:30 - 9:00	Rafael de la Rosa Silva (Universidad de Cádiz), *The natural extension to PDEs of Lie's reduction of order algorithm for ODEs*, SymAlgS (p. 67), R 2540
8:30 - 9:00	Kin Ming Tsang (University of British Columbia), *Comparing Hecke eigenvalues of automorphic representations for GL(2)*, NumTheo (p. 125), R 2550 A&B
8:30 - 9:30	Dan Wang (IST, University of Lisbon), *Geometric Quantization on Toric Varieties*, GeoQuan (p. 144), R 1690
9:00 - 9:30	César Hernández Cruz (UNAM, Mexico), *Full homomorphisms to trees*, GraStAl (p. 151), R 2435
9:00 - 9:30	Willy Hereman (Colorado School of Mines), *Symbolic computation of conservation laws of nonlinear partial differential equations*, SymAlgS (p. 65), R 2540
9:00 - 9:30	Prangya Parida (Ottawa), *Cover-free families on graphs*, CombDes (p. 95), R 2005
9:00 - 9:30	Sarah Plosker (Brandon University), *Quantum state transfer in weakly Hadamard diagonalizable graphs*, AlgGrT2 (p. 57), R 1380
9:00 - 9:30	Emily Quesada-Herrera (University of Lethbridge), *Fourier optimization and quadratic forms*, NumTheo (p. 124), R 2550 A&B
9:30 - 10:00	Stathis Charalampidis (San Diego State University), *Computational Analysis of self-similar blow-up in nonlinear dispersive PDEs*, SymAlgS (p. 65), R 2540
9:30 - 10:00	Alex Kazachek (University of Waterloo), *Quantum Channel Capacities and Additivity Conjectures*, GeoQuan (p. 143), R 1690
9:30 - 10:00	Hadi Kharaghani (Lethbridge), *Hadamard matrices related to orthogonal arrays*, CombDes (p. 94), R 2005
9:30 - 10:00	Gabor Lippner (Northeastern University), *Regular graphs with the most number of k-cycles.*, AlgGrT2 (p. 57), R 1380
9:30 - 10:00	Kiara McDonald (University of Victoria), *Broadcast Independence in Different Classes of Graphs*, GraStAl (p. 152), R 2435
9:30 - 10:00	Paul Péringuey (University of British Columbia), *Sign correlation between error terms of counting functions of primes in arithmetic progressions modulo 11*, NumTheo (p. 124), R 2550 A&B
9:30 - 10:00	Henry Wolkowicz (Waterloo), *The $omega$-condition number for optimal preconditioning of linear systems*, AlgAppA (p. 106), R 2530
10:00 - 10:30	Jaiden Dahlke (Brock University), SymAlgS (p. 65), R 2540
10:00 - 10:30	Jelena Diakonikolas (University of Wisconsin), *Faster solutions to variational inequalities with highly nonuniform component or block Lipschitz constants*, AlgAppA (p. 103), R 2530
10:00 - 10:30	Zhenchao Ge (University of Waterloo), *A discrete mean value for Dirichlet L-function over local extrema*, NumTheo (p. 122), R 2550 A&B
10:00 - 10:30	Shannon Ogden (University of Victoria), *The Rainbow Connection*, GraStAl (p. 153), R 2435
10:00 - 10:30	Open problem discussion, CombDes (p. 95), R 2005
10:00 - 10:30	Kaleb D. Ruscitti (University of Waterloo), *Degeneration of Holomorphic Sections to Bohr-Sommerfeld points for Moduli of SL(2,C) Bundles*, GeoQuan (p. 144), R 1690
10:30 - 11:00	Break / Pause, KPU - WSOD Entrance
11:00 - 12:00	Trevor Wooley (Purdue University), *Waring's problem and its relatives*, Plen (p. 46), R 2550 A&B
13:30 - 14:30	David Urbanik (Institut des Hautes Études Scientifiques), *New Directions in Unlikely Intersections*, PzDoc (p. 47), R 2550 A&B
14:30 - 15:00	Break / Pause, KPU - WSOD Entrance
15:00 - 15:30	Ahmet Alacaoglu (UBC), *Towards Weaker Variance Assumptions for Stochastic Optimization: A Blast From the Past*, AlgAppA (p. 102), R 2530
15:00 - 15:30	Iain Beaton (Acadia University), *Reconfiguration Graphs for Minimal Domination Sets*, GraStAl (p. 150), R 2435
15:00 - 16:00	Michael Francis (MacEwan University), *Towards b^k-analogues of Berezin-Toeplitz quantization*, GeoQuan (p. 142), R 1690

15:30 - 16:00	Nancy Clarke (Acadia University), *On the Structure of Dominating Graphs of Trees and Cycles*, GraStAl (p. 151), R 2435
15:30 - 16:00	Tianyi Lin (Columbia), *Lower bound construction in nonsmooth optimization*, AlgAppA (p. 105), R 2530
16:00 - 16:30	Kathie Cameron (Wilfrid Laurier University), *Frozen Colourings*, GraStAl (p. 151), R 2435
16:00 - 16:30	Cho Ho (Peter) Lam (Huawei Technologies), *Faster Infeasibility Analysis for Linear Programs*, AlgAppA (p. 104), R 2530
16:00 - 17:00	Ood Shabtai (University of Toronto), *Pairs of spectral projections of quantum observables on Riemann surfaces*, GeoQuan (p. 144), R 1690
16:30 - 17:00	Pavol Hell (Simon Fraser University), *Signed Graphs and Homomorphisms*, GraStAl (p. 152), R 2435
16:30 - 17:00	Nicholas Richardson (UBC), *Density Separation with Tensor Factorization*, AlgAppA (p. 105), R 2530
17:00 - 17:30	Tim Hoheisel (McGill), *Stability in nonsmooth optimization via graphical differentiation*, AlgAppA (p. 104), R 2530
17:00 - 18:00	Zhongkai Tao (U.C. Berkeley), *Spectral asymptotics for kinetic Brownian motion*, GeoQuan (p. 144), R 1690

Talk List

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Public Mitacs Lecture
Conférence publique Mitacs

Schedule/Horaire **Room/Salle: Minoru A-B, Sheraton**

Friday November 29 **vendredi 29 novembre**

18:00 - 19:00 Mark Lewis (University of Victoria), *One equation helps solve three paradoxes in the spatial ecology of predators and prey* (p. 45)

Abstract/Résumé

MARK LEWIS, University of Victoria

[Friday November 29 / vendredi 29 novembre, 18:00 – Minoru A-B, Sheraton]

One equation helps solve three paradoxes in the spatial ecology of predators and prey

In this talk I will illustrate the rich interplay that is now emerging between mathematics and spatial ecology. I will start by introducing three paradoxes in the spatial ecology of predators and prey (1) Buffer Zone Paradox: Why do wolves maintain stable buffer zones for prey, even though they may be only saving prey for the neighboring packs? (2) Road Use Paradox: Why are wolves attracted to roads and related linear features, even though that can mean higher chances of dying? (3) Path Less Travelled Paradox: Why do wolves preferentially travel to places they haven't been recently, even if it means fewer prey? To help solve these paradoxes, I will start with the Fokker-Planck equation, which describes the probability density function for an individual undergoing a random walk. I will then employ a mixture of mathematical approaches including nonlinear advection-diffusion, differential games, first passage time theory and stochastic processes. All of the resulting models will be fit to data before drawing scientific conclusions.

Plenary Lectures
Conférences plénières

Schedule/Horaire **Room/Salle: R 2550 A&B**

Sunday December 1 — dimanche 1er décembre

11:00 - 12:00 Steve Rayan (University of Saskatchewan), *A Snapshot of Mathematics in the Second Quantum Revolution* (p. 46)

Monday December 2 — lundi 2 décembre

11:00 - 12:00 Trevor Wooley (Purdue University), *Waring's problem and its relatives* (p. 46)

Abstracts/Résumés

STEVE RAYAN, University of Saskatchewan
[Sunday December 1 / dimanche 1er décembre, 11:00 – R 2550 A&B]
A Snapshot of Mathematics in the Second Quantum Revolution

We are in the midst of an exciting revolution in quantum science and technology, comparable in ways to the first one that occurred about 100 years ago. One of the most tantalizing and potentially disruptive innovations to emerge from this second revolution is the prospect of quantum computing. Serious attempts in both academia and industry to design practical quantum computers are pushing physical materials to their extremes. The rise of quantum materials, influenced in part by these attempts, has involved new perspectives and tools not only from physics, chemistry, and material science, but also from mathematics — and not only applied mathematics, but also pure mathematics. I will discuss my work over the past half decade in using ideas from pure mathematics — especially from complex algebraic geometry and Riemann surfaces — to anticipate new models of quantum materials as well as new paradigms for programming quantum devices that would result from these materials. I will explain, with lots of pictures, not only the mathematical and scientific ideas here, but also how the path to fabrication and actualization has led to exciting interdisciplinary collaborations between mathematics and other sciences and between academia and industry.

TREVOR WOOLEY, Purdue University
[Monday December 2 / lundi 2 décembre, 11:00 – R 2550 A&B]
Waring's problem and its relatives

In 1770, E. Waring made an assertion these days interpreted as conjecturing that when k is a natural number, all positive integers may be written as the sum of a number g(k) of positive integral k-th powers, with g(k) finite. This conjecture generalises the familiar theorem of Lagrange showing that all positive integers are the sum of four squares. Since the work of Hardy and Littlewood a century ago, attention has largely shifted to the problem of bounding G(k), the least number s having the property that all sufficiently large integers can be written as the sum of s positive integral k-th powers. The principal tool for investigations associated with Waring's problem, namely the Hardy-Littlewood (circle) method, is Fourier-analytic in flavour. In this talk we survey progress on Waring's problem that has emerged in the past 15 years, its connection with numbers having only small prime divisors as well as recent progress on discrete harmonic analysis, and implications of these recent ideas for cognate problems. Emerging developments, for example, touch on the topic of representing prime numbers as sums of powers, and impact the apparently mundane topic of controlling small solutions of congruences.

Prize Lectures
Conférence des lauréats

Schedule/Horaire **Rooms/Salles: R 2550 A&B, WSOD 4900**

Saturday November 30 — samedi 30 novembre

11:00 - 12:00	Florence Glanfield (University of Alberta), *Exploring Intersectionality: Mathematics, Indigenous Worldviews, and Educative Practices* (p. 48), WSOD 4900
13:30 - 14:30	Dr. André Boileau (UQAM), *Les hauts et les bas d'un prof de maths* (p. 47), WSOD 4900

Sunday December 1 — dimanche 1er décembre

13:30 - 14:30	Michael Groechenig (University of Toronto), *Applications of finite and p-adic fields to complex algebraic geometry* (p. 48), R 2550 A&B

Monday December 2 — lundi 2 décembre

13:30 - 14:30	David Urbanik (Institut des Hautes Études Scientifiques), *New Directions in Unlikely Intersections* (p. 47), R 2550 A&B

Abstract/Résumé

Adrien Pouliot Award
Prix Adrien-Pouliot

DR. ANDRÉ BOILEAU, Université du Québec à Montréal

[Saturday November 30 / samedi 30 novembre, 13:30 – WSOD 4900]

Les hauts et les bas d'un prof de maths

Pendant cette conférence, je tenterai de retracer diverses tentatives utilisées pour amener mes étudiant.e.s, surtout des professeur.e.s de mathématiques au secondaire (en formation initiale ou en perfectionnement), à approfondir leur appréciation et leur compréhension des mathématiques élémentaires.

Je décrirai tout d'abord divers moyens mis en œuvre pour induire une compréhension profonde de concepts mathématiques élémentaires, et le succès mitigé qui en est résulté: vous serez peut-être surpris de certains résultats obtenus.

Puis je donnerai un aperçu de diverses approches employées pour susciter une compréhension intuitive de certains concepts, complémentant ainsi les façons de faire plutôt formelles généralement employées, et des doutes qu'elles ont suscité chez certain.e.s.

J'aborderai ensuite le défi de la gestion de la composante expérimentale dans l'enseignement des mathématiques, en lien avec des objectifs de vérification et de compréhension.

Puis je parlerai de l'utilisation de projet personnels, susceptibles de permettre aux étudiant.e.s d'inclure certains de leurs intérêts personnels dans leurs travaux mathématiques. Je présenterai quelques exemples pour illustrer le tout.

Je terminerai en décrivant brièvement certains outils que j'ai dû créer pour faciliter diverses productions de mes étudiant.e.s.

Blair Spearman Doctoral Prize
Prix de doctorat Blair Spearman

Prize Lectures
Conférence des lauréats

DAVID URBANIK, IHES
[Monday December 2 / lundi 2 décembre, 13:30 – R 2550 A&B]
New Directions in Unlikely Intersections

We first give a general introduction to the field of unlikely intersections, including a broad overview of the problems under its banner and the techniques used by practitioners. We then explain how the speaker is working to expand the scope of the field to tackle problems in other areas of mathematics.

Coxeter-James Prize
Prix Coxeter-James

MICHAEL GROECHENIG, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 13:30 – R 2550 A&B]
Applications of finite and p-adic fields to complex algebraic geometry

The arithmetic properties of finite and p-adic fields and the topological aspects of complex geometry are intricately linked. Starting with the Weil conjectures and ensuing theories, this talk will span a narrative arc between classical and recent applications of this connection, with a particular focus on those regarding moduli spaces of Higgs bundles. Joint work with de Jong, Esnault, Wyss, and Ziegler will be discussed during the talk's second half.

Education Plenary
Conférence plénière sur l'éducation

FLORENCE GLANFIELD, University of Alberta
[Saturday November 30 / samedi 30 novembre, 11:00 – WSOD 4900]
Exploring Intersectionality: Mathematics, Indigenous Worldviews, and Educative Practices

In this talk I will share insights into learnings that I've had around the relationality and Intersectionality among and between mathematics, Indigenous worldviews, and ethnomathematics. These insights will offer possibilities to invite learners in classrooms to come to 'see' themselves as mathematical. These possibilities will invite each participant to reflect on their role, positionality, and responsibility as professors and instructors of mathematics.

Algebraic Geometry
Géométrie algébrique

Org: **Katrina Honigs** and/et **Nathan Ilten** (Simon Fraser University)

This session will focus on recent developments in algebraic geometry. Given the wide range of interests represented in the Canadian algebraic geometry landscape, topics covered may include such areas as classical algebraic geometry, derived categories, combinatorial algebraic geometry, and mirror symmetry, among others.

Schedule/Horaire **Room/Salle: R 1780**

Saturday November 30 **samedi 30 novembre**

8:30 - 9:00	Sasha Zotine (McMaster University), *Kawaguchi-Silverman for Projective Bundles on Elliptic Curves* (p. 51)
9:00 - 9:30	Susan Cooper (University of Manitoba), *Viewing Codes Through the Lens of Fat Points* (p. 49)
9:30 - 10:00	Kalle Karu (UBC), *Anisotropy in Stanley-Reisner rings* (p. 49)
10:00 - 10:30	Sharon Robins (Simon Fraser University), *Versal Deformations of Smooth Complete Toric Varieties* (p. 51)
15:00 - 15:30	Shubhodip Mondal (UBC), *Unipotent homotopy theory of schemes* (p. 51)
15:30 - 16:00	Michael Groechenig (University of Toronto), *Bialynicki-Birula theory for quotient stacks* (p. 49)
16:00 - 16:30	Ahmad Mokhtar (Simon Fraser University), *Connectedness of Fano schemes of matrices of bounded rank* (p. 50)
16:30 - 17:00	Haggai Liu (Simon Fraser University), *Moduli Spaces of Weighted Stable Curves and their Fundamental Groups* (p. 50)
17:00 - 17:30	Arnab Kundu (University of Toronto), *Motivic cohomology in mixed-characteristic* (p. 50)
17:30 - 18:00	Jake Levinson (Université de Montréal), *Limits in tropical compactifications and tropical psi classes* (p. 50)

Abstracts/Résumés

SUSAN COOPER, University of Manitoba
[Saturday November 30 / samedi 30 novembre, 9:00 – R 1780]
Viewing Codes Through the Lens of Fat Points

One can associate a linear code to a fat point set in projective space. It is natural to investigate how we can use properties of one of these objects to understand properties of the other. For example, it has been shown that the minimum Hamming distance of the code can be bounded using graded shifts from the graded minimal free resolution of the fat point set. We will investigate such connections for some special families of fat point sets.

MICHAEL GROECHENIG, University of Toronto
[Saturday November 30 / samedi 30 novembre, 15:30 – R 1780]
Bialynicki-Birula theory for quotient stacks

BB-theory allows one to describe motivic invariants of a variety acted on by a torus in terms of the fixpoints. It is a useful computational tool akin to Morse theory in differential geometry. I will report on joint work in progress with Evan Sundbo devoted to extending Bialynicki-Birula theory to the setting of algebraic stacks.

Algebraic Geometry
Géométrie algébrique

KALLE KARU, The University of British Columbia
[Saturday November 30 / samedi 30 novembre, 9:30 – R 1780]
Anisotropy in Stanley-Reisner rings

A smooth projective toric variety defined by a complete simplicial fan satisfies the classical Hard Lefschetz theorem and Hodge-Riemann bilinear relations. I will discuss the extensions of these theorems to the case of not necessarily projective simplicial fans, and more generally, to simplicial homology spheres. We construct an algebra of simplicial spheres, where the algebra operation is the connected sum of spheres. Using this algebra, one can decompose the cohomology ring of a simplicial sphere into elementary pieces and study each piece separately. We apply this to generalize the anisotropy theorem of Papadakis and Petrotou. This is a joint work with Elizabeth Xiao.

ARNAB KUNDU, University of Toronto
[Saturday November 30 / samedi 30 novembre, 17:00 – R 1780]
Motivic cohomology in mixed-characteristic

Motivic cohomology is a cohomology theory that can be defined internally within Grothendieck's category of motives. Voevodsky developed this theory for smooth varieties, demonstrating its profound connections to algebraic cycles and algebraic K-theory. However, its behavior beyond the smooth case remains less well understood. Building upon recent advancements by Bachmann, Elmanto, Morrow, and Bouis, we establish its $\mathbb{A}^1$-homotopy invariance for a broader class of "smooth" schemes. This is part of ongoing work in collaboration with Tess Bouis.

JAKE LEVINSON, Université de Montréal
[Saturday November 30 / samedi 30 novembre, 17:30 – R 1780]
Limits in tropical compactifications and tropical psi classes

Tropical intersection theory allows us to express intersections of subvarieties of algebraic tori using piecewise linear data, in particular polyhedral complexes in $\mathbb{R}^n$. In a similar vein, a method due to Katz shows how to use tropical data to compute flat limits of subvarieties X_t of a toric variety Y, where as $t \to 0$, X_t degenerates to a union of boundary strata of Y (with multiplicities). I will describe an extension of this method in which X_t instead degenerates to a union of boundary strata of an appropriately stratified subvariety $\overline{M} \subseteq Y$. Time permitting, I will describe an application to tropical psi classes on the moduli space of genus zero curves. This work is joint with Sean T. Griffin, Rohini Ramadas and Rob Silversmith.

HAGGAI LIU, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 16:30 – R 1780]
Moduli Spaces of Weighted Stable Curves and their Fundamental Groups

The Deligne-Mumford compactification, $\overline{M_{0,n}}$, of the moduli space of n distinct ordered points on $\mathbb{P}^1$, has many well understood geometric and topological properties. For example, it is a smooth projective variety over its base field. Many interesting properties are known for the manifold $\overline{M_{0,n}}(\mathbb{R})$ of real points of this variety. In particular, its fundamental group, $\pi_1(\overline{M_{0,n}}(\mathbb{R}))$, is related, via a short exact sequence, to another group known as the cactus group. Henriques and Kamnitzer gave an elegant combinatorial presentation of this cactus group.

In 2003, Hassett constructed a weighted variant of $\overline{M_{0,n}}(\mathbb{R})$: For each of the n labels, we assign a weight between 0 and 1; points can coincide if the sum of their weights does not exceed one. We seek combinatorial presentations for the fundamental groups of Hassett spaces with certain restrictions on the weights. In particular, we express the Hassett space as a blow-down of $\overline{M_{0,n}}$ and modify the cactus group to produce an analogous short exact sequence. The relations of this modified cactus group involves extensions to the braid relations in S_n. To establish the sufficiency of such relations, we consider a certain cell decomposition of these Hassett spaces, which are indexed by ordered planar trees.

AHMAD MOKHTAR, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 16:00 – R 1780]
Connectedness of Fano schemes of matrices of bounded rank

Fano schemes are fine moduli spaces that parameterize linear spaces contained in an embedded projective variety. The study of Fano schemes of matrices with bounded rank provides a geometric approach to the classical problem of classifying spaces of matrices with rank conditions. In this talk, I will present a complete combinatorial classification of the connectedness of Fano schemes of matrices with bounded rank. Our approach will treat rectangular, symmetric, and alternating matrices simultaneously. Furthermore, I will characterize the irreducibility of these Fano schemes in the case of symmetric matrices and propose a conjecture for the alternating case.

SHUBHODIP MONDAL, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 15:00 – R 1780]
Unipotent homotopy theory of schemes

Building on Toen's work on affine stacks, I will discuss a notion of homotopy theory for algebraic varieties, which we call "unipotent homotopy theory". Over a field of characteristic $p > 0$, I will explain how our unipotent homotopy group schemes recover (1) unipotent completion of the Nori fundamental group scheme, (2) p-adic etale homotopy groups, and (3) certain formal group laws arising from algebraic varieties constructed by Artin and Mazur. Time permitting, I will discuss unipotent homotopy types of Calabi–Yau varieties and show that the unipotent homotopy group schemes π_i^U of Calabi–Yau varieties (of dimension n) are derived invariant for all i; the case $i = n$ corresponds to a recent result of Antieau–Bragg. This is a joint work with Emanuel Reinecke.

SHARON ROBINS, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 10:00 – R 1780]
Versal Deformations of Smooth Complete Toric Varieties

Deformation theory is a vital tool for understanding the local structure of a moduli space around a fixed object X. A systematic approach to studying infinitesimal deformations of X involves defining a functor, Def_X, that associates, for every local Artin ring, the set of deformations over that ring up to equivalence. Despite a theoretical understanding of Def_X, explicit computations with examples are challenging. In this talk, I will discuss the combinatorial description of Def_X when X is a smooth complete toric variety. This is joint work with Nathan Ilten.

SASHA ZOTINE, McMaster University
[Saturday November 30 / samedi 30 novembre, 8:30 – R 1780]
Kawaguchi-Silverman for Projective Bundles on Elliptic Curves

The Kawaguchi-Silverman Conjecture is a recent conjecture equating two invariants of a dominant rational map between projective varieties: the *first dynamical degree*, which measures the topological mixing of the map; and the *arithmetic degree*, which measures the complexity of rational points under iteration. Recently, the conjecture was established for several classes of varieties, including projective bundles over any non-elliptic curve. We will discuss my recent work with Brett Nasserden to resolve the elliptic curve case, hence proving the conjecture for all projective bundles on curves.

Algebraic Graph Theory I
Théorie algébrique des graphes I

Org: Sooyeong Kim (University of Guelph), **Sarobidy Razafimahatratra** (Fields Institute) and/et **Harmony Zhan** (Worcester Polytechnic Institute)

The goal of this scientific session is to bring together mathematicians working in algebraic graph theory and applications to discuss the most recent advances in the area, disseminate new ideas, and inspire future collaborations. This is Part I of the two part session on algebraic graph theory, and will focus on the spectra, eigenvectors and symmetries of graphs.

Schedule/Horaire **Room/Salle: R 1380**

Saturday November 30 — samedi 30 novembre

9:00 - 9:30	Sarobidy Razafimahatratra (Fields Institute), *The intersection density of transitive groups of degree $3p$* (p. 54)
10:00 - 10:30	Thedore Kolokolnikov (Dalhousie University), *Maximizing network connectivity subject to resource constraints* (p. 53)
15:00 - 15:30	Bojan Mohar (Simon Fraser University), *Square energy of graphs* (p. 54)
15:30 - 16:00	Kumar Hitesh (Simon Fraser University), *Combinations of first and second eigenvalue of trees* (p. 53)
16:00 - 16:30	Shivaram Pragada (Simon Fraser University), *Bollobas-Nikiforov conjecture and triangle counting* (p. 54)
16:30 - 17:00	Allen Herman (University of Regina), *Parameters of quotient-polynomial graphs* (p. 52)
17:00 - 17:30	Jinting Liang (UBC), *Log-concavity and log-convexity via distributive lattices* (p. 54)

Sunday December 1 — dimanche 1er décembre

8:30 - 9:00	Thomás Spier (University of Waterloo), *Efficient reconstruction of the characteristic polynomial* (p. 55)
9:00 - 9:30	Lord Kavi (University of Ottawa), *Towards Haemers Laplacian Toughness Conjecture* (p. 53)
9:30 - 10:00	Kim Sooyeong (University of Guelph), *Perfect state transfer in a graph and its line graph* (p. 55)
17:00 - 17:30	Himanshu Gupta (University of Regina), *Minimum number of distinct eigenvalues of Johnson and Hamming graphs* (p. 52)

Abstracts/Résumés

HIMANSHU GUPTA, University of Regina
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 1380]
Minimum number of distinct eigenvalues of Johnson and Hamming graphs

This talk focuses on the inverse eigenvalue problems for graphs (IEPG), which investigates the possible spectra of real symmetric matrices associated with a graph G. These matrices have off-diagonal non-zero entries corresponding to the edges of G, while diagonal entries are unrestricted. A key parameter in IEPG is $q(G)$, the minimum number of distinct eigenvalues among such matrices. We present lower bounds on $q(G)$ based on the existence or non-existence of certain cycles in G. Notably, we show that every Johnson graph admits a $\{-1, 0, 1\}$-matrix with exactly two distinct eigenvalues. Additionally, we explore $q(G)$ for Hamming graphs and other distance-regular graphs. This work is in collaboration with Shaun Fallat, Allen Herman, and Johnna Parenteau.

ALLEN HERMAN, University of Regina
[Saturday November 30 / samedi 30 novembre, 16:30 – R 1380]
Parameters of quotient-polynomial graphs

Algebraic Graph Theory I
Théorie algébrique des graphes I

It is well-known that the parameters of a distance-regular graph (DRG) are determined by its intersection array. The intersection array is a minimal collection of intersection numbers that completely determines the intersection matrices of the association scheme determined by the DRG, and the adjacency algebra of this scheme is naturally polynomial in the adjacency matrix A_1 of the DRG.

It has been observed that many other symmetric association schemes are "polynomial" in the sense that their adjacency algebra is generated by the adjacency matrix of one of the graphs in the scheme. In a 2016 paper, Miguel Fiol referred to these graphs as quotient-polynomial graphs (QPGs). In 2023, a result of Xia, Tan, Liang, and Koolen showed that Q-polynomial association schemes are generated by the adjacency matrix of a QPG.

Earlier this year, Roghayeh Maleki and I released a database of parameters of QPGs whose association schemes are polynomial in A_1, where A_1 is the adjacency matrix of the QPG. We show each such QPG determines an equivalence class of QPG-parameter arrays, and the intersection matrices of the corresponding association scheme are determined by the QPG-parameter array.

In this talk I will explain how to work with QPG-parameter arrays, the techniques used to generate this database, and discuss the feasibility and realizability tests we have developed for QPG-parameter arrays. This is joint work with Roghayeh Maleki.

KUMAR HITESH, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 15:30 – R 1380]
Combinations of first and second eigenvalue of trees

For an n-vertex graph G, let $\lambda_1(G) \geq \lambda_2(G) \geq \cdots \geq \lambda_n(G)$ denote the eigenvalues of its adjacency matrix. In this talk, the speaker will present results concerning the extremization of combinations of λ_1 and λ_2 in the class of trees. These results are part of an ongoing project with Bojan Mohar, Shivaramakrishna Pragada, and Hanmeng Zhan.

LORD KAVI, Concordia University of Edmonton
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 1380]
Towards Haemers Laplacian Toughness Conjecture

This talk focuses on graph connectivity and toughness, highlighting an improved bound on vertex connectivity as initially proposed by Krivelevich and Sudakov. Toughness, introduced by Chvátal in 1973, is a key measure of how well different parts of a graph are connected, with implications for Hamiltonicity, spanning trees, connectivity, and more. We derive new bounds on graph toughness and confirm specific cases of a Laplacian-based toughness conjecture by Haemers. Our results include confirmations for regular bipartite graphs, trees, graphs with at least one leaf, graphs with up to 8 vertices, and some specially constructed examples.

THEDORE KOLOKOLNIKOV, Dalhousie University
[Saturday November 30 / samedi 30 novembre, 10:00 – R 1380]
Maximizing network connectivity subject to resource constraints

One way to measure how fast the network can propagate the information is using the Algebraic Connectivity (AC, or spectral gap) of a graph, which corresponds to the second eigenvalue of the Laplacian of the graph. We address the following question. Among all graphs of a given number of nodes n and edges m, which graph maximizes the AC ? Generally, this question is very difficult for all but very small n and m (e.g. n=20, m=30).

For regular graphs, we derive attainable upper bounds on AC in terms of diameter and girth. Our diameter bound agrees with the well-known Alon-Boppana-Friedman bound for graphs of even diameter, but is an improvement for graphs of odd diameter. We then use a combination of stochastic algorithms and exhaustive search to find graphs which attain the diameter bound.

For 3-regular graphs, we find attainable graphs for all diameters D up to and including D = 9 (the case of D = 10 is open). These graphs are extremely rare and also have high girth ; for example we found exactly 45 distinct cubic graphs on 44 vertices attaining the upper bound when D = 7 ; all had girth 8 (out of a total of 266362 girth-8 graphs on 44 vertices).

We also derive an asymptotic bound for AC for several classes of random semi-regular graphs. In particular, we show that certain semi-regular graphs of average degree $d < 8$ are better than regular graphs of the same average degree, but regular graphs win when $d \geq 8$.

JINTING LIANG, UBC
[Saturday November 30 / samedi 30 novembre, 17:00 – R 1380]
Log-concavity and log-convexity via distributive lattices

In this work we present a lemma, which we call the Order Ideal Lemma, that can be used to demonstrate a wide array of log-concavity and log-convexity results in a combinatorial manner using order ideals in distributive lattices. We use the Order Ideal Lemma to prove log-concavity and log-convexity of various sequences involving lattice paths (Catalan, Motzkin and large Schröder numbers), intervals in Young's lattice, order polynomials, specializations of Schur and Schur Q-functions, Lucas sequences, descent and peak polynomials of permutations, pattern avoidance, set partitions, and noncrossing partitions. This is a joint work with Bruce E. Sagan.

BOJAN MOHAR, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 1380]
Square energy of graphs

Let G be a graph of order n with eigenvalues $\lambda_1 \geq \cdots \geq \lambda_n$. Let

$$s^+(G) = \sum_{\lambda_i > 0} \lambda_i^2, \qquad s^-(G) = \sum_{\lambda_i < 0} \lambda_i^2.$$

The smaller value, $s(G) = \min\{s^+(G), s^-(G)\}$ is called the square energy of G. In 2016, Elphick, Farber, Goldberg, and Wocjan conjectured that for every connected graph G of order n, $s(G) \geq n - 1$. The bound is attained for any tree and also for every complete graph. No linear lower bound for $s(G)$ in terms of n is known. The speaker will prove that $s(G) \geq \frac{3n}{4}$ for every connected graph G of order $n \geq 4$. This is joint work with Saieed Akbari, Hitesh Kumar, and Shivaramakrishna Pragada.

SHIVARAM PRAGADA, SIMON FRASER UNIVERSITY
[Saturday November 30 / samedi 30 novembre, 16:00 – R 1380]
Bollobas-Nikiforov conjecture and triangle counting

Let G be a graph with n vertices. Let $A(G)$ be its adjacency matrix. Let $\lambda_1(G), \lambda_2(G)$ denote the largest and second largest eigenvalues of the adjacency matrix. Bollobás and Nikiforov (2007) conjectured that for any graph $G \neq K_n$ with m edges

$$\lambda_1^2 + \lambda_2^2 \leq \left(1 - \frac{1}{\omega(G)}\right) 2m$$

where $\omega(G)$ denotes the clique number of G. In this talk, we prove this conjecture for graphs with not so many triangles, using the method of triangle counting. This is a joint work with Hitesh Kumar.

SAROBIDY RAZAFIMAHATRATRA, Fields Institute
[Saturday November 30 / samedi 30 novembre, 9:00 – R 1380]
The intersection density of transitive groups of degree $3p$

Algebraic Graph Theory I
Théorie algébrique des graphes I

Given a finite transitive group $G \leq \mathrm{Sym}(\Omega)$, a subset $\mathcal{F} \subset G$ is *intersecting* if for any $g, h \in G$, there exists $\omega \in \Omega$ such that $\omega^g = \omega^h$. The *intersection density* of G is the rational number

$$\rho(G) := \max\left\{ \frac{|\mathcal{F}|}{|G|/|\Omega|} : \mathcal{F} \subset G \text{ is intersecting} \right\}.$$

In 2022, Meagher asked whether $\rho(G) \in \left\{1, \frac{3}{2}, 3\right\}$ for any transitive group $G \leq \mathrm{Sym}(\Omega)$ of degree $|\Omega| = 3p$, where $p \geq 5$ is an odd prime. Except for the cases where $p = q + 1$ is a Fermat prime and Ω admits a unique G-invariant partition $\mathcal{B}$, whose blocks are of size 3, such that the induced action of G on $\mathcal{B}$ is isomorphic to $\mathrm{PSL}_2(q)$, I will answer Meagher's question positively for imprimitive groups admitting a normal block system.

Joint work with Roghayeh Maleki.

KIM SOOYEONG, University of guelph

[Sunday December 1 / dimanche 1er décembre, 9:30 – R 1380]

Perfect state transfer in a graph and its line graph

In the study of continuous quantum walks on graphs, perfect state transfer between $\mathbf{x}$ and $\mathbf{y}$ has been well-explored when $\mathbf{x}$ and $\mathbf{y}$ are standard basis vectors, specifically $\mathbf{e}_v$ and $\mathbf{e}_w$ corresponding to vertices v and w. Chen and Chris extended this by investigating cases where $\mathbf{x} = \mathbf{e}_a \pm \mathbf{e}_b$ and $\mathbf{y} = \mathbf{e}_c \pm \mathbf{e}_d$.

This led us to a graph-theoretic question: Given a graph G that permits perfect state transfer between $\mathbf{e}_a + \mathbf{e}_b$ and $\mathbf{e}_c + \mathbf{e}_d$ for edges $\{a, b\}$ and $\{c, d\}$, does its line graph $\ell(G)$ also exhibit perfect state transfer between $\mathbf{e}_v$ and $\mathbf{e}_w$, where v and w correspond to the edges $\{a, b\}$ and $\{c, d\}$, respectively? Moreover, is the converse true? We will address this question and provide relevant examples.

THOMÁS SPIER, University of Waterloo

[Sunday December 1 / dimanche 1er décembre, 8:30 – R 1380]

Efficient reconstruction of the characteristic polynomial

It was proved by Hagos that, for every graph G, the pair of characteristic polynomials $(\phi^G, \phi^{\overline{G}})$ is reconstructible from the pairs $(\phi^{G\setminus i}, \phi^{\overline{G}\setminus i})$ for i in $V(G)$. In this talk, we present an efficient algorithm that reconstructs $(\phi^G, \phi^{\overline{G}})$ and some related results.

Algebraic Graph Theory II
Théorie algébrique des graphes II

Org: Hermie Monterde (University of Manitoba), **Thomás Spier** (University of Waterloo) and/et **Xiaohong Zhang** (Université de Montréal)

"The goal of this scientific session is to bring together mathematicians working in algebraic graph theory and applications to discuss the most recent advances in the area, disseminate new ideas, and inspire future collaborations. This is Part II of the two part session on algebraic graph theory, and will focus on the applications of algebraic graph theory, specifically to quantum information and quantum walks on graphs. "

Schedule/Horaire **Room/Salle: R 1380**

Saturday November 30 — samedi 30 novembre

8:30 - 9:00	Luc Vinet (Université de Montréal), *Spin systems on q-hypercubes and the connection to dual polar graphs* (p. 58)
10:00 - 10:30	Harmony Zhan (Worcester Polytechnic Institute), *Limiting behavior of coined quantum walks with marked vertices* (p. 58)

Sunday December 1 — dimanche 1er décembre

15:00 - 15:30	Chris Godsil (University of Waterloo), *Continuous quantum walks on locally finite graphs.* (p. 57)
15:30 - 16:00	Hermie Monterde (University of Manitoba), *New results in vertex sedentariness* (p. 57)
16:00 - 16:30	David Feder (University of Calgary), *Hard-core bosons on lattices as the symmetric power of cycle graphs* (p. 56)
16:30 - 17:00	Xiaohong Zhang (Université de Montréal), *Real state transfer* (p. 58)

Monday December 2 — lundi 2 décembre

8:30 - 9:00	Ada Chan (York University), *Pair-state transfer in distance regular graphs* (p. 56)
9:00 - 9:30	Sarah Plosker (Brandon University), *Quantum state transfer in weakly Hadamard diagonalizable graphs* (p. 57)
9:30 - 10:00	Gabor Lippner (Northeastern University), *Regular graphs with the most number of k-cycles.* (p. 57)

Abstracts/Résumés

ADA CHAN, York University

[Monday December 2 / lundi 2 décembre, 8:30 – R 1380]

Pair-state transfer in distance regular graphs

In 2020, Chen and Godsil introduced pair-state transfer in the continuous-time quantum walk. In the joint work with Kim, Monterde, Ahmadi, Kirkland and Plosker, we studied a generalization called s-pair state transfer.

Let $U(t)$ be the transition matrix of the continuous-time quantum walk on a graph X, and let e_u denote the characteristic vector of a vertex u in X. We say *perfect s-pair state transfer* occurs at time τ if

$$U(\tau)\left(e_a + se_b\right) = \alpha\left(e_c + se_d\right),$$

for some vertices a, b, c, d in X. We can view perfect s-pair state transfer as the transfer of an entangled state on two qubits to another two qubits in the quantum spin network. In this talk, we focus on transfer in distance-regular graphs.

Algebraic Graph Theory II
Théorie algébrique des graphes II

DAVID FEDER, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 1380]
Hard-core bosons on lattices as the symmetric power of cycle graphs

The complexity for obtaining the energies and wavefunctions for n interacting bosons on a lattice with m sites is generally exponential in both n and m, underpinning recent quantum supremacy arguments for sampling the output distribution of photon interferometer arrays. Remarkably, for infinitely strong boson-boson interactions corresponding to the hard-core boson (HCB) limit, Tonks and Girardeau found an exact solution for the ground state in one dimension. But, the solution is unwieldy for the calculation of expectation values, and cannot be readily extended to excited states or to other lattices. An equivalent description of the problem in algebraic graph theory is to determine the spectrum of the nth symmetric power of the m-cycle adjacency matrix, with the maximum eigenvector corresponding to the HCB ground state. I will discuss both approaches to the HCB problem, and show that the symmetric power provides a much simpler solution as well as new insights.

CHRIS GODSIL, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 1380]
Continuous quantum walks on locally finite graphs.

A continuous quantum walk on a graph with adjacency matrix is determined by its transition matrix $U(t) = \exp(itA)$. We are interested in locally finite infinite graphs. The entry $(U(t))_{0,0}$ of $U(t)$ is the characteristic function of a probability distribution , the spectral density of the adjacency matrix of the graph.. I will discuss two interesting cases. For the first, the unweighted path, $(U(t))_{0,0}$ is a Bessel function, and we will see what this tells us about the continuous walk. For the second, we describe a locally finite graph (using the Poisson distribution) where the vertex 0 is periodic ; this is interesting because we have shown that connected bounded infinite graphs cannot contain a periodic vertex.

GABOR LIPPNER, Northeastern University
[Monday December 2 / lundi 2 décembre, 9:30 – R 1380]
Regular graphs with the most number of k-cycles.

We investigate which d-regular graphs have the most k-cycles per node, and find the answer for $k \leq 6$ and large enough d. Besides the usual notion of cycles, we also study variants for counting closed walks and closed non-backtracking walks. It turns out that these variants are actually easier to handle, and we can determine the answer for all k. Joint work with Arturo Ortiz San Miguel.

HERMIE MONTERDE, University of Manitoba
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 1380]
New results in vertex sedentariness

A vertex in a graph is said to be sedentary if a quantum state assigned on that vertex tends to stay on that vertex. In this talk, we survey new results on the topic of vertex sedentariness, provide new constructions, and discuss its connection to other types of quantum state transfer such as pretty good state transfer and uniform mixing.

SARAH PLOSKER, Brandon University
[Monday December 2 / lundi 2 décembre, 9:00 – R 1380]
Quantum state transfer in weakly Hadamard diagonalizable graphs

Graphs whose Laplacian matrix is diagonalized by a Hadamard matrix (a $\{-1, 1\}$-valued matrix H satisfying $H^T H = nI$) have been of interest in recent years, and in particular have been studied for their quantum state transfer properties. This

concept has recently been generalized to the notion of weakly Hadamard diagonalizable graphs: graphs whose Laplacian matrix is diagonalized by a $\{-1, 0, 1\}$-matrix P such that PP^T is tridiagonal. We consider quantum state transfer properties of such graphs.

LUC VINET, CRM/IVADO
[Saturday November 30 / samedi 30 novembre, 8:30 – R 1380]
Spin systems on q-hypercubes and the connection to dual polar graphs

The totally symmetric multi-qubit Dicke states arise in many quantum computing contexts. They also provide the dimensional reduction of uniform spin systems on the hypercube to the Krawtchouk chain with perfect state transfer. A q-version of these connections and their relation to the dual polar graphs will be presented.

HARMONY ZHAN, Worcester Polytechnic Institute
[Saturday November 30 / samedi 30 novembre, 10:00 – R 1380]
Limiting behavior of coined quantum walks with marked vertices

A quantum walk based search algorithm assigns to the marked vertices a special coin that incorporates the oracle. In this talk, we consider such walks where the marked vertices receive $-I$ while the unmarked vertices receive the Grover coin. We find combinatorial bases for the eigenspaces of the transition matrix, show their connection to submatrices of the adjacency matrix, Laplacian matrix and signless Laplacian matrix, and use this connection to study the limiting behavior of the walk. This is joint work with Amulya Mohan.

XIAOHONG ZHANG, Université de Montréal
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 1380]
Real state transfer

Let X be a graph, and let M be a Hermitian matrix associated to X, which is usually taken to be the adjacency or Laplacian matrix. At time t, the transition matrix of the continuous quantum walk on X relative to M is $U(t) = e^{itM}$. If the initial state of the walk is given by a density matrix D (positive semidefinite matrix of trace 1), then the state of the walk at time t is $D(t) = U(t)DU(-t)$. In this talk, we consider state transfer between real states (all entries of D are real), with focus on when D is rational, for example, when D is the Laplacian matrix of some graph scaled to have trace 1.

Applications of Dynamical Systems in Biology
Applications des systèmes dynamiques en biologie

Org: Adam Stinchcombe (University of Toronto) and/et **Afroditi Talidou** (University of Calgary)

This session will explore recent applications of dynamical systems to several areas of biology, including neuroscience, biochemical reaction networks, cell biology, and systems biology. This will demonstrate how mathematical modelling and simulation can capture the dynamics that underlie biological systems and lead to insight into biological phenomena. By bringing together young and senior researchers in mathematics, biology, and computer science, this session aims to foster interdisciplinary collaborations and inspire novel approaches to tackling complex biological phenomena through the lens of dynamical systems theory.

Schedule/Horaire **Room/Salle: R2060**

Sunday December 1 **dimanche 1er décembre**

8:00 - 8:30	Qi Deng (York University), *Uncovering the impact of infection routes on within-host MPXV dynamics: insights from a mathematical modeling study* (p. 60)
8:30 - 9:00	Belal Abuelnasr (Waterloo), *Effects of Diabetes on Renal Calcium Homeostasis* (p. 59)
9:00 - 9:30	Adam Stinchcombe (Toronto), *A mathematical model for the role of dopamine-D2 self-regulation in the production of ultradian rhythms* (p. 62)
9:30 - 10:00	Spandan Sengupta (Toront/Krembil), *Using a Population Rate Model of the CA1 Hippocampus to examine cell-type specific contributions to theta-gamma coupled rhythms* (p. 62)
10:00 - 10:30	Merlin Pelz (UMN), *Synchronized Memory-Dependent Intracellular Oscillations in Compartmental-Reaction Diffusion Systems* (p. 62)
15:00 - 15:30	Sue Ann Campbell (Waterloo), *Distributed Time Delay and Synchronization in a Neural Mass Model* (p. 59)
15:30 - 16:00	Kelsey Gasior (Notre Dame), *The Impact of Dynamical System Nondimensionalization on Sensitivity Analysis when Modeling the Epithelial Mesenchymal Transition* (p. 61)
16:00 - 16:30	Katharine Faulkner (UBC), *Modelling Glucose Regulation: Lipotoxicity and the Progression to Type 2 Diabetes* (p. 61)
16:30 - 17:00	Eric Cytrynbaum (UBC), *Spatiotemporal patterning in reptile tooth replacement* (p. 60)
17:00 - 17:30	Nicolas Doyon (Laval), *Using the Finite Element method to solve the Poisson Nernst-Planck equations in neural structures* (p. 60)
17:30 - 18:00	Donglin Han (University of Alberta), *Retrospective estimation of proportion of total infections of COVID-19 during the first wave in Alberta* (p. 61)

Abstracts/Résumés

BELAL ABUELNASR, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 8:30 – R2060]
Effects of Diabetes on Renal Calcium Homeostasis

We present a model of the nephron tubule, accounting for renal epithelial solute reabsorption. This renal epithelial transport model was employed to investigate a variety of conditions and illnesses that significantly impact renal function, such as diabetes. This model was recently improved and currently accounts for 17 solutes, including calcium. We employ this model to study diabetes with a focus on diabetic renal calcium homeostasis. In particular, we investigate seemingly contradicting experimental findings in regard to renal calcium transport in diabetes. We also use the model to investigate the effects of diabetic treatments on calcium homeostasis.

Applications of Dynamical Systems in Biology
Applications des systèmes dynamiques en biologie

SUE ANN CAMPBELL, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 15:00 – R2060]
Distributed Time Delay and Synchronization in a Neural Mass Model

We consider a neural field model for a brain network which is a network of Wilson-Cowan nodes with homeostatic adjustment of the inhibitory coupling strength and time delayed, excitatory coupling. Without time delay, the system has been show to exhibit rich dynamics including oscillations, mixed-mode oscillations, and chaos. We how synchronization of the nodes depends on both the connectivity structure of the network and the attributes of the distribution of time delays in the connections between nodes. We show that Hopf bifurcations induced by the excitatory coupling, the connectivity structure and the delay lead to different patterns of phase-locked oscillations, either synchronized or desynchronized. Finally, we study how the mean and variance of the distribution affect the results.

ERIC CYTRYNBAUM, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:30 – R2060]
Spatiotemporal patterning in reptile tooth replacement

For over a century, the development and replacement of reptile teeth has been of interest in comparative anatomy and evolutionary biology due to the prevalence of teeth in the fossil record and, more recently, for understanding spatiotemporal patterning in developmental biology as well as the fundamentals of tooth replacement for a clinical context. In collaboration with the Richman Lab (UBC Dentistry), we are using the Leopard Gecko as a model organism to understand the mechanisms underlying the regular and long-lasting spatiotemporal patterns of tooth replacement seen in many polyphyodonts. I will describe the data and our implementation and analysis of several mechanisms that have been proposed in the past to explain the observations. Finding shortcomings in these models, I will describe a new model consisting of phase oscillators coupled by a diffusing inhibitor which does better at explaining the data.

QI DENG, York University
[Sunday December 1 / dimanche 1er décembre, 8:00 – R2060]
Uncovering the impact of infection routes on within-host MPXV dynamics: insights from a mathematical modeling study

The unprecedented mpox outbreak in non-endemic regions during 2022-2023, which has seen a recent resurgence in late 2023-2024, poses a significant public health threat. Despite its global spread, the viral dynamics of mpox infection and the specific characteristics driving these outbreaks remain insufficiently explored. We propose mathematical models to examine the interactions between host immune responses and the virus across three distinct infection routes (intravenous, intradermal, and intrarectal). The models are calibrated using viral load data from macaques infected through each of these three infection routes. Subsequently, we calculate the infectiousness of each infected macaque, finding that the proportion of presymptomatic infectiousness is highest in those infected via sexual contact, followed by skin-to-skin contact. These observations demonstrate that close contact during sexual activity is a significant route of viral transmission, with presymptomatic spread playing a crucial role in the 2022-2023 multi-country outbreak and potentially also in the 2023-2024 multi-source outbreak. Leveraging model predictions and infectiousness data, we assess the impact of antiviral drugs on interventions against mpox infection. The results suggest that early administration of antiviral drugs can reduce peak viral loads, even in individuals with compromised immunity.

NICOLAS DOYON, Laval University
[Sunday December 1 / dimanche 1er décembre, 17:00 – R2060]
Using the Finite Element method to solve the Poisson Nernst-Planck equations in neural structures

Systems of ordinary differential equation are often used in models of computational neuroscience. While this is appropriate when the spatial dimension is neglected or when the geometry is greatly simplified, this formalism is not well suited to describe complex spatial structures in which case one has to rely on systems of partial differential equations.

In neural structures, the concentration of ionic species and the electric potential evolve in an intertwined manner according to the Poisson-Nernst-Planck system of equations. Solving this system provides the evolution of the distribution of the electric field and ionic concentrations without having to rely on oversimplifying assumptions. However, solving these equations poses many methodological challenges as there is a trade-off between computational cost and accuracy.

Except for very simple geometries, the spatial domain has to be divided into a mesh or a grid on which an approximate solutions can be computed. However, to best way to do this is unclear as many numerical approaches are available. We apply the finite element method with second order elements to two typical structures: a single node of Ranvier and a dendritic spine. We show that this improves the quality of the solution when compared to simpler approaches and that the solutions can be computed at a reasonable numerical cost.

KATHARINE FAULKNER, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:00 – R2060]
Modelling Glucose Regulation: Lipotoxicity and the Progression to Type 2 Diabetes

As an individual moves from healthy to pre-diabetic to diabetic, there are many physiological changes that occur, but it is not known which of these changes are the main drivers of the progression to type II diabetes. In this talk, I will describe a simple model for glucose regulation and how modeling can help determine which of these physiological changes are capable of pushing an individual from healthy to diseased. By framing this problem in terms of bifurcations, we can find models that create qualitative changes to the system that allow for movement between healthy and diseased states. We will examine a model that includes the toxicity of lipids in the pancreas, and find a bifurcation that describes the progression to type II diabetes.

KELSEY GASIOR, University of Notre Dame
[Sunday December 1 / dimanche 1er décembre, 15:30 – R2060]
The Impact of Dynamical System Nondimensionalization on Sensitivity Analysis when Modeling the Epithelial Mesenchymal Transition

The epithelial mesenchymal transition (EMT) is a process that allows carcinoma cells to lose their adhesivity and migrate away from a tumor. Further, cells can maintain this invasiveness after they leave their original microenvironment, suggesting that there is an underlying bistable switch. We developed a mathematical model that examined the relationships between E-cadherin and Slug and their responses to tumor-level factors, such as cell-cell contact and TGF-b. Phenomenological model behavior was derived from biological experiments and, ultimately, this model showed how cells at different positions within a tumor can use exogenous factors to undergo EMT. However, the nonlinear dynamics and estimated model parameters make it challenging to analyze and understand what parameters contribute to the observed E-cadherin and Slug changes. Thus, we turn to sensitivity analysis. This work seeks to understand the true impact of commonly used mathematical techniques on dynamical systems, such as nondimensionalization, on sensitivity analysis results. The global sensitivity analysis Latin Hypercube Sampling (LHS) and Partial Rank Correlation Coefficient (PRCC) was used on the original E-cadherin-Slug model, as well as seven different possible nondimensionalized versions. By comparing these eight different iterations against each other, this work shows that the issues from performing sensitivity analysis following nondimensionalization are two-fold: (1) nondimensionalization can obscure or exclude important parameters from in-depth analysis and (2) how a model is nondimensionalized can, potentially, change analysis results. Ultimately, this work cautions against using model nondimensionalization prior to sensitivity analysis if the subsequent results are meant to guide future experiments.

DONGLIN HAN, University of Alberta
[Sunday December 1 / dimanche 1er décembre, 17:30 – R2060]
Retrospective estimation of proportion of total infections of COVID-19 during the first wave in Alberta

Mathematical modeling has been extensively used during the COVID-19 pandemic to project the spatial and temporal trend of the transmission and spread of the infection. However, earlier model projections were overestimated due to factors such as limited data and understanding of the virus at the beginning of the pandemic, rapidly evolving situations, and changes in

human behavior. After almost three years of the pandemic, with all the medical knowledge we have gained of the SARS-Cov-2 virus and its variants, information on the public health measures that were implemented, and the epidemiological and public health data on the pandemic that are available, can we use mathematical models to retrospectively estimate the proportion of a population that were infected during a COVID-19 wave ? Our study aimed to give an affirmative answer to this question, by demonstrating how simple mathematical models of COVID-19 of SIR type can be used to produce estimations of the proportion of infected population during the first COVID-19 wave in the Province of Alberta, Canada, during March-May of 2020. We analyzed daily new COVID-19 case and testing data during the period from March 5 - June 1, 2020 from Alberta Health and incorporated information on changes in public health measures related to COVID-19, such as social gathering restrictions, school closures, testing policies, quarantine and isolation, and contact tracing, to ensure accurate reflection in our model. Our modeling approach was also adapted to provide dependable long-term model projections for subsequent COVID-19 waves.

MERLIN PELZ, University of Minnesota, Twin Cities
[Sunday December 1 / dimanche 1er décembre, 10:00 – R2060]
Synchronized Memory-Dependent Intracellular Oscillations in Compartmental-Reaction Diffusion Systems

The Kuramoto model has been used in the last decades to gain insight into the behaviour of coupled discrete oscillators, as it is simple enough to be analyzed and exhibits a breadth of possible behaviours, such as synchronization, oscillation quenching, and chaos. However, the question arises how one can derive precise coupling terms between spatially localized oscillators that interact through a time-dependent diffusion field. We focus on a compartmental-reaction diffusion system with nonlinear intracellular kinetics of two species inside each small and well-separated cell with reactive boundary conditions. For the case of one-bulk diffusing species in $\mathbb{R}^2$, we derive a new memory-dependent integro-ODE system that characterizes how intracellular oscillations in the collection of cells are coupled through the PDE bulk-diffusion field. By using a fast numerical approach relying on the "sum-of-exponentials" method to derive a time-marching scheme for this nonlocal system, diffusion induced synchrony (in-phase, anti-phase, mixed-mode etc.) is examined for various spatial arrangements of cells. This theoretical modelling framework, relevant when spatially localized nonlinear oscillators are coupled through a PDE diffusion field, is distinct from the traditional Kuramoto paradigm for studying oscillator synchronization on networks or graphs. It opens up new avenues for characterizing synchronization phenomena associated with various discrete oscillatory systems in the sciences, such as quorum-sensing behaviour. (This is joint work with Michael J. Ward.)

SPANDAN SENGUPTA, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 9:30 – R2060]
Using a Population Rate Model of the CA1 Hippocampus to examine cell-type specific contributions to theta-gamma coupled rhythms

The rodent hippocampus is an extensively studied brain region expressing well-defined rhythmic activities with functional and behavioural correlates. The co-expression of theta (3-12 Hz) and gamma (20-100 Hz) rhythms may represent a general coding scheme and particular changes in these coupled rhythms occur in disease states.

We develop a population rate model of the CA1 hippocampus that combines excitatory pyramidal cells and three distinct inhibitory cell types (bistratified cells, PV-expressing and CCK-expressing basket cells), that were found to be essential for theta-gamma coupled rhythms. We use a combination of theoretical and numerical analyses to examine specific contributions by cell types and subcircuits.

We find CCK-expressing basket cells initiate coupled rhythms and regularise theta ; PV-expressing basket cells enhance both theta and gamma rhythms ; pyramidal and bistratified cells govern the generation of theta rhythms, and PV-expressing basket and pyramidal cells play dominant roles in controlling theta frequencies. We use these insights to predict a two-stage process by which theta-gamma coupled oscillations may arise in generalisable circuit motifs of excitatory and inhibitory cell types.

ADAM STINCHCOMBE, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 9:00 – R2060]
A mathematical model for the role of dopamine-D2 self-regulation in the production of ultradian rhythms

Ultradian behavioural rhythms are highly-flexible oscillations in goal-directed behaviour with periods shorter than a day. They remain mysterious in both their biochemical mechanisms and their functional significance, but are generally believed to be a reflection of neural dynamics. We propose that D2 autoreceptor-dependent dopamine self-regulation in the midbrain-striatal synapses gives rise to ultradian rhythmicity. We express this hypothesis in an ordinary differential equation based mathematical model in a dual-negative feedback-loop structure. Numerical integration and bifurcation analysis shows that the oscillations have a flexible and parameter-sensitive period in agreement with experimental observation. The model also demonstrates the masking-entraining effects of circadian (approximately 24 hour) regulation on ultradian rhythms and the rapid-resetting effect of transient excitation. This reveals the crucial role of circadian-ultradian interaction in consolidating behavioural activity and coordinating the motivation to engage in recurring, albeit not highly predictable events, such as social interactions.

Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations
Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires

Org: Stephen Anco (Brock Univ.), **Kostya Druzhkov** (University of Saskatchewan) and/et **Alexey Shevyakov** (University of Saskatchewan)

Development and application of symmetry analysis, methods for conservation laws, and related algebraic structures that are useful for studying PDE models in theoretical and applied science. The session is dedicated in part to celebrate the life-long work of George Bluman as a leader in symmetry.

Schedule/Horaire **Room/Salle: R 2540**

Sunday December 1 — dimanche 1er décembre

8:30 - 9:00	Shawn McAdam (University of Saskatchewan) (p. 66)
9:00 - 9:30	Rehana Naz (Lahore School of Economics), *Lie symmetries, closed-form solutions, and conservation laws* (p. 66)
9:30 - 10:00	Michel Grundland (CRM, Université de Montréal) (p. 65)
10:00 - 10:30	Alexey Shevyakov (University of Saskatchewan), *Exact Internal Waves in a Two-Fluid System* (p. 66)
15:00 - 15:30	George Bluman (University of British Columbia), *Use of the symmetry-based method to construct non-invertible mappings* (p. 65)
15:30 - 16:00	Zuhal Kucukarslan Yuzbasi (University of British Columbia), *New non-invertible mappings of Schrödinger equations to free particle equations* (p. 67)
16:00 - 16:30	Subhankar Sil (University of British Columbia), *Non-invertible mappings relating linear PDEs to corresponding nonlinear PDEs through symmetry-based method* (p. 67)
16:30 - 17:00	Stephen Anco (Brock University), *Hidden symmetry groups in classical mechanics and beyond* (p. 64)
17:00 - 17:30	Kostya Druzhkov (University of Saskatchewan) (p. 65)

Monday December 2 — lundi 2 décembre

8:00 - 8:30	Mahdieh Moghadam (Brock University) (p. 66)
8:30 - 9:00	Rafael de la Rosa Silva (Universidad de Cádiz), *The natural extension to PDEs of Lie's reduction of order algorithm for ODEs* (p. 67)
9:00 - 9:30	Willy Hereman (Colorado School of Mines), *Symbolic computation of conservation laws of nonlinear partial differential equations* (p. 65)
9:30 - 10:00	Stathis Charalampidis (San Diego State University), *Computational Analysis of self-similar blow-up in nonlinear dispersive PDEs* (p. 65)
10:00 - 10:30	Jaiden Dahlke (Brock University) (p. 65)

Abstracts/Résumés

STEPHEN ANCO, Brock University
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2540]
Hidden symmetry groups in classical mechanics and beyond

Integrability and superintegrabitiy are important notions in n-dimensional classical Hamiltonian mechanics. A main example of superintegrable system in 3 dimensions comes from the Kepler potential, which possesses the Laplace-Runge-Lenz (LRL) vector as a global constant of motion in addition to energy and angular momentum. The Poisson bracket algebra of these constants of motion has the structure of the Lie algebra of the group $S0(4)$. This group represents a hidden symmetry structure since it is larger than the kinematic symmetry group $SO(3) \times R$ manifestly given by rotations and time translation.

Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations
Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires

This talk will explain how a similar hidden symmetry structure exists for all central force systems in n dimensions when local constants of motion are considered. In particular, every such system possesses $2n-1$ local constants of motion, including a generalized LRL vector, plus an integral of motion that depend explicitly on time. The latter quantity will be shown to lead to an enlarged symmetry group structure.A key tool is a version of Noether's theorem holding in the space of configuration variables extended to include time.

Mathematical and physical properties of the generalized LRL vector and the additional integral of motion, along with the associated symmetry group, will be presented.The n-dimensional Kepler potential and isotropic oscillator are used as examples.

GEORGE BLUMAN, UBC Vancouver
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2540]
Use of the symmetry-based method to construct non-invertible mappings

In this talk we review the recently introduced symmetry-based method to construct a nonlocally related system for any admitted Lie point symmetry of a given PDE. We focus on how to use the symmetry-based method to find non-invertible mappings that relate nonlinear PDEs to linear PDEs; linear PDEs to other linear PDEs.

Two situations arise for the admitted trivial Lie point symmetries of a linear PDE. A third situation arises for an admitted nontrivial Lie point symmetry of a PDE.

STATHIS CHARALAMPIDIS, San Diego State University
[Monday December 2 / lundi 2 décembre, 9:30 – R 2540]
Computational Analysis of self-similar blow-up in nonlinear dispersive PDEs

The spectral stability analysis of coherent structures to nonlinear dispersive PDEs is important for investigating whether solutions are stable or not, as a parameter varies. More crucially, if a solution is deemed unstable, it is quite often that such instabilities lead to blow-up in finite or infinite time. This talk will focus on the self-similar blow-up of the (1+1)-dimensional NLS equation by treating it as a bifurcation problem over the nonlinear exponent σ. Upon performing a dynamic rescaling on the NLS, we will present a general method that is capable of identifying self-similar waveforms as stationary solutions in the so-called "co-exploding frame". The spectral analysis of NLS' solutions in the co-exploding frame reveals the emergence of real instabilities but those are connected with symmetries of the PDE in the original frame. Time permitting, recent advances in the generalized Korteweg-de Vries and 2D NLS equations will be discussed.

JAIDEN DAHLKE, Brock University
[Monday December 2 / lundi 2 décembre, 10:00 – R 2540]

KOSTYA DRUZHKOV, University of Saskatchewan
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2540]

MICHEL GRUNDLAND, CRM, Université de Montréal
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2540]

WILLY HEREMAN, Colorado School of Mines
[Monday December 2 / lundi 2 décembre, 9:00 – R 2540]
Symbolic computation of conservation laws of nonlinear partial differential equations

Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations
Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires

A direct method will be presented for the symbolic computation of conservation laws of nonlinear PDEs involving multiple space variables and time. Using the scaling symmetries of the PDE, the conserved densities are constructed as linear combinations of scaling homogeneous terms with undetermined coefficients. The variational derivative is used to compute the undetermined coefficients. The homotopy operator is used to invert the divergence operator, leading to an analytic expression of the flux vector.

The method is algorithmic and has been implemented in Mathematica. The software is being used to compute conservation laws of nonlinear PDEs occurring in the applied sciences and engineering. The software package will be demonstrated for PDEs that model, e.g., shallow water waves, ion-acoustic waves in plasmas, sound waves in nonlinear media, transonic gas flow, and stress and displacement in elastic materials. Examples include the Korteweg-de Vries and Zakharov-Kuznetsov equations, and a constitutive equation arising in elasticity.

SHAWN MCADAM, University of Saskatchewan
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2540]

MAHDIEH MOGHADAM, Brock University
[Monday December 2 / lundi 2 décembre, 8:00 – R 2540]

REHANA NAZ, Lahore School of Economics
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2540]
Lie symmetries, closed-form solutions, and conservation laws

Title: Lie symmetries, closed-form solutions, and conservation laws of a constitutive equation modeling stress in elastic materials and a technology diffusion model

Abstract:

The Lie-point symmetry method is used to find some closed-form solutions for a constitutive equation modeling stress in elastic materials and a technology diffusion model.

The Lie algebra for the governing PDE system for a constitutive equation modeling stress in elastic materials is five-dimensional. Using the optimal system of one-dimensional subalgebras, closed-form solutions for the model are obtained. Based on the scaling symmetry of the PDE and using Euler and homotopy operators, several conservation laws are computed with symbolic software.

A critical component of economic growth is growth in productivity which is dependent on technology adoption. While most technologies are created in developed economies, they diffuse to developing economies through various channels such as trade, migration and knowledge spillovers. The first model that integrates compartmental models with diffusion is developed to analyze technology adoption within a framework of a system of second-order non-linear partial differential equations. A three-dimensional Lie algebra is established for a technology diffusion model. The combinations of Lie symmetries are used to obtain reductions and establish closed-form solution for the technology diffusion model. The closed-form solutions allow for graphical representations of the technology diffusion process over an effective distance and time and show the commonly observed S-curve path of technology diffusion. Furthermore, a sensitivity analysis is performed to develop policy insights into the factors influencing the diffusion of technology.

ALEXEY SHEVYAKOV, University of Saskatchewan
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2540]
Exact Internal Waves in a Two-Fluid System

Although the Euler and Navier-Stokes fluid dynamics equations have been known for over 150 years, modern science is far from fully understanding their analytical properties. Exact and approximate solutions are available in a limited number of simplified cases, while direct numerical simulations are resource-intensive and often lack precision.

Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations
Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires

Many simplified models have been derived from Euler and Navier-Stokes equations to describe specific phenomena, such as surface and internal waves. These models aim to reduce the complexity of the original equations while preserving essential features of the phenomena and offering physical insight and computational accuracy. Examples include dimension and symmetry reductions, linearizations, and more general approximations based on asymptotic relationships. Fundamental nonlinear partial differential equations of mathematical physics, including Burgers', Korteweg-de Vries, nonlinear Schrödinger, and Kadomtsev-Petviashvili equations, arise in this context. Reduced models often reveal rich mathematical structures ; their exact solutions can closely describe physical phenomena.

I will discuss a model of nonlinear internal waves in a stratified system of two non-mixing fluids with different densities, contained in a horizontal channel. This model, developed by Miyata and then Choi and Camassa, was derived through layer-averaging under the "shallow water" assumption, which assumes a small ratio of channel depth to wavelength, without requiring wave amplitudes to be small. I will introduce a transformation that simplifies the Choi-Camassa model, reducing it to a simpler dimensionless form, and demonstrate that the model admits simple physical exact solutions, including traveling waves, cnoidal waves, and kinks.

SUBHANKAR SIL, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2540]
Non-invertible mappings relating linear PDEs to corresponding nonlinear PDEs through symmetry-based method

We show that the well-known Hopf-Cole transformation mapping the linear heat equation to the nonlinear Burgers' equation naturally extends to the mapping of any linear PDE to a non-invertibly equivalent nonlinear PDE. This map is obtained through the symmetry-based method by using the admitted obvious scaling symmetry in the dependent variable of any linear homogeneous PDE. Moreover, each nontrivial point symmetry of any linear PDE yields a corresponding nonlocally related nonlinear PDE through the symmetry-based method. The mapping relating the linear PDE and the corresponding nonlinear PDE is not one-to-one. We demonstrate interesting examples of how the linear heat equation (one-dimensional and two-dimensional) can be non-invertibly mapped into corresponding nonlocally related nonlinear PDEs through its admitted point symmetries.

RAFAEL DE LA ROSA SILVA, Universidad de Cádiz
[Monday December 2 / lundi 2 décembre, 8:30 – R 2540]
The natural extension to PDEs of Lie's reduction of order algorithm for ODEs

In this talk, we further consider the symmetry-based method for constructing nonlocally related systems for PDEs. We look at Lie's reduction of order algorithm from a different point of view to show how a given ODE is nonlocally related to its reduced ODE. We show that the natural extension to PDEs of Lie's reduction of order method for ODEs is simply the symmetry-based method for PDEs.

THOMAS WOLF, Brock University
[R 2540]
Towards a classification of evolution equations with Lax pairs over the octonions

The talk reports on a project on classifying integrable polynomial evolutionary equations with operator Lax pairs for an octonion variable. The method uses a scaling ansatz to set up a general polynomial form for the evolution equation and the Lax pair. A condition for linear differential operators to be a Lax pair over octonions is formulated and solved for the unknown coefficients in the polynomials. The talk will also report on computational aspects including improvements of algorithms to solve over-determined non-linear algebraic systems and even corrections of the programming language itself. First results include 3rd and 5th order equations with KdV and mKdV scaling weights.

Applications of Symmetries, Conservation Laws, and Related Algebraic Structures for Nonlinear Partial Differential Equations
Applications des symétries, des lois de conservation et des structures algébriques connexes aux équations aux dérivées partielles non linéaires

ZUHAL KUCUKARSLAN YUZBASI, University of British Columbia and Fırat University

[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2540]

New non-invertible mappings of Schrödinger equations to free particle equations

Discovering an equivalent PDE system for a given PDE system that is not invertibly related to the given system is a successful strategy. Such an equivalent PDE system is called a nonlocally related system. Nonlocally related PDE systems, which are obtained through the symmetry-based method and the CL-based method, are important in the analysis of a given PDE system. In this talk, we focus on an application of the symmetry-based method. Particularly, we show how to obtain systematically non-invertible mappings of Schrödinger equations to free particle equations in (1+1) and (2+1) dimensions, respectively.

Arithmetic Aspects of Galois Representations
Aspects arithmétiques des représentations de Galois

Org: Debanjana Kundu (UTRGV) and/et **Antonio Lei** (University of Ottawa)

Galois representations naturally emerge in various contexts within number theory, ranging from elliptic curves and modular forms to the Langlands program. There is a wide array of sophisticated tools available to study these representations, including p-adic L-functions, deformation theory, and moduli spaces. This session will focus on new developments in this area.

Schedule/Horaire **Room/Salle: R 2630**

Saturday November 30 — samedi 30 novembre

8:30 - 9:00	Daniel Vallieres (California State University Chico), *Iwasawa theory for branched $\mathbb{Z}_p$-towers of finite graphs* (p. 72)
9:00 - 9:30	Kim Tuan Do (UCLA), *Euler systems over imaginary quadratic and biquadratic fields* (p. 70)
9:30 - 10:00	Payman Eskandari (Winnipeg), *On the unipotent parts of the Hodge and Tate conjectures* (p. 70)
10:00 - 10:30	Raul Alonso (UC Santa Barbara), *An anticyclotomic Euler system for Hilbert cuspforms over a real quadratic field* (p. 69)
15:00 - 15:30	Sujatha Ramdorai (UBC), *Iwasawa theory over anticyclotomic extensions* (p. 71)
15:30 - 16:00	Heejong Lee (Purdue), *Recent advances on the Serre weight conjectures* (p. 71)
16:00 - 16:30	Peikai Qi (MSU), *An analogue of Greenberg pseudo-null conjecture for CM fields* (p. 71)
16:30 - 17:00	Chi-Yun Hsu (Santa Clara), *p-adic companion forms for Yoshida lifts* (p. 70)
17:00 - 17:30	Tam Nguyen (UBC), *Residually isomorphic modular forms and BDP p-adic L-functions* (p. 71)
17:30 - 18:00	Ila Varma (University of Toronto), *The number of D_4-fields ordered by Artin conductor* (p. 72)

Sunday December 1 — dimanche 1er décembre

8:30 - 9:00	Pavel Coupek (MSU), *Heights of modular forms and Eisenstein congruences* (p. 70)
9:00 - 9:30	Adithya Chakravarthy (Toronto), *The Iwasawa μ-invariants of elliptic curves over the rational numbers* (p. 69)
9:30 - 10:00	Simone Maletto (UBC), *Congruences of special values of the symmetric square L-function* (p. 71)

Abstracts/Résumés

RAUL ALONSO, UC Santa Barbara
[Saturday November 30 / samedi 30 novembre, 10:00 – R 2630]
An anticyclotomic Euler system for Hilbert cuspforms over a real quadratic field

Let g be a Hilbert cuspform of parallel weight over a real quadratic field F and let $\mathrm{As}(V_g)$ denote the Asai representation associated with g. Let χ be a Hecke character of an imaginary quadratic field K for which the G_K-representation $\mathrm{As}(V_g)(\chi)$ is conjugate self-dual. In this talk we will explain how to construct an Euler system for $\mathrm{As}(V_g)(\chi)$. Expected applications include results towards the Bloch-Kato conjecture and towards an Iwasawa Main Conjecture for this representation.

This is joint work in progress with Francesc Castella, Michele Fornea and Óscar Rivero.

ADITHYA CHAKRAVARTHY, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2630]
The Iwasawa μ-invariants of elliptic curves over the rational numbers

Arithmetic Aspects of Galois Representations
Aspects arithmétiques des représentations de Galois

In the 1990s, Ralph Greenberg formulated a striking conjecture about the Iwasawa μ-invariants of elliptic curves over the rational numbers. In this talk, I will introduce this conjecture of Greenberg and discuss some recent results surrounding it.

PAVEL COUPEK, Michigan State University
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2630]
Heights of modular forms and Eisenstein congruences

Let f be an automorphic Hecke eigenform. The automorphic height $H_{aut}(f)$ is defined in terms of the L^2 norm of harmonic forms representing the singular cohomology group in which f is realized, while the arithmetic height $H_{arit}(f)$ is a version of height of motives developed by Kato and Koshikawa. The height conjecture of Venkatesh predicts that $H_{aut}(f)/H_{arit}(f)$ is related to the value of the adjoint L-function of f at $s = 1$.

As the arithmetic height depends on a choice of a lattice in the Galois representation of f, it is natural to ask to what extent does the quotient $H_{aut}(f)/H_{arit}(f)$ depend on such a choice, especially in the presence of congruences between f and an Eisenstein series. I will talk about joint work in progress with Preston Wake in this direction, in the context of classical weight 2 modular forms.

KIM TUAN DO, UCLA
[Saturday November 30 / samedi 30 novembre, 9:00 – R 2630]
Euler systems over imaginary quadratic and biquadratic fields

Let $f \in S_{2k}(\Gamma_0(N))$ be a newform and χ be an anticyclotomic Hecke character of K. Let $V_{f,\chi}$ be the Galois representation attached to f twisted by χ. In this talk, I will describe an (anticyclotomic) Euler system over K for $V_{f,\chi}$ with no restriction on the infinity type of χ (the main innovation here is χ can be an infinite order character). Here, K can represent either an imaginary quadratic field, where this case is a collaboration with F. Castella, or an imaginary biquadratic field.

Arithmetic applications include results towards the Bloch-Kato Conjecture and the (anticyclotomic) Iwasawa Main Conjecture for $V_{f,\chi}$.

PAYMAN ESKANDARI, University of Winnipeg
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2630]
On the unipotent parts of the Hodge and Tate conjectures

The motivic version of the Hodge conjecture for *mixed* motives (over appropriate base fields) predicts that for any mixed motive, the motivic Galois group and the Mumford-Tate group should coincide. The motivic version of the Tate conjecture for mixed motives (again, over appropriate base fields) predicts that after a change of coefficients to $\mathbb{Q}_\ell$, the motivic Galois group of any mixed motive should be equal to the closure of the image of the absolute Galois group in the corresponding ℓ-adic representation. One may consider the unipotent parts of these conjectures, i.e., the equality of the unipotent radicals of the groups in question in the case of each conjecture. In this talk, we formulate refinements of the unipotent parts of these conjectures, and give sufficient criteria in terms of End and Ext groups for these refinements to hold. The results are in the context of abstract neutral tannakian categories. In particular, the results apply to the setting of any neutral tannakian category of mixed motives and any of the fullness conjectures for enriched realizations.

CHI-YUN HSU, Santa Clara University
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2630]
p-adic companion forms for Yoshida lifts

Coleman defined a p-adic theta operator on overconvergent forms, mapping forms of slope 0 and weight $2-k$ to forms of slope $k-1$ and weight k. By explicitly computing the q-expansion, he proved that the critical p-stabilization of a p-ordinary

CM form lies in the image of the theta operator. The parallel statement on the Galois side is that the Galois representation of a CM form splits locally at p. Coleman and Greenberg conjectured the respective converse, but both still remain open. In the GSp_4 setting, the Galois representation of a Yoshida lift splits locally into two 2-by-2 blocks at p. Our goal is to prove that the critical p-stabilization of a Yoshida lift lies in the image of a relevant theta operator. With Bharathwaj Palvannan, we figured out the effect of the relevant theta operator on the q-expansion as a first step toward the goal.

HEEJONG LEE, Purdue University
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2630]
Recent advances on the Serre weight conjectures

The Langlands reciprocity associates a Galois representation with a certain modular form/automorphic representation. One can ask how this association reflects structures on both sides. For example, the weights of modular forms/automorphic representations are matched by the Hodge-Tate weights of Galois representations. The Serre weight conjectures are mod p analogues of this structural correspondence.

In this talk, we introduce the Serre weight conjectures and their role in the Langlands program. Then, we discuss a novel idea proving the conjecture for the group GSp_4 under technical assumptions using a new geometric result on Galois deformation rings. This is based on a joint work with Daniel Le and Bao Viet Le Hung.

SIMONE MALETTO, The University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2630]
Congruences of special values of the symmetric square L-function

In this talk I will give a brief exposition of my upcoming thesis, generalizing work of Ray, Sujatha and Vatsal on special values of the symmetric square L-function. Then, I will show the existence of a Λ-adic two-variable p-adic L-function interpolating the classical complex L-function associated to the χ-twist of the symmetric square L-function induced by an ordinary p-distinguished, non-Eisenstein modular form.

TAM NGUYEN, UBC
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2630]
Residually isomorphic modular forms and BDP p-adic L-functions

Let $p > 2$ be a prime that is split in an imaginary quadratic field K and let $f \in S_{2r}(\Gamma_0(N))$ be a newform whose conductor N satisfies the strong Heegner hypothesis with respect to K. In this setting, one may construct the Bertolini-Darmon-Prasanna (BDP) p-adic L-function $L_{BDP}(f)$. In this talk, we show a congruence between $L_{BDP}(f_1)$ and $L_{BDP}(f_2)$ when f_1 and f_2 are residually isomorphic modulo some prime power. We will also discuss some implications for the logarithms of Heegner cycles and the anticyclotomic Iwasawa main conjecture.

PEIKAI QI, Michigan State University
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2630]
An analogue of Greenberg pseudo-null conjecture for CM fields

We will give an analogue of Greenberg's pseudo-null conjecture for CM fields. Let K be a CM field and K^+ be the unique totally real subfield of K. Assume that primes above p in K^+ all splits in K. Let $\mathfrak{P}_1, \mathfrak{P}_2, \cdots, \mathfrak{P}_s, \tilde{\mathfrak{P}}_1, \tilde{\mathfrak{P}}_2, \cdots, \tilde{\mathfrak{P}}_s$ be prime ideas in K above p, where $\tilde{\mathfrak{P}}_i$ is the complex conjugation of $\mathfrak{P}_i$. We show that there is unique $\mathbb{Z}_p$-extension of K unramified outside $\mathfrak{P}_1, \mathfrak{P}_2, \cdots, \mathfrak{P}_s$. We also show that such $\mathbb{Z}_p$-extension for CM field has similar properties as cyclotomic $\mathbb{Z}_p$-extension of a totally real field. We also give some criteria for Iwasawa invariant $\mu = \lambda = 0$. The work is joint with Matt Stokes.

Arithmetic Aspects of Galois Representations
Aspects arithmétiques des représentations de Galois

SUJATHA RAMDORAI, UBC
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2630]
Iwasawa theory over anticyclotomic extensions

We give simpler and more direct proofs of the known results for the Iwasawa theory of elliptic curves over anticyclotomic extensions.

DANIEL VALLIERES, California State University - Chico
[Saturday November 30 / samedi 30 novembre, 8:30 – R 2630]
Iwasawa theory for branched $\mathbb{Z}_p$-towers of finite graphs

In this talk, we will explain that the analogue of Iwasawa's asymptotic class number formula in graph theory can be extended to $\mathbb{Z}_p$-towers of finite connected graphs that are not necessarily unramified. This is joint work with Rusiru Gambheera.

ILA VARMA, University of Toronto
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2630]
The number of D_4-fields ordered by Artin conductor

We consider the family of D_4-quartic fields ordered by the Artin conductors of the corresponding 2-dimensional irreducible Galois representations. In this talk, I will describe ways to compute the number of such D_4-quartic fields with bounded conductor. Traditionally, there have been two approaches to counting quartic fields, using arithmetic invariant theory in combination of geometry-of-number techniques, and applying Kummer theory together with L-function methods. Both of these strategies fall short in the case of D_4 fields since counting quartic fields containing a quadratic subfield of large discriminant is difficult. However, when ordering by conductor, these techniques can be utilized due to additional algebraic structure that the Galois closures of such quartic fields have, arising from the outer automorphism of D_4. This result is joint work with Ali Altug, Arul Shankar, and Kevin Wilson.

Asymptotic Geometric Analysis
Analyse géométrique asymptotique

Org: Susanna Dann (Universidad de los Andes, Bogota, Colombia), **Daniel Galicer** (Universidad de Buenos Aires , Argentina) and/et **Alexander Litvak** (University of Alberta)

Asymptotic Geometric Analysis (AGA) is mainly concerned with geometric and linear properties of infinite dimensional objects, such as convex sets and normed spaces, especially with the characteristic behavior that emerges when the dimension, or a number of other relevant free parameters, is suitably large or tends to infinity. High-dimensional systems are very frequent in mathematics and applied sciences hence understanding of high-dimensional phenomena is becoming increasingly important. By virtue of AGA general framework, methods, and its impact on related fields, AGA can be situated at the crossroads of many branches of mathematics: functional analysis, convex and discrete geometry (described below), several areas of probability including random matrix theory, some aspects of graph theory, among others.

Schedule/Horaire **Room/Salle: WSOD 2930**

Saturday November 30 **samedi 30 novembre**

8:30 - 9:00	Mathias Sonnleitner (University of Alberta), *Strange shadows of ℓ_p-balls* (p. 74)
9:00 - 9:30	Andrii Arman (University of Manitoba), *Bodies of constant width that have small volume* (p. 73)
9:30 - 10:00	Kirill Kashkan (University of Toronto), *Dense Forests With Low Visibility* (p. 74)
10:00 - 10:30	Veatriki Eleni Vritsiou (University of Alberta), *Illuminating certain high-dimensional 1-unconditional convex bodies* (p. 75)
15:00 - 15:30	Vishesh Jain (University of Illinois), *Entangled states are typically incomparable* (p. 73)
15:30 - 16:00	Sudan Xing (University of Arkansas), *On the s-Gaussian Measure in $\mathbb{R}^n$* (p. 75)
16:00 - 16:30	Serhii Myroshnychenko (University of the Fraser Valley), *Stability of simplex slicing* (p. 74)
16:30 - 17:00	Alina Stancu (Concordia University), *An asymmetric flow with many symmetric solutions* (p. 75)

Abstracts/Résumés

ANDRII ARMAN, University of Manitoba
[Saturday November 30 / samedi 30 novembre, 9:00 – WSOD 2930]
Bodies of constant width that have small volume

Oded Schramm (1988) asked if there are convex bodies (in $\mathbb{R}^n$) of constant width 2 with the volume that is exponentially smaller than the volume of the unit ball $\mathbb{B}^n$.

In this talk I will provide a construction that answers the question of Schramm in affirmative, namely I will show that for a large enough n there is a convex body $M_n \subset \mathbb{R}^n$ of constant width 2 such that $\mathrm{Vol}(M_n) \leq 0.9^n \mathrm{Vol}(\mathbb{B}^n)$.

This talk is based on a joint work with Andriy Bondarenko, Fedor Nazarov, Andriy Prymak, and Danylo Radchenko.

MANUEL FERNANDEZ, The Georgia Institute of Technolog
[WSOD 2930]

VISHESH JAIN, University of Illinois Chicago
[Saturday November 30 / samedi 30 novembre, 15:00 – WSOD 2930]
Entangled states are typically incomparable

Asymptotic Geometric Analysis
Analyse géométrique asymptotique

Consider a bipartite quantum system, where Alice and Bob jointly possess a pure state $|\psi\rangle$. Using local quantum operations on their respective subsystems, and unlimited classical communication, Alice and Bob may be able to transform $|\psi\rangle$ into another state $|\phi\rangle$. Famously, Nielsen's theorem provides a necessary and sufficient algebraic criterion for such a transformation to be possible (namely, the entanglement spectrum of $|\phi\rangle$ should majorise the entanglement spectrum of $|\psi\rangle$). In the same paper, Nielsen conjectured that in the limit of large dimensionality, for almost all pairs of states $|\psi\rangle, |\phi\rangle$ (according to the natural unitary invariant measure) such a transformation is not possible. That is to say, typical pairs of quantum states $|\psi\rangle, |\phi\rangle$ are entangled in fundamentally different ways, that cannot be converted to each other via local operations and classical communication.

Via Nielsen's theorem, this conjecture can be equivalently stated as a conjecture about majorisation of spectra of random matrices from the so-called trace-normalised complex Wishart–Laguerre ensemble. Concretely, let X and Y be independent $n \times m$ random matrices whose entries are i.i.d. standard complex Gaussians ; then Nielsen's conjecture says that the probability that the spectrum of $XX^\dagger/\mathrm{tr}(XX^\dagger)$ majorises the spectrum of $YY^\dagger/\mathrm{tr}(YY^\dagger)$ tends to zero as both n and m grow large. We prove this conjecture, and we also confirm some related predictions of Cunden, Facchi, Florio and Gramegna.

Joint work with Matthew Kwan (IST Austria) and Marcus Michelen (UIC).

KIRILL KASHKAN, University of Toronto
[Saturday November 30 / samedi 30 novembre, 9:30 – WSOD 2930]
Dense Forests With Low Visibility

A set of points F in $\mathbb{R}^d$ is called a dense forest if there is a decreasing visibility function $V(\varepsilon)$ such that any line segment in $\mathbb{R}^d$ of length $V(\varepsilon)$ has a point of F within distance ε of it and F has finite density. Since being introduced in the 2010s, many forests with desirable properties have been constructed. Those properties being: low visibility, the forest being uniformly discrete, or having a deterministic construction.

This talk will present a dense forest constructed by modifying a set of points obtained from a Poisson Process. The dense forest has visibility $V(\varepsilon) \in O(\varepsilon^{-(d-1)} \log \varepsilon^{-1})$.

SERHII MYROSHNYCHENKO, University of the Fraser Valley
[Saturday November 30 / samedi 30 novembre, 16:00 – WSOD 2930]
Stability of simplex slicing

We establish dimension-free stability estimates for volume of central hyperplane sections of the regular simplex. This provides a refinement of Webb's sharp upper bound on the volume of central slices from 1996. Incidentally, we investigate Lipschitzness of volume of central sections of arbitrary convex bodies. Joint work with C. Tang, K. Tatarko, T. Tkocz.

CHASE REUTER, University of Alberta
[WSOD 2930]

MATHIAS SONNLEITNER, University of Alberta
[Saturday November 30 / samedi 30 novembre, 8:30 – WSOD 2930]
Strange shadows of ℓ_p-balls

With growing dimension, a typical random projection of the ℓ_p^n-ball onto a subspace of fixed dimension tends to a Euclidean ball of some fixed radius. This is related to the strong law of large numbers of the p^*-sum of independent and identically distributed line segments, where p^* is the conjugate index. It is thus not surprising that L_{p^*}-zonoids appear as shadows and the typical shadow of the ℓ_p^n-ball is close to the above Euclidean ball. We are interested in shadows which are strange, meaning that they occur with probability exponentially decaying with some rate. This is formalized by a large deviations principle in the space of convex bodies equipped with Hausdorff distance in the case of $p > 2$. Building on work of Kim and Ramanan, we

identify the rate of decay via the entropy of representing measures of the corresponding L_{p^*}-zonoid. Via duality we obtain a result for random sections. Based on joint work with Zakhar Kabluchko.

ALINA STANCU, Concordia University
[Saturday November 30 / samedi 30 novembre, 16:30 – WSOD 2930]
An asymmetric flow with many symmetric solutions

We define an isotropic, asymmetric, flow on smooth, compact, convex surfaces in Euclidean 3-space that exhibits distinct centrally-symmetric self-similar solutions including the Euclidean ball. The flow is not affine invariant, yet ellipsoids of revolution evolve self-similarly and can be generalized in all dimensions. This is joint work with Valentina-Mira Wheeler.

VEATRIKI ELENI VRITSIOU, University of Alberta
[Saturday November 30 / samedi 30 novembre, 10:00 – WSOD 2930]
Illuminating certain high-dimensional 1-unconditional convex bodies

Let us think of a convex body in $\mathbb{R}^n$ as an opaque object, and let us place point light sources around it, wherever we want, to illuminate its entire surface. What is the minimum number of light sources that we need ? The Hadwiger-Boltyanski illumination conjecture from the 1950's-60's states that we need at most 2^n light sources, with the upper bound conjectured to be attained only by parallelotopes.

The conjecture is still open in dimension 3 and above, and has only been fully settled for certain classes of convex bodies (e.g. zonoids, bodies of constant width, etc.). Moreover, there are some rare examples for which a basic, folklore argument could quickly lead to the upper bound 2^n, while at the same time understanding the equality cases has remained elusive for decades. One such example would be convex bodies very close to the cube, which was settled by Livshyts and Tikhomirov in 2017.

In this talk I will discuss another such instance, which comes from the class of 1-unconditional convex bodies, and which also 'forces' us to settle the conjecture for a few more cases of 1-unconditional bodies. This is based on joint work with Wen Rui Sun, and our arguments are primarily combinatorial.

SUDAN XING, University of Arkansas at Little Rock
[Saturday November 30 / samedi 30 novembre, 15:30 – WSOD 2930]
On the s-Gaussian Measure in $\mathbb{R}^n$

In this talk, I will present my recent work with Prof. Youjiang Lin. The s-Gauss probability space is introduced based on the s-Gaussian density function in $\mathbb{R}^n$ for $s \geq 0$, a generalization of the classic Gaussian density function. We also propose the (s,k)-Ehrhard symmetrization which is an extension of the traditional Ehrhard symmetrization for sets in $\mathbb{R}^n$. In particular, we establish the s-Gaussian isoperimetric inequality with respect to s-Gaussian measure in $\mathbb{R}^2$ and prove the s-Ehrhard-Borell inequalities for $s > 0$ when one of the two sets is a Borel set whilst the other being a convex set as well as the case when two sets are convex in $\mathbb{R}^1$.

Automorphic forms and number theory
Formes automorphes et théorie des nombres

Org: Lior Silberman (University of British Columbia), **Nahid Walji** (University of British Columbia) and/et **Tian An Wong** (University of Michigan - Dearborn)

Automorphic forms appear in many number theoretic contexts, including elliptic curves, modular forms, and up to the broader viewpoint of the Langlands program. This session will focus on new developments in various topics involving automorphic forms, including, but not limited to, results for Fourier coefficients and Hecke eigenvalues, beyond endoscopy, and distribution results within families.

Schedule/Horaire — Room/Salle: R 2800

Saturday November 30 — samedi 30 novembre

9:00 - 9:30	Kimball Martin (University of Oklahoma), *Distributions of root numbers and Fourier coefficients of modular forms* (p. 77)
9:30 - 10:00	Amir Akbary (University of Lethbridge), *Dual pairs of eta quotients* (p. 76)
10:00 - 10:30	Isabella Negrini (University of Toronto), *Modular generating series for rigid cocycles* (p. 78)
15:00 - 15:30	Julia Gordon (University of British Columbia), *Explicit improvement on Harish-Chandra's integrability bound* (p. 77)
15:30 - 16:00	Sarah Dijols (University of British Columbia), *Parabolically induced representations of p-adic G2 distinguished by SO4* (p. 77)
16:00 - 16:30	Jennifer Johnson-Leung (University of Idaho), *Index lowering operators on Jacobi forms and stable Klingen theory* (p. 77)
16:30 - 17:00	Malors Espinosa Lara (University of Toronto) (p. 77)

Sunday December 1 — dimanche 1er décembre

9:00 - 9:30	Naomi Tanabe (Bowdoin College), *Subconvexity for L-functions of Hilbert modular forms* (p. 78)
9:30 - 10:00	Khalil Besrour (University of Ottawa), *Modular Solutions to Modular Differential Equations* (p. 77)
10:00 - 10:30	Lucas Villagra Torcomian (Simon Fraser University), *The modular method for Generalized Fermat equations* (p. 78)

Abstracts/Résumés

AMIR AKBARY, University of Lethbridge
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2800]
Dual pairs of eta quotients

The Dedekind eta function is defined by the infinite product

$$\eta(z) = e^{\pi i z/12} \prod_{n=1}^{\infty} (1 - e^{2\pi i n z}).$$

An eta quotient of level N is a function of the form

$$f(z) = \prod_{t|N} \eta^{r_t}(tz),$$

where the exponents r_t are integers. We call a pair (f, g) of eta quotients a dual pair if the derivative of f is a constant multiple of g. In this talk, we determine the dual pairs of eta quotients of prime power levels. We achieve this by finding upper bounds

for orders of zeros (at cusps) of a class of Eisenstein series of weight 2 and prime power level. This is joint work with Zafer Selcuk Aygin (American University of Sharjah).

KHALIL BESROUR, University of Ottawa
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2800]
Modular Solutions to Modular Differential Equations

In this talk, we investigate the modular differential equation $y'' + F(z)y = 0$ on the upper half-plane , where F is a weight 4 modular form for $\Gamma_0(2)$. Our method involves solving the associated Schwarzian equation $\{h, z\} = 2F(z)$, where $\{h, z\}$ denotes the Schwarzian derivative of a meromorphic function h. We will establish the conditions under which the solutions to this equation are modular functions for subgroups of the modular group, and we provide explicit expressions for these solutions in terms of classical modular functions.

SARAH DIJOLS, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2800]
Parabolically induced representations of p-adic G2 distinguished by SO4

Distinguished representations are representations of a reductive group G on a vector space V such that there exists a H-invariant linear form for a subgroup H of G. They intervene in the Plancherel formula in a relative setting, as well as in the Sakellaridis-Venkatesh conjectures for instance. I will explain how the Geometric Lemma allows us to classify parabolically induced representations of the p-adic group G_2 distinguished by SO_4. In particular, I will describe a new approach, in progress, where we use the structure of the p-adic octonions and their quaternionic subalgebras to describe the double coset space $P\backslash G_2/SO_4$, where P stands for the maximal parabolic subgroups of G_2.

JULIA GORDON, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2800]
Explicit improvement on Harish-Chandra's integrability bound

It is a well-known result of Harish-Chandra that many invariant distributions on real and p-adic reductive groups (e.g., Fourier transforms of orbital integrals, and characters of representations) are represented by locally integrable functions on the group, and this function's singularities are 'smoothed' by the zeroes of the Weyl discriminant. In the recent joint work with Itay Glazer and Yotam Hendel, we analyze the singularities of the inverse of the Weyl discriminant, and from that, obtain an explicit improvement on the integrability exponent of the Fourier transforms of nilpotent orbital integrals, and consequently, of characters. I will discuss this improvement and some surprising applications.

JENNIFER JOHNSON-LEUNG, University of Idaho
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2800]
Index lowering operators on Jacobi forms and stable Klingen theory

I will introduce two new index-lowering operators on Jacobi forms which are dual to the Hecke operators U_p and V_p introduced by Eichler and Zagier. These operators were found by studying the action of stable Klingen operators on the Fourier-Jacobi expansions of paramodular Siegel modular forms, in joint work with Brooks Roberts and Ralf Schmidt. I will also explain the usefulness of the stable Klingen theory for computing paramodular forms of deep level.

MALORS ESPINOSA LARA, University of Toronto
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2800]

Automorphic forms and number theory
Formes automorphes et théorie des nombres

KIMBALL MARTIN, University of Oklahoma
[Saturday November 30 / samedi 30 novembre, 9:00 – R 2800]
Distributions of root numbers and Fourier coefficients of modular forms

While asymptotically root numbers of modular forms are +1 half the time and -1 half the time, there is in fact a bias towards sign +1. Moreover, an unexpected correlation between root numbers and Fourier coefficients of modular forms, termed murmurations, was recently discovered. I will discuss these phenomena, along with analogues for local root numbers.

ISABELLA NEGRINI, University of Toronto
[Saturday November 30 / samedi 30 novembre, 10:00 – R 2800]
Modular generating series for rigid cocycles

Rigid cocycles were defined in 2017 by Darmon and Vonk and give a promising framework to extend the theory of complex multiplication to real quadratic fields, towards a theory of "real multiplication". They share striking parallels with modular forms, and their generalizations are the main ingredient in the emerging p-adic Kudla program. In this talk I will show how rigid cocycles can be used to build modular generating series.

NAOMI TANABE, Bowdoin College
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2800]
Subconvexity for L-functions of Hilbert modular forms

This talk explores the subconvexity problem for GL_2 L-functions, a central challenge in analytic number theory. After outlining key developments in the field, I will discuss ongoing joint work with Keshav Aggarwal, focusing on refining approaches to this problem and improving bounds, particularly in the setting of totally real number fields.

LUCAS VILLAGRA TORCOMIAN, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2800]
The modular method for Generalized Fermat equations

Automorphic forms appear naturally when following the modular method to solve Diophantine equations of the form

$$Ax^q + By^r = Cz^p.$$

In this talk we will explore some of the limitations of this approach, as well as a particular family of equations that we focus on in a work in progress.

Automorphic forms and representations
Formes automorphes et représentations

Org: Sarah Dijols (UBC), **Andrew Fiori** (University of Lethbridge) and/et **Ray Mishty** (Carleton University)

The purpose of this session is to offer the opportunity for a large and diverse list of mathematicians to present their recent works on the topics of Representation theory over local and global fields (directly related to automorphic forms) ; Langlands program, including its geometric or categorical perspectives ; Analytical aspects of the Langlands program (for instance L-functions, their construction and properties) ; Connections with Galois representations, and Shimura varieties.

Le but de cette session est d'offrir l'opportunité à un ensemble divers de mathématicien.nes de présenter leur récent travaux sur les thèmes de la théorie des représentions sur les corps locaux et globaux, le programme de Langlands et ses aspects géométriques, analytiques (constructions et propriétés des fonctions L) et catégoriels. Nous invitons également les mathématicien.nes dont les travaux s'inscrivent dans les thèmes des représentations de Galois et des variétés de Shimura.

Schedule/Horaire — Room/Salle: R 3625

Saturday November 30 — samedi 30 novembre

8:30 - 9:10	James Steele (University of Calgary), *Between equivariant and constructible Yoneda algebras in the p-adic local Langlands correspondence* (p. 82)
9:20 - 9:40	Jacob Stockton (University of British Columbia), *A derived Hecke algebra* (p. 82)
9:50 - 10:30	Rachel Ollivier (University of British Columbia), *Rigid dualizing complexes for affine Hecke algebras.* (p. 81)
15:00 - 15:40	Ila Varma (University of Toronto), *Geometry of numbers in the cusp* (p. 82)
15:50 - 16:30	Alex Hazeltine (University of Michigan), *The local theta correspondence and functoriality* (p. 81)
16:40 - 17:00	Jose Cruz (University of Calgary), *On the Fourier transform and Vogan's perspective on the Local Langlands Correspondence* (p. 80)
17:10 - 17:50	Chi-Heng Lo (Purdue University), *On local Arthur packets and unitary dual of classical groups* (p. 81)

Sunday December 1 — dimanche 1er décembre

8:00 - 8:40	Kristaps Balodis (University of Calgary), *The Status and Consequences of the p-adic Kazhdan-Lusztig Hypothesis* (p. 80)
8:50 - 9:10	Wong Tian An (University of Michigan), *Towards a notion of mesoscopy* (p. 79)
9:20 - 9:40	Serine Bairakji (University of Ottawa), *Lost in Levis: The Case of the Missing Middle* (p. 80)
9:50 - 10:30	Miao (Pam) Gu (University of Michigan), *On Triple Product L-functions* (p. 81)
15:00 - 15:40	Yanze Chen (University of Alberta), *Eisenstein series on metaplectic covers and multiple Dirichlet series* (p. 80)
15:50 - 16:10	Danielle Wang (Berkely), *Twisted GGP conjecture in the unramified case* (p. 83)
16:20 - 16:40	Fatma Cicek (UNBC), *Moments of Rankin-Selberg Convolution L-functions Near the Central Point* (p. 80)
16:50 - 17:10	Manish M. Patnaik (University of Alberta) (p. 82)
17:20 - 17:40	Lior Silberman (University of British Columbia), *Arithmetic Quantum Unique Ergodicity on Hyperbolic spaces* (p. 82)

Abstracts/Résumés

Automorphic forms and representations
Formes automorphes et représentations

WONG TIAN AN, University of Michigan-Dearborn
[Sunday December 1 / dimanche 1er décembre, 8:50 – R 3625]
Towards a notion of mesoscopy

The theory of endoscopy concerns the transfer of distributions between a reductive group G and G', an endoscopic group of G. At the heart of Langlands' original study on Beyond Endoscopy is the notion of stable transfer between groups G and G', where G' is no longer required to be an endoscopic group. Arthur refered to these as 'beyond endoscopic groups,' and which we call mesoscopic groups. In this talk I will introduce these ideas, the role they play in functoriality, and open problems that arise in their study.

SERINE BAIRAKJI, University of Ottawa
[Sunday December 1 / dimanche 1er décembre, 9:20 – R 3625]
Lost in Levis: The Case of the Missing Middle

The Adler-Yu construction of supercuspidal representations posits, among other things, an exhaustive list of sequences of "twisted Levi subgroups". In this talk we define these and give an explicit construction of their conjugacy classes in the group SO(5), focusing particularly on elliptic tori, adapting methods by Lawrence Morris (1991) ; this parallels work by Ju-Lee Kim and JK Yu for Sp(4). Surprisingly, not all elliptic tori allow intermediate twisted Levis in the sequence. Even stranger, some other elliptic tori not only allow, but actually require, an intermediate Levi. These issues are governed by the regularity and genericity of elements of the torus. Our results allow a completely explicit construction of all supercuspidal representations of SO(5).

KRISTAPS BALODIS, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 3625]
The Status and Consequences of the p-adic Kazhdan-Lusztig Hypothesis

In recent history, the Langlands program has undergone a process of "geometrization" in a variety of different ways. In this talk, we will focus on a version which relates a category $\mathrm{Rep}_\lambda(G)$ of smooth representations the F-points $G(F)$ of a reductive group, to (a full sub-category of) the category $\mathrm{Per}(V_\lambda)$ of perverse sheaves on a kind of moduli space of Langlands parameters. In particular, we will articulate both the status, and recent consequences of the p-adic Kazhdan-Lusztig hypothesis.

YANZE CHEN, University of Alberta
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 3625]
Eisenstein series on metaplectic covers and multiple Dirichlet series

We computed the first Whittaker coefficient of a Borel Eisenstein series on a metaplectic cover of a semisimple simply-connected group under a mild assumption of the root system, which results in a Weyl group multiple Dirichlet series. This confirms a conjecture of Brubaker-Bump-Friedberg.

FATMA CICEK, University of Northern British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:20 – R 3625]
Moments of Rankin-Selberg Convolution L-functions Near the Central Point

We will talk about our recent results on the first and second twisted moments of some Rankin-Selberg convolution L-functions of primitive forms of prime power level. This is joint work with Alia Hamieh.

Automorphic forms and representations
Formes automorphes et représentations

JOSE CRUZ, University of Calgary
[Saturday November 30 / samedi 30 novembre, 16:40 – R 3625]
On the Fourier transform and Vogan's perspective on the Local Langlands Correspondence

Deligne's Fourier transform is an endofunctor defined on the derived category of l-adic sheaves on vector bundles. It maps sheaves with small support to sheaves with large support, and its first appearance was in the proof of the Weil conjectures. Nowadays it has proved to be a fundamental tool in geometric representation theory and in the Local Langlands correspondence. In this talk, I am going to introduce the Fourier transform via Grothendieck's function-sheaf dictionary, and I am going to apply it on some small examples that appear in Vogan's persepective of the local Langlands correspondence, just as Cunningham et al. did in their work.

MIAO (PAM) GU, University of Michigan
[Sunday December 1 / dimanche 1er décembre, 9:50 – R 3625]
On Triple Product L-functions

The Poisson summation conjecture of Braverman-Kazhdan, Lafforgue, Ngô and Sakellaridis is an ambitious proposal to prove analytic properties of quite general Langlands L-functions using vast generalizations of the Poisson summation formula. In this talk, we present the construction of a generalized Whittaker induction such that the associated L-function is the product of the triple product L-function and L-functions whose analytic properties are understood. We then formulate an extension of the Poisson summation conjecture and prove that it implies the expected analytic properties of triple product L-functions. Finally, we use the fiber bundle method to reduce this extended Poisson summation conjecture to a case of the Poisson summation conjecture in which spectral methods can be employed together with certain local compatibility statements. This is joint work with Jayce Getz, Chun-Hsien Hsu, and Spencer Leslie.

ALEX HAZELTINE, University of Michigan
[Saturday November 30 / samedi 30 novembre, 15:50 – R 3625]
The local theta correspondence and functoriality

Langlands conjectured that the local theta correspondence is an instance of Langlands functoriality, e.g., it should preserve L-packets. Unfortunately, this was false. As a remedy, Adams conjectured that instead of L-packets, the local theta correspondence should preserve Arthur packets. Mœglin showed that this was "mostly" true ; however, Mœglin also gave examples where the Adams conjecture was false. In this talk, we discuss a conjecture which would remedy the failure of the Adams conjecture along with some supporting evidence.

CHI-HENG LO, Purdue University
[Saturday November 30 / samedi 30 novembre, 17:10 – R 3625]
On local Arthur packets and unitary dual of classical groups

Recently, Tadić classified the unitary dual for representations of corank at most 3 of classical groups over p-adic fields. Based on the classification, he conjectured that a representation of critical type is unitary if and only if it is of Arthur type, and that any isolated representation in the unitary dual is of critical type. These conjectures indicate that representations of Arthur type form an important subset inside the whole unitary dual.

Jointly with A. Hazeltine, D. Jiang, B. Liu and Q. Zhang, we proposed a refinement of Tadić's conjecture: A representation of good parity is unitary if and only if it is of Arthur type. Moreover, we gave a conjectural description of the whole unitary dual for classical groups. In this talk, I will introduce these two conjectures, discuss their applications, and present our main result that they hold for representations of corank at most 3 of symplectic and split special odd orthogonal groups.

Automorphic forms and representations
Formes automorphes et représentations

RACHEL OLLIVIER, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 9:50 – R 3625]
Rigid dualizing complexes for affine Hecke algebras.

Grothendieck's duality theory relies on the notion of a dualizing complex. In the non-commutative setting such dualizing complexes were studied in the 90s beginning with work by Yekutieli. Since these complexes are not unique (for example, one can tensor them with any invertible object) Van der Bergh subsequently introduced the notion of a rigid dualizing complex.

Generic (and nil) affine Hecke algebras appear naturally in the mod p Langlands program.

We will discuss rigid dualizing complexes in the context of generic affine Hecke algebras and see what sort of consequences one can draw.

MANISH M. PATNAIK, University of Alberta
[Sunday December 1 / dimanche 1er décembre, 16:50 – R 3625]

LIOR SILBERMAN, The University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 17:20 – R 3625]
Arithmetic Quantum Unique Ergodicity on Hyperbolic spaces

I will report on progress toward the Arithmetic Quantum Unique Ergodicity (AQUE) Conjecture for locally symmetric spaces, that is on the equidistribution problem for Hecke–Maass forms, specifically in the case of hyperbolic 3-space and 4-space, in joint work with Z. Shem-Tov.

JAMES STEELE, University of Calgary
[Saturday November 30 / samedi 30 novembre, 8:30 – R 3625]
Between equivariant and constructible Yoneda algebras in the p-adic local Langlands correspondence

For a p-adic group G, extensions between perverse sheaves on an associated moduli space of Langlands parameters have been used in a variety of ways to model local portions of **Rep**(G). Famously, Lusztig was able to realise particular graded affine Hecke algebras describing subcategories of **Rep**(G) as the Yoneda algebra generated by certain $\widehat{G}$-equivariant perverse sheaves on the moduli space, where extensions are taken in the $\widehat{G}$-equivariant derived category. If one instead takes extensions in the usual constructible, derived category, this alternative approach, due to Chriss and Ginzburg and others, produces a localization of the same affine Hecke algebra at a point on the Bernstein centre for G.

In this talk, we describe cases where these two Yoneda algebras are, in fact, Koszul dual to one-another, producing a Koszul duality in-kind between the graded affine Hecke algebra and the localized affine Hecke algebra.

JACOB STOCKTON, UBC
[Saturday November 30 / samedi 30 novembre, 9:20 – R 3625]
A derived Hecke algebra

Let F be a p-adic field and G the F-rational points of a connected reductive group over F. We discuss the derived Hecke algebra $\mathrm{Ext}^*_G(\mathrm{ind}_U^G 1, \mathrm{ind}_U^G 1)$, where U is a compact open subgroup and 1 its trivial representation, which has appeared recently in the context of the mod-p local Langlands program. This talk is based in part on joint work with Karol Koziol and Rachel Ollivier.

Automorphic forms and representations
Formes automorphes et représentations

ILA VARMA, University of Toronto
[Saturday November 30 / samedi 30 novembre, 15:00 – R 3625]
Geometry of numbers in the cusp

In joint work with Arul Shankar, Artane Siad, and Ashwin Swaminathan, we develop a new method for counting integral orbits having bounded invariants and satisfying congruence conditions that lie inside the cusps of fundamental domains for coregular representations — i.e., representations of semisimple groups for which the ring of invariants is a polynomial ring. During this talk, we will illustrate this method in the case of counting 3-torsion elements in class groups of quadratic orders, and time permitting, we will discuss the new applications of these methods, including to counting 2-torsion ideal classes of monogenized degree-n orders.

DANIELLE WANG, UC Berkeley
[Sunday December 1 / dimanche 1er décembre, 15:50 – R 3625]
Twisted GGP conjecture in the unramified case

We present the relative trace formula approach to the global twisted Gan-Gross-Prasad conjecture. In particular, we explain how the relevant fundamental lemma can be reduced to the Jacquet-Rallis fundamental lemma, which allows us to prove the conjecture in the unramified case under some additional local conditions.

Cayley Graphs
Graphes de Cayley

Org: Soffia Arnadottir (UFMG (Federal University of Minas Gerais)) and/et **Joy Morris** (University of Lethbridge)

Cayley graphs are a special class of graphs that have very nice symmetry properties and are closely connected to permutation group theory. In this session, a variety of cutting-edge research on Cayley graphs will be presented. The session will include diverse presenters from a variety of countries, and at a variety of career stages, who have been achieving important results in this area.

Schedule/Horaire **Room/Salle: WSOD 1950**

Saturday November 30 **samedi 30 novembre**

8:30 - 9:00	Amarpreet Rattan (SFU), *Centrality of star factorizations* (p. 85)
9:00 - 9:30	Soffía Árnadóttir (Universidade Federal de Minas Gerais (Brazil)), *Cayley incidence graphs* (p. 84)
9:30 - 10:00	Raghu Pantangi (University of Regina), *Perfect State Transfer in Cayley and double coset graphs related to linear groups in two dimensions.* (p. 85)
10:00 - 10:30	Xiaohong Zhang (Université de Montréal), *Signed or oriented Cayley graphs with nice spectrum* (p. 86)
15:00 - 15:30	Bobby Miraftab (Carleton University), *From finite to infinite: hamiltonian structures in Cayley graphs* (p. 84)
15:30 - 16:00	Gabriel Verret (University of Auckland), *Density of quotient orders in groups and applications to locally-transitive graphs* (p. 85)
16:00 - 16:30	Primoz Potocnik (University of Ljubljana (Slovenia)), *Extended Census of Cubic Cayley Graphs* (p. 85)
16:30 - 17:00	Ted Dobson (University of Primorska (Slovenia)), $\mathbb{Z}_p \times \mathbb{Z}_p$ *is a BCI-group* (p. 84)
17:00 - 17:30	Shasha Zheng (Comenius University in Bratislava (Slovakia)), *Asymptotic proportion of graphical regular representations among Cayley graphs* (p. 86)

Abstracts/Résumés

SOFFÍA ÁRNADÓTTIR, Federal University of Minas Gerais
[Saturday November 30 / samedi 30 novembre, 9:00 – WSOD 1950]
Cayley incidence graphs

Abstract: Cayley graphs are an important notion in algebraic graph theory as they connect the structures of groups and graphs. The concept of Cayley incidence graphs was first introduced by Evra et al in 2023 (referred to as Cayley bigraphs). They are bipartite, biregular graphs arising from Cayley graphs and in this talk we will explore their properties and connections with other algebraic structures. This is joint work with Alexey Gordeev, Sabrina Lato, Tovohery Randrianarisoa and Joannes Vermant.

TED DOBSON, University of Primorska
[Saturday November 30 / samedi 30 novembre, 16:30 – WSOD 1950]
$\mathbb{Z}_p \times \mathbb{Z}_p$ *is a BCI-group*

Haar graphs are natural bipartite analogues of Cayley digraphs. The BCI-problem asks whether two Haar graphs of a group G are isomorphic if and only if they are isomorphic group by a list of specific maps, all of which are automorphisms of $\mathbb{Z}_2 \ltimes G$. Let p be an odd prime. We show that $\mathbb{Z}_p \times \mathbb{Z}_p$ is a BCI-group, meaning two Haar graphs of $\mathbb{Z}_p \times \mathbb{Z}_p$ are isomorphic if and only if they are isomorphic by maps on the specific list. This is the first example of a group G that is a BCI-group where the group $\mathbb{Z}_2 \ltimes G$ is not a CI-group with respect to digraphs.

Cayley Graphs
Graphes de Cayley

BOBBY MIRAFTAB, Carleton University
[Saturday November 30 / samedi 30 novembre, 15:00 – WSOD 1950]
From finite to infinite: hamiltonian structures in Cayley graphs

A weaker version of the celebrated Lovász conjecture states that every finite, connected Cayley graph contains a hamiltonian cycle. Although infinite graphs cannot have hamiltonian cycles in the traditional sense, there are natural analogues. In this talk, we focus on one such analogue—a topological approach—and show that some known results for finite Cayley graphs can be extended to infinite Cayley graphs.

RAGHU PANTANGI
[Saturday November 30 / samedi 30 novembre, 9:30 – WSOD 1950]
Perfect State Transfer in Cayley and double coset graphs related to linear groups in two dimensions.

Quantum walk on a graph, a quantum analogue of the random walk on a graph, is a model originating from quantum physics and is of interest in quantum information theory. Of central importance to this theory is the perfect state transfer (PST). A result by Godsil shows that for a given maximum valency, there are only finitely many connected graphs that exhibit PST. For this reason, it is interesting to find infinite classes of examples of connected graphs that admit PST. In this talk, we will construct examples of PST admitting Cayley and double coset graphs associated with $\mathrm{SL}(2,q)$ $\mathrm{GL}(2,q)$, and $\mathrm{GU}(2,q^2)$. The Cayley graphs we construct, as far as we know, are the first such PST admitting examples in which the underlying groups are not solvable. This is joint work with Peter Sin.

PRIMOZ POTOCNIK, University of Ljubljana
[Saturday November 30 / samedi 30 novembre, 16:00 – WSOD 1950]
Extended Census of Cubic Cayley Graphs

When studying combinatorial objects of a certain type, it is useful to have an extensive list of such objects, upon which our conjectures can be built or tested ; think of the famous Foster census of cubic arc-transitive graphs, for example. The main purpose of my talk is to discusses a recently extended census of cubic Cayley graphs on at most 4094 vertices, available at https://graphsym.net, which extends a previous census containing all such graph of order up to 1280 obtained by Verret, Spiga and myself. I will present ways how to use the census as well as show some interesting emerging patterns.

AMARPREET RATTAN, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 8:30 – WSOD 1950]
Centrality of star factorizations

Let $\mathfrak{S}_n$ be the symmetric group on $\{1,2,\ldots,n\}$ and $S := \{(i\,n) : 1 \leq i \leq n-1\}$. It is known that Cayley graph on $\mathfrak{S}_n$ with generating set S, denoted $\Gamma(\mathfrak{S}_n, S)$, has an interesting spectrum: all of its eigenvalues are integral. Walks on this Cayley graph beginning at the identity can be interpreted as *factorizations* of elements in $\mathfrak{S}_n$ where factors come from S. We call these *star factorizations*. Call a walk (or the corresponding factorization) *transitive* if the transpositions corresponding to the walk generate a transitive subgroup of $\mathfrak{S}_n$. The set of such walks in $\Gamma(\mathfrak{S}_n, S)$ have a remarkable property: the number of transitive walks to an element γ only depends on the conjugacy class of γ, a surprising result because of the asymmetry in the set S. We refer to this property | that the number of factorizations of conjugate elements is the same | as the *centrality* property. Goulden and Jackson (2009) showed that transitive star factorizations are central, but this result was obtained as a corollary of their enumerative formulae. They posed the natural problem of finding a combinatorial explanation for centrality. In this talk, I will discuss the centrality property of star factorizations and related factorizations that are central despite asymmetries in their underlying factorization problems. Our main result is that we give a combinatorial proof of the centrality of star factorizations, resolving the problem posed by Goulden and Jackson.

This is joint work with J. Campion Loth (Heilbronn Institute).

Cayley Graphs
Graphes de Cayley

GABRIEL VERRET, University of Auckland
[Saturday November 30 / samedi 30 novembre, 15:30 – WSOD 1950]
Density of quotient orders in groups and applications to locally-transitive graphs

We will discuss a recent result that the set of orders of finite quotients of a finitely generated group has natural density 0, 1/2 or 1. We also discuss applications of this result to the natural density of the set of orders of various families of symmetric graphs.

XIAOHONG ZHANG, Université de Montréal
[Saturday November 30 / samedi 30 novembre, 10:00 – WSOD 1950]
Signed or oriented Cayley graphs with nice spectrum

Let G be a finite abelian group. We consider signed or oriented Cayley graphs on G, whose adjacency matrices are symmetric or skew symmetric (0,1,-1) matrices, respectively. We give a characterization of when all the eigenvalues of such a graph are integer multiples of $\sqrt{\Delta}$ for some fixed square-free integer Δ. This generalizes a result of Bridges and Mena on when a Cayley graph on G has only integer eigenvalues. Our result also characterizes signed or oriented Cayley graphs on which continuous quantum walks are periodic. This is joint work with Chris Godsil.

SHASHA ZHENG, Comenius University in Bratislava
[Saturday November 30 / samedi 30 novembre, 17:00 – WSOD 1950]
Asymptotic proportion of graphical regular representations among Cayley graphs

A Cayley graph whose group of symmetries is as small as its underlying group is called a graphical regular representation (GRR for short) of the group. In this talk we are concerned with the existence of GRRs and their asymptotic behaviour. Here are some natural questions: What kind of automorphism group of a Cayley graph is 'typical' ; what kind of Cayley graph is 'common' ? Viewing that 'symmetry is rare', a rough guess for the first question would be the groups that are 'as small as possible' in some sense, and one may guess for the second question that the Cayley graphs with the lowest level of symmetry would be the most common ones. We estimate the number of GRRs of a given group with large enough order and, based on some previously known results, show that almost all finite Cayley graphs have full automorphism groups 'as small as possible'. This confirms a conjecture of Babai–Godsil–Imrich–Lovász.

Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory
Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres

Org: Alia Hamieh (UNBC) and/et **Habiba Kadiri** (University of Lethbridge)

This session is a celebration of analytic number theory, especially the topics that have been influenced by the work of Greg Martin. Experts in multiplicative number theory, comparative prime number theory, elementary number theory, and Diophantine approximations at various career stages will present and discuss their work, particularly in collaboration with Greg Martin or inspired by his influential work.

Cette session célèbre les thèmes de la théorie analytique des nombres influencés par les travaux de Greg Martin. Des experts de tous âges présenteront et discuteront de leurs recherches en théorie multiplicative des nombres, en théorie des nombres premiers comparatifs, en théorie élémentaire des nombres et en approximations diophantiennes, notamment celles réalisées en collaboration avec Greg Martin ou inspirées par ses travaux

Schedule/Horaire **Room/Salle: WSOD 1960**

Saturday November 30 — samedi 30 novembre

8:30 - 9:00	Welcome (p. 91)
9:00 - 9:30	Paul Pollack (University of Georgia), *Counting primes with a given primitive root, uniformly* (p. 90)
9:30 - 10:00	Lucile Devin (LMPA Université du Littoral Côte d'Opale), *Polynomial races with big ties* (p. 88)
10:00 - 10:30	Paul Péringuey (UBC), *Refinements of Artin's primitive root conjecture* (p. 90)
15:00 - 15:30	Lee Troupe (Mercer University), *The number of subgroups of the multiplicative group* (p. 90)
15:30 - 16:00	Ayla Gafni (University of Mississippi), *Exponential Sums with Additive Coefficients* (p. 89)
16:00 - 16:30	Susan Cooper (University of Manitoba), *A Little Support Goes A Long Way - An EDI Journey* (p. 88)
16:30 - 17:00	Matilde Lalin (Université de Montréal), *Variances of prime independent multiplicative functions over function fields* (p. 89)
17:00 - 17:30	Yu-Ru Liu (University of Waterloo), *Equidistribution of Polynomial Sequences in Function Fields* (p. 89)
17:30 - 18:00	Asif Zaman (University of Toronto), *Improving the trivial bound for class group torsion* (p. 91)

Sunday December 1 — dimanche 1er décembre

9:00 - 9:30	Chi Hoi Yip (Georgia Tech), *Counting powerfree-like numbers* (p. 91)
9:30 - 10:00	Cecile Dartyge (Institut Élie Cartan de Lorraine), *Exponential sums and reducible polynomials.* (p. 88)
10:00 - 10:30	Daniel Fiorilli (CNRS Université Paris-Saclay), *Biases and variances in the distribution of primes* (p. 88)
15:00 - 15:30	Andrey Feuerverger (University of Toronto), *Statistics in Number Theory ? ? ?* (p. 88)
15:30 - 16:00	Stephen Choi (Simon Fraser University), *Polynomials whose reducibility is related to the Goldbach conjecture* (p. 87)
16:00 - 16:30	Miao Gu (University of Michigan), *Factorization tests arising from counting modular forms and automorphic representations* (p. 89)
16:30 - 17:00	Amita Malik (Penn State University), *Zeros of derivatives of L-functions attached to Maass forms* (p. 90)
17:00 - 17:30	Reginald Simpson (UBC), *The Density and Distribution of Cyclic Groups in the Invariant Factor Decomposition of the Multiplicative Group* (p. 90)
17:30 - 18:00	Trevor Wooley (Purdue University), *Smooth values of polynomials and superirreducibility* (p. 91)

Abstracts/Résumés

STEPHEN CHOI, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 15:30 – WSOD 1960]
Polynomials whose reducibility is related to the Goldbach conjecture

Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory
Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres

In this talk, we introduce a collection of polynomials F_N, associated to each positive integer N, whose divisibility properties yield a reformulation of the Goldbach conjecture. While this reformulation certainly does not lead to a resolution of the conjecture, it does suggest two natural generalizations for which we provide some numerical evidence. As these polynomials F_N are independently interesting, we further explore their basic properties, giving, among other things, asymptotic estimates on the growth of their coefficients.

This is a joint work with Peter Borwein, Greg Martin, and Charles Samuels.

SUSAN COOPER, University of Manitoba
[Saturday November 30 / samedi 30 novembre, 16:00 – WSOD 1960]
A Little Support Goes A Long Way - An EDI Journey

Incorporating equity, diversity, and inclusivity (EDI) into all areas of one's life can be extremely challenging. In this talk, I will highlight how Greg Martin has contributed to important discussions at PIMS while supporting my EDI journey. I will primarily focus on concrete impacts that I have been involved in, including a summer school recently co-organized for undergraduates.

CECILE DARTYGE, Université de Lorraine, France
[Sunday December 1 / dimanche 1er décembre, 9:30 – WSOD 1960]
Exponential sums and reducible polynomials.

Abstract: Hooley proved that if f is a polynomial with integer coefficients, irreducible and with degree bigger than 2, then the fractions r/n with $0 < r < n$, n divising f(r), are uniformly distributed in]0,1[. I will present some results obtained for some reducible polynomials in a joint work with Greg Martin.

LUCILE DEVIN, Université du Littoral Côte d'Opale
[Saturday November 30 / samedi 30 novembre, 9:30 – WSOD 1960]
Polynomial races with big ties

In the context of prime number races, Greg Martin and Nathan Ng gave a pretty weak condition under which "ties have density zero". We investigate counter-examples to this condition when we consider the analog race for polynomial with coefficients in finite fields. This is joint work with Alexandre Bailleul, Daniel Keliher and Wanlin Li.

ANDREY FEUERVERGER, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 15:00 – WSOD 1960]
Statistics in Number Theory ? ? ?

Bradley Efron – the widely respected professor of statistics at Stanford – is famously quoted as having once said: "Those who ignore statistics are condemned to reinvent it." But does this caution also apply to analytic number theorists ? There was a time – dating back to the 1920s and 1930s, and prior to Kolmogorov's 1933 seminal work – when probability theory itself had a bad rap. And the story of how that prejudice led Hardy, Turan, and others to miss out on some spectacular results in number theory is well documented by Efron's colleague, Perci Diaconis, in his nice paper titled "G.H. Hardy and probability ? ? ?, 2002, Bulletin of the London Math. Society. (The " ? ? ?" in the title of our talk owes its origins to that paper.) Although some basic probability theory will be used, knowledge of statistics theory will not be required to follow this number-theoretically oriented talk. However, both the Fourier transform as well as the Riemann zeta function will each make star appearances in it. This talk is based on joint work with Greg Martin.

DANIEL FIORILLI, Université Paris-Saclay
[Sunday December 1 / dimanche 1er décembre, 10:00 – WSOD 1960]
Biases and variances in the distribution of primes

Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory
Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres

I will discuss some of my earlier work with Greg and how it has impacted the way I think about primes. In particular, I will talk about biases in the distribution of primes in arithmetic progressions, higher moments of their limiting distribution, effective central limit theorems, Diophantine properties of zeros of L-functions, and other related results.

AYLA GAFNI, University of Mississippi
[Saturday November 30 / samedi 30 novembre, 15:30 – WSOD 1960]
Exponential Sums with Additive Coefficients

For an arithmetic function f and a real number α, consider the exponential sum

$$S_f(x,\alpha) = \sum_{n\leq x} f(n)e^{2\pi in\alpha}.$$

The growth of these sums as x increases plays an important role in many number theory techniques. We will discuss new bounds on these exponential sums for various additive functions f, including $\omega(n)$ (the number of distinct prime factors of n) and $\Omega(n)$ (the total number of prime factors of n). We will then apply these bounds to enumerate certain integer partitions and solutions to Diophantine equations. This is joint work with Nicolas Robles.

MIAO GU, University of Michigan
[Sunday December 1 / dimanche 1er décembre, 16:00 – WSOD 1960]
Factorization tests arising from counting modular forms and automorphic representations

A theorem of Gekeler compares the number of non-isomorphic automorphic representations associated with the space of cusp forms of weight k on $\Gamma_0(N)$ to a simpler function of k and N, showing that the two are equal whenever N is squarefree. We prove the converse of this theorem (with one small exception), thus providing a characterization of squarefree integers. We also establish a similar characterization of prime numbers in terms of the number of Hecke newforms of weight k on $\Gamma_0(N)$.

It follows that a hypothetical fast algorithm for computing the number of such automorphic representations for even a single weight k would yield a fast test for whether N is squarefree. We also show how to obtain bounds on the possible square divisors of a number N that has been found to not be squarefree via this test, and we show how to probabilistically obtain the complete factorization of the squarefull part of N from the number of such automorphic representations for two different weights. If in addition we have the number of such Hecke newforms for even a single weight k, then we show how to probabilistically factor N entirely. All of these computations could be performed quickly in practice, given the number(s) of automorphic representations and modular forms as input. This is joint work with Greg Martin.

MATILDE LALIN, Université de Montréal
[Saturday November 30 / samedi 30 novembre, 16:30 – WSOD 1960]
Variances of prime independent multiplicative functions over function fields

We consider the family of multiplicative functions of $\mathbb{F}_q[T]$ with the property that the value at a power of an irreducible polynomial depends only on the exponent, but does not depend on the polynomial or its degree. We study variances of such functions in different regimes, relating them to variances of the divisor function $d_k(f)$. We consider some settings that can be related to distributions over the ensemble of unitary matrices and others related to distributions over the ensemble of unitary symplectic matrices. While most questions give very similar answers as the distributions of the divisor function, some of the symplectic problems, dealing with quadratic characters, are different and vary according to the values of the function at the square of the primes. This is joint work with Olha Zhur (Taras Shevchenko National University of Kyiv).

YU-RU LIU, University of Waterloo
[Saturday November 30 / samedi 30 novembre, 17:00 – WSOD 1960]
Equidistribution of Polynomial Sequences in Function Fields

Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory
Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres

We prove a conjecture about Weyl's equidistribution theorem of polynomial sequences. This is joint work with Jérémy Champagne,Thái Hoàng Lê and Trevor Wooley.

AMITA MALIK, Pennsylvania State
[Sunday December 1 / dimanche 1er décembre, 16:30 – WSOD 1960]
Zeros of derivatives of L-functions attached to Maass forms

Motivated by the close connection of the zeros of the derivative of the Riemann zeta function, we study the zeros of higher order derivatives of L-function attached to Maass forms. This is joint work with Rahul Kumar.

PAUL PÉRINGUEY, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 10:00 – WSOD 1960]
Refinements of Artin's primitive root conjecture

Let $\mathrm{ord_p(a)}$ be the order of a in $(\mathbb{Z}/p\mathbb{Z})^*$. In 1927, Artin conjectured that the set of primes p for which an integer $a \neq -1, \square$ is a primitive root (i.e. $\mathrm{ord_p(a)} = \mathrm{p} - 1$) has a positive asymptotic density among all primes. In 1967 Hooley proved this conjecture assuming the Generalized Riemann Hypothesis (GRH).

In this talk we will study the behaviour of $\mathrm{ord_p(a)}$ as p varies over primes, in particular we will show, under GRH, that the set of primes p for which $\mathrm{ord_p(a)}$ is "k prime factors away" from $p-1$ has a positive asymptotic density among all primes except for particular values of a and k. We will interpret being "k prime factors away" in three different ways, namely $k = \omega(\frac{p-1}{\mathrm{ord_p(a)}})$, $k = \Omega(\frac{p-1}{\mathrm{ord_p(a)}})$ and $k = \omega(p-1) - \omega(\mathrm{ord_p(a)})$, and present conditional results analogous to Hooley's in all three cases and for all integer k. From this, we will derive conditionally the expectation for these quantities.

Furthermore we will provide partial unconditional answers to some of these questions.

This is joint work with Leo Goldmakher and Greg Martin.

PAUL POLLACK, University of Georgia
[Saturday November 30 / samedi 30 novembre, 9:00 – WSOD 1960]
Counting primes with a given primitive root, uniformly

I will discuss work in progress with Kai (Steve) Fan on the problem of counting primes up to x possessing a given primitive root g, uniformly in g. As a sample of our results, we show under GRH that if g is a nonsquare integer, then the least prime p having g as a primitive root is $O((\log 3|g|)^B)$ for some absolute constant B. Connections will be drawn with work done during the speaker's time as a postdoc with Greg at UBC.

REGINALD SIMPSON, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 17:00 – WSOD 1960]
The Density and Distribution of Cyclic Groups in the Invariant Factor Decomposition of the Multiplicative Group

For any integer m the multiplicative group $(\mathbb{Z}/m\mathbb{Z})^\times$ has a unique decomposition into a product of cyclic groups $\mathbb{Z}_{d_1} \times \mathbb{Z}_{d_2} \times \cdots \times \mathbb{Z}_{d_N}$ where $d_i \mid d_{i+1}$ for $1 \leq i < N$, called the invariant factor decomposition. In this talk we discuss three results from a forthcoming paper concerning this decomposition, and the techniques used to prove those results. First, for any order d: we determine the natural density of m where $\mathbb{Z}_d$ is in the invariant factor decomposition of m. Second, for any order d: we determine asymptotic formulas (in terms of some n) for how many copies of $\mathbb{Z}_d$ are there on average in the invariant factor decomposition of m in the range $1 \leq m \leq n$. Third, for any order d: we determine Erdős-Kac-like limiting distributions for the number of copies of $\mathbb{Z}_d$ in the invariant factor decomposition of the multiplicative group. The details of these results reveal a delightfully elegant pattern and the discussion of the proof techniques will demonstrate why this pattern is, when thought about carefully, intuitive.

Celebrating Greg Martin: A Chorus of Contributions to Analytic Number Theory
Célébration de Greg Martin : Une chorale de contributions à la théorie analytique des nombres

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LEE TROUPE, Mercer University
[Saturday November 30 / samedi 30 novembre, 15:00 – WSOD 1960]
The number of subgroups of the multiplicative group

Let $\omega(n)$ denote the number of distinct prime factors of the positive integer n. According to the celebrated Erdős–Kac theorem, the values of $\omega(n)$ are, in a sense, normally distributed with mean and variance $\log\log n$. We say that an arithmetic function f satisfies an Erős–Kac law if, in the same sense, its values are normally distributed with a certain mean and variance.

Let $I(n)$ denote the number of isomorphism classes of subgroups of $(\mathbb{Z}/n\mathbb{Z})^\times$, and let $G(n)$ denote the number of subsets of $(\mathbb{Z}/n\mathbb{Z})^\times$ which are subgroups. Then $\log I(n)$ and $\log G(n)$ each satisfy an Erdős-Kac law. We will also discuss the maximal order of $\log I(n)$ and $\log G(n)$. These results date back to the speaker's time as a postdoctoral researcher at the University of British Columbia under the wise and benevolent supervision of Greg Martin.

WELCOME,
[Saturday November 30 / samedi 30 novembre, 8:30 – WSOD 1960]

TREVOR WOOLEY, Purdue University
[Sunday December 1 / dimanche 1er décembre, 17:30 – WSOD 1960]
Smooth values of polynomials and superirreducibility

We discuss k-superirreducible polynomials, by which we mean irreducible polynomials that remain irreducible under any polynomial substitution of positive degree at most k. The existence of superirreducible polynomials with integral coefficients places constraints on potential approaches to generating smooth values of polynomials (values having only small prime factors), a topic investigated by Schinzel in 1967. We describe the motivation and background to such considerations, and report on recent work restricted to finite fields. In particular, we give an explicit formula for the number of monic 2-superirreducible polynomials having even degree d analogous to the famous formula of Gauss for the number of monic irreducible polynomials of given degree over a finite field. This talk is based on joint work of the speaker with Jonathan Bober, Lara Du, Dan Fretwell, Gene Kopp and Greg Martin.

CHI HOI YIP, Georgia Institute of Technology
[Sunday December 1 / dimanche 1er décembre, 9:00 – WSOD 1960]
Counting powerfree-like numbers

Recently, Martin, Mossinghoff and Trudgian investigated oscillation results for a family of arithmetic functions called "fake μ's". In particular, they proved oscillation results at scale $\sqrt{x}$ for a family of fake μ's. In this talk, I will discuss new oscillation results for the summatory functions of all nontrivial fake μ's, focusing on their connections with classical results on the indicator functions of powerfree numbers. Joint work with Greg Martin.

ASIF ZAMAN, University of Toronto
[Saturday November 30 / samedi 30 novembre, 17:30 – WSOD 1960]
Improving the trivial bound for class group torsion

Let $K \neq \mathbb{Q}$ be a number field of degree $[K:\mathbb{Q}]$ and absolute discriminant $D_K = |\mathrm{Disc}(K)|$. Let Cl_K be the class group of K. For an integer $\ell \geq 2$, the ℓ-torsion of the class group of K satisfies the well-known trivial bound

$$|\mathrm{Cl}_K[\ell]| \leq |\mathrm{Cl}_K| \ll_{[K:\mathbb{Q}]} D_K^{1/2} (\log D_K)^{[K:\mathbb{Q}]-1}$$

due to Landau. Improvements over this trivial bound, both conditional and unconditional, have generated significant interest in many cases depending on ℓ, the degree $[K:\mathbb{Q}]$, and the subfield structure of K. In this talk, I will discuss an unconditional

log-power savings improvement over this trivial bound for all ℓ and all number fields K. The method will be traced back to the teachings of Greg Martin.

This is joint work with Robert Lemke Oliver.

Combinatorial Designs
Conceptions combinatoires

Org: Peter Danziger (Toronto Metropolitan University) and/et **Peter Dukes** (University of Victoria)

Combinatorial design theory has a history dating back to the 18th century when Leonhard Euler pondered the existence of orthogonal pairs of Latin squares. This session will showcase recent results in topics such as classical designs, cycle systems, graph decompositions, Latin squares and other aspects of design theory.

Schedule/Horaire **Rooms/Salles: R 2005, R 2520**

Sunday December 1 — dimanche 1er décembre

8:00 - 8:30	David Pike (Memorial), *2-Block-Intersection Graphs of Twofold Triple Systems* (p. 95), R 2520
8:30 - 9:00	Esther Lamken (unaffiliated), *Duplicated Steiner triple systems with self-orthogonal near resolutions* (p. 95), R 2520
9:00 - 9:30	Andrea Burgess (UNB), *Colourings of Kirkman triple systems* (p. 93), R 2520
9:30 - 10:00	Kianoosh Shokri (Ottawa), *A construction of strength-4 covering arrays using three k-caps in $PG(3,q)$* (p. 96), R 2520
10:00 - 10:30	Alice Lacaze-Masmonteil (Ottawa), *Completing the solution of the directed Oberwolfach problem with two tables* (p. 94), R 2520
15:00 - 15:30	Doug Stinson (Waterloo), *Recent results on near-factorizations of groups* (p. 96), R 2520
15:30 - 16:00	Trent Marbach (TMU) (p. 95), R 2520
16:00 - 16:30	Jonathan Jedwab (SFU), *Additive triples in groups of odd prime order* (p. 94), R 2520
16:30 - 17:00	Shuxing Li (Delaware), *Intersection Distributions and Related Steiner Systems* (p. 95), R 2520
17:00 - 17:30	Masoomeh Akbari (Ottawa), *The Generalized Honeymoon Oberwolfach Problem with one large table of size 2m* (p. 93), R 2520

Monday December 2 — lundi 2 décembre

9:00 - 9:30	Prangya Parida (Ottawa), *Cover-free families on graphs* (p. 95), R 2005
9:30 - 10:00	Hadi Kharaghani (Lethbridge), *Hadamard matrices related to orthogonal arrays* (p. 94), R 2005
10:00 - 10:30	Open problem discussion (p. 95), R 2005

Abstracts/Résumés

MASOOMEH AKBARI, University of Ottawa

[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2520]

The Generalized Honeymoon Oberwolfach Problem with one large table of size 2m

The Honeymoon Oberwolfach Problem (HOP), introduced by Šajna, is a recent variant of the classic Oberwolfach Problem. This problem asks whether it is possible to seat $2m_1 + 2m_2 + \cdots + 2m_t = 2n$ participants, consisting of n newlywed couples, at t round tables of sizes $2m_1, 2m_2, \ldots, 2m_t$ for $2n - 2$ successive nights so that each participant sits next to their spouse each night and next to each other participant exactly once. HOP has been studied by Jerade, Lepine, and Šajna, with some significant cases already solved.

We generalize HOP by allowing tables of size two, rather than a minimum size of four as previously defined in HOP. Thus, in the generalized HOP, we aim to seat the $2n$ participants at s tables of size 2 and t round tables of sizes $2m_1, 2m_2, \ldots, 2m_t$, with the requirement that $2n = 2s + 2m_1 + 2m_2 + \cdots + 2m_t$ and $m_i \geq 2$. Our current goal is to prove that the necessary condition for the HOP with s tables of size 2 and one large table of size $2m$ to have a solution is sufficient. In this talk, we will present a general approach to this problem and discuss the progress we have made so far.

Combinatorial Designs
Conceptions combinatoires

ANDREA BURGESS, University of New Brunswick Saint John
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2520]
Colourings of Kirkman triple systems

A δ-*colouring* of a Steiner triple system S is an assignment of δ colours to its points so that no triple has all its points of the same colour. The chromatic number of S is the minimum number of colours δ so that S admits a δ-colouring. While much is known regarding colourings of Steiner triple systems in general (in particular, there exists a δ-chromatic STS(v) for every sufficiently large admissible order v), little is known about colouring properties of resolvable triple systems.

A *Kirkman triple system* consists of a resolvable Steiner triple system together with a partition of its blocks into parallel classes. We show that for every integer $\delta \geq 3$, there exist infinitely many δ-chromatic Kirkman triple systems. Moreover, in the case $\delta = 3$, we give a complete existence result for 3-chromatic Kirkman triple systems.

This is joint work with Nicholas Cavenagh, Peter Danziger and David Pike.

JONATHAN JEDWAB, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2520]
Additive triples in groups of odd prime order

Let p be an odd prime. For nontrivial proper subsets A, B of $\mathbb{Z}_p$ of size s, t, respectively, we count the number $r(A, B, B)$ of *additive triples*, namely elements of the form $(a, b, a+b)$ in $A \times B \times B$. For given s, t, what is the spectrum of possible values for $r(A, B, B)$?

In the special case $A = B$, the additive triple is called a *Schur triple*. It is known that the Cauchy-Davenport Theorem gives bounds on the number $r(A, A, A)$ of Schur triples, and that the lower and upper bound can each be attained by a set A that is an interval of s consecutive elements of $\mathbb{Z}_p$. However, it is known that there are values of p, s for which not every value from the lower bound to the upper bound is attainable.

In the case where A, B can be distinct, we use Pollard's generalization of the Cauchy-Davenport Theorem to derive bounds on the possible values of the number $r(A, B, B)$ of additive triples. In contrast to the case $A = B$, we show that every value from the lower bound to the upper bound is attainable ; and it is sufficient to take B to be an interval of t consecutive elements of $\mathbb{Z}_p$.

This is joint work with Sophie Huczynska and Laura Johnson.

HADI KHARAGHANI, University of Lethbridge
[Monday December 2 / lundi 2 décembre, 9:30 – R 2005]
Hadamard matrices related to orthogonal arrays

Let $n \equiv 3 \pmod 4$ be a positive integer. The following statements are equivalent:

(i) There exists an Orthogonal Array OA$(n+1, n)$ and an $n \times (n+1)$ partial Hadamard matrix.

(ii) There exists a balancedly multi-splittable $n^2 \times n(n+1)$ partial Hadamard matrix.

Additionally, the concept of balancedly multi-splittable Balanced Incomplete Block Designs will be introduced and discussed.

A joint work with Sho Suda and Yash Khobragade.

ALICE LACAZE-MASMONTEIL, University of Regina
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2520]
Completing the solution of the directed Oberwolfach problem with two tables

A $(\vec{C}_{m_1}, \vec{C}_{m_2})$-factor of a directed graph G is a spanning subdigraph of G comprised of two disjoint directed cycles of lengths m_1 and m_2. In this talk, we show that the complete symmetric digraph K_n^* can be decomposed into $(\vec{C}_{m_1}, \vec{C}_{m_2})$-factors when

$m_1 + m_2 = n$, $m_1 \in \{4, 6\}$, and $m_2 \geqslant 8$ is even. In conjunction with recent results of Kadri and Šajna (2024+), this result completes the solution of the two-table case of the directed Oberwolfach problem. This work was done in collaboration with Daniel Horsley.

ESTHER LAMKEN, Independent Scholar
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2520]
Duplicated Steiner triple systems with self-orthogonal near resolutions

A Steiner triple system, STS(v), is a family of 3-subsets (blocks) of a set of v elements such that any two elements occur together in precisely one block. A collection of triples consisting of two copies of each block of an STS is called a duplicated Steiner triple system, DSTS. A resolvable (or near resolvable) DSTS is called self-orthogonal if every pair of distinct classes in the resolution has at most one block in common. We provide several methods to construct self-orthogonal near resolvable DSTS and almost completely settle the existence of such designs. At present, there is one remaining possible exception for v. This addresses a recent question of Bryant, Davies and Neubecker. This is joint work with Peter Dukes.

SHUXING LI, University of Delaware
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2520]
Intersection Distributions and Related Steiner Systems

Given a polynomial f over finite field $\mathbb{F}_q$, its intersection distribution concerns the collective behaviour of a series of polynomials $\{f(x)+cx|c \in \mathbb{F}_q\}$. We outline the ideas determining the intersection distributions of degree three and degree four polynomials, from which Steiner systems $S(2, 3, 3^n)$ and $S(2, 4, 2^n)$ can be derived.

TRENT MARBACH, TMU
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2520]

OPEN PROBLEM DISCUSSION,
[Monday December 2 / lundi 2 décembre, 10:00 – R 2005]

PRANGYA PARIDA, University of Ottawa
[Monday December 2 / lundi 2 décembre, 9:00 – R 2005]
Cover-free families on graphs

A family of subsets of $[t]$ is called a *d-cover-free family* (d-CFF) if no subset is contained in the union of any d others. We denote by $t(d, n)$ the minimum t for which there exists a d-CFF of $[t]$ with n subsets. $t(1, n)$ is determined using Sperner's Theorem. For $d \geq 2$, we rely on bounds for $t(d, n)$. Using the probabilistic approach, Erdös, Frankl, and Füredi proved $3.106 \log(n) < t(2, n) < 5.512 \log(n)$. Porat and Rothschild provided a deterministic polynomial-time algorithm to construct d-CFFs achieving $t = O(d^2 \log(n))$. Some upper bounds of $t(2, n)$(in some cases exact bounds) for small n were provided by Li, van Rees, and Wei.

We extend the definition of 2-CFF to include a graph(G), called $\overline{G}$-CFF, where the edges of G specify the pair of subsets whose union must not cover any other subset. We denote by $t(G)$ as the minimum t for which there exists a $\overline{G}$-CFF. Thus, $t(K_n) = t(2, n)$. We will discuss some classical results on CFFs, along with constructions of $\overline{G}$-CFFs. We prove that for a graph G with n vertices, $t(1, n) \leq t(G) \leq t(2, n)$ and for an infinite family of star graphs with n vertices, $t(S_n) = t(1, n)$. We also provide constructions for $\overline{P_n}$-CFF and $\overline{C_n}$-CFF using a mixed-radix Gray code. This yields an upper bound for $t(P_n)$ and $t(C_n)$ that is smaller than the lower bound of $t(2, n)$ mentioned above.

Joint work with Lucia Moura.

Combinatorial Designs
Conceptions combinatoires

DAVID PIKE, Memorial University of Newfoundland
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2520]
2-Block-Intersection Graphs of Twofold Triple Systems

A twofold triple system (TTS) is a combinatorial design for which every block has exactly three points, and each pair of points occurs together in precisely two blocks. The 2-block-intersection graph (2-BIG) of a TTS is the graph having the blocks of the TTS as its vertices, and vertices are adjacent if their corresponding blocks have exactly two elements in common. We discuss several properties of the 2-BIGs of TTSs, including recent observations about planarity and vertex-transitivity.

Joint work with Benjamin Stanley.

KIANOOSH SHOKRI, University of Ottawa
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2520]
A construction of strength-4 covering arrays using three k-caps in $PG(3,q)$

A covering array, denoted by CA$(N;t,k,v)$, is an $N \times k$ array over an alphabet with v symbols with the property that for any t-set of column indices $\{c_1,\ldots,c_t\}$, each t-tuple of the alphabet occurs at least once as a row of the sub-array indexed by $c_1,\ldots,c_t$. Here, N is the size, and t is the strength of the covering array.

Raaphorst, Moura, and Stevens (2014) give a construction for a CA$(2q^3-1;3,q^2+q+1,q)$, for any prime power q. This is obtained by two projective planes $PG(2,q)$ such that any three collinear points in one is mapped to three non-collinear points in the other.

A k-cap of $PG(m-1,q)$ is a set of k points no three of which are collinear. In $PG(3,q)$, an ovoid is a k-cap with maximum size of k. In a paper by Tzanakis, Moura, Panario, and Stevens (2016), a CA$(511;4,17,4)$ is constructed, which was formed by two ovoids in $PG(3,4)$ such that any four coplanar points in one is mapped to four non-coplanar points in the other.

In this talk, we give a construction for strength-4 covering arrays using three k-caps in $PG(3,q)$, which has been verified for all odd prime powers q such that $3 \leq q \leq 101$. We conjecture that our construction is valid for any odd prime power q. This is joint work with Lucia Moura.

DOUG STINSON, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2520]
Recent results on near-factorizations of groups

Let $(G,\cdot)$ be a finite multiplicative group with identity e. For $A,B \subseteq G$, define $AB = \{gh\colon g \in A, h \in B\}$. We say that (A,B) is a *near-factorization* of G if $|A| \times |B| = |G| - 1$ and $G \setminus \{e\} = AB$. We prove some new structural properties of near-factorizations in certain classes of groups. We also show that a "mate" B of a set A in a near-factorization (A,B) of a finite group G is unique, and we describe how to compute the mate B very efficiently using an explicit formula for B. Then we examine all the noncyclic abelian groups of order less than 200 in a search for a possible nontrivial near-factorization. All of these possibilities are ruled out, either by theoretical criteria or by exhaustive computer searches. (In contrast, near-factorizations in cyclic or dihedral groups are known to exist by previous results.)

Computational aspects of arithmetic geometry and analytic number theory

Org: **Nils Bruin** (SFU) and/et **Stanley Xiao** (UNBC)

In this session we discuss aspects of computation in arithmetic geometry and analytic number theory. This includes explicit results, experimental results, and related topics.

Schedule/Horaire **Rooms/Salles: R 2170 ; Westminster 2-3, Sheraton**

Saturday November 30 — samedi 30 novembre

9:00 - 9:30	Nathan Grieve (Acadia University), *On Schmidt's Subspace Theorem, Vojta's height inequalities and algebraic points in projective varieties: selected recent progres* (p. 98), Westminster 2-3, Sheraton
9:30 - 10:00	Asif Zaman (University of Toronto), *Explicit Deuring-Heilbronn phenomenon for Dirichlet L-functions* (p. 100), Westminster 2-3, Sheraton
10:00 - 10:30	Ila Varma (University of Toronto), *Counting number fields and predicting asymptotics* (p. 100), Westminster 2-3, Sheraton
15:00 - 15:30	Julie Desjardins (University of Toronto), *Trisections of Low Genus on Del Pezzo Surfaces of Degree 1* (p. 98), Westminster 2-3, Sheraton
15:30 - 16:00	Imin Chen (Simon Fraser University), *Improved constants for Serre's open image theorem* (p. 98), Westminster 2-3, Sheraton
16:00 - 16:30	Yixin Chen (Simon Fraser University), *Two-torsion in Brauer groups of hyperelliptic fibered surface* (p. 98), Westminster 2-3, Sheraton
16:30 - 17:00	Colin Weir (Tutte Institute for Mathematics and Computing), *On the distribution of a-numbers of hyperelliptic curves.* (p. 100), Westminster 2-3, Sheraton
17:00 - 17:30	Liljana Babinkostova (Boise State University) (p. 98), Westminster 2-3, Sheraton
17:30 - 18:00	Renate Scheidler (University of Calgary), *Solving norm equations in global function fields using compact representations* (p. 100), Westminster 2-3, Sheraton

Sunday December 1 — dimanche 1er décembre

9:00 - 9:30	Matilde Lalin (Université de Montréal), *Arithmetic constants for symplectic variances of the divisor function* (p. 99), R 2170
9:30 - 10:00	Marion Scheepers (Boise State University), *Fine structure of real quadratic integer rings* (p. 100), R 2170
10:00 - 10:30	Brett Nasserden (University of Western Ontario), *Some Explicit Computations on Toric Vector Bundles with Applications to Arithmetic Dynamics* (p. 99), R 2170
15:00 - 15:30	Dave McKinnon (University of Waterloo), *How do rational points cluster on wonderful varieties ?* (p. 99), R 2170
15:30 - 16:00	Shabnam Akhtari (Penn State), *Index Form Equations and Monogenized Orders in Quartic Number Fields* (p. 97), R 2170
16:00 - 16:30	Kevin Hare (University of Waterloo), *Non-expansive matrix number systems with bases similar to certain Jordan blocks* (p. 99), R 2170

Abstracts/Résumés

SHABNAM AKHTARI, Pennsylvania State University
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2170]
Index Form Equations and Monogenized Orders in Quartic Number Fields

We will explore the question of counting the number of monogenic orders, those that are generated by a single element as an integral ring, with given index in a quartic number field. This will require the study of index form equations. In particular, we will discuss how the resolution of an index form equation can give precise information on the number of distinct monogenized orders of a given index, as well the number of monogenizations of a given order.

LILJANA BABINKOSTOVA, Boise State University
[Saturday November 30 / samedi 30 novembre, 17:00 – Westminster 2-3, Sheraton]

IMIN CHEN, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 15:30 – Westminster 2-3, Sheraton]
Improved constants for Serre's open image theorem

For an elliptic curve E over a number field without complex multiplication, Serre proved the mod p representation of E is surjective except for finitely many primes p. Assuming GRH, Mayle-Wang have recently given bounds on such primes p which are logarithmic in the conductor of E and have explicit constants. In joint work with Joshua Swidinsky, we will describe improvements to these constants using deviation groups of 2-adic representations. Other results of independent interest are improved effective isogeny theorems for certain elliptic curves over the rationals.

YIXIN CHEN, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 16:00 – Westminster 2-3, Sheraton]
Two-torsion in Brauer groups of hyperelliptic fibered surface

The Brauer group encodes many important arithmetic propeties of a variety. One of them is the Brauer-Manin obstruction, which plays an important role in determining if surfaces have any rational points.

We will outline a technique that uses a hyperelliptic fibration on a surface to determine two-torsion elements in the Brauer group of a surface. Of particular note is that this technique can also find transcendental Brauer elements, which remain non-trivial upon extending the base field to its algebraic closure.

JULIE DESJARDINS, University of Toronto
[Saturday November 30 / samedi 30 novembre, 15:00 – Westminster 2-3, Sheraton]
Trisections of Low Genus on Del Pezzo Surfaces of Degree 1

Let X be a del Pezzo surface of degree d (it can be understood as the blowup of $9-d$ points in $\mathbb{P}^1$ if $d \neq 8$). We are interested in the set of rational points over char 0 fields: Zariski-density and unirationality. Those properties are fairly well understood when the degree of X is 3 or more, but still partial in degree 2 and 1. In this talk, I recall what is known about these two properties, and present new results with V. Jovanovic when $d = 1$ or 2 that are based on the construction of a family of trisections of low genus on such del Pezzo surfaces satisfying technical assumptions.

NATHAN GRIEVE, Acadia U. / Carleton U. / UQAM / U. Waterloo
[Saturday November 30 / samedi 30 novembre, 9:00 – Westminster 2-3, Sheraton]
On Schmidt's Subspace Theorem, Vojta's height inequalities and algebraic points in projective varieties: selected recent progres

I will give a brief sampling of recent results and guiding directions that pertain to Schmidt's Subspace Theorem, Vojta's height inequalities and applications thereof.

As some examples:

(i) It is of interest to understand qualitative features, in the form of tight defining inequalities for the Diophantine approximation sets that are defined as an application of the asymptotic theory of linear sections, with respect to a given linear system, that arise via the Diophantine arithmetic exceptional sets of the Subspace Theorem.

(ii) It is of interest to understand the extent to which algebraic points of a given bounded degree in a given projective variety, and more generally Deligne-Mumford stack, accumulate along proper subvarieties.

(iii) It is of interest to understand the extent to which defining equations and higher syzygies of embedded projective varieties govern questions about effectivity and complexity for calculation of local Weil and height functions (and twisted variants thereof).

As I will explain, there are several points of departure for these inter-related themes.

Finally, I intend to report on the recent and very interesting joint work, with Chatchai Noytaptim, in which we give criteria for non-Zariski density of (D,S)-integral points in forward orbits. This is achieved as an application of Schmidt's Subspace Theorem.

KEVIN HARE, University of Waterloo

[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2170]

Non-expansive matrix number systems with bases similar to certain Jordan blocks

We study representations of integer vectors as combinations $\sum_{i=0}^{k} M^i a_i$, where the base $M \in \mathbb{Z}^{n\times n}$ is an integral matrix and the digits a_i take values from a finite digit set $\mathcal{D} \subset \mathbb{Z}^n$. The pair $(M, \mathcal{D})$ is called a *number system*. Our focus is to study more deeply a relatively simple, but intriguing case when M is similar to J_n, a Jordan block with eigenvalue 1 and dimension n.

MATILDE LALIN, Université de Montréal

[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2170]

Arithmetic constants for symplectic variances of the divisor function

In previous work, we formulated some conjectures on the variance of certain sums of the divisor function $d_k(n)$ over number fields, which were inspired by analogous results over function fields. These problems are related to certain symplectic matrix integrals. While the function field results can be directly related to the random matrix integrals, the connection between the random matrix integrals and the number field results is less direct and involves arithmetic factors. We will give heuristic arguments for the formulas of these arithmetic factors and report on some experiments supporting the conjectures. This is joint work with Vivian Kuperberg (ETH Zürich)

DAVE MCKINNON, University of Waterloo

[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2170]

How do rational points cluster on wonderful varieties?

Rational points tend to keep their distance from one another. (Not like those irrational points, that can get unseemly close.) But how much distance do they keep? How complicated must two rational points be to be really close to each other? Luckily for my mortgage payments, this question turns out to be pretty complicated in general, and yet still amenable to analysis and computation. I'll give an overview of the situation in general, and then describe how the case of wonderful compactifications of Lie groups of adjoint type fits in.

BRETT NASSERDEN, McMaster University

[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2170]

Some Explicit Computations on Toric Vector Bundles with Applications to Arithmetic Dynamics

Toric varieties form a rich class of rational varieties with interesting geometric and arithmetic properties, Moreover, their combinatorial nature makes explicit computational approaches possible. In this talk, I will focus on:

Computational aspects of arithmetic geometry and analytic number theory

1)How explicit descriptions and computations of global sections of toric vector bundles can be employed to study heights, arithmetic dynamics, and potentially moduli spaces of morphisms.
2) How to carry out these computations using Macaulay2, along with a report on recent progress and applications to the Kawaguchi-Silverman conjecture in arithmetic dynamics.

MARION SCHEEPERS, Boise State University
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2170]
Fine structure of real quadratic integer rings

For a fixed integer $D > 1$, represent the set $\mathbb{Z}(\sqrt{D})$ by the set $\mathbb{Z} \times \mathbb{Z}$. The D-norm of an element (a, b) of $\mathbb{Z} \times \mathbb{Z}$, denoted $N_D(a, b)$, is the integer $a^{2\breve{}}Db^2$. For each integer k, $\mathbb{Z}_k(D)$ is the k-norm class $\{(a, b) : k = N_D(a, b)\}$. For D the set $V(D) = \{k : \mathbb{Z}_k(D)$ is nonempty$\}$ is closed under integer multiplication. Each norm class $\mathbb{Z}_k(D)$ has an algebraic structure and is generated by specific elements. Moreover each of these specific generating elements produces a structural component satisfying a well-known distribution known as Benford's Law. Benford's Law is perpetuated, via algebraic properties of $\mathbb{Z} \times \mathbb{Z}$ to larger substructures of $\mathbb{Z} \times \mathbb{Z}$.

In this talk we present results on these structural aspect of the quadratic integer ring $\mathbb{Z}(\sqrt{N})$.

RENATE SCHEIDLER, University of Calgary
[Saturday November 30 / samedi 30 novembre, 17:30 – Westminster 2-3, Sheraton]
Solving norm equations in global function fields using compact representations

We present two new algorithms for solving norm equations in global function fields with at least one infinite place of degree one. The first is a substantial improvement of a method due to Gaál and Pohst, while the second approach uses index calculus techniques and is significantly faster asymptotically and in practice. Both algorithms incorporate compact representations of field elements which results in a major gain in performance compared to the Gaál-Pohst approach. We analyze the complexity of all three algorithms under varying asymptotics on the field parameters, and provide empirical data on their performance using our Magma implementation. This is joint work with Sumin Leem and Mike Jacobson.

ILA VARMA, University of Toronto
[Saturday November 30 / samedi 30 novembre, 10:00 – Westminster 2-3, Sheraton]
Counting number fields and predicting asymptotics

A guiding question in number theory, specifically in arithmetic statistics, is: Fix a degree n and a Galois group G in S_n. How does the count of number fields of degree n whose normal closure has Galois group G grow as their discriminants tend to infinity? In this talk, we will discuss the history of this question and take a closer look at the story in the case that $n = 4$, i.e. the counts of quartic fields.

COLIN WEIR, Tutte Institute for Mathematics and Computing
[Saturday November 30 / samedi 30 novembre, 16:30 – Westminster 2-3, Sheraton]
On the distribution of a-numbers of hyperelliptic curves.

This talk will focus on various statistics regarding the distribution of class groups of quadratic fields in the function field setting. In particular, we present a new approach to counting the proportion of hyperelliptic curves of genus g defined over a finite field $\mathbb{F}_q$ with a given a-number. In characteristic three this method gives exact probabilities for curves of the form $y^2 = f(x)$ with $f(x) \in \mathbb{F}_q[x]$ monic and cubefree. These results are sufficient to show that a-numbers of hyperelliptic curves are not "distributed like random". Specifically, we compute the codimensions of the a-number strata of the moduli space of hyperelliptic curves and show that they differ from those of the full moduli space of abelian varieties.

Computational aspects of arithmetic geometry and analytic number theory

ASIF ZAMAN, University of Toronto

[Saturday November 30 / samedi 30 novembre, 9:30 – Westminster 2-3, Sheraton]

Explicit Deuring-Heilbronn phenomenon for Dirichlet L-functions

A Landau-Siegel zero is a possible real zero near $s = 1$ of a quadratic Dirichlet L-function modulo q. This zero conjecturally does not exist, but its possibility is a significant barrier to the equidistribution of primes in arithmetic progressions. The Deuring-Heilbronn phenomenon, pioneered by Linnik in 1944, can allow one to sidestep this barrier because it quantifies how other zeros of all Dirichlet L-functions modulo q are repelled based on the severity of the Landau-Siegel zero. In this talk, I will discuss a completely explicit Deuring-Heilbronn phenomenon for Dirichlet L-functions which is uniform in the entire critical strip, and improves over the previous best known explicit estimate due to Thorner and Zaman. This is joint work with Kübra Benli, Shivani Goel, and Henry Twiss.

Continuous Optimization – Algorithms, Applications, and Analysis

Org: Ahmet Alacaoglu, **Michael Friedlander** and/et **Jiajin Li** (University of British Columbia)

Algorithms for continuous optimization are crucial to numerous applications in science, engineering, and industry, where they play a central role in data-driven decision-making and scientific discovery. Ensuring these methods are reliable, efficient, and theoretically sound is essential. This session brings together researchers focusing on theory, analysis, software implementation, and innovative applications to foster collaboration and encourage emerging research.

Schedule/Horaire **Room/Salle: R 2530**

Sunday December 1 **dimanche 1er décembre**

9:30 - 10:00	Heinz Bauschke (UBC Okanagan), *On the Bredies-Chenchene-Lorenz-Naldi algorithm* (p. 103)
10:00 - 10:30	Michael Friedlander (UBC), *Density Estimation from Moments* (p. 104)
15:00 - 15:30	Dominique Orban (Ecole Polytechnique), *Complexity of trust-region methods in the presence of unbounded Hessian approximations* (p. 105)
15:30 - 16:00	Zhaosong Lu (University of Minnesota), *Variance-reduced first-order methods for stochastic optimization with deterministic constraints* (p. 105)
16:00 - 16:30	Ying Cui (UC Berkeley), *Variational Theory and Algorithms for a Class of Asymptotically Approachable Nonconvex Problems* (p. 103)
16:30 - 17:00	Jiajin Li (UBC), *Unveiling Spurious Stationarity and Hardness Results for Bregman Proximal-Type Algorithms* (p. 104)
17:00 - 17:30	Alp Yurtsever (Umea University), *Block Coordinate DC Programming* (p. 106)

Monday December 2 **lundi 2 décembre**

9:30 - 10:00	Henry Wolkowicz (Waterloo), *The $omega$-condition number for optimal preconditioning of linear systems* (p. 106)
10:00 - 10:30	Jelena Diakonikolas (University of Wisconsin), *Faster solutions to variational inequalities with highly nonuniform component or block Lipschitz constants* (p. 103)
15:00 - 15:30	Ahmet Alacaoglu (UBC), *Towards Weaker Variance Assumptions for Stochastic Optimization: A Blast From the Past* (p. 102)
15:30 - 16:00	Tianyi Lin (Columbia), *Lower bound construction in nonsmooth optimization* (p. 105)
16:00 - 16:30	Cho Ho (Peter) Lam (Huawei Technologies), *Faster Infeasibility Analysis for Linear Programs* (p. 104)
16:30 - 17:00	Nicholas Richardson (UBC), *Density Separation with Tensor Factorization* (p. 105)
17:00 - 17:30	Tim Hoheisel (McGill), *Stability in nonsmooth optimization via graphical differentiation* (p. 104)

Abstracts/Résumés

AHMET ALACAOGLU, UBC

[Monday December 2 / lundi 2 décembre, 15:00 – R 2530]

Towards Weaker Variance Assumptions for Stochastic Optimization: A Blast From the Past

In this talk, we focus on a classical assumption for analyzing stochastic gradient algorithms where the squared norm of the stochastic subgradient (or the variance for smooth problems) is allowed to grow as fast as the squared norm of the optimization variable. We contextualize this assumption in view of its inception in the 1960s, its seemingly independent appearance in the recent literature, its relationship to weakest-known variance assumptions for analyzing stochastic gradient algorithms, and its relevance even in deterministic problems for non-Lipschitz nonsmooth convex optimization. We build on and extend a

connection recently made between this assumption and the Halpern iteration in view of nonasymptotic convergence rates for stochastic optimization. For convex nonsmooth, and potentially stochastic, optimization we provide horizon-free algorithms with last-iterate rates. For problems beyond simple constrained optimization, such as convex problems with functional constraints, we obtain rates for optimality measures that do not require boundedness of the feasible set. (Joint work with Yura Malitsky and Stephen J. Wright)

HEINZ BAUSCHKE, UBC Okanagan

[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2530]

On the Bredies-Chenchene-Lorenz-Naldi algorithm

Monotone inclusion problems are central in optimization and variational analysis, often solved using splitting methods featuring resolvents or proximal mappings. In 2022, Bredies, Chenchene, Lorenz, and Naldi introduced an elegant framework that unifies well-known algorithms, including Douglas-Rachford and Chambolle-Pock, with strong convergence results under certain conditions.

In this talk, I will report on joint work with Walaa Moursi, Shambhavi Singh, and Xianfu Wang. We extend the analysis of Bredies et al., providing new strong convergence results for linear relations. For the Chambolle-Pock algorithm, we prove convergence to the projection onto an intersection of linear subspaces. We also discuss algorithms by Ryu and by Malitsky and Tam.

YING CUI, University of California Berkeley

[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2530]

Variational Theory and Algorithms for a Class of Asymptotically Approachable Nonconvex Problems

We investigate a class of composite nonconvex functions, where the outer function is the sum of univariate extended-real-valued convex functions and the inner function is the limit of difference-of-convex functions. A notable feature of this class is that the inner function can be merely lower semicontinuous instead of continuously differentiable. It covers a range of important yet challenging applications, including the composite value functions of nonlinear programs and the value-at-risk constraints. We propose an asymptotic decomposition of the composite function that guarantees epi-convergence to the original function, leading to necessary optimality conditions for the corresponding minimization problem. The proposed decomposition also enables us to design a numerical algorithm such that any accumulation point of the generated sequence, if exists, satisfies the newly introduced optimality conditions. These results expand on the study of so-called amenable functions introduced by Poliquin and Rockafellar in 1992, which are compositions of convex functions with smooth maps, and the prox-linear methods for their minimization.

JELENA DIAKONIKOLAS, University of Wisconsin-Madison

[Monday December 2 / lundi 2 décembre, 10:00 – R 2530]

Faster solutions to variational inequalities with highly nonuniform component or block Lipschitz constants

Block coordinate methods have a rich history in optimization, particularly for minimization problems, where they offer computational advantages over full vector (single block) methods whenever the problem at hand is compatible with blockwise updates. In contrast, the potential of block coordinate updates remains underexplored in the realm of variational inequalities—a class of equilibrium problems. To date, a rigorous demonstration of computational advantages for block coordinate updates in this context has largely been lacking.

I will present a novel block coordinate method addressing a standard class of variational inequalities with monotone Lipschitz operators. This method achieves a provably lower computational cost than traditional full vector update methods—by a factor scaling with the number of blocks—in settings where blockwise Lipschitz constants are highly nonuniform, which is the very setting where block coordinate methods are known to excel. I will also discuss how this method can be adapted for problems involving finite sum operators, where it functions as a variance reduction method. In this context, and for cases with highly

nonuniform Lipschitz constants among the components, the method leads to complexity improvements over state-of-the-art approaches by a factor scaling with the square-root of the number of components in the finite sum.

I will conclude by highlighting some intriguing open questions.

The talk is based on a recent preprint, available here: https://arxiv.org/abs/2411.00979.

DIMA DRUSVYATSKIY, University of Washington
[R 2530]

MICHAEL FRIEDLANDER, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2530]
Density Estimation from Moments

We present a maximum entropy method for estimating probability densities from a limited set of moment measurements, with applications to x-ray Thomson scattering in high-energy physics. A stable dual formulation using indirect linear algebra operations yields robust density estimates. (Joint work with Nicholas Barnfield, Thomas Chuna, Tobias Dornheim, Tim Hoheisel, and Matthew Rose-Kamp.)

NAOMI GRAHAM, UBC
[R 2530]

TIM HOHEISEL, McGill University
[Monday December 2 / lundi 2 décembre, 17:00 – R 2530]
Stability in nonsmooth optimization via graphical differentiation

We present some applications of implicit function theorems from variational analysis to stability analysis of prominent optimization problems with a focus on regularized least-squares. These contain results on well-posedness, Lipschitz stability and smoothness of the optimal solution function

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CHO HO (PETER) LAM, Huawei Technologies Canada
[Monday December 2 / lundi 2 décembre, 16:00 – R 2530]
Faster Infeasibility Analysis for Linear Programs

Presolving a linear program is important for fast solution and can sometimes detect infeasibility before the reduced model is solved. But presolving typically interferes with finding an Irreducible Infeasible Subset (IIS) of row constraints and variable bounds, the main way to analyze infeasibility. Early attempts to backtrack the set of logical model reductions when the presolver detects infeasibility, with the goal of finding an IIS, were abandoned as impractical. However, the OptVerse solver has now implemented a very fast backtrack capability that greatly speeds IIS isolation whether or not the presolver detects infeasibility. In both cases, the backtracker isolates a small subset of the model that is then subjected to typical IIS isolation procedures. The speed advantage is demonstrated experimentally vs. other major LP solvers.

JIAJIN LI, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2530]
Unveiling Spurious Stationarity and Hardness Results for Bregman Proximal-Type Algorithms

Bregman proximal-type algorithms, such as mirror descent, are popular in optimization and data science for effectively exploiting problem structures and optimizing them under tailored geometries. However, most of existing convergence results rely on the

gradient Lipschitz continuity of the kernel, which unfortunately excludes most commonly used cases, such as the Shannon entropy. In this paper, we reveal a fundamental limitation of these methods: Spurious stationary points inevitably arise when the kernel is not gradient Lipschitz. The existence of these spurious stationary points leads to an algorithm-dependent hardness result: Bregman proximal-type algorithms cannot escape from a spurious stationary point within any finite number of iterations when initialized from that point, even in convex settings. This limitation is discovered through the lack of a well-defined stationarity measure based on Bregman divergence for non-gradient Lipschitz kernels. Although some extensions attempt to address this issue, we demonstrate that they still fail to reliably distinguish between stationary and non-stationary points for such kernels. Our findings underscore the need for new theoretical tools and algorithms in Bregman geometry, paving the way for further research.

TIANYI LIN, Columbia University
[Monday December 2 / lundi 2 décembre, 15:30 – R 2530]
Lower bound construction in nonsmooth optimization

In this talk, we discuss the lower bound construction in non-smooth optimization under a Lipschitz condition. First, we review the classical results when the function to be minimized is convex where the hard instance is piecewise linear. Second, we explain why the Goldstein stationarity is more favorable than the Clarke stationarity from a computational viewpoint. Finally, we construct a new hard instance and prove that (1) a lower bound of $Omega(d)$ and (2) no finite-time guarantee under linear span condition, for any deterministic algorithm that has access to 1-order and 0-order oracles to find an approximate Goldstein stationary point up to sufficiently small parameter and tolerance.

ZHAOSONG LU, University of Minnesota
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2530]
Variance-reduced first-order methods for stochastic optimization with deterministic constraints

We consider stochastic optimization problems with deterministic constraints. Existing methods typically focus on finding an approximate stochastic solution that ensures the expected constraint violations and optimality conditions meet a prescribed accuracy. However, such an approximate solution can possibly lead to significant constraint violations in practice. To address this issue, we propose variance-reduced first-order methods that treat the objective and constraints differently. Under suitable assumptions, our proposed methods achieve stronger approximate stochastic solutions with complexity guarantees, offering more reliable constraint satisfaction than existing approaches.

DOMINIQUE ORBAN, GERAD/Polytechnique Montreal
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2530]
Complexity of trust-region methods in the presence of unbounded Hessian approximations

We extend traditional complexity analyses of trust-region methods for unconstrained, possibly nonconvex, optimization. Whereas most complexity analyses assume uniform boundedness of model Hessians, we work with potentially unbounded model Hessians. Boundedness is not guaranteed in practical implementations, in particular ones based on quasi-Newton updates. Our analysis is conducted for a family of trust-region methods that includes most known methods as special cases. We examine two regimes of Hessian growth: one bounded by a power of the number of successful iterations, and one bounded by a power of the number of iterations. This allows us to formalize and confirm the profound intuition of Powell (2010), who studied convergence under a special case of our assumptions, but whose proof contained complexity arguments. Specifically, for $0 \leq p < 1$, we establish sharp $O(\epsilon^{-2/(1-p)})$ evaluation complexity to find an ϵ-stationary point when model Hessians are $O(k^p)$, where k is the iteration counter. For $p = 1$, which is the case studied by Powell, we establish a sharp $O(\exp(c\epsilon^{-2}))$ evaluation complexity for a certain constant $c > 0$. This is as Powell suspected and is far worse than other bounds surmised elsewhere in the literature. We establish similar bounds when model Hessians are $O(|S_k|^p)$, where $|S_k|$ is the number of iterations where the step was accepted, up to iteration k. To the best of our knowledge, ours is the first work to provide complexity bounds when model Hessians grow linearly with $|S_k|$ or at most linearly with k, which covers multiple quasi-Newton approximations.

Continuous Optimization – Algorithms, Applications, and Analysis

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NICHOLAS RICHARDSON, University of British Columbia
[Monday December 2 / lundi 2 décembre, 16:30 – R 2530]
Density Separation with Tensor Factorization

The nonnegative Tucker-1 tensor factorization is used to separate mixtures of probably densities. A kernel density estimation transforms raw samples into compressed and discretized densities. An implementation of a specialized block coordinate descent algorithm that enforces the required simplex constraints is guaranteed to converge to Nash equilibria. Numerical experiments on real geological data, using our open source Julia implementation, illustrate the model's effectiveness at separating the density mixtures. Portability of the method to other applications like spacial transcriptomics and audio decomposition is discussed.

HENRY WOLKOWICZ, University of Waterloo
[Monday December 2 / lundi 2 décembre, 9:30 – R 2530]
The $omega$-condition number for optimal preconditioning of linear systems

Preconditioning is essential in iterative methods for solving linear systems. It is also the implicit objective in updating approximations of Jacobians in optimization methods, e.g., in quasi-Newton methods. We study a nonclassic matrix condition number, the $omega$-condition number, the ratio of the arithmetic and geometric means of the singular values. We do this in the context of optimal conditioning for: (i) low rank updating of generalized Jacobians; (ii) iterative methods for linear systems: (iia) clustering of eigenvalues and (iib) convergence rates. In particular, we show the advantages over the classical kappa-condition number. (work with Woosuk L. Jung and David Torregrosa-Gelén)

ALP YURTSEVER, Umeå University
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2530]
Block Coordinate DC Programming

We introduce an extension of the Difference of Convex Algorithm (DCA) in the form of a block coordinate approach for problems with separable structure. For n coordinate-blocks and k iterations, our main result proves a non-asymptotic convergence rate of $O(n/k)$ for the proposed method. Furthermore, leveraging the connection between DCA and Expectation Maximization (EM), we propose a block coordinate EM algorithm.

Descriptive Set Theory, Continuous Logic, and Applications

Org: Christopher Eagle (UVic), **Marcin Sabok** (McGill) and/et **Assaf Shani** (Concordia)

Descriptive set theory and continuous model theory are two central topics in mathematical logic. Both have deep connections and applications to analysis, topology, and other fields of mathematics. This session will showcase recent work on the theory and applications of both fields.

Schedule/Horaire **Rooms/Salles: R 2005 ; Westminster 1, Sheraton**

Saturday November 30 — samedi 30 novembre

9:00 - 9:30	Clement Yung (Toronto), *An alternative proof of the Mathias-Silver theorem using the Kastanas game* (p. 110), Westminster 1, Sheraton
9:30 - 10:00	Allison Wang (Carnegie Mellon), *Complexity of codes for Ramsey positive sets* (p. 109), Westminster 1, Sheraton
10:00 - 10:30	Michael Wolman (Caltech), *Invariant uniformization* (p. 110), Westminster 1, Sheraton
15:00 - 15:30	Samuel Murray (McGill), *Borel Fractional Perfect Matchings in Quasitransitive Amenable Graphs* (p. 108), R 2005
15:30 - 16:00	Spencer Unger (Toronto), *Equidecomposition and discrepancy* (p. 109), R 2005
16:00 - 16:30	Bo Peng (McGill), *Generalized Oxtoby systems and hyperfiniteness* (p. 109), R 2005
16:30 - 17:00	Antoine Poulin (McGill University), *Borel quasi-trees are treeable* (p. 109), R 2005

Sunday December 1 — dimanche 1er décembre

9:00 - 9:30	Andy Zucker (Waterloo), *Topological groups with tractable minimal dynamics* (p. 110), R 2005
9:30 - 10:00	Josh Lau (Toronto), *Algebro-topological invariants of co-existentially closed continua* (p. 108), R 2005
10:00 - 10:30	Tori Noquez (Saint Mary's College of California), *Fractals as Final Coalgebras in Various Categories of Metric Spaces* (p. 108), R 2005
15:00 - 15:30	Jan Arulseelan (McMaster), *Computability in Continuous Logic with Applications to Operator Algebras* (p. 107), R 2005
15:30 - 16:00	Rachael Alvir (Waterloo), *Scott Complexity and Torsion Abelian Groups* (p. 107), R 2005
16:00 - 16:30	Christopher Karpinski (McGill), *Hyperfiniteness of boundary actions of small cancellation groups* (p. 108), R 2005
16:30 - 17:00	Forte Shinko (Berkeley), *Hyperfiniteness of graphs of slow intermediate growth* (p. 109), R 2005

Abstracts/Résumés

RACHAEL ALVIR, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2005]
Scott Complexity and Torsion Abelian Groups

In this talk we review the connection between Scott sentences of countable structures and descriptive set theory. In particular, we show that the optimal Scott sentences of reduced Abelian p-Groups is arbitrarily high (below ω_1). In particular, this yields a new proof that the isomorphism relation on this class of structures is not a Borel equivalence relation. To do this, we first characterized the back-and-forth relations on this class of structures, which has many potential applications in computable structure theory. This work is joint with Luke MacLean and Barbara Csima.

Descriptive Set Theory, Continuous Logic, and Applications

JAN ARULSEELAN, McMaster University
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2005]
Computability in Continuous Logic with Applications to Operator Algebras

We will discuss computable axiomatizations, computable presentations and their utility. We will sample some of the key theoretical hurdles to a working computable model theory of non-tracial von Neumann algebras and how they were overcome. We will then consider some directions for future work. Joint work with Isaac Goldbring, Bradd Hart, and Thomas Sinclair.

CHRISTOPHER KARPINSKI, McGill University
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2005]
Hyperfiniteness of boundary actions of small cancellation groups

A metric space is *(Gromov) hyperbolic* if geodesic triangles in the metric space are uniformly slim. To any Gromov hyperbolic metric space, one can associate a boundary at infinity, called the *Gromov boundary*, which often has a natural Polish topology. A group acting on a hyperbolic metric space by isometries induces an action on the associated Gromov boundary by homeomorphisms. Given a hyperbolic space equipped with an action of a group, one can study the orbit equivalence relation of the boundary action. Interestingly, this orbit equivalence relation turns out to be hyperfinite in many cases (including for actions of free groups, and more generally hyperbolic groups, on the boundaries of their Cayley graphs). We show that a class of groups of interest in geometric group theory, the *small cancellation groups*, induce hyperfinite orbit equivalence relations on the boundaries of their natural hyperbolic Cayley graphs. This is joint work with Damian Osajda and Koichi Oyakawa.

JOSH LAU, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2005]
Algebro-topological invariants of co-existentially closed continua

We will discuss the Čech cohomology and pro-fundamental groups of compact Hausdorff spaces X for which the C*-algebra $C(X)$ of continuous functions on X is an existentially closed model of the theory of continua. This is joint work with C. Eagle and V. Marin-Marquez.

SAMUEL MURRAY, McGill
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2005]
Borel Fractional Perfect Matchings in Quasitransitive Amenable Graphs

A fractional perfect matching is the linear programming analog of a perfect matching, where we allow edges to take on values in the interval $[0, 1]$ instead of just $\{0, 1\}$. Descriptive fractional perfect matchings have recently become an object of interest in descriptive combinatorics, as results of Bowen, Sabok, and Kun have shown that the existence of nice measurable fractional perfect matchings implies the existence of measurable perfect matchings in hyperfinite bipartite locally finite graphings.

A compactness argument shows that any locally finite hyperfinite graphing that admits a perfect matching will admit a measurable fractional perfect matching. However, in an upcoming paper by Bernshteyn and Weilacher, they construct a polynomial growth Borel forest on a Polish space that has no Borel fractional perfect matching, even after throwing away an invariant meager set. In contrast to this result, we will show that if a Borel graph has components that are quasi-transitive and amenable, then if it admits a perfect matching it will admit a Borel fractional perfect matching.

TORI NOQUEZ, Saint Mary's College of California
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2005]
Fractals as Final Coalgebras in Various Categories of Metric Spaces

In this talk we will explore a collection of results about obtaining fractal sets as final coalgebras of functors on various categories of metric spaces. This is a line of research started by Freyd and continued by Leinster, in which fractal sets are obtained as final coalgebras (a natural category theoretic construction used to capture infinite continuous behavior, such as streams) in categories of sets, and then topological spaces. The results presented here adapt this work to the metric setting, and examine this question in categories with different morphisms, namely short (non-expanding) maps, continuous maps, and Lipschitz maps. Interestingly, we obtain positive results for categories with short and continuous maps, but a negative result for the appropriate category of metric spaces with Lipschitz maps. We will conclude with a conjecture about a generalization of this negative result.

BO PENG, McGill University
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2005]
Generalized Oxtoby systems and hyperfiniteness

We show that conjugacy relation of generalized Oxtoby systems is hyperfinite which generalizes Kaya's results to a kind of system where all Choquet Simplices can be realized as its invariant measures.

ANTOINE POULIN, McGill
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2005]
Borel quasi-trees are treeable

In this talk, we consider countable Borel equivalence relations structured (in the sense of Chen-Kechris) by quasi-trees, that is graph quasi-isometric to trees. Using the Isbel-Werner duality between median graphs and (a class of) poset with complements, we show that all such equivalence relations are treeable.

FORTE SHINKO, University of California, Berkeley
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2005]
Hyperfiniteness of graphs of slow intermediate growth

A definable graph on a standard Borel space is hyperfinite if it is the increasing union of component-finite definable subgraphs. Hyperfiniteness is a strong form of amenability, and it is a long-standing open problem to determine whether every amenable graph is in fact hyperfinite. We are quite far from resolving the problem, which is most notably still open for Schreier graphs of solvable groups, although there is a positive answer for nilpotent and polycyclic groups. Another natural class where the problem is open is graphs of subexponential growth, that is, graphs for which there is a subexponential function $f(n)$ such that every n-ball has at most $f(n)$ vertices. Recently, it was shown by Bernshteyn and Yu that every graph of polynomial growth is hyperfinite. We extend this to show that there is a constant $0 < c < 1$ such that every graph of growth $\exp(n^c)$ is hyperfinite. This is joint with Jan Grebík, Andrew Marks and Václav Rozhoň.

SPENCER UNGER, University of Toronto
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2005]
Equidecomposition and discrepancy

We survey some recent results about equidecomposition which rely on discrepancy estimates for measures that come from actions of rotations on the torus. These results come from joint work with Andrew Marks and with Anton Bernshteyn and Anush Tserunyan.

ALLISON WANG, Carnegie Mellon University
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2005]
Complexity of codes for Ramsey positive sets

A subset X of the Ellentuck space is called Ramsey null if given any non-empty basic open set $[s, A]$, there is some $B \in [s, A]$ such that $[s, B]$ and X are disjoint. A set is Ramsey positive if it is not Ramsey null. Sabok proved that in Ellentuck space, the set of codes for G_δ Ramsey positive sets is $\mathbf{\Sigma^1_2}$-complete. We build on Sabok's result to show that the same holds in the Milliken space of strong subtrees of the complete binary tree. In fact, we will see that the result holds for any topological Ramsey space satisfying a certain condition, including many common Ramsey spaces.

MICHAEL WOLMAN, Caltech

[Saturday November 30 / samedi 30 novembre, 10:00 – R 2005]

Invariant uniformization

Given sets X, Y and $P \subseteq X \times Y$ with $\mathrm{proj}_X(P) = X$, a uniformization of P is a function $f : X \to Y$ satisfying $(x, f(x)) \in P$ for $x \in X$. If E is an equivalence relation on X, say P is E-invariant if $x_1 E x_2 \implies P_{x_1} = P_{x_2}$, where $P_x = \{y : (x, y) \in P\}$ is the x-section of P. In this case, an E-invariant uniformization is a uniformization f satisfying $x_1 E x_2 \implies f(x_1) = f(x_2)$.

When X, Y are Polish spaces and P is Borel, standard results in descriptive set theory provide conditions which imply the existence of Borel uniformizations. These fall mainly into two categories: "small section" and "large section" results.

Suppose that E is a Borel equivalence relation on X, P is E-invariant, and P has "small" or "large" sections. We address the following question: When does there exist a Borel E-invariant uniformization of P?

We show that for a fixed E, every such P admits a Borel E-invariant uniformization iff E is smooth. Moreover, we compute the minimal definable complexity of counterexamples when E is not smooth. Our counterexamples use category, measure, and Ramsey-theoretic methods.

We also consider "local" dichotomies for such pairs (E, P). We give new proofs of a dichotomy of Miller in the case where P has countable sections, and prove anti-dichotomy results for the "large section" case. We discuss the "K_σ section" case, which is open.

This is joint with Alexander Kechris.

CLEMENT YUNG, University of Toronto

[Saturday November 30 / samedi 30 novembre, 9:00 – R 2005]

An alternative proof of the Mathias-Silver theorem using the Kastanas game

The Kastanas game was introduced by Kastanas as a game-theoretic characterisation of (completely) Ramsey subsets of $[\mathbb{N}]^\infty$. While, by Borel determinacy, this immediately implies the Galvin-Prikry theorem (every Borel subset of $[\mathbb{N}]^\infty$ is Ramsey), the characterisation alone is insufficient to conclude the Mathias-Silver theorem (every analytic subset of $[\mathbb{N}]^\infty$ is Ramsey). We prove that, by considering the same game in the space $[\mathbb{N}]^\infty \times 2^{\mathbb{N}}$, we may utilise this characterisation to conclude the Mathias-Silver theorem. We will also briefly discuss how we may apply this argument to weak A2 spaces, a class of spaces which includes topological Ramsey spaces and countable vector spaces.

ANDY ZUCKER, University of Waterloo

[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2005]

Topological groups with tractable minimal dynamics

In joint work with Gianluca Basso, we explore the class of Polish groups whose universal minimal flows admit a comeager orbit. By work of Ben Yaacov, Melleray, and Tsankov, this class contains all Polish groups with metrizable universal minimal flow, and by an example of Kwiatkowska, this inclusion is strict. We isolate the correct generalization of this class of Polish groups to the class of all topological groups. We call these the topological groups with "tractable minimal dynamics (TMD)." One way of phrasing what makes this class "tractable" is an "abstract Kechris-Pestov-Todorcevic correspondence," which characterizes membership in TMD using a Ramsey-theoretic property of the group. In particular, this implies that TMD is absolute between models of set theory. We also state some conjectures to the effect that any topological group not in TMD has "wild" minimal dynamics.

Determination and Resilience in Mathematics

Org: Carmen Bruni (University of Waterloo), **Hannah Keese** (University of British Columbia) and/et **Vanessa Radzimski** (University of the Fraser Valley)

Determination and resilience are pillars for lifelong learning. In this session, we will explore the ways in which university mathematics instructors can support students to develop resilience through mathematical practice.

Schedule/Horaire **Room/Salle: WSOD 4900**

Saturday November 30 **samedi 30 novembre**

8:30 - 9:00	Brian Forrest (Waterloo), *It's ok to be wrong ! ! ! Really !* (p. 112)
9:00 - 9:30	Cindy Blois and Pam Sargent (University of Toronto), *Building Resilience in a Community of Learners* (p. 111)
9:30 - 10:00	Diana Skrzydlo (Waterloo), *Resilience Through Reflection* (p. 112)
10:00 - 10:30	Lindsay Daniels (UBC), *Building resilience through self-affirmation and reflection exercises* (p. 112)
15:00 - 15:30	Danielle Cox (MSVU), *Reflective Practices & Interpreting Student Errors* (p. 111)
15:30 - 16:00	Peter Harrington (UBC), *Mastery grading and its effect on student resilience and determination* (p. 112)
16:00 - 16:30	Asmita Sodhi (Victoria), *Ms. Frizzle Teaches Calculus* (p. 113)
16:30 - 17:00	Jeremy Chiu (Langara), *What inhibits resilience, and what can we do about it ?* (p. 111)
17:00 - 17:30	Joanna Niezen (SFU), *Assignment Resubmission and Resilience* (p. 112)
17:30 - 18:00	Judy Larsen (UFV) (p. 112)

Abstracts/Résumés

CINDY BLOIS AND PAM SARGENT, University of Toronto
[Saturday November 30 / samedi 30 novembre, 9:00 – WSOD 4900]
Building Resilience in a Community of Learners

How can a sense of community in the classroom impact the development of resilience in our students ? In this talk, we will discuss the development of resilience among individuals within the community and resilience of the community as a whole. We'll also share some approaches that we've taken to foster community in a large course of over 1200 students.

JEREMY CHIU, Langara College / Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 16:30 – WSOD 4900]
What inhibits resilience, and what can we do about it ?

In this roundhouse discussion, I will facilitate participants to brainstorm and share our thoughts about challenges that undergraduate students face. We will then brainstorm and share strategies of what we can do about these adversities to help students be resilient. The session is gamified to promote active learning.

DANIELLE COX, Mount Saint Vincent University
[Saturday November 30 / samedi 30 novembre, 15:00 – WSOD 4900]
Reflective Practices & Interpreting Student Errors

Determination and Resilience in Mathematics

Assignments provide learning opportunities and feedback on comprehension of material, but students do not always see them in that light. During a small study in first year calculus classes at Mount Saint Vincent University we implemented reflective practices and obtained data regarding their thoughts on whether this practice assisted them in their understanding of course material. The results of this study will be shared and discussed. We will also look at common errors seen in introductory math classes and discuss how we can intrepret these errors to understand how we can best support our students in their learning. This is joint work with Dr. Karyn McLellan (MSVU).

LINDSAY DANIELS, The University of British Columbia
[Saturday November 30 / samedi 30 novembre, 10:00 – WSOD 4900]
Building resilience through self-affirmation and reflection exercises

Throughout their university career, there are often non-content specific learning outcomes that students master to aid in their learning. Two such outcomes are determination and resilience, which are key skills to becoming lifelong learners. With growing class sizes, it can often be challenging to implement targeted activities to help advance these non-content specific learning objectives in student cohorts. One such tool is the inclusion of self-affirmation interventions, which have been shown to improve problem-solving and academic outcomes, and to reduce achievement gaps (Jordt et al). In this talk, we explore how self-affirmation and reflection activities can be implemented before summative assessments in both large and small classrooms.

BRIAN FORREST, University of Waterloo
[Saturday November 30 / samedi 30 novembre, 8:30 – WSOD 4900]
It's ok to be wrong ! ! ! Really !

One of the biggest obstacles for many students in learning mathematics is the fear of being "wrong". Many of our students are conditioned to believe that the sole goal in working a mathematics problem is to get "the right answer". Anything less is a failure. In this talk I will try to illustrate how I address this issue from day one in my Calculus classes and in general.

PETER HARRINGTON, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 15:30 – WSOD 4900]
Mastery grading and its effect on student resilience and determination

Mastery grading is an approach to grading that involves three key features: a clear list of learning objectives, assessment of mastery of those learning objectives instead of points or partial credit, and multiple attempts for students to demonstrate mastery. In this talk I will discuss my implementation of mastery grading in a differential equations course, how mastery grading might help build student resilience, and how my students surprised me with their determination to succeed.

JUDY LARSEN, UFV
[Saturday November 30 / samedi 30 novembre, 17:30 – WSOD 4900]

JOANNA NIEZEN, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 17:00 – WSOD 4900]
Assignment Resubmission and Resilience

The process of writing a proof is naturally iterative – something which tends to be hidden when proofs are presented in class. When first studying how to prove things, students must learn how to be gritty in addition to the logic they are implementing. In this talk, I will discuss how students in an introductory proofs class were graded and how resubmitting assignments affected student behaviour and attitude. Student survey results will be discussed.

Determination and Resilience in Mathematics

DIANA SKRZYDLO, University of Waterloo
[Saturday November 30 / samedi 30 novembre, 9:30 – WSOD 4900]
Resilience Through Reflection

Reflective activities allow students to see their own growth, improve, and build their metacognition, as well as give them the tools to develop resilience. In this talk I will discuss several ways I incorporate reflection in classes from second year all the way to graduate level, and the impact on student learning.

ASMITA SODHI, University of Victoria
[Saturday November 30 / samedi 30 novembre, 16:00 – WSOD 4900]
Ms. Frizzle Teaches Calculus

Of many influential teachers in my life, one is undoubtedly Ms. Valerie Frizzle, the teacher in the Magic School Bus series who encourages her third-grade class to "Take chances, make mistakes, and get messy!". This is something we hope our students do when looking for a solution to a problem: try something, maybe get stuck, and learn from the experience. However, if all they see is perfectly modelled solutions, it will be hard for students to recognize when a strategy is not working. In this talk, I'll share ways in which I've tried to foster a culture of taking chances, making mistakes, and getting messy in my classroom when teaching integration techniques.

Discrete Probability

Org: Sarai Hernandez-Torres (Instituto de Matemáticas, UNAM) and/et **Gourab Ray** (University of Victoria)

The session will gather early-career researchers across different topics in discrete probability. The topics considered for this session include random trees and maps, percolation and related statistical mechanics models, extremal combinatorics, and disordered systems.

Schedule/Horaire — Room/Salle: R 2515

Sunday December 1 — dimanche 1er décembre

9:30 - 10:00	Minghao Pan (Caltech), *Dimension jump at the uniqueness threshold for percolation in $\infty+d$ dimensions* (p. 115)
10:00 - 10:30	Hannah Cairns (McGill), *Cooperative motion in higher dimensions* (p. 114)
15:00 - 15:30	Kesav Krishnan (U. Victoria), *Local Convergence of Integer Valued Lipschitz Functions on Trees* (p. 114)
15:30 - 16:00	Lily Reeves (Caltech), *Phase Transitions of Ballistic Annihilation* (p. 115)
16:00 - 16:30	Daniel de la Riva Massaad (UBC), *Voter Model stability with respect to conservative noises* (p. 115)
16:30 - 17:00	Yucheng Liu (UBC), *The torus plateau for the high-dimensional Ising model* (p. 115)
17:00 - 17:30	Johannes Bäumler (UCLA), *The truncation problem for long-range percolation* (p. 114)

Abstracts/Résumés

JOHANNES BÄUMLER, UCLA
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2515]
The truncation problem for long-range percolation

In long-range percolation on the integer lattice, for each pair of points {x,y}, there is an open edge between these points with probability depending on the Euclidean distance between the points, independent of all other edges. When are the long edges necessary for the existence of an infinite cluster ? The truncation problem asks whether one can remove all long enough edges while still retaining an infinite open cluster. We discuss this question in the non-summable regime in dimensions $d \geq 3$. Here we show that the truncation problem has an affirmative answer.

HANNAH CAIRNS, McGill University
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2515]
Cooperative motion in higher dimensions

Cooperative motion is a random walk process defined on a tree which has a recursive distributional equation. We discuss the scaling limit of the simple symmetric case of the process on the lattice $\mathbb{Z}^d$ for all dimensions $d \geq 1$. This is the first higher-dimensional result for this process. Joint work with Louigi Addario-Berry, Gavin Barill, and Jessica Lin.

KESAV KRISHNAN, University of Victoria
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2515]
Local Convergence of Integer Valued Lipschitz Functions on Trees

The study of uniformly sampled integer valued Lipschitz functions of trees and related height function models has been of great recent interest. In particular, the phenomenon of localization, that is tightness of the law at the root has been established. In

this talk, I will discuss joint work with Nathaniel Butler, Gourab Ray and Yinon Spinka that examines the local convergence of uniformly sampled 1-Lipschitz functions on $d-$ary trees which take the value zero on the leaves. In particular, as the number of generations goes to infinity, we show that local convergence holds if and only if $d < 8$. We also show that if the boundary values are allowed to be in $\{0, 1\}$, then local convergence always holds via an FKG argument.

YUCHENG LIU, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2515]
The torus plateau for the high-dimensional Ising model

We consider the Ising model on a d-dimensional discrete torus of volume r^d, in dimensions $d > 4$ and for large r, in the vicinity of the infinite-volume critical point β_c. We prove that for $\beta = \beta_c - \text{const}\, r^{-d/2}$ (with a suitable constant) the susceptibility is bounded above and below by multiples of $r^{d/2}$, and that the two-point function has a "plateau" in the sense that it decays like $|x|^{-(d-2)}$ when $|x|$ is small relative to the volume but for larger $|x|$ it levels off to a constant value of order $r^{-d/2}$. We also prove that at $\beta = \beta_c - \text{const}\, r^{-d/2}$ the renormalised coupling constant is nonzero, which implies a non-Gaussian limit for the average spin. The random current representation of the Ising model plays a central role in our analysis.

DANIEL DE LA RIVA MASSAAD, UBC
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2515]
Voter Model stability with respect to conservative noises

The notions of noise sensitivity and stability were recently extended for the voter model, a well-known and studied interactive particle system. In this model, vertices of a graph have opinions that are updated by uniformly selecting edges. We further extend stability results to a different class of perturbations when an exclusion process or Brownian motions are performed in the collection of edge selections. We prove stability of the consensus opinion provided that the noise is being run for a short amount of time, which depends on the underlying graph structure. This is done by analyzing the expected size of the pivotal set, which needs to be properly defined for each setting.

MINGHAO PAN, Caltech
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2515]
Dimension jump at the uniqueness threshold for percolation in $\infty + d$ dimensions

Consider percolation on $T \times \mathbb{Z}^d$, the product of a k-regular tree with the hypercubic lattice $\mathbb{Z}^d$. It is known that this graph has $p_c < p_u$, so that there are non-trivial regimes in which percolation has 0, ∞, and 1 infinite clusters a.s., and it was proven by Schonmann (1999) that there are infinitely many infinite clusters a.s. at the uniqueness threshold $p = p_u$. We strengthen this result significantly by showing that if $\delta_H(p)$ denotes the Hausdorff dimension of the set of accumulation points of an infinite cluster in the boundary of the tree then $\delta_H(p)$ has a jump discontinuity from $\delta_H(p_u) \leq 1/2$ to 1 at the uniqueness threshold p_u. We also prove that various other critical thresholds including the L^2 boundedness threshold $p_{2\to 2}$ coincide with p_u for such products, which are the first examples proven to have this property. All our results apply more generally to products of trees with arbitrary infinite amenable Cayley graphs and to the lamplighter on the tree.

LILY REEVES, California Institute of Technology
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2515]
Phase Transitions of Ballistic Annihilation

Ballistic annihilation is a simple annihilating particle system motivated by the study of the kinetics of chemical reactions. In it, particles with presampled random velocities move across the real line and mutually annihilate upon collision. Many results were inferred by physicists, but it was only until recently that rigorous mathematical solutions were derived. In this talk, I will discuss Haslegrave—Sidoravicius—Tournier's breakthrough result in the symmetrical three-velocity setting and introduce two

variants, for which we are able to prove the existence of phase transitions and compute the critical density despite considerably more complicated dynamics.

Embedding Ethics In Mathematics

Org: Diana Skrzydlo (University of Waterloo)

Mathematics, statistics, and computer science have a major impact on many aspects of life, and with that comes important ethical considerations, such as cryptography and privacy laws, bias in data collection, algorithms reinforcing existing inequalities, pricing of insurance, and misleading investment products. Students need to be thinking about these issues throughout their education, so they can use mathematics ethically and responsibly. This session will have several speakers discuss the work they have done to embed ethics education into their math courses, and will also have an opportunity for a large group discussion.

Schedule/Horaire **Room/Salle: WSOD 4900**

Sunday December 1 **dimanche 1er décembre**

8:00 - 8:30	Carmen Bruni (University of Waterloo), *On the Ethics of Social Computing for Computer Science Majors* (p. 118)
8:30 - 9:00	Matt Hayat (Georgia State University), *Integrating Ethics into Mathematics and Statistics Education* (p. 118)
9:00 - 9:30	Samantha-Jo Caetano (University of Toronto), *Teaching Ethics in the Era of Data* (p. 118)
9:30 - 10:00	Vicki Zhang (University of Toronto), *Taking Stock: Eight Years of Embedded Ethics at UofT's Actuarial Science Program* (p. 119)
10:00 - 10:30	Judith Koeller (University of Waterloo), *Experiences teaching About Ethics in Math via Peace Studies* (p. 118)
15:00 - 15:30	Dan Brown and Maura Grossman (University of Waterloo), *Teaching computer ethics by focusing on discrimination and surveillance: takeaways from an online teaching experiment* (p. 117)
15:30 - 16:00	Maritza Branker (Niagara University), *Viewing our students as ambassadors of our discipline: a new approach to the mathematics senior seminar.* (p. 117)
16:00 - 16:30	Lindsay Poirier (Smith College), *Data Ethnography: Cultivating Reflexive Sensibilities through the Cultural Analysis* (p. 119)
16:30 - 17:00	Nathalie Moon (University of Toronto), *Embracing Uncertainty: Weaving Ethics into Statistics Education* (p. 119)
17:00 - 18:00	Talkback/roundtable session (open to all), *Talkback/roundtable discussion* (p. 119)

Abstracts/Résumés

MARITZA BRANKER, Niagara University
[Sunday December 1 / dimanche 1er décembre, 15:30 – WSOD 4900]
Viewing our students as ambassadors of our discipline: a new approach to the mathematics senior seminar.

The capstone course is traditionally an opportunity for students to delve deeper into the mathematical discipline. This talk outlines the rationale and details of designing a senior seminar course on the theme of the relevance of mathematics to society. Viewing students as ambassadors of the discipline provides the flexibility to accommodate math majors, preservice teachers with a math concentration and actuarial science majors within a single section of the course. More importantly it provides a venue for students to articulate their personal philosophy on the significance of mathematics and grapple with ethical ramifications of the discipline on our society. By the end they are cognizant of the need to consider not only if they are capable of crafting an effective solution to any given problem but also the implicit duty to avoid causing harm with their mathematical knowledge.

Embedding Ethics In Mathematics

DAN BROWN AND MAURA GROSSMAN, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 15:00 – WSOD 4900]
Teaching computer ethics by focusing on discrimination and surveillance: takeaways from an online teaching experiment

We discuss our experiences teaching a computer ethics course focused on discrimination and surveillance. Our course's content includes algorithmic bias ; how gender, racial, and sexual minorities are disproportionately impacted by technology ; surveillance and privacy concerns ; and methods technologists can use for ameliorating these concerns in the workplace and in society. We also discuss the results of an experiment in different formats of teaching this material: online versus in-person. Our analysis concentrated on the extent and contents of self-disclosure by both students and instructors. Using both quantitative and qualitative methods, we observed a higher prevalence of self-disclosure by both students and instructors in the online section. Notably, an analysis of demographic data revealed that minority group members were particularly active in self-disclosure in both formats. Overall, our findings suggest that an online setting may be more effective for delivering computer ethics courses where a primary goal is increasing open discussion and self-disclosure among participants.

CARMEN BRUNI, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 8:00 – WSOD 4900]
On the Ethics of Social Computing for Computer Science Majors

In the rapidly evolving field of computer science, the intersection of technology, society, and human behaviour presents both immense opportunities and complex ethical challenges. As computer science majors, students must not only learning how to build systems but also how their actions effect the environments in which millions of people interact with. This talk will explore a course taught at the University of Waterloo concerning the ethical implications of designing and developing technologies that impact societies.

SAMANTHA-JO CAETANO, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 9:00 – WSOD 4900]
Teaching Ethics in the Era of Data

In this talk, I will discuss the integration of ethics into statistical education through the Embedded Ethics program developed by the Department of Statistical Sciences in collaboration with the Department of Philosophy. Recognizing that ethics permeates all aspects of statistics, we have introduced ethics modules in four undergraduate statistics courses. I will specifically focus on the implementation of these modules and the associated ethics assessments in a large third-year statistics course taught in Fall 2023. The presentation will highlight the benefits of this program while also addressing the challenges we encountered. Additionally, I will outline plans for future adaptations and the expansion of the program to include more courses.

MATT HAYAT, Georgia State University
[Sunday December 1 / dimanche 1er décembre, 8:30 – WSOD 4900]
Integrating Ethics into Mathematics and Statistics Education

Data examples in mathematics and statistics education often includes data collected on human subjects. Thus, educators have a responsibility to educate their students about the ethical aspects related to the collection of those data. With technological advancement and the increase in availability of real-world datasets, it is necessary that instructors educate about integrating the ethical aspects around data sources, such as privacy, how the data were obtained and whether participants consent to the use of their data. In this talk, we propose incorporating ethics into established curricula and integrating ethics into undergraduate-level introductory mathematics and statistics courses based on recommendations in the American Statistical Association's evidence-based Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report. We provide a few examples of how to prompt students to constructively think about their ethical responsibilities when working with data.

Embedding Ethics In Mathematics

JUDITH KOELLER, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 10:00 – WSOD 4900]
Experiences teaching About Ethics in Math via Peace Studies

Collaborations between University of Waterloo's Peace and Conflict Studies department and Faculty of Mathematics exposed the need for a course in Ethics in Math. Along with Peace Scholar Lowell Ewert, Judith Koeller co-developed and co-taught the course "Math for Good and Evil" starting in 2019 ; registrants included students from math/CS, peace studies and many other programs. Koeller also teaches "Math and Peace for Teachers" in the Masters for Math Teachers program, and will launch the Math Faculty elective "Social Implications of Math" in Winter 2025.

NATHALIE MOON, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 16:30 – WSOD 4900]
Embracing Uncertainty: Weaving Ethics into Statistics Education

The foundational role of uncertainty in statistics provides a unique opportunity to meaningfully integrate ethics into the curriculum. While many students, particularly those with strong mathematical backgrounds, seek definitive answers, statistical practice inherently involves judgment under uncertainty. This talk explores how the ubiquitous "it depends" of statistical decision-making naturally aligns with ethical reasoning. Rather than treating ethics as an isolated topic confined to a dedicated week, we demonstrate how uncertainty serves as a bridge between technical content and ethical considerations. Through examining both clear-cut ethical rules and context-dependent dilemmas, students learn that navigating uncertainty is both a statistical and ethical skill. This integrated approach not only produces more ethically-minded practitioners but also develops students' comfort with ambiguity – a crucial skill for modern statistical practice. I will present practical examples of how I have integrated ethical discussions into core statistical curricula, transforming students' discomfort with uncertainty into a valuable professional asset.

LINDSAY POIRIER, Smith College
[Sunday December 1 / dimanche 1er décembre, 16:00 – WSOD 4900]
Data Ethnography: Cultivating Reflexive Sensibilities through the Cultural Analysis

Canonical ideologies tend to position data as neutral, when they may be more aptly characterized as power-laden systems for signification. While critical for interpreting the cultural meaning of data, the skills needed to historicize, situate, and deconstruct data are often underrepresented in STEM education. In this talk, I outline a series of pedagogical approaches to teaching cultural analysis of datasets, data infrastructures, and data work. I show how, by cultivating competency in hermeneutics, ethnography, and critical theory, students can learn to attend to the cultural provenance of data across a number of registers – from interrogating the belief systems of data designers, to examining the cultural logics of data infrastructures, to analyzing the interests of data-producing institutions, to unpacking the discourses that shape public understandings of data. Further, by pluralizing the epistemic lenses through which data are analyzed, students have an opportunity to nourish reflexive sensibilities – discerning their own cultural positioning as they question why culture tends to be deleted from data science work.

TALKBACK/ROUNDTABLE SESSION, Various
[Sunday December 1 / dimanche 1er décembre, 17:00 – WSOD 4900]
Talkback/roundtable discussion

We'll have an opportunity for audience members and speakers from the session to discuss ideas that were presented and share new ones.

Embedding Ethics In Mathematics

VICKI ZHANG, University of Toronto

[Sunday December 1 / dimanche 1er décembre, 9:30 – WSOD 4900]

Taking Stock: Eight Years of Embedded Ethics at UofT's Actuarial Science Program

For over eight years, we have conducted various embedded ethics pedagogical experiments in University of Toronto's actuarial science program. We incorporate ethical discussions organically into technical teaching, and to use examples and case studies with an ethical dimension to discuss technical content.

For our introductory courses, we have incorporated narrative-based pedagogy for life contingencies, creative artmaking in financial math, exploring financial puzzles from pop culture, and team-based projects to explore insurance ethics.

For higher-year courses, we coached students to write modified op-ed to deep dive in different perspectives, taught students to code in industry software AXIS while exploring insurance regulations. We have also approached insurance decision-making (i.e. whether to insure or deny access to insurance protection) as a distributive justice and fairness question. We explored with our students alternative fairness frameworks including Luck-Egalitarianism and Democratic Equality, and how insurability decisions would be made differently - from the industry-standard "actuarial fairness" perspective - under those alternative frameworks.

In this talk, I will present the key examples of embedding ethics education in actuarial math education, and discuss the importance of marrying active learning activities with embedded ethics to maximize the impact. I will also share students' feedback and lessons learned.

Emerging Frontiers in Number Theory: Insights from Early-Career Researchers

Org: **Seda Albayrak** and/et **Renate Scheidler** (UCalgary)

This session provides a platform for early-career researchers, including PhD students nearing graduation, recent PhD graduates, and postdoctoral fellows, to present their cutting-edge work in number theory. With contributions spanning algebraic and analytic number theory, as well as arithmetic geometry, we aim to foster collaboration, exchange innovative ideas, and offer a space for networking. This is an excellent opportunity for young researchers to gain visibility and engage with the broader number theory community.

Schedule/Horaire **Room/Salle: R 2550 A&B**

Sunday December 1 **dimanche 1er décembre**

8:00 - 8:30	Jaxon Shumaker (University of Oregon), *Classifying monogenic quartic orders* (p. 124)
8:30 - 9:00	Rebecca DeLand (University of Colorado Boulder), *Limiting Density of Elliptic Divisibility Sequences* (p. 122)
9:00 - 9:30	Fatemezahra Janbazi (University of Toronto), *Boundedness of average rank of elliptic curves ordered by the coefficients* (p. 123)
9:30 - 10:00	Nathan Heisz (McMaster University), *Densities of Bounded Primes in Hypergeometric Series* (p. 123)
10:00 - 10:30	Dan Barake (McMaster University), *Characters in p-adic Vertex Operator Algebras* (p. 122)
15:00 - 15:30	Samprit Ghosh (University of Calgary), *Certain Polytopes associated to Algebraic integer conjugates* (p. 123)
15:30 - 16:00	Nic Banks (University of Waterloo), *Galois Theory and Computation of Intersective Polynomials* (p. 122)
16:00 - 16:30	Jose Cruz and Fatemeh Jalalvand (University of Calgary), *Geometric Properties of Log Unit Lattices* (p. 122)
16:30 - 17:00	Abbas Maarefparvar (University of Lethbridge), *An Application of Terada's Principal Ideal Theorem* (p. 124)
17:00 - 17:30	Brett Nasserden (McMaster University), *Some Progress on Fulton's Local-Global Question* (p. 124)
17:30 - 18:00	Kristaps Balodis (University of Calgary), *L-functions, representation theory, and geometry.* (p. 121)

Monday December 2 **lundi 2 décembre**

8:00 - 8:30	James Cumberbatch (Purdue University) (p. 122)
8:30 - 9:00	Kin Ming Tsang (University of British Columbia), *Comparing Hecke eigenvalues of automorphic representations for GL(2)* (p. 125)
9:00 - 9:30	Emily Quesada-Herrera (University of Lethbridge), *Fourier optimization and quadratic forms* (p. 124)
9:30 - 10:00	Paul Péringuey (University of British Columbia), *Sign correlation between error terms of counting functions of primes in arithmetic progressions modulo 11* (p. 124)
10:00 - 10:30	Zhenchao Ge (University of Waterloo), *A discrete mean value for Dirichlet L-function over local extrema* (p. 122)

Abstracts/Résumés

KRISTAPS BALODIS, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 17:30 – R 2550 A&B]
L-functions, representation theory, and geometry.

The local Langlands program predicts that one can associate representations π of p-adic groups to group homomorphisms called "L-parameters" ϕ. Moreover, one can attach complex meromorphic functions $L(\pi, s)$ and $L(\phi, s)$ to these objects, in

such a way that if π is "associated" with ϕ, then $L(\pi, s) = L(\phi, s)$. It is predicted that algebraic properties of π and ϕ are encoded in the analytic behavior of the functions $L(\pi, s)$ and $L(\phi, s)$. In this talk, we will discuss recent progress on some of these conjectures which relies on a certain "geometrization" of these ideas ; namely the p-adic Kazhdan-Lusztig hypothesis.

NIC BANKS, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2550 A&B]
Galois Theory and Computation of Intersective Polynomials

A polynomial with integer coefficients is called intersective if it has a root modulo n for all positive integers n. This talk will focus on intersective polynomials without integer roots, which represent a local-global failure. We will discuss classification efforts for such polynomials of low degree, utilizing a Galois-theoretic characterization of Berend and Bilu (1996). We conclude by discussing data collection and computational aspects of this problem, facilitated by Sage and GAP.

DAN BARAKE, McMaster University
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2550 A&B]
Characters in p-adic Vertex Operator Algebras

Vertex operator algebras (VOAs) play a central role in two-dimensional conformal field theory, however their number-theoretical properties have also garnered significant attention over the past two decades. In particular, a celebrated result of Zhu shows that the character map (i.e. 1-point correlation function or graded trace) on VOAs gives a surjection on the space of modular forms. In this talk, we will first give an introduction to these structures as well as their p-adic variants which were constructed recently by Franc and Mason. Then, we will discuss new results on the connections to p-adic modular forms, with the goal of establishing a Zhu-type theorem in this p-adic case.

JOSE CRUZ AND FATEMEH JALALVAND, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2550 A&B]
Geometric Properties of Log Unit Lattices

The log unit lattice is the image of the unit group of the ring of integers under the Minkowski embedding in the euclidean space. By studying Minkowski's lattice constructions, one can explore how the intrinsic algebraic features of number fields are reflected in the geometric invariants of the corresponding lattices.This perspective offers valuable insights into the arithmetic structure of number fields and has been fundamental in deriving key results, such as the celebrated class number formula.

In this talk, we will introduce parametrizing spaces for certain families of number fields, within which the associated log unit lattices live. This framework allows us to investigate geometric properties such as orthogonality and well-roundedness.

JAMES CUMBERBATCH, Purdue University
[Monday December 2 / lundi 2 décembre, 8:00 – R 2550 A&B]

REBECCA DELAND, University of Colorado, Boulder
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2550 A&B]
Limiting Density of Elliptic Divisibility Sequences

Let $E/\mathbb{Q}$ be an elliptic curve and P be a rational point of infinite order. If we write the points $[n]P = \left(\frac{A_n}{D_n^2}, \frac{B_n}{D_n^3}\right)$, the D_n's form an elliptic divisibility sequence. In this talk, we will explore the residue classes of elliptic divisibility sequences modulo p^λ for $\lambda \geq 1$. We will then discuss how we can use elliptic curves over local fields to gain information about the residue classes as $\lambda \to \infty$.

ZHENCHAO GE, University of Waterloo
[Monday December 2 / lundi 2 décembre, 10:00 – R 2550 A&B]
A discrete mean value for Dirichlet L-function over local extrema

The classical second integral moment of $\zeta(s)$ shows that the integral average of $|\zeta(\frac{1}{2}+it)|^2$ is $\log t$. Assuming the Riemann Hypothesis and letting γ, γ^+ be the imaginary parts of consecutive critical zeros of $\zeta(s)$, Conrey and Ghosh proved that the mean value of $|\zeta(\frac{1}{2}+it)|^2$ over the maxima between γ, γ^+ up to T is asymptotic to $\frac{1}{2}(e^2-5)\frac{T}{2\pi}\log(\frac{T}{2\pi})^2$. In other words, the discrete mean of $|\zeta(\frac{1}{2}+it)|^2$ at a critical point is $\frac{1}{2}(e^2-5)\log t$, which is a constant factor larger.

In this talk, we will demonstrate that the analogous phenomenon does not exist for the Z-function associated to a Dirichlet L-functions. Specifically, we show that the discrete mean value of Hardy's Z-function over its local extrema has an asymptotic formula with a negative leading coefficient. In contrast, Korolev and Jutila have proven that the integral mean value of Hardy's Z-function does not exhibit such behavior. Moreover, by improving Conrey and Ghosh's method, we can compute as many lower-order terms as desired.

This is joint work with Jonathan Bober (Bristol) and Micah Milinovich (Mississippi).

SAMPRIT GHOSH, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2550 A&B]
Certain Polytopes associated to Algebraic integer conjugates

In a recent paper, Bugeaud and Nguyen proved a stronger version of a Theorem of Lenstra and Shallit related to the convergents of certain algebraic integers. One of the key ingredients of their proof was certain exponential relations observed among the absolute values of the Galois conjugates of an algebraic integer. Motivated by their work, we let α be an algebraic integer of degree d and label its Galois conjugates $\alpha_0, \alpha_1, \cdots, \alpha_{d-1}$ written in decreasing order of magnitude, i.e. $|\alpha_0| \geq \cdots \geq |\alpha_{d-1}|$. Let $E_{k,d}$ be the set of $(c_1, \ldots, c_k) \in \mathbb{R}^k_{\geq 0}$ such that $|\alpha_0||\alpha_1|^{c_1} \cdots |\alpha_k|^{c_k} \geq 1$. In this talk we'll first give an explicit description of $E_{k,d}$ as a polytope with 2^k vertices. Then we will look at when the inequality is strict and give a quantitative version of the inequality depending on d and the height of the minimal polynomial of α. This is a joint work with S. Albayrak, G. Knapp and K.D. Nguyen.

NATHAN HEISZ, McMaster University
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2550 A&B]
Densities of Bounded Primes in Hypergeometric Series

A Hypergeometric series ${}_mF_n(\alpha, \beta; z)$ is said to be p-adically bounded if the p-adic valuation of the coefficients is bounded below. A logical extension of this problem is to consider the Dirichelet density of bounded primes in a series with fixed parameters α and β. We will briefly summarize existing results from Franc et.al. on the densities of bounded primes for ${}_2F_1$ over $\mathbf{Q}$ before presenting new results on the densities of general ${}_mF_n$. Furthermore we will discuss a lower bound of the density of bounded primes in ${}_2F_1$ over quadratic number fields $\mathbf{Q}(\sqrt{D})$ and an interesting conjecture that gives an exact formulation for the densities in this case.

FATEMEZAHRA JANBAZI, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2550 A&B]
Boundedness of average rank of elliptic curves ordered by the coefficients

In arithmetic statistics, elliptic curves are typically ordered by the naive height, defined for $E_{A,B} : y^2 = x^3 + Ax + B$ as $H(E_{A,B}) = \max\{4|A|^3, 27B^2\}$, which effectively orders curves by the size of their roots. In this paper, we consider an alternative height function, $h(E_{A,B}) = \max\{|A|, |B|\}$, ordering elliptic curves by the magnitudes of their coefficients. We demonstrate that, under this new height function, the average size of the 2-Selmer group is bounded above by 3, aligning

with the findings of Bhargava and Shankar under the naive height. We study the 2-Selmer group by analyzing integral binary quartic forms within non-uniformly expanding regions defined by the height function. Developing a new technique, we count and establish the equidistribution of lattice points in these spaces, overcoming challenges where standard methods fall short.

ABBAS MAAREFPARVAR, University of Lethbridge
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2550 A&B]
An Application of Terada's Principal Ideal Theorem

For a number field K, denote by $\Gamma(K)$ the absolute genus field of K. In 2014, Amandine Leriche proved that if $K/\mathbb{Q}$ is an abelian extension, then the strongly ambiguous ideal class group of $\Gamma(K)/\mathbb{Q}$ is trivial. In this talk, we give a generalization of Leriche's result for finite cyclic extensions of number fields. More precisely, using Terada's Principal Ideal Theorem, we show that for a finite cyclic extension K/F, the strongly ambiguous ideal class group of $\Gamma(K/F)/F$ coincides with the image of the capitulation map from the ideal class group of F to the ideal class group of $\Gamma(K/F)$, where $\Gamma(K/F)$ denotes the relative genus field of K over F. This is a joint work with Ali Rajaei (Tarbiat Modares University) and Ehsan Shahoseini (Institute For Research In Fundamental Sciences).

BRETT NASSERDEN, McMaster University
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2550 A&B]
Some Progress on Fulton's Local-Global Question

Fulton posed the question of whether a variety that locally resembles a quotient of a smooth variety by a finite group must globally be a quotient of a smooth variety by a finite group. In this talk, we discuss recent progress on this question, specifically in the context of surfaces with finite abelian quotient singularities. This work provides a reinterpretation of Fulton's question through the lenses of intersection theory, Brauer groups, and derived categories of singularities.

PAUL PÉRINGUEY, University of British Columbia
[Monday December 2 / lundi 2 décembre, 9:30 – R 2550 A&B]
Sign correlation between error terms of counting functions of primes in arithmetic progressions modulo 11

In this talk we will investigate the sign of the normalized error term for the primes in arithmetic progression, i.e the quantity $E^{\psi}(x;q,a) = \frac{\varphi(q)\psi(x;q,a)-x}{\sqrt{x}}$, where $\psi(x;q,a) = \sum_{\substack{n\leq x \\ n\equiv a \bmod q}} \Lambda(n)$ and Λ denotes the Von Mangoldt function.

More precisely, we study, under the Generalized Riemann Hypothesis and the Linear Independence Hypothesis, the logarithmic density of integers x for which $E^{\psi}(x;q,a)$ and $E^{\psi}(x;q,b)$ are of the same sign, for $(ab,q)=1$.

Furthermore we will provide numerical values for these densities when $q=11$.

This is a joint work with Kübra Benli and Greg Martin.

EMILY QUESADA-HERRERA, University of Lethbridge
[Monday December 2 / lundi 2 décembre, 9:00 – R 2550 A&B]
Fourier optimization and quadratic forms

The study of integers and primes represented by binary quadratic forms is a classical problem, going back to Fermat. We will discuss a Fourier analysis approach to this problem, based on joint work with Andrés Chirre. For a given form and integer $\ell \geq 2$, this approach gives us strong estimates for the average number of representations of integers that are multiples of ℓ. This leads to unconditional upper bounds on the number of primes in short intervals represented by a given form, and, conditionally on the generalized Riemann hypothesis, an upper bound on the maximum gap between such consecutive primes. The latter extends a method of Carneiro, Milinovich, and Soundararajan.

JAXON SHUMAKER, University of Oregon
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2550 A&B]
Classifying monogenic quartic orders

An order is a subring of the ring of integers of a number field. We say an order is *monogenic* if it is generated by a single element as an algebra over $\mathbb{Z}$. Following Bèrczes, Evertse, Győry, we consider two types of monogenic orders. A monogenic order is *type I* if there are two monogenizers ξ and β and there exist integers $a, b, c, d \in \mathbb{Z}$, with $c \neq 0$, such that $\beta = \dfrac{a\xi + b}{c\xi + d}$ and $ad - bc = \pm 1$. Additionally, a monogenic order is said to be type II if, for two generators ξ and β, there exist $f, g \in \mathbb{Z}[T]$, such that, $\deg(f) = \deg(g) = 2$ and $f(\xi) = \beta$, $g(\beta) = \xi$. It is proven by Bérczes, Evertse, and Győry that for a given number field, with certain conditions on the Galois group of the number field, nearly all the monogenic orders having at least two distinct generators, are type I or type II.

The work in this presentation is motivated by the following question "Do there exist monogenic quartic orders that are neither type I nor type II, and if so, can an explicit bound on the number of exceptional orders in a given quartic number field be given ?" We use some of Akhtari's explicit results about index form equations in quartic number fields, to explore this question.

KIN MING TSANG, University of British Columbia
[Monday December 2 / lundi 2 décembre, 8:30 – R 2550 A&B]
Comparing Hecke eigenvalues of automorphic representations for GL(2)

In this talk, we will discuss the strong multiplicity one theorem for $\mathrm{GL}(2)$, which basically states that if the local components of two cuspidal unitary automorphic representations are isomorphic for all but finitely many places, then they are globally equivalent. Ramakrishnan improved the result by showing that if two representations agree at places of Dirichlet density $7/8$, then they are globally equivalent. We will then discuss questions of similar flavour – comparing Hecke eigenvalues of two non-twist-equivalent cuspidal unitary automorphic representations.

Finite Fields and Applications

Org: Ariane Masuda (New York City College of Technology (CUNY)) and/et **Daniel Panario** (Carleton University)

This session will delve into the rich and diverse world of finite fields, which play a pivotal role in various branches of mathematics and computer science, such as coding theory, cryptography, and combinatorics. We aim to bring together a group of researchers to discuss and showcase the latest advancements and practical implementations of finite fields. By fostering an environment of knowledge exchange, this session seeks to disseminate and inspire new research directions.

Schedule/Horaire **Room/Salle: R 2125**

Saturday November 30 — samedi 30 novembre

8:00 - 8:30	Lucia Moura (University of Ottawa), *New families of strength-3 covering arrays using LFSR sequences* (p. 129)
8:30 - 9:00	Neranga Fernando (College of the Holy Cross), *Idempotents and Tripotents in Quandle Rings* (p. 126)
9:00 - 9:30	Chi Hoi (Kyle) Yip (Georgia Institute of Technology), *Extensions of Carlitz-McConnel theorem on permutations over finite fields* (p. 130)
9:30 - 10:00	Shuxing Li (University of Delaware), *On the Nonexistence of Generalized Bent Functions* (p. 128)
10:00 - 10:30	Jonathan Jedwab (Simon Fraser University), *Quaternary Legendre pairs of even length* (p. 127)
15:00 - 15:30	Daniel Katz (California State University), *Almost perfect nonlinear power functions with exponents expressed as fractions* (p. 127)
15:30 - 16:00	Petr Lisonek (Simon Fraser University), *On a new class of Hadamard matrices* (p. 128)
16:00 - 16:30	Kenza Guenda (University of Victoria and University of Science and Technology Houari Boumediene), *Code-based cryptography* (p. 127)
16:30 - 17:00	Hugo Teixeira (Carleton University), *The functional graph of $f(X) = (cX^q + aX)(X^q - X)^{n-1}$ over quadratic extensions of finite fields* (p. 130)
17:00 - 17:30	Hassan Khodaiemehr (The University of British Columbia), *Quantum Bosonic Codes and Finite Fields* (p. 128)
17:30 - 18:00	David Thomson (Tutte Institute for Mathematics and Computing) (p. 130)

Sunday December 1 — dimanche 1er décembre

8:00 - 8:30	Ariane Masuda (New York City College of Technology/The City University of New York), *Involutions over finite fields* (p. 128)
8:30 - 9:00	Welington Santos (University of Wisconsin-Stout), *Codes for Secure Distributed Matrix Multiplication* (p. 129)
9:00 - 9:30	Bianca Sosnovski (Queensborough Community College/The City University of New York), *Applications of Finite Fields in Cayley Hash Functions* (p. 130)
9:30 - 10:00	Jozsef Solymosi (The University of British Columbia), *On the Thue-Vinogradov Lemma* (p. 130)
10:00 - 10:30	Daniel Panario (Carleton University), *Stable binomials over finite fields* (p. 129)

Abstracts/Résumés

NERANGA FERNANDO, College of the Holy Cross, Worcester, Massachusetts, United States of America
[Saturday November 30 / samedi 30 novembre, 8:30 – R 2125]
Idempotents and Tripotents in Quandle Rings

A *quandle* is a set Q with a binary operation $* : Q \times Q \to Q$ satisfying:

• For all $x \in Q$, $x * x = x$

• For all $y \in Q$, the map $\beta_y : Q \to Q$ defined by $\beta_y(x) = x * y$ is invertible.

• For all $x, y, z \in Q$, $(x * y) * z = (x * z) * (y * z)$.

The three axioms of a quandle algebraically encode the three Reidemeister moves in knot theory. Let R be an associative ring with unity, and $R[Q]$ be the set of all formal finite R-linear combinations of elements of Q:

$$R[Q] := \Big\{ \sum_i \alpha_i x_i \,|\, \alpha_i \in R,\, x_i \in Q \Big\}$$

The set $R[Q]$ is a non-associative ring with coefficients in R. We study idempotents and tripotents in quandle rings $\mathbb{F}_p[Q]$. The Gröbner basis technique plays a pivotal role in our study.

This is a joint work with Zhaoqi Wu (College of the Holy Cross).

KENZA GUENDA, UVIC/ USTHB

[Saturday November 30 / samedi 30 novembre, 16:00 – R 2125]

Code-based cryptography

In the realm of post-quantum cryptography, code-based cryptography has garnered significant attention. The ongoing NIST standardization process for post-quantum cryptographic primitives has further heightened interest and accelerated research in this field. Code-based cryptographic primitives, which rely on the difficulty of decoding seemingly random error-correcting codes, have proven particularly robust against quantum computer-based attacks. Unlike traditional cryptographic methods that rely on the hardness of number-theoretic problems (such as the factorization problem or the discrete logarithm problem), code-based cryptography exploits the complexity of general decoding issues, like the syndrome decoding problem. The purpose of this talk is to discuss the codes based cryptography. We will discuss some systemes preset their weakess, discuss some attacks. We also present our new variants .

JONATHAN JEDWAB, Simon Fraser University

[Saturday November 30 / samedi 30 novembre, 10:00 – R 2125]

Quaternary Legendre pairs of even length

One of the most famous open problems in discrete mathematics is Paley's 1933 conjecture that there is a Hadamard matrix of order $n > 2$ if and only if n is a multiple of 4. It has long been known that this conjecture would follow from the existence of a pair of binary Legendre sequences for every odd length. It has recently been shown that this conjecture would also follow from the existence of a pair of quaternary Legendre sequences for every even length.

We use finite fields to give the first general constructions of quaternary Legendre sequences of even length. In particular, we modify a classical construction due to Szekeres to show that there is a quaternary Legendre sequence of even length $(q-1)/2$ for every prime power q congruent to 1 modulo 4.

This is joint work with Thomas Pender.

DANIEL KATZ, California State University, Northridge

[Saturday November 30 / samedi 30 novembre, 15:00 – R 2125]

Almost perfect nonlinear power functions with exponents expressed as fractions

Let F be a finite field, let f be a function from F to F, and let a be a nonzero element of F. The discrete derivative of f in direction a is $\Delta_a f \colon F \to F$ with $(\Delta_a f)(x) = f(x+a) - f(x)$. The differential spectrum of f is the multiset of cardinalities of

all the fibers of all the derivatives $\Delta_a f$ as a runs through F^*. The function f is almost perfect nonlinear (APN) if the largest cardinality in the differential spectrum is 2. Almost perfect nonlinear functions are of interest as cryptographic primitives. If d is a positive integer, the power function over F with exponent d is the function $f\colon F \to F$ with $f(x) = x^d$ for every $x \in F$. There is a small number of known infinite families of APN power functions. In this talk, we re-express the exponents for one such family in a more convenient form. This enables us to give the differential spectrum and, even more, to give a very precise determination of individual fibers of the derivatives.

HASSAN KHODAIEMEHR, The University of British Columbia (UBC)
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2125]
Quantum Bosonic Codes and Finite Fields

In this talk, we explore the intersection of quantum error correction and finite field theory through the lens of quantum bosonic codes. As quantum systems, particularly those involving continuous variables, become increasingly relevant in quantum computing and communication, the development of robust error-correcting codes is essential for enhancing the reliability of quantum information processes. We begin by discussing bosonic codes, specifically designed to protect quantum information encoded in bosonic systems, such as photons and phonons. These codes leverage the mathematical properties of harmonic oscillators and are described using coherent state representations and lattice structures. We will explore the underlying mathematical framework of these codes, highlighting their connection to finite fields and the algebraic structures that aid in encoding and decoding processes. In particular, we will examine the construction of Gottesman-Kitaev-Preskill (GKP) codes, illustrating how finite fields enhance the design and optimization of these codes to improve their error correction capabilities.

SHUXING LI, University of Delaware
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2125]
On the Nonexistence of Generalized Bent Functions

An (m, n)-generalized bent function is a function from $\mathbb{Z}_2^n$ to $\mathbb{Z}_m$ so that its associated Fourier transformations have constant absolute value. It is known that an (m, n)-generalized bent function exists whenever one of the following holds:

(1) both m and n are even.

(2) $4 \mid m$.

On the other hand, all known results suggest that for (m, n) pair that fails to satisfy both of the above conditions, (m, n)-generalized bent function does not exist. In this talk, we will discuss the recent nonexistence result of $(m, 4)$-generalized bent functions with m being odd. This result crucially relies on analyzing vanishing sums of complex roots of unity.

This is joint work with Ka Hin Leung (National University of Singapore) and Songtao Mao (Johns Hopkins University).

PETR LISONEK, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2125]
On a new class of Hadamard matrices

A complex Hadamard matrix is a square matrix whose each entry is a complex number with absolute value 1, and whose any two distinct rows are orthogonal. In this talk we focus on the class of complex Hadamard matrices called S-Hadamard, which satisfy the additional condition that the elementwise product of the matrix with itself (Schur product) is also a complex Hadamard matrix. We will discuss algebraic constructions of such matrices using finite fields, as well as various methods that can be employed for computational constructions. Our recently discovered parametric construction provides further insight into possible structure of these matrices. Existence results will be presented ; for some matrix orders the existence question remains open. The study of these matrices is motived by an application in quantum information theory.

Finite Fields and Applications

ARIANE MASUDA, New York City College of Technology, CUNY
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2125]
Involutions over finite fields

In the context of memory-limited environments, involutions are desirable because they allow for efficient use of limited memory resources. Specifically, in many applications, both the permutation and its inverse must be stored in memory, which can be a challenge in resource-constrained environments. By using an involution as the interleaver, the same structure and technology used for encoding can be used for decoding as well. Fixed points are points that remain unchanged under the permutation. In cryptographic applications, such as the design of S-boxes, it is desirable to have permutations with a small number of fixed points to increase the security of the system. Therefore, understanding the number of fixed points and how to construct involutions with few fixed points is an important area of research. In this talk we will present some families of involutions over finite fields, including some explicit constructions based on a prescribed number of fixed points.

LUCIA MOURA, University of Ottawa
[Saturday November 30 / samedi 30 novembre, 8:00 – R 2125]
New families of strength-3 covering arrays using LFSR sequences

A *covering array* of strength t, denoted by CA$(N; t, k, v)$, is an $N \times k$ array C over an alphabet with v symbols with the property that for any subarray consisting of t columns of C, every t-tuple of the alphabet appears at least once as a row of the subarray. An additional parameter λ is used when we require that every t-tuple of the alphabet appears at least λ times as a row of the subarray. An *orthogonal array* is a special case of a covering array, where each t-tuple appears exactly λ times, so in this case $N = \lambda v^t$. Given t, k, v, we aim to determine CAN(t, k, v) which is the minimum N for which a CA$(N; t, k, v)$ exists. This is a hard problem in general, so we seek good upper bounds for CAN.

Raaphorst, Moura and Stevens (DCC 2014) gave a construction for a CA$(2q^3 - 1; 3, q^2 + q + 1, q)$, for every prime power q, using linear feedback shift register (LFSR) sequences over finite fields. In the present work (to appear in the Journal of Combinatorial Designs), we explore the use of this "good" ingredient to build covering arrays of strength 3 with a larger number of columns via recursive constructions and elimination of redundant rows. Several of these covering arrays improve the best upper bounds currently found in Colbourn's covering array tables. This is joint work with Kianoosh Shokri.

DANIEL PANARIO, Carleton University
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2125]
Stable binomials over finite fields

We study stable binomials over finite fields, that is, irreducible binomials $x^t - b \in \mathbb{F}_q[x]$ such that all their iterates are also irreducible over $\mathbb{F}_q$. We obtain a simple criterion on the stability of binomials based on the forward orbit of 0 under the map $z \mapsto z^t - b$. In particular, our criterion extends the one obtained by Jones and Boston (2011) for the quadratic case. As applications of our main result, we obtain an explicit 1-parameter family of stable quartics over prime fields $\mathbb{F}_p$ with $p \equiv 5 \pmod{24}$, and also develop an algorithm to test the stability of binomials over finite fields. Finally, building upon a result of Ostafe and Shparlinski (2010), we employ character sums to bound the complexity of such algorithm.

Joint work with Arthur Fernandes and Lucas Reis (Universidade Federal de Minas Gerais, Brazil).

WELINGTON SANTOS, University of Wisconsin Stout
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2125]
Codes for Secure Distributed Matrix Multiplication

In this talk, we will explore how elements of coding theory can be applied to the problem of Secure Distributed Matrix Multiplication (SDMM). In this scenario, a user seeks to compute the product of two matrices, A and B, with the assistance of

N honest-but-curious servers, ensuring that no server gains any information about either A or B. Specifically, we will introduce the HerA scheme, an SDMM model based on Hermitian codes. Additionally, we will demonstrate how matrix Reed-Solomon codes and their duality theory can be employed to detect malicious servers in the context of the SDMM problem.

JOZSEF SOLYMOSI, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2125]
On the Thue-Vinogradov Lemma

Thue's Lemma is a helpful tool in elementary number theory. The most famous application of the lemma is to prove Fermat's theorem on sums of two squares. Vinogradov extended this Lemma to an asymmetric form. He used it in the paper *"On a general theorem concerning the distribution of the residues and non-residues of powers"*, where he gave an elementary proof of the Pólya-Vinogradov inequality. Vinogradov's formulation is the following: Let p be a prime. For any $a \in \mathbb{N}$, $p \nmid a$, and $\alpha \in \mathbb{F}_p^*$, there are x, y where $x \in \{1, 2, \ldots, \alpha\}$, $\quad y \in \left\{1, 2, \ldots, \left\lfloor \frac{p}{\alpha} \right\rfloor\right\}$ such that $ax \equiv \pm y \pmod{p}$.

The proof is based on a clever application of the pigeon-hole principle. We will extend this result to smaller sets and show some applications of the improved result. We will use Rédei polynomials and a simple variant of Stepanov's method for the proof.

BIANCA SOSNOVSKI, Queensborough Community College/The City University of New York
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2125]
Applications of Finite Fields in Cayley Hash Functions

Cayley hash functions are a class of cryptographic hashing algorithms that employ group-theoretic constructions based on Cayley graphs to achieve security and efficiency. This presentation explores the role of finite fields within Cayley hash functions, illustrating how finite field structures enable efficient encoding and provide a robust defense against conventional cryptographic attacks. We will examine specific examples of Cayley hash functions, analyze their constructions using various groups and finite fields, and discuss the key properties and trade-offs associated with different types of Cayley hash functions.

HUGO TEIXEIRA, Carleton University
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2125]
The functional graph of $f(X) = (cX^q + aX)(X^q - X)^{n-1}$ over quadratic extensions of finite fields

Let $\mathbb{F}_q$ be the finite field with q, where q is an odd prime power. In this presentation we describe completely the dynamics of the family of functions $f(X) = (cX^q + aX)(X^q - X)^{n-1}$, for $a, c \in \mathbb{F}_q$ and $n \geq 2$, over the finite field $\mathbb{F}_{q^2}$. We provide the number and size of its cycles as well as the behavior of the trees hanging from each periodic element.

DAVID THOMSON, Tutte Institute for Mathematics and Computing
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2125]

CHI HOI (KYLE) YIP, Georgia Institute of Technology
[Saturday November 30 / samedi 30 novembre, 9:00 – R 2125]
Extensions of Carlitz-McConnel theorem on permutations over finite fields

Let p be a prime, $q = p^n$, and $D \subset \mathbb{F}_q^*$. A celebrated result of Carlitz-McConnel states that if D is a proper subgroup of $\mathbb{F}_q^*$, and $f : \mathbb{F}_q \to \mathbb{F}_q$ is a function such that $(f(x) - f(y))/(x - y) \in D$ whenever $x \neq y$, then $f(x)$ necessarily has the form $ax^{p^j} + b$. In this talk, I will discuss some extensions of this result and their applications.

From single to collective cell migration: A geometric multi-physics bulk-surface PDE approach

Org: Anotida Madzvamuse (University of British Columbia) and/et **Stephanie Portet** (University of Manitoba)

Schedule/Horaire **Room/Salle: R 2725**

Saturday November 30 — samedi 30 novembre

8:00 - 8:30	Fabian Spill (Birmingham), *Cellular and Subcellular Geometry and Mechanics as Determinants of Cell Migration* (p. 135)
8:30 - 9:00	Davide Cusseddu (Lisbon), *A bulk–surface modelling framework for cell polarisation* (p. 132)
9:00 - 9:30	Steven Ruuth (SFU), *A Closest Point Method for PDEs on Manifolds with Interior Boundary Conditions for Geometry Processing* (p. 135)
9:30 - 10:00	Michael Ward (UBC), *Pattern Forming Systems Coupling Linear Bulk Diffusion to Dynamically Active Membranes or Cells* (p. 136)
15:00 - 15:30	Kudzanayi Mapfumo (UBC) (p. 134)
15:30 - 16:00	Thedore Kolokolnikov (Dalhousie), *Stripe patterns for Gierer-Meinhard model in thin domains* (p. 133)
16:00 - 16:30	David Holloway (British Columbia Institute of Technology), *What makes cotyledon numbers so variable in conifers ?* (p. 133)
16:30 - 17:00	Jupiter Algorta (UBC) (p. 131)
17:00 - 17:30	Fengwei Yang (UBC), *Combining image analysis and cell migration model for whole cell tracking* (p. 136)
17:30 - 18:00	Chunyi Gai (UNBC), *An Asymptotic Analysis of Spike Self-Replication and Spike Nucleation of Reaction-Diffusion Patterns on Growing 1-D Domains* (p. 132)

Sunday December 1 — dimanche 1er décembre

8:00 - 8:30	Brian Camley (Johns Hopkins University), *Controlling Cell Exploration and Oscillation Using Deposited Footprints* (p. 132)
8:30 - 9:00	Ali Fele Paranj, *Generation and Evolution of Vascular Netowrks* (p. 134)
9:00 - 9:30	Raquel Barreira (Polytechnic University of Setúbal and CMAFcIO), *The evolving surface finite element method as a tool for solving PDEs on continuously evolving domains* (p. 131)
9:30 - 10:00	Victor Juma (UBC), *Diffusion-driven dynamics in bistable reaction-diffusion systems: Beyond Turing Instabilities* (p. 133)
15:00 - 15:30	Clement Soubrier (UBC), *Experimental analysis of M. smegmatis morphological feature dynamics and modelling using reaction-diffusion systems.* (p. 135)
15:30 - 16:00	Merlin Pelz (Minnesota), *Symmetry-Breaking in Compartmental-Reaction Diffusion Systems with Comparable Diffusivities* (p. 134)
16:00 - 16:30	Pearson W. Miller (USCD) (p. 134)
16:30 - 17:00	Jack Hughes (UBC), *Travelling waves and wave pinning (polarity): Switching between random and directional cell motility* (p. 133)

Abstracts/Résumés

JUPITER ALGORTA, UBC
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2725]

From single to collective cell migration: A geometric multi-physics bulk-surface PDE approach

RAQUEL BARREIRA, Polytechnic University of Setúbal
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2725]
The evolving surface finite element method as a tool for solving PDEs on continuously evolving domains

In this talk we will demonstrate the capability, flexibility, versatility and generality of the evolving surface finite element method for solving partial differential systems on continuously evolving domains and surfaces with numerous applications in developmental biology, tumour growth and cell movement and deformation. Some applications will be presented, including on the numerical results of reaction-diffusion systems, with and without cross-diffusion, both on static and on evolving domains.

BRIAN CAMLEY, Johns Hopkins University
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2725]
Controlling Cell Exploration and Oscillation Using Deposited Footprints

For eukaryotic cells to heal wounds, respond to immune signals, or metastasize, they must migrate, often by adhering to extracellular matrix. Cells may also deposit matrix, leaving behind a footprint that influences their crawling. Recent experiments showed that epithelial cells on micropatterned adhesive stripes move persistently in regions they have previously crawled on, where footprints have been formed, but barely advance into unexplored regions, creating an oscillatory migration of increasing amplitude. Here, we explore through mathematical modeling how footprint deposition and cell responses to footprint combine to allow cells to develop oscillation and other complex migratory motions. We simulate cell crawling with a phase field model coupled to a biochemical model of cell polarity, assuming local contact with the deposited footprint activates Rac1, a protein that establishes the cell's front. Depending on footprint deposition rate and response to the footprint, cells on micropatterned lines can display many types of motility, including confined, oscillatory, and persistent motion. On 2D substrates, we predict a transition between cells undergoing circular motion and cells developing an exploratory phenotype. Consistent with our computational predictions, we find in earlier experimental data evidence of cells undergoing both circular and exploratory motion.

DAVIDE CUSSEDDU, CMAT Centre of Mathematics, University of Minho
[Saturday November 30 / samedi 30 novembre, 8:30 – R 2725]
A bulk–surface modelling framework for cell polarisation

The bulk–surface wave–pinning model constitutes one of the simplest models of cell polarisation. It is a toy model that is derived from minimal key properties of GTPase proteins. In particular, the model takes into account the activation/inactivation dynamics as well as the spatial cycling of proteins between the cell membrane and the cytosol. In this talk I will present the model, some results and numerical simulations on different three–dimensional geometries.

CHUNYI GAI, University of Northern British Columbia
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2725]
An Asymptotic Analysis of Spike Self-Replication and Spike Nucleation of Reaction-Diffusion Patterns on Growing 1-D Domains

Pattern formation on growing domains is one of the key issues in developmental biology, where domain growth has been shown to generate robust patterns under Turing instability. In this work, we investigate the mechanisms responsible for generating new spikes on a growing domain within the semi-strong interaction regime, focusing on three classical reaction-diffusion models: the Schnakenberg, Brusselator, and Gierer-Meinhardt (GM) systems. Our analysis identifies two distinct mechanisms of spike generation as the domain length increases. The first mechanism is spike self-replication, in which individual spikes split into two, effectively doubling the number of spikes. The second mechanism is spike nucleation, where new spikes emerge from a quiescent background via a saddle-node bifurcation of spike equilibria. Critical stability thresholds for these processes are

derived, and global bifurcation diagrams are computed using the bifurcation software pde2path. These results yield a phase diagram in parameter space, outlining the distinct dynamical behaviors that can occur.

DAVID HOLLOWAY, British Columbia Institute of Technology
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2725]
What makes cotyledon numbers so variable in conifers ?

Flowering plants are characterized by having one (e.g. grasses) or two (e.g. broadleaf plants) embryonic leaves, or cotyledons. In contrast, conifer trees have a variable number of cotyledons, commonly ranging from 2 to 12 even in clonal cultures. What underlies this developmental freedom in number ? I will present results using a hierarchical two-stage reaction-diffusion model to explore the pattern forming dynamics involved in forming the ringed arrangement of conifer cotyledons. This leads to a model of mutual inhibition between gene expression domains and the factors that can vary the cotyledon ring radius and produce the experimentally observed range of cotyledon number. The variability in conifer cotyledon ring size may have similarities to spatial scaling in fly embryos, in which gene expression pattern variation compensates for embryo length variability. The model provides a framework for quantitative experiments on the positional control of lateral organ initiation in embryos and mature plants. This could further understanding of the factors that control the leaf arrangements, or phyllotaxy, characteristic of plant species.

JACK HUGHES, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2725]
Travelling waves and wave pinning (polarity): Switching between random and directional cell motility

We derive a simple model of actin waves consisting of three partial differential equations (PDEs) for active and inactive GTPase promoting growth of filamentous actin (F-actin, F). The F-actin feeds back to inactivate the GTPase at rate sF, where $s \geq 0$ is a "negative feedback" parameter. In contrast to previous models for actin waves, the simplicity of this model and its geometry (1D periodic cell perimeter) permits a local and global PDE bifurcation analysis. Based on a combination of continuation methods, linear stability analysis, and PDE simulations, we explore the existence, stability, interactions, and transitions between homogeneous steady states (resting cells), wave-pinning (polar cells), and travelling waves (cells with ruffling protrusions). We show that the value of s and the size of the cell can affect the existence, coexistence, and stability of the patterns, as well as the dominance of one or another cell state. Implications to motile cells are discussed.

VICTOR JUMA, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2725]
Diffusion-driven dynamics in bistable reaction-diffusion systems: Beyond Turing Instabilities

Bistability is a key feature in reaction-diffusion (RD) systems, enabling the coexistence of two stable equilibrium states and driving complex spatiotemporal behaviors ; such as traveling waves, oscillatory pulses, and spatial patterns. While traditional analyses often focus on diffusion-driven instabilities (commonly known as Turing instability) arising from a uniform stable steady state, this study investigates the effect of diffusion on general steady states and limit cycles within a bistable reaction-diffusion system.

Using numerical simulations, we analyze how diffusion influences an ODE system exhibiting different dynamical behaviours ; including stable steady state dynamics, bistable dynamics, limit cycle dynamics, and coexistence between uniform steady states and limit cycles.

In this talk, I will present a two-species reaction-diffusion model whose reaction kinetics are derived from first principles based on experimental observations. I will describe the model formulation and highlight key temporal dynamics of the model in the absence of diffusion. I will thereafter describe diffusion-driven transitions, such as spatial pattern formation and migration between steady states and migration of limit cycle in parameter regions far from classical Turing scenarios.

From single to collective cell migration: A geometric multi-physics bulk-surface PDE approach

THEDORE KOLOKOLNIKOV, Dalhousie University
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2725]
Stripe patterns for Gierer-Meinhard model in thin domains

We expore pattern formation for the GM model on thin domains. A motivating example is the development bone structure within the embryonic eye of birds. Experimental evidence to-date points to a Turing mechanism of pattern formation on thin domains.

If the domain is sufficiently thin, the pattern consists of stripes which are nearly one-dimensional. We analyse patterns consisting of one, two or many stripes. We find that a single stripe can be located either at the thickest or thinnest part of the channel, depending on the choice of parameters. In the limit of many stripes, we derive an effective pattern density description of the equilibrium state. The effective density is easily computable as a solution of a first order ODE subject to an integral constraint. Depending on problem parameters, the resulting pattern can be either global spanning the entire domain, or can be clustered near either thickest or thinnest part of the domain. In addition, instability thresholds are derived from the continuum density limit of many stripes. Full two-dimensional numerical simulations are performed and are shown to be in agreement with the asymptotic results. Results are shown to be applicable to

KUDZANAYI MAPFUMO, UBC
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2725]

PEARSON W. MILLER, USCD
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2725]

ALI FELE PARANJ, UBC
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2725]
Generation and Evolution of Vascular Netowrks

Vascular networks are hierarchical structures essential for delivering oxygen and nutrients to tissues while removing waste from the body. The initial microvasculature plexus has no hierarchical organization. This immature network, characterized by high hydrodynamic energy dissipation, is inefficient for fulfilling the functions of a mature vascular network. We used a Branching Annihilating Random Walk process to generate the initial microvascular plexus and investigate the mechanisms by which this premature network evolves into a mature, and hierarchical system.

MERLIN PELZ, University of Minnesota, Twin Cities
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2725]
Symmetry-Breaking in Compartmental-Reaction Diffusion Systems with Comparable Diffusivities

Since Alan Turing's pioneering publication on morphogenetic pattern formation obtained with reaction-diffusion (RD) systems, it has been the prevailing belief that two-component reaction diffusion systems have to include a fast diffusing inhibiting component (inhibitor) and a much slower diffusing activating component (activator) in order to break symmetry from a uniform steady-state. This time-scale separation is often unbiological for cell signal transduction pathways. We modify the traditional RD paradigm by considering nonlinear reaction kinetics only inside compartments (cells) with reactive boundary conditions to the extra-compartmental space which diffusively couples the compartments via two (chemical) species. The construction of a nonlinear algebraic system for all existing steady-states, or quasi-steady-states, enables us to derive a globally coupled matrix eigenvalue problem for the growth rates of eigenperturbations from the symmetric steady-state in 1-D, 2-D, and 3-D. We show that the membrane reaction rate ratio of inhibitor rate to activator rate is a key bifurcation parameter leading to robust symmetry-breaking of the compartments. Illustrated with Gierer-Meinhardt, FitzHugh-Nagumo and Rauch-Millonas

intra-compartmental kinetics, our compartmental-reaction diffusion system does not require diffusion of inhibitor and activator on vastly different time scales. Our results reveal a possible simple mechanism of the ubiquitous biological steady and oscillatory cell specialization observed in nature. (This is joint work with Michael J. Ward.)

STEVEN RUUTH, Simon Fraser University

[Saturday November 30 / samedi 30 novembre, 9:00 – R 2725]

A Closest Point Method for PDEs on Manifolds with Interior Boundary Conditions for Geometry Processing

Solving partial differential equations (PDEs) on manifolds is fundamental to many geometry processing tasks, such as diffusion curves on surfaces, geodesic computations, tangent vector field design, and reaction-diffusion textures. These PDEs often involve boundary conditions prescribed at points or curves on the manifold's interior or along the geometric boundary of an open manifold.

We present a robust extension of the closest point method (CPM) for handling interior boundary conditions. The CPM reformulates the manifold PDE as a volumetric PDE in the Cartesian embedding space, requiring only the closest point representation of the manifold. This approach inherently supports open or closed manifolds, orientable or not, and of any codimension. To address interior boundary conditions, we derive a technique that implicitly partitions the embedding space across interior boundaries, modifying finite difference and interpolation stencils to respect these partitions while preserving second-order accuracy.

Our method includes an efficient sparse-grid implementation and scalable numerical solver capable of handling tens of millions of degrees of freedom, enabling solutions on complex manifolds. We demonstrate the convergence and accuracy of our approach using model PDEs and showcase applications to a range of geometry processing problems.

This is joint work with Nathan King (University of Waterloo), Haozhe Su (Lightspeed Studios), Mridul Aanjaneya (Rutgers University), and Christopher Batty (University of Waterloo).

CLEMENT SOUBRIER, UBC

[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2725]

Experimental analysis of M. smegmatis morphological feature dynamics and modelling using reaction-diffusion systems.

Atomic Force Microscopy (AFM) is a quantitative scanning technology capturing cell surface mechanical properties such as height, chemical adhesion or stiffness. Recent advances in coupling AFM-based nanoscale spatial resolution with temporal data has allowed to observe the dynamics of cellular morphology at an unprecedented scale, and study key cellular mechanisms over long time range.

In this talk, we analyze experimental data to investigate *Mycobacterium smegmatis* morphology over time, and model pattern dynamics using a reaction-diffusion system. This non pathogenic and fast growing bacterium is commonly studied as a model for harmful mycobacteria such as *M. tuberculosis*, since they share a similar cell wall structure. Upon using our pipeline to reduce the cell surface geometry to its center-line and measure height variation along it, we confirm the presence of peaks and troughs on the cell surface, as consistent features of the morphology. We also show how these features relate to bi-phasic and asymmetric polar growth dynamics, as well as division site selection. Finally, we show that a minimal reaction-diffusion model on a growing domain can reproduce and maintain similar feature over time, enabling a better understanding of yet unknown morphology controlling pathways.

FABIAN SPILL, University of Birmingham

[Saturday November 30 / samedi 30 novembre, 8:00 – R 2725]

Cellular and Subcellular Geometry and Mechanics as Determinants of Cell Migration

The migration of epithelial cells plays a critical role in physiological processes such as wound healing. In this context, cells utilize distinct migration modes based on the geometric properties of gaps: lamellipodial crawling at convex edges and purse-string-like

movements at concave edges. Despite advances in identifying biochemical pathways, the underlying mechanisms determining these mode switches in response to curvature remain unclear. Our study addresses this by focusing on the endoplasmic reticulum (ER), a dynamic organelle whose morphology depends on cellular geometry. Through a combination of experimental data and theoretical modeling, we show that the ER undergoes curvature-specific morphological reorganizations that act as a determinant of migration modes. At convex edges, the ER forms tubular networks that align perpendicularly, facilitating lamellipodial crawling. At concave edges, the ER reorganizes into dense sheet-like structures favoring actomyosin-driven purse-string contractions. Our mathematical model describes the ER as a flexible fiber whose morphology-dependent strain energy guides these transitions, revealing a lower energy state when ER tubules or sheets form in accordance with local edge curvature. This study positions the ER as a critical player in cellular mechanotransduction, providing a mechanistic link between subcellular organization and cellular migration strategies. Our findings offer insights into how cellular and subcellular geometries dynamically influence the physical properties and behaviors of cells, forming a basis for understanding migration regulation in complex tissues.

MICHAEL WARD, UBC

[Saturday November 30 / samedi 30 novembre, 9:30 – R 2725]

Pattern Forming Systems Coupling Linear Bulk Diffusion to Dynamically Active Membranes or Cells

Some analytical and numerical results are presented for pattern formation properties associated with novel types of reaction-diffusion (RD) systems that involve the coupling of bulk diffusion in the interior of a multi-dimensional spatial domain to nonlinear processes that occur either on the domain boundary or within localized compartments that are confined within the domain. The class of bulk-membrane system considered herein is derived from an asymptotic analysis in the limit of small thickness of a thin domain that surrounds the bulk medium. When the bulk domain is a 2-D disk, a weakly nonlinear analysis is used to characterize Turing and Hopf bifurcations that can arise from the linearization around a radially symmetric, but spatially non-uniform, steady-state of the bulk-membrane system. Some results in 1-D coupling bulk diffusion to dynamically active compartments with chaotic dynamics are also discussed. Finally, the emergence of collective intracellular oscillations is studied for a class of PDE-ODE bulk-cell model that involves spatially localized, but dynamically active, cells that are coupled through a linear bulk diffusion field. Applications of such coupled bulk-membrane or bulk-cell systems to some biological systems are outlined, and some open problems are discussed. Joint work with Frederic Paquin-Lefebvre, Sarafa Iyaniwura, Wayne Nagata, and Merlin Pelz

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FENGWEI YANG, University of British Columbia

[Saturday November 30 / samedi 30 novembre, 17:00 – R 2725]

Combining image analysis and cell migration model for whole cell tracking

Cell tracking algorithms which automate and systematise the analysis of time-lapse image data sets of cells are an indispensable tool in the modelling and understanding cellular phenomena. we present a theoretical framework and an algorithm for whole-cell tracking. Within this work, we consider that "tracking" is equivalent to a dynamic reconstruction of the whole cell data (morphologies) from static image data sets. This work aims to design a framework for cell tracking within which the recovered data reflects the physics of the forward model.

Geometric Analysis and PDE

Org: Joshua Flynn (NSF and MIT), **Ryan Gibara** (Cape Breton University) and/et **Maria Ntekoume** (Concordia University)

This session will bring together researchers working on various subfields of geometric analysis and partial differential equations, with an emphasis on geometric techniques and nonlinearity. Participants will have expertise in areas ranging from nonlinear PDE to nonlinear potential theory, from harmonic analysis to analysis on manifolds. The mix of specialties of the intended participants/audience will foster the fruitful exchange of ideas and possible cross-field collaborations.

Schedule/Horaire **Room/Salle: WSOD 2920**

Saturday November 30 — samedi 30 novembre

9:00 - 9:30	Sergii Myroshnychenko (University of Fraser Valley), *Centroid of a convex body can be rarely the centroid of its sections* (p. 140)
9:30 - 10:00	Ailana Fraser (University of British Columbia), *Minimal surfaces in higher codimension* (p. 137)
10:00 - 10:30	Yuveshen Mooroogen (University of British Columbia), *A large-scale variant of the Erdos similarity conjecture* (p. 139)
15:30 - 16:00	Slim Ibrahim (University of Victoria), *Persistence of vorticity concentration in the two-point vortex system of the 2D Euler equations* (p. 138)
16:00 - 16:30	Stephen Gustafson (University of British Columbia), *Two-solitons with logarithmic separation for 1D NLS with repulsive delta potential* (p. 138)
16:30 - 17:00	Jose Palacios (University of Toronto), *Linearized dynamic stability for vortices of Ginzburg-Landau evolutions* (p. 140)
17:00 - 17:30	Chenkuan Li (Brandon University), *The analytical solution to the multi-term time-fractional diffusion-wave equation* (p. 138)
17:30 - 18:00	Ilmari Kangasniemi (University of Cincinnati), *On the theory of quasiregular values* (p. 138)

Sunday December 1 — dimanche 1er décembre

9:00 - 9:30	Cristian Rios (University of Calgary), *Continuity of solutions to infinite degenerate elliptic equations in the plane* (p. 140)
9:30 - 10:00	Scott Rodney (Cape Breton University), *Existence, Boundedness, and Regularity - an overview of some recent results in Partial Differential Equations* (p. 140)
10:00 - 10:30	Ignacio Uriarte-Tuero (University of Toronto), *Muckenhoupt Ap weights, BMO, distance functions and related problems* (p. 141)
15:30 - 16:00	Beatrice-Helen Vritsiou (University of Alberta), *On a Blaschke-Santaló-type inequality for projections of (non-symmetric) convex bodies, and some applications* (p. 141)
16:00 - 16:30	Joshua Zahl (University of British Columbia), *A survey of the Kakeya problem* (p. 141)
16:30 - 17:00	Caleb Marshall (University of British Columbia), *The Size of Spanning Sets of Lines for Fractal Subsets of $\mathbb{R}^n$* (p. 139)
17:00 - 17:30	Siddharth Sabharwal (Texas A&M University), *Existence and Asymptotics of Nonlinear Helmholtz Eigenfunctions* (p. 141)

Abstracts/Résumés

AILANA FRASER, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 9:30 – WSOD 2920]
Minimal surfaces in higher codimension

I will describe recent progress on the stability theory for minimal surfaces in higher codimension, in particular on Bernstein theorems, and applications of minimal surfaces in higher codimension in Riemannian geometry.

STEPHEN GUSTAFSON, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 16:00 – WSOD 2920]
Two-solitons with logarithmic separation for 1D NLS with repulsive delta potential

For the nonlinear Schrodinger equation in one dimension, with a repulsive delta potential that is not too strong, we show the existence of two-soliton solutions with logarithmic (in time) separation. The construction is based on that of Nguyen for the case without potential, modified to account for the additional interaction between the potential and the solitons. This interaction manifests through a perturbed translational eigenfunction, whose detailed properties play a key role. This is joint work with Takahisa Inui.

SLIM IBRAHIM, University of Victoria
[Saturday November 30 / samedi 30 novembre, 15:30 – WSOD 2920]
Persistence of vorticity concentration in the two-point vortex system of the 2D Euler equations

In this talk, I will investigate the vortex confinement property of solutions to the 2D Euler equations, specifically focusing on the stability around the critical point. For the two-point vortex system, I will analyze the duration over which vorticity concentration is sustained and show that, regardless of the vorticity strength, this concentration persists indefinitely. This is a joint work with R. Qin and S. Shen.

ILMARI KANGASNIEMI, University of Cincinnati
[Saturday November 30 / samedi 30 novembre, 17:30 – WSOD 2920]
On the theory of quasiregular values

A quasiregular (QR) map is a Sobolev map f between domains of $\mathbb{R}^n$ satisfying the distortion inequality $|Df(x)|^n \leq K \det(Df(x))$ at almost every x, where $K \geq 1$ is a constant. QR maps form a higher-dimensional class of maps with many similar geometric properties as single-variable holomorphic maps. In this talk, we consider a generalization of the distortion inequality of the form $|Df(x)|^n \leq K \det(Df(x)) + \Sigma(x)|f(x) - y|^n$, where Σ is a real-valued weight function and $y \in \mathbb{R}^n$ is a fixed point. Our recent results show that under various L^p-integrability assumptions on Σ, this condition can be used to prove single-value counterparts to many fundamental results of QR-maps at the point y. The list of generalized results includes e.g. the QR-versions of the open mapping theorem, Liouville theorem, Picard theorem, and the small K -theorem. Joint work with Jani Onninen.

CHENKUAN LI, Brandon University
[Saturday November 30 / samedi 30 novembre, 17:00 – WSOD 2920]
The analytical solution to the multi-term time-fractional diffusion-wave equation

Applying the inverse operator method and the multivariate Mittag-Leffler function, we derive the analytic solution for the

following multi-term time-fractional diffusion-wave equation in the Caputo fractional derivative sense:

$$\begin{cases} \frac{{}_c\partial^{\rho}}{\partial t^{\rho}} M(t,\sigma) + \sum_{j=1}^{m} \lambda_j \, \frac{{}_c\partial^{\rho_j}}{\partial t^{\rho_j}} M(t,\sigma) = \triangle M(t,\sigma) + g(t,\sigma), \\ M(0,\sigma) = \theta(\sigma), \quad M_t'(0,\sigma) = \beta(\sigma), \end{cases}$$

where $\triangle = \sum_{i=1}^{n} \frac{\partial^2}{\partial \sigma_i^2}$, all λ_j for $j = 1, 2, \cdots, m$ are arbitrary constants, and $1 < \rho_1 < \rho_2 < \cdots < \rho_m < \rho \leq 2$. In particular if $\lambda_1 = \cdots = \lambda_m = 0$ and $\rho = 2$, then the above equation turns out to be the non-homogeneous wave equation in $\mathbb{R}^n$:

$$\begin{cases} \frac{\partial^2}{\partial t^2} M(t,\sigma) = \triangle M(t,\sigma) + g(t,\sigma), \\ M(0,\sigma) = \theta(\sigma), \quad M_t'(0,\sigma) = \beta(\sigma), \end{cases}$$

which has the uniform solution for all $n \geq 1$

$$M(t,\sigma) = \sum_{s=0}^{\infty} I_t^{2s+2} \triangle^s g(t,\sigma) + \sum_{s=0}^{\infty} \frac{t^{2s}}{(2s)!} \triangle^s \theta(\sigma) + \sum_{s=0}^{\infty} \frac{t^{2s+1}}{(2s+1)!} \triangle^s \beta(\sigma),$$

where I_t^{2s+2} is the Riemann–Liouville fractional partial integral operator. We further show that the solution given above coincides with the classical results, such as d'Alembert and Kirchoff's formulas, with an example demonstrating its power and simplicity.

CALEB MARSHALL, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:30 – WSOD 2920]
The Size of Spanning Sets of Lines for Fractal Subsets of $\mathbb{R}^n$

Given $X \subset \mathbb{R}^n$, we let $L(X)$ denote the family of lines in $\mathbb{R}^n$ which contain at least two points of X. We call this line family $L(X)$ the *spanning set of lines* for X. In some sense, $L(X)$ is the "greediest possible" cover of X by lines; and so, it makes sense to ask: how large (relative to the size of X) must this set $L(X)$ be?

If X has finite cardinality, a result from the mid 1980's known as Beck's Theorem states: either X is essentially contained in a single line, or else $L(X)$ has cardinality $\sim |X|^2$. Recent works of T. Orponen, P. Shmerkin, and H. Wang, as well as K. Ren, establish a continuum Beck Theorem for fractal sets X, bounding the Hausdorff dimension of $L(X)$ in terms of the dimension of X.

In this talk, we discuss our recent improvement of these continuum Beck Theorems–improvements which are conditional upon our fractal sets $X \subset \mathbb{R}^n$ satisfying more restrictive anti-concentration conditions on hyperplanes. We also construct examples showing our estimate can be sharp for all possible values of Hausdorff dimension.

We conclude the talk by discussing a new conjectured *equality* for the Hausdorff dimension of $L(X)$. This conjecture is compatible with the previous results of Orponen, Shmerkin and Wang, Ren, and Bright-M, and suggests a decomposition of fractal sets into concentrated and anti-concetrated parts.

This talk is based on joint work with P. Bright (UBC).

YUVESHEN MOOROOGEN, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 10:00 – WSOD 2920]
A large-scale variant of the Erdos similarity conjecture

Consider a sequence of real numbers increasing to infinity. How large can a subset of the real line be before it is forced to contain some affine image of that sequence? This question fits into a huge body of work in analysis and number theory

concerned with constructing large sets that fail to contain prescribed structures. I will discuss recent progress on this question and comment on its connections with a now 50-year old open problem of Erdos.

SERGII MYROSHNYCHENKO, University of the Fraser Valley
[Saturday November 30 / samedi 30 novembre, 9:00 – WSOD 2920]
Centroid of a convex body can be rarely the centroid of its sections

We construct a convex body K in $\mathbb{R}^n$, $n \geq 5$, with the property that there is exactly one hyperplane H passing through $c(K)$, the centroid of K, such that the centroid of $K \cap H$ coincides with $c(K)$. This provides answers to questions of Grunbaum and Loewner for $n \geq 5$. The proof is based on the existence of non-intersection bodies in these dimensions. Joint work with K. Tatarko and V. Yaskin.

JOSE PALACIOS, University of Toronto
[Saturday November 30 / samedi 30 novembre, 16:30 – WSOD 2920]
Linearized dynamic stability for vortices of Ginzburg-Landau evolutions

We consider the problem of dynamical stability for the vortex of the Ginzburg-Landau model. Vortices are one of the main examples of topological solitons, and their dynamic stability is the basic assumption of the asymptotic "particle plus field" description of interacting vortices. In this talk we focus on co-rotational perturbations of vortices and establish a variety of pointwise dispersive and decay estimates for their linearized evolution in the relativistic (or Klein-Gordon) case. One of the main ingredients is the construction of the distorted Fourier transform associated with the (two) linearized operators at the vortex. The general approach follows that of Krieger-Schlag-Tataru and Krieger-Miao-Schlag in the context of stability of blow-up for wave maps and relies on the spectral analysis of Schrodinger operators with strongly singular potentials (see also Gezstesy-Zinchenko). However, since the vortex is not given by an explicit formula, and one of the operators appearing in the linearization has zero energy solutions that oscillate at infinity, the linear analysis requires some additional work. In particular, to construct the distorted Fourier basis and to control the spectral measure some additional arguments are needed, compared to previous works. This is joint work with Fabio Pusateri.

CRISTIAN RIOS, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 9:00 – WSOD 2920]
Continuity of solutions to infinite degenerate elliptic equations in the plane

We obtain the continuity of weak solutions to infinite degenerate quasilinear equations

$$-\mathrm{div}\mathcal{A}\left(x,u\right)\nabla u = \phi_0 - \mathrm{div}_A\vec{\phi}_1$$

where one of the eigenvalues of the elliptic matrix $\mathcal{A}$ is allowed to vanish to infinite order as x approaches the vertical axis. This is an application of an abstract result obtained in all dimensions $n \geq 2$. The Carnot-Carathéodory metric associated with the operator is highly non-doubling, so traditional methods have to be adapted to Orlicz-Sobolev embeddings with gains smaller than any power $p > 1$. In particular, our methods include the first realization of a Moser iteration technique in such infinite degenerate geometries. This work was done in collaboration with Lyudmila Korobenko, Eric Sawyer, and Ruipeng Shen.

SCOTT RODNEY, Cape Breton University
[Sunday December 1 / dimanche 1er décembre, 9:30 – WSOD 2920]
Existence, Boundedness, and Regularity - an overview of some recent results in Partial Differential Equations

In this talk I will discuss joint work with D. Cruz-Uribe (Alabama), Y. Zeren, S. Cetin, F. Dal (Yildiz Technical Institute). This work surrounds existence and regularity of weak solutions to linear degenerate elliptic PDEs of the form

$$-v^{-1}\mathrm{Div}(Q(x)\nabla u) + K(x,u,\nabla u) = F$$

in a bounded domain Ω where Q is a symmetric non-negative definite measurable matrix of coefficient functions, v is a weight on Ω, K defines 1^{st} and 0^{th}-order terms, and where the data function F may take different forms. I will put this work in contrast with recent results in the area.

SIDDHARTH SABHARWAL, Texas A&M University
[Sunday December 1 / dimanche 1er décembre, 17:00 – WSOD 2920]
Existence and Asymptotics of Nonlinear Helmholtz Eigenfunctions

We discuss the problem of proving existence and asymptotics of solutions to equation $-\Delta_M u = N(u)$, where $N(u)$ is a monomial. We consider the space to be even asymptotically hyperbolic. I will introduce the main technique, which is module regularity, and how it is used for proving existence of solution, and that these nonlinear eigenfunctions have the same asymptotics as the linear eigenfunctions.

IGNACIO URIARTE-TUERO, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 10:00 – WSOD 2920]
Muckenhoupt Ap weights, BMO, distance functions and related problems

I will present a new characterization of BMO (similar to existing ones) and applications we derive from it, such as solving a problem on Muckenhoupt Ap weights and distance functions. Joint work with Marcus Pasquariello.

BEATRICE-HELEN VRITSIOU, University of Alberta
[Sunday December 1 / dimanche 1er décembre, 15:30 – WSOD 2920]
On a Blaschke-Santaló-type inequality for projections of (non-symmetric) convex bodies, and some applications

Consider a convex body K in $\mathbb{R}^n$ and a projection $P_F(K)$ of it to a subspace F of $\mathbb{R}^n$. If K is not origin-symmetric, then even if we 'centre' it well (that is, 'force' K to have barycentre or Santaló point at the origin), its projection may still fail to have any of these nice properties. Therefore the classical Blaschke-Santaló inequality (which upper-bounds the product of volumes of $P_F(K)$ and of its polar set within the subspace F) cannot apply directly. We will show how to derive an essentially optimal Blaschke-Santaló inequality in such settings.

This also has applications to the existence of *regular* covering ellipsoids for not-necessarily-symmetric convex bodies (a concept introduced in a celebrated theorem of Pisier, which was proved in the symmetric case).

JOSHUA ZAHL, UBC
[Sunday December 1 / dimanche 1er décembre, 16:00 – WSOD 2920]
A survey of the Kakeya problem

A Kakeya set is a compact subset of $\mathbb{R}^n$ that contains a unit line segment pointing in every direction. The Kakeya conjecture asserts that every Kakeya set in $\mathbb{R}^n$ must have Minkowski and Hausdorff dimension n. I will survey historical and more recent results on this conjecture.

Geometric quantization for young people

Org: Tatyana Barron (University Western Ontario), **Lisa Jeffrey** (University of Toronto) and/et **Yael Karshon** (University of Toronto Mississauga and Tel-Aviv University)

Geometric quantization provides recipes to get from a classical mechanical system to a corresponding quantum mechanical system. Introduced in the 1960s, the field continues to thrive. The purpose of this session is to foster exchanges of ideas between graduate students and postdoctoral fellows who work on different aspects of geometric quantization.

Schedule/Horaire **Room/Salle: R 1690**

Sunday December 1 **dimanche 1er décembre**

8:30 - 9:30	Yu-Tung (Tony) Yau (University of Michigan), *Berezin-Toeplitz quantization in real polarizations* (p. 144)
9:30 - 10:30	Ethan Ross (University of Toronto), *Quantization of Symplectic Stratified Spaces* (p. 143)
15:00 - 16:00	Reebhu Bhattacharyya (University of Michigan), *Isotropic States on Kähler Manifolds* (p. 142)
16:00 - 16:30	Matthew Koban (University of Toronto), *Bundle representations of double quivers* (p. 143)
16:30 - 17:30	Hyunmoon Kim (University of Toronto), *Stratification of families of representations of the Heisenberg Lie algebra* (p. 143)
17:30 - 18:00	Discussion (p. ??)

Monday December 2 **lundi 2 décembre**

8:30 - 9:30	Dan Wang (IST, University of Lisbon), *Geometric Quantization on Toric Varieties* (p. 144)
9:30 - 10:00	Alex Kazachek (University of Waterloo), *Quantum Channel Capacities and Additivity Conjectures* (p. 143)
10:00 - 10:30	Kaleb D. Ruscitti (University of Waterloo), *Degeneration of Holomorphic Sections to Bohr-Sommerfeld points for Moduli of SL(2,C) Bundles* (p. 144)
15:00 - 16:00	Michael Francis (MacEwan University), *Towards b^k-analogues of Berezin-Toeplitz quantization* (p. 142)
16:00 - 17:00	Ood Shabtai (University of Toronto), *Pairs of spectral projections of quantum observables on Riemann surfaces* (p. 144)
17:00 - 18:00	Zhongkai Tao (U.C. Berkeley), *Spectral asymptotics for kinetic Brownian motion* (p. 144)

Abstracts/Résumés

REEBHU BHATTACHARYYA, University of Michigan, Ann Arbor
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 1690]
Isotropic States on Kähler Manifolds

We will define classes of (semi-classical) wave packets (whose wavefront set is a single point) on pre-quantized compact Kähler manifolds and describe a symbol calculus for them. This is a generalization of squeezed/coherent states, which have been studied extensively, especially in Euclidean space. We will generalize these further to isotropic states (whose wavefront set is an isotropic submanifold) which we define as a superposition of such wave packets, and then obtain a symbol calculus for them. Finally, we will describe our results on the overlap and Hermitian propagation of these states.

MICHAEL FRANCIS, MacEwan University
[Monday December 2 / lundi 2 décembre, 15:00 – R 1690]
Towards b^k-analogues of Berezin-Toeplitz quantization

Geometric quantization for young people

A b-manifold is a smooth manifold with a specified hypersurface ; its b-tangent bundle (Melrose's terminology) has for sections those vector fields that are tangent to the hypersurface. Scott introduced higher-order generalizations of b-manifolds called b^k-manifolds. A slightly different approach to b^k-manifolds that allows for global holonomy phenomena was introduced by Francis and (independently) Bischoff-del Pino-Witte. Various classical geometries extend to these settings: b^k-manifolds can be complex, symplectic, Riemannian etc. Geometric quantization of symplectic b^k-manifolds has been the subject of recent work of Guillemin-Miranda-Weitsman, Braverman-Loizides-Song and others. For complex b^k-manifolds, one expects analogues of Berezin-Toeplitz quantization. Systematic study of complex b-manifolds was initiated by Mendoza. The Newlander-Nirenberg theorem for complex b-manifolds was obtained by Barron-Francis and extended to the b^k case by Francis. In this talk, we will survey what is known about complex b^k-manifolds and consider function spaces analogous to those relevant in Berezin-Toeplitz quantization.

ALEX KAZACHEK, University of Waterloo
[Monday December 2 / lundi 2 décembre, 9:30 – R 1690]
Quantum Channel Capacities and Additivity Conjectures

Quantum channels are a model for communicating information via the transmission of quantum states. The propensity for such a channel to send information is known as its capacity, taking several different forms depending on operational constraints. Unlike classical channels, computing such capacities is both computationally and mathematically intractable due to a phenomenon known as non-additivity. As a result, taming and bounding their capacities involves the interplay of sophisticated mathematics such as asymptotic geometric analysis, creating quantum analogues of information-theoretic notions, as well as heuristic and numerical work with low-dimensional counterexamples. I will review the history of the field and its central concepts, as well as present the modern techniques for tackling additivity problems such as log-singularity arguments and degradability. Moreover, I will briefly discuss how channels in their abstract may be connected to prior work of mine with T. Barron on coherent states in Kähler quantization.

HYUNMOON KIM, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 1690]
Stratification of families of representations of the Heisenberg Lie algebra

We discuss a parametrization of a family of irreducible representations of the Heisenberg Lie algebra by Poincare-Birkhoff-Witt isomorphisms, or equivalently, complex Lagrangian splittings. Complex conjugation stratifies this family, and in two dimensions, this stratification assembles well known families of representations of the canonical commutation relations. We discuss various properties of the stratification on the complex Lagrangian Grassmannian induced by complex conjugation–incidence relations, homotopy type of each stratum, and discrete symmetries between preferred basepoints. We speculate the potential role of the family as a classifying space for quantizations.

MATTHEW KOBAN, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 1690]
Bundle representations of double quivers

Representations of finite quivers in the category of vector spaces have been used to great effect in mathematical physics, geometric representation theory, and beyond. In this talk I will discuss a symplectic construction of moduli spaces of representations of quivers in the category of vector bundles over a Riemann surface. For specific quivers these spaces recover both moduli spaces of flat connections, as well as moduli spaces of Higgs bundles, each of which has a rich interaction with geometric quantization. At the same time quiver varieties themselves (in the ordinary sense) can be quantized and one can ask about the extent to which this more general construction admits any reasonable quantization. This is work in progress joint with Lisa Jeffrey and Steven Rayan.

Geometric quantization for young people

ETHAN ROSS, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 1690]
Quantization of Symplectic Stratified Spaces

Symplectic stratified spaces are a natural class of singular spaces which appear in equivariant symplectic geometry. There have been many approaches to trying to quantize stratified symplectic spaces that can be quite ad-hoc and rely on a quotient structure. In this talk I will discuss a new more intrinsic way of quantizing that generalizes the more classical approaches for manifolds and doesn't require a group action, but still functions nicely in the presence of one.

KALEB D. RUSCITTI, University of Waterloo
[Monday December 2 / lundi 2 décembre, 10:00 – R 1690]
Degeneration of Holomorphic Sections to Bohr-Sommerfeld points for Moduli of SL(2,C) Bundles

The moduli spaces of $\mathrm{SL}(2,\mathbb{C})$ bundles on a compact Riemann surface ($g > 1$) are one example of the invariance of polarization principle: Jeffrey and Weitsman showed the number of Bohr-Sommerfeld points is equal to the Verlinde formula, which counts the dimension of the Kähler quantization. This is a numerical equivalence, but there is no canonical isomorphism taking holomorphic sections to Bohr-Sommerfeld points. Their proof uses a moment polytope coming from the Goldman flows associated to a trinion decomposition of the Riemann surface, but existing proofs of the Verlinde formula are not clearly related to this polytope.

Biswas and Hurtubise recently showed that by degenerating the Riemann surface along a trinion decomposition, one obtains a degeneration of the moduli space to a toric variety of framed parabolic bundles. In this talk, we discuss how to use this degeneration at the level of holomorphic sections to degenerate a section over the moduli space into a section over the toric variety, which is directly related to the Bohr-Sommerfeld points via standard toric-geometric results. This also provides another proof of the Verlinde formula, via the moment polytope defined by the Goldman flows.

OOD SHABTAI, University of Toronto
[Monday December 2 / lundi 2 décembre, 16:00 – R 1690]
Pairs of spectral projections of quantum observables on Riemann surfaces

We discuss the semiclassical behaviour of pairs of spectral projections corresponding to incompatible quantum observables, in the framework of geometric quantization of closed Riemann surfaces.

ZHONGKAI TAO, UC Berkeley
[Monday December 2 / lundi 2 décembre, 17:00 – R 1690]
Spectral asymptotics for kinetic Brownian motion

I will talk about the kinetic Brownian motion operator which serves as an interpolation of geodesic flow and the Laplace operator on a compact Riemannian manifold. Then I will motivate open problems on how to define it on differential forms.

DAN WANG, IST, University of Lisbon
[Monday December 2 / lundi 2 décembre, 8:30 – R 1690]
Geometric Quantization on Toric Varieties

Geometric quantization on symplectic manifolds plays an important role in representation theory and mathematical physics, deeply relating to symplectic geometry and differential geometry. A crucial problem is to understand the relationship among geometric quantizations associated with different polarizations. In this talk, we will discuss the quantum spaces associated with mixed polarizations and the large limit of quantum spaces on toric varieties.

Geometric quantization for young people

YU-TUNG (TONY) YAU, University of Michigan
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 1690]
Berezin-Toeplitz quantization in real polarizations

A fundamental theorem in Berezin-Toeplitz quantization states that, on a compact Kaehler manifold, a unique deformation quantization is determined by its asymptotic action via Toeplitz operators on the quantum Hilbert space in Kaehler polarization. Since Schlichenmaier proved this result, numerous research in this area has been emerging. In this talk, I will discuss how to construct Toeplitz type operators beyond the case of Kaehler polarizations so as to obtain an analogue to Schlichenmaier's result. I will especially focus on compact symplectic manifolds with a pair of transversal real polarizations. Noting that the construction of Toeplitz operators in the Kaehler case involves the inner product on the space of L^2 sections of the prequantum line bundle, I will also explain how to overcome the difficulty that the quantum Hilbert spaces in real polarizations are distributional sections.

Graph Coloring, Minors, and Hypergraphs (previously Graph Theory)

Org: Alexander Clow, **Bojan Mohar** and/et **Ladislav Stacho** (Simon Fraser University)

This session focuses on recent progress in graph coloring as well as the related areas of graph minor theory and hypergraph theory. By bringing together researchers active in one or more of these areas the session aims to stimulate discussion on recent advancements.

Schedule/Horaire **Room/Salle: R 2060**

Saturday November 30 **samedi 30 novembre**

8:00 - 8:30	Penny Haxell (Waterloo), *A bounded diameter strengthening of Kőnig's Theorem* (p. 147)
8:30 - 9:00	Andrew Lane (UVic), *Proper Rainbow Saturation for Trees* (p. 147)
9:00 - 9:30	Emily Heath (Cal Poly Pomona), *Proper Rainbow Saturation for Cliques* (p. 147)
9:30 - 10:00	Ben Moore (ISTA), *On powers of sparse graphs* (p. 148)
10:00 - 10:30	Gena Hahn (UMontreal), *Resurrection – revisiting old problems* (p. 146)
15:00 - 15:30	Alexander Clow (SFU), *A Map Colour Theorem for Oriented Colouring* (p. 146)
15:30 - 16:00	Joshua Nevin (UOttawa), *Distant 2-Colored Components on Embeddings* (p. 148)
16:00 - 16:30	Jeannette Janssen (Dalhousie), *Orthogonal Colourings of Random Geometric Graphs* (p. 147)
16:30 - 17:00	Jozsef Solymosi (UBC), *A sparse removal lemma for pentagons* (p. 148)

Abstracts/Résumés

ALEXANDER CLOW, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2060]
A Map Colour Theorem for Oriented Colouring

A classical problem in graph colouring theory, dating back to Heawood, is to study the number of colours required to colour graphs embeddable on a surface of bounded Euler genus. In this talk we will present a nearly tight bound on the oriented chromatic number in terms of the Euler genus of the graph being coloured. In particular, we will show that there exists oriented graphs with Euler genus at most g that require $\Omega(\frac{g}{\log(g)})$-colours in any oriented colouring, before proving that every oriented graph with Euler genus at most g has an oriented colouring using at most $O(g\log(g))$-colours.

GENA HAHN, Université de Montéal
[Saturday November 30 / samedi 30 novembre, 10:00 – R 2060]
Resurrection – revisiting old problems

There are problems that themselves are perhaps rather unimportant but whose solutions require new approaches, new ideas, new theories. This talk is about three of these that have been haunting me for over twenty years.
– We invented the *injective chromatic number* in [2] and there are now many papers on the subject. But one of the original questions, also asked in [4] in a different context, remains.
– The ultimate independence ratio of a graph has been studied extensively and much is known. Still, one of the problems from [1] is still very much open.
– In [3] the *b-chromatic number* of a graph is defined and questions answered. But in spite of sporadic results, not much is known.

Bonus A problem I recently learnt from John Gimbel could fall in the same category, though we do not know, it is too young.

Références

[1] G. Hahn, P. Hell, S. Poljak, *On the ultimate independence ratio*, European Journal of Combinatorics **16** (1995), 253 – 261

[2] G. Hahn, J. Kratochvíl, D. Sotteau, J. Širáň, On injective colourings, *Discrete Math.* **256** (2002), 179 – 192.

[3] R. W. Irving, D. Manlove, The b-chromatic number of a graph, *Discrete Math.* **91** (1999), 127 – 141.

[4] N. Linial, R. Meshulam, M. Tarsi, Matroidal bijections between graphs, *J. Combin. Theory Ser. B* **45** (1988), 31 – 44.

PENNY HAXELL, University of Waterloo

[Saturday November 30 / samedi 30 novembre, 8:00 – R 2060]

A bounded diameter strengthening of Kőnig's Theorem

Kőnig's theorem says that the vertex cover number of every bipartite graph is equal to its matching number. An equivalent formulation of Kőnig's theorem states that for every 2-colouring of the edges of a graph G, the vertex set of G can covered by a set of at most $\alpha(G)$ monochromatic components. Here $\alpha(G)$ denotes the independence number of G.

We strengthen Kőnig's theorem by proving the existence of a function f such that the following holds. For every 2-colouring of the edges of a graph G, there exists a set of at most $\alpha(G)$ monochromatic subgraphs, each of diameter at most $f(\alpha)$, that covers the vertex set of G.

Joint work with Louis DeBiasio, António Girão and Maya Stein

EMILY HEATH, Cal Poly Pomona

[Saturday November 30 / samedi 30 novembre, 9:00 – R 2060]

Proper Rainbow Saturation for Cliques

Given a graph H, we say that a graph G is properly rainbow H-saturated if there is a proper edge-coloring of G which contains no rainbow copy of H, but adding any edge to G makes such an edge-coloring impossible. The proper rainbow saturation number is the minimum number of edges in an n-vertex properly rainbow H-saturated graph. There are few graphs for which the proper rainbow saturation number is known asymptotically, including P_4 and C_4. In this talk, we will discuss new results for cliques, including determining the proper rainbow saturation number of K_4 asymptotically.

This is joint work with Dustin Baker, Enrique Gomez-Leos, Anastasia Halfpap, Ryan Martin, Joe Miller, Alex Parker, Hope Pungello, Coy Schwieder, and Nicholas Veldt.

JEANNETTE JANSSEN, Dalhousie University

[Saturday November 30 / samedi 30 novembre, 16:00 – R 2060]

Orthogonal Colourings of Random Geometric Graphs

An orthogonal colouring of a graph $G = (V, E)$ is an injective assignment $f : V \to [k]^2$ of a pair of colours to each vertex of G, so that each coordinate constitutes a proper colouring. So if $f(u) = (a, b)$, $f(v) = (a', b')$ and u and v are adjacent, then $a \neq a'$ and $b \neq b'$. Since f is injective, every pair of colours occurs at most once on any vertex. We show results on the minimum number of colours needed for an orthogonal colouring of a regular type of grid graph, and use this to find orthogonal colourings of the random geometric graph $GR(n, r)$. In particular, we investigate for which choice of parameters we have that $GR(n, r)$ almost surely has an orthogonal colouring that uses every colour pair exactly once.

ANDREW LANE, University of Victoria

[Saturday November 30 / samedi 30 novembre, 8:30 – R 2060]

Proper Rainbow Saturation for Trees

Graph Coloring, Minors, and Hypergraphs (previously Graph Theory)

Given a graph H, say that a graph G is properly rainbow H-saturated if there exists a rainbow H-free proper edge-colouring of G, and, for any non-edge e of G, every proper edge-colouring of $G + e$ contains a rainbow copy of H. The proper rainbow saturation number is the minimum number of edges in a properly rainbow H-saturated graph on n vertices. This is a natural variant of the graph saturation problem based on the rainbow extremal number. In this talk, we will discuss results on the proper rainbow saturation number, including exact values and asymptotically tight bounds for several classes of graphs, with a particular focus on trees.

Joint work with Natasha Morrison.

BEN MOORE, Institute of Science and Technology Austria
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2060]
On powers of sparse graphs

It is conjectured that if C is a class of graphs with structurally bounded expansion, then even if we do not know the underlying transduction and bounded expansion class, we can solve all first order logic problems in polynomial time on C.

A simple class of graphs with structurally bounded expansion is d-powers of minor closed classes. I'll discuss some results on this class of graphs, in particular:

1) It is NP-complete to decide if a graph G has a square root H such that H is from a minor closed class M, so long as M contains at least 6 apex vertices

2) There exists an algorithm to 2-approximate the subchromatic number of bounded layered cliquewidth (which includes powers of planar graphs)

3) The subchromatic number of squares of planar graphs is at most 43

This is joint work with subsets of: Zdenek Dvorak and Abhiruk Lahari ; Pankaj Kumar, Patrice Ossona de Mendez,Pedro Cortez, and Daniel Quiorz.

JOSHUA NEVIN, University of Ottawa
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2060]
Distant 2-Colored Components on Embeddings

In this talk, we present a new result which consists of the following generalization of Thomassen's 5-choosability theorem: Let G be a finite graph embedded on a surface of genus g. Then G can be L-colored, where L is a list-assignment for G in which every vertex has a 5-list except for a collection of pairwise far-apart components, each precolored with an ordinary 2-coloring, as long as the face-width of G is $2^{\Omega(g)}$ and the precolored components are of distance $2^{\Omega(g)}$ apart. This provides an affirmative answer to a generalized version of a conjecture of Thomassen and also generalizes a result from 2017 of Dvořák, Lidický, Mohar, and Postle about distant precolored vertices.

JOZSEF SOLYMOSI, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2060]
A sparse removal lemma for pentagons

Counting pentagons in graphs and hypergraphs is a classical problem in extremal graph theory. The following basic question has equivalent formulations using graphs or 3-uniform linear hypergraphs. Here, we use the hypergraph notation to state our main result. A 3-uniform hypergraph is linear if any two edges have at most one vertex common. A C_5 in a triple system is a set of ten distinct vertices $\{u_1, \dots, u_5, v_1, \dots, v_5\}$ and five (distinct) edges $u_i u_{i+1} v_i$ where $i \in [5]$ and indices are taken modulo 5. We say that this C_5 is an expansion of $u_1 \dots u_5$. Given a hypergraph H, write $e(H)$ and $d(H)$ for the number of edges and average degree of H, respectively.

Let $n > 10$ and let H be an n-vertex linear triple system with $m > 100\, n^{3/2}$ edges. Then the number of copies of C_5 in H is at least m^6/n^7.

This result has interesting applications in additive combinatorics and discrete geometry. Joint work with Dhruv Mubayi.

Graph Structure and Algorithms

Org: Richard Brewster (Thompson Rivers University), **Benjamin Cameron** (University of Prince Edward Island) and/et **Kathie Cameron** (Wilfrid Laurier University)

It is generally believed that for most fundamental problems on graphs and networks, efficient algorithms that apply to all possible inputs cannot exist. One approach to finding efficient algorithms is to study the structure of graphs which are restricted in various ways. This session will focus on graph structure and its application to designing efficient algorithms for important problems including graph colouring, homomorphisms, combinatorial reconfiguration, flows, packings and coverings, and finding Hamiltonian cycles.

Schedule/Horaire **Room/Salle: R 2435**

Sunday December 1 — dimanche 1er décembre

15:00 - 15:30	Ben Moore (Institute of Science and Technology, Austria), *Orientations of Highly Edge Connected Graphs* (p. 152)
15:30 - 16:00	Kathryn Nurse (Simon Fraser University), *Nowhere-zero flows and group connectivity - an intermediate step* (p. 153)
16:00 - 16:30	Benjamin Cameron (University of PEI), *Vertex-critical graphs in co-gem-free graphs* (p. 150)
16:30 - 17:00	Ben Seamone (Dawson College), *Ramsey numbers of signed graphs* (p. 153)
17:00 - 17:30	Angèle Foley (Wilfrid Laurier University), *When is a graph e-positive ?* (p. 152)

Monday December 2 — lundi 2 décembre

9:00 - 9:30	César Hernández Cruz (UNAM, Mexico), *Full homomorphisms to trees* (p. 151)
9:30 - 10:00	Kiara McDonald (University of Victoria), *Broadcast Independence in Different Classes of Graphs* (p. 152)
10:00 - 10:30	Shannon Ogden (University of Victoria), *The Rainbow Connection* (p. 153)
15:00 - 15:30	Iain Beaton (Acadia University), *Reconfiguration Graphs for Minimal Domination Sets* (p. 150)
15:30 - 16:00	Nancy Clarke (Acadia University), *On the Structure of Dominating Graphs of Trees and Cycles* (p. 151)
16:00 - 16:30	Kathie Cameron (Wilfrid Laurier University), *Frozen Colourings* (p. 151)
16:30 - 17:00	Pavol Hell (Simon Fraser University), *Signed Graphs and Homomorphisms* (p. 152)

Abstracts/Résumés

IAIN BEATON, Acadia University
[Monday December 2 / lundi 2 décembre, 15:00 – R 2435]
Reconfiguration Graphs for Minimal Domination Sets

A dominating set S in a graph is a subset of vertices such that every vertex is either in S or adjacent to a vertex in S. A minimal dominating set M is a dominating set such that $M - v$ is not a dominating set for all $v \in M$. In this talk we introduce a reconfiguration graph $\mathcal{R}(G)$ for minimal dominating sets under a generalization of the token sliding model. We give some preliminary results which include showing that $\mathcal{R}(G)$ is connected for trees and split graphs. Additionally we classify all graphs which have $\mathcal{R}(G) = K_n$ and $\mathcal{R}(G) = \overline{K_n}$ for all n.

BENJAMIN CAMERON, University of Prince Edward Island
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2435]
Vertex-critical graphs in co-gem-free graphs

In this talk, we will show that there are only finitely many k-vertex-critical (co-gem, H)-free graphs for all k when H is any graph of order 4 by showing finiteness in the three remaining open cases, those are the cases when H is $2P_2$, $K_3 + P_1$, and K_4. Here a graph G is k-vertex-critical if $\chi(G) = k$ but $\chi(G - v) < k$ for all $v \in V(G)$ and (G, H)-free if it contains no induced subgraph isomorphic to G or H. The co-gem is the the disjoint union of a path of order 4 and a single vertex. For the first two cases we actually prove the stronger results:

– There are only finitely many k-vertex-critical (co-gem, paw+P_1)-free graphs for all k and that only finitely many k-vertex-critical (co-gem, paw+P_1)-free graphs for all $k \geq 1$.
– There are only finitely many k-vertex-critical (co-gem, P_5, $P_3 + cP_2$)-free graphs for all $k \geq 1$ and $c \geq 0$.

Our results imply the existence of simple polynomial-time certifying algorithms to decide the k-colourability of (co-gem, H)-free graphs for all k and all H of order 4 by searching for the vertex-critical graphs as induced subgraphs. As time allows, we will sketch some of the new ideas used in our proofs, including an application of Sperner's Theorem on the number of antichains in a partially ordered set.

KATHIE CAMERON, Wilfrid Laurier University
[Monday December 2 / lundi 2 décembre, 16:00 – R 2435]
Frozen Colourings

A k-colouring of a graph is an assignment of at most k colours to its vertices so that the ends of each edge get different colours. We consider the question: When it is possible to obtain any k-colouring from any other by changing the colour of one vertex at a time, while always having a k-colouring? This is equivalent to asking whether the "reconfiguration graph" is connected: The reconfiguration graph of the k-colourings, denoted $R_k(G)$, is the graph whose vertices are the k-colourings of G, and two colourings are adjacent in $R_k(G)$ if they differ in colour on exactly one vertex.

A k-colouring is called frozen if there is no vertex whose colour can be changed so that the result is still a k-colouring. A frozen colouring corresponds to an isolated vertex of the reconfiguration graph. Equivalently, a frozen k-colouring is a partition of the vertices into at most k sets, each of which is both independent and dominating. The terms fall colouring and indominable have also been used. We have found several new classes of graphs with frozen colourings and an operation which transforms a k-chromatic graph with a frozen $(k+1)$-colouring into a $(k+1)$-chromatic graph with a frozen $(k+2)$-colouring, without using the "join" operation or adding universal vertices. I will discuss the recently resolved problem: For which values of k and t does there exist a k-colourable graph with no induced path on t vertices with a frozen $(k+1)$-colouring?

This is joint work with Manoj Belavadi and Elias Hildred.

NANCY CLARKE, Acadia University
[Monday December 2 / lundi 2 décembre, 15:30 – R 2435]
On the Structure of Dominating Graphs of Trees and Cycles

The dominating graph of a graph G has as its vertices all dominating sets of G, with two vertices adjacent if the corresponding dominating sets differ by the addition or deletion of a single vertex of G. We are interested in the properties of such graphs. In particular, we show that the dominating graph of any tree has a Hamilton path and that the dominating graph of a cycle on n vertices has a Hamilton path if and only if n is not a multiple of 4. Joint work with K. Adaricheva, H. Smith Blake, C. Bozeman, R. Haas, M. Messinger, and K. Seyffarth.

CÉSAR HERNÁNDEZ CRUZ, Universidad Nacional Autónoma de México
[Monday December 2 / lundi 2 décembre, 9:00 – R 2435]
Full homomorphisms to trees

Given two graphs G and H, a full homomorphism from G to H is a function $\varphi\colon V_G \to V_H$ which preserves adjacencies and non-adjacencies. When a full homomorphism exists from G to H we say that G is fully H-colourable; the full H-colouring problem is the problem of deciding whether an input graph G admits a full H-colouring for a fixed graph H. In 2008, Feder

and Hell proved that there are always finitely many minimal obstructions to the full H-colourability problem, and moreover, the order of any such minimal obstruction is at most $|V_H| + 1$. Thus, there is a brute force polynomial time algorithm to solve the full H-colouring problem.

In this talk we consider the full H-colouring problem when H is a tree ; in particular, we are interested in the optimal time for recognizing a fully H-colourable graph. We present a linear time algorithm to solve the full H-colouring problem when H is a path. We also define the class of *fully tree-colourable graphs* as the family of graphs admitting a full homomorphism to some tree, and exhibit a characterization in terms of minimal induced subgraphs for such a class.

ANGÈLE FOLEY, Wilfrid Laurier University
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2435]
When is a graph e-positive ?

In 1995 Stanley introduced the chromatic symmetric function of a graph and posed a central question: when can it be written as a linear combination of elementary symmetric functions using only positive coefficients ? When it can, the graph is called e-positive. He also presented the Stanley-Stembridge conjecture that a particular kind of clawfree graph is e-positive. In 2024 Hikita announced a proof of this conjecture, but along the way there have been many related results. This talk will explore our 2019 contribution with Hoang and Merkel, as well as some more recent developments.

PAVOL HELL, Simon Fraser University
[Monday December 2 / lundi 2 décembre, 16:30 – R 2435]
Signed Graphs and Homomorphisms

Signed graphs first arose in the theory of social balance, and also arise in clustering in networks, root systems, matroids, and flows on non-orientable surfaces. They offer a refined view of many basic graph theory results. They are particularly intriguing from the perspective of graph homomorphisms. I will focus on the complexity dichotomy problem, discuss the solution of the basic homomorphism problem, and the new results and remaining challenges for the list homomorphism problem. The new results are joint with Jan Bok, Rick Brewster, and Nikola Jedličková.

KIARA MCDONALD, University of Victoria
[Monday December 2 / lundi 2 décembre, 9:30 – R 2435]
Broadcast Independence in Different Classes of Graphs

In the area of Graph Theory, the well-known problems of domination, packing and independence are generalized by broadcast domination, broadcast packing and broadcast independence. As an analogy and application, consider a city, where one wants to place cell towers of different signal strengths subject to certain conditions. If every building in the city hears the signal from at least (respectively at most) one tower, then the broadcast is dominating (respectively packing). If no tower hears the signal from another tower, the broadcast is independent. The sum of the tower signal strengths is called the cost of the broadcast. The total cost of a maximum independent broadcast is called the broadcast independence number.

Our research was focused on determining explicit formulas and polynomial time algorithms for the broadcast independence number of various types of graphs. This parameter is difficult to compute for graphs in general, so we restrict the problem to specific classes of graphs to make use of their special structural properties to solve the problem. For a graph from a given class, we constructed a new graph, called the broadcast ball intersection graph. We were able to show that if the broadcast ball intersection graph is weakly chordal, then broadcast independence is polynomial time solvable for the given class of graphs. This talk is based on joint work with Richard Brewster (TRU) and Jing Huang (UVic).

BEN MOORE, Institute of Science and Technology Austria
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2435]
Orientations of Highly Edge Connected Graphs

A nowhere zero 3 flow (henceforth: NZ3F) is an orientation of a graph such that, at each vertex, the indegree minus the outdegree is divisible by 3. Grotzsch's Theorem says that every triangle-free planar graph is 3-colourable. Tutte conjectured a wide-sweeping generalization: every 4-edge-connected graph admits a NZ3F. Lovasz, Thomassen, Wu and Zhang proved that 6-edge-connected graphs admit such a flow. We extend this result by showing that one can allow arbitrarily many 5-edge-cuts or 4-edge-cuts — under some technical conditions.

Our theorem generalizes the more technical version of the Lovasz, Thomassen, Wu, Zhang theorem.

This is joint work with Soffia Arnadottir, Evelyne Smith Roberge, Zdenek Dvorak, Bernard Lidicky, and Robert Samal.

KATHRYN NURSE, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2435]
Nowhere-zero flows and group connectivity - an intermediate step

We give an overview of nowhere-zero flows and group-connectivity. We discuss a generalization of Seymour's 6-flow theorem. This generalization is an intermediate step between group connectivity and nowhere-zero flows, where the user may prescribe certain boundary constraints on the vertices. Based on joint work with M. DeVos (Simon Fraser University), and J. McDonald (Auburn University).

SHANNON OGDEN, University of Victoria
[Monday December 2 / lundi 2 décembre, 10:00 – R 2435]
The Rainbow Connection

Given a graph H, an edge-coloured graph G is H-rainbow saturated if it does not contain a rainbow copy of H, but the addition of any non-edge in any colour creates a rainbow copy of H. The rainbow saturation number, denoted by rsat(n, H), is the minimum number of edges among all H-rainbow saturated edge-coloured graphs on n vertices. We will prove that, for any non-empty graph H, the rainbow saturation number is linear in n. This confirms a recent conjecture of Girão, Lewis, and Popielarz. Based on joint work with Natalie Behague, Tom Johnston, Shoham Letzter, and Natasha Morrison.

BEN SEAMONE, Dawson College
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2435]
Ramsey numbers of signed graphs

A signed graph is a pair (G, σ) where $G = (V, E)$ is a graph and $\sigma : E(G) \to \{+, -\}$ is a signature which assigns a sign to each edge of G. One well-studied operation on signed graphs is that of switching at a vertex $v \in V(G)$, by which we mean that every edge incident to v has its sign changed. Two signed graphs are called equivalent if one can be obtained from the other by a sequence of vertex switches.

We call a complete signed graph positive (negative) if every edge is positive (negative). We study the following Ramsey problem on signed graphs – for positive integers s and t, what is the smallest n such that every signed complete graph on n vertices has an equivalent signed complete graph containing either a negative K_s or positive K_t. This "signed Ramsey number" is denoted $r_{\pm}(s, t)$. We show how a variety of approaches lead to upper and lower bounds on $r_{\pm}(s, t)$, settle an open problem by establishing the exact value of $r_{\pm}(4, t)$ for every t, and determine the asymptotics of $r_{\pm}(5, t)$ and $r_{\pm}(6, t)$.

Harmonic Analysis and Geometric Measure Theory

Org: Sean Douglas, **Caleb Marshall** and/et **Yuveshen Mooroogen** (University of British Columbia)

This session aims to provide a venue for established experts, early-career researchers, and graduate students to discuss recents advances in harmonic analysis on Euclidean spaces and geometric measure theory. Possible topics include Fourier restriction and decoupling, maximal functions, projection theorems, distance problems, Kakeya sets, fractal geometry, weighted inequalities, and related problems in areas such as probability, number theory and fractals.

Schedule/Horaire **Room/Salle: R 3080**

Saturday November 30 **samedi 30 novembre**

8:00 - 8:30	Angel Cruz (University of British Columbia), *Fourier Dimension and Trasnlation-Invariant Linear Equations* (p. 156)
8:30 - 9:00	Ryan Bushling (University of Washington), *An Integral Identity with Applications to Convex Sets* (p. 156)
9:00 - 9:30	Break (p. 155)
9:30 - 10:00	Igancio Uriarte-Turo (University of Toronto), *Two weight norm inequalities for singular and fractional integral operators in* $\mathbb{R}^n$ (p. 159)
10:00 - 10:30	Pablo Shmerkin (University of British Columbia), *Restricted projections and self-similar sets* (p. 158)
15:00 - 15:30	Shahaboddin Shaabani (Concordia University), *The Operator Norm of Paraproducts on Bi-parameter Hardy Spaces* (p. 158)
15:30 - 16:00	Alex Cohen (Massachusetts Institute of Technology), *Lower bounds for incidences* (p. 156)
16:00 - 16:30	Break (p. 155)
16:30 - 17:00	Paige Bright (University of British Columbia), *A Continuum Erdős–Beck Theorem* (p. 155)
17:00 - 17:30	Josh Zahl (University of British Columbia), *curve tangencies and maximal functions* (p. 159)
17:30 - 18:00	Meet for Group Dinner (p. 157)

Sunday December 1 **dimanche 1er décembre**

8:00 - 8:30	Jacob Denson (University of Wisconsin–Madison), *A Characterization of Boundedness For Multipliers of Spherical Harmonic Expansions* (p. 157)
8:30 - 9:00	Sean Douglas (University of British Columbia), *Chain Rule For Weighted Triebel-Lizorkin Spaces* (p. 157)
9:00 - 9:30	Break (p. 155)
9:30 - 10:00	Rodolfo Torres (University of Calafornia Riverside), *EXTRAPOLATION OF COMPACTNESS FOR CERTAIN PSEUDODIFFERENTIAL OPERATORS* (p. 159)
10:00 - 10:30	Izabella Łaba (University of British Columbia), *A short survey of integer tilings* (p. 157)
15:00 - 15:30	Alexia Yavicoli (University of British Columbia), *The Erdős similarity problem for non-small Cantor sets* (p. 159)
15:30 - 16:00	Emily Casey (University of Washington), *Anisotropic singular integrals and rectifiability* (p. 156)
16:00 - 16:30	Break (p. 155)
16:30 - 17:00	Junjie Zhu (University of British Columbia), *Hausdorff dimension and quadratic Roth* (p. 160)
17:00 - 17:30	Krystal Taylor (Ohio State University), *Projections and Favard length in a nonlinear setting* (p. 158)
17:30 - 18:00	Bodan Arsovski (IAS) (p. 154)

Abstracts/Résumés

BODAN ARSOVSKI, IAS
[Sunday December 1 / dimanche 1er décembre, 17:30 – R 3080]

TAINARA BORGES, Brown University
[R 3080]
Bounds for bilinear averages and associated maximal functions

Let S^{2d-1} be the unit sphere in $\mathbb{R}^{2d}$, and σ_{2d-1} the normalized spherical measure in S^{2d-1}. The (scale t) bilinear spherical average is given by

$$\mathcal{A}_t(f,g)(x) := \int_{S^{2d-1}} f(x-ty)g(x-tz)\,d\sigma_{2d-1}(y,z).$$

There are geometric motivations to study bounds for such bilinear spherical averages, in connection to the study of some Falconer distance problem variants. Sobolev smoothing bounds for the operator

$$\mathcal{M}_{[1,2]}(f,g)(x) = \sup_{t\in[1,2]} |\mathcal{A}_t(f,g)(x)|$$

are also relevant to get bounds for the bilinear spherical maximal function

$$\mathcal{M}(f,g)(x) := \sup_{t>0} |\mathcal{A}_t(f,g)(x)|.$$

In a joint work with B. Foster and Y. Ou, we put that in a general framework where S^{2d-1} can be replaced by more general smooth surfaces in $\mathbb{R}^{2d}$, and one can allow more general dilation sets in the maximal functions: instead of supremum over $t>0$, the supremum can be taken over $t\in\tilde{E}$ where $\tilde{E}$ is the set of all scales obtained by dyadic dilation of fixed set of scales $E\subseteq[1,2]$.

BREAK,
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 3080]

BREAK,
[Saturday November 30 / samedi 30 novembre, 16:00 – R 3080]

BREAK,
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 3080]

BREAK,
[Saturday November 30 / samedi 30 novembre, 9:00 – R 3080]

BREAK,
[R 3080]

PAIGE BRIGHT, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 16:30 – R 3080]
A Continuum Erdős–Beck Theorem

In discrete geometry, a classical result of Beck roughly shows that given a set $X \subset \mathbb{R}^n$ that is not too concentrated on any line, there are many (i.e. roughly $\gtrsim |X|^2$) distinct lines that contain at least 2 points of X. In 2022, Orponen, Shmerkin, and Wang proved a continuum version of Beck's theorem using tools from geometric measure theory. In this talk, we will present a continuum variant of Beck's theorem, known as the Erdős–Beck theorem, obtained in joint work with Caleb Marshall.

RYAN BUSHLING, University of Washington
[Saturday November 30 / samedi 30 novembre, 8:30 – R 3080]
An Integral Identity with Applications to Convex Sets

We propose a notion of "orientation" for $(n-1)$-rectifiable sets in $\mathbb{R}^n$. Using the classical methods of geometric measure theory, we prove that the integral of a certain Riesz-type kernel over these "oriented" sets is an absolute constant, from which a formula for surface measure immediately follows. Geometric interpretations are given, and the solution to a geometric variational problem characterizing the family of convex sets follows as a corollary.

EMILY CASEY, University of Washington
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 3080]
Anisotropic singular integrals and rectifiability

Since the work of Mattila and Preiss in 1995, it's been known that for a Radon measure with reasonable density assumptions, the almost everywhere existence of principal values of the Riesz transform is equivalent to the measure being rectifiable. In ongoing work with M. Goering, T. Toro, and B. Wilson, we prove a version of this result of Mattila and Preiss in a rough Riemannian setting. In this talk, we discuss the geometric techniques used in proving the almost everywhere existence of principal values for smooth Calderon Zygmund kernels for rectifiable measures, even when the kernel is not of convolution type.

ALEX COHEN, MIT
[Saturday November 30 / samedi 30 novembre, 15:30 – R 3080]
Lower bounds for incidences

Lots of problems in combinatorics and analysis are connected to upper bounds for incidences: given a set of points and tubes, how much can they intersect? On the other hand, lower bounds for incidences have not been studied much. We prove that if you choose n points in the unit square and a line through each point, there is a nontrivial point-line pair with distance $\leq n^{-2/3+o(1)}$. It quickly follows that in any set of n points in the unit square some three form a triangle of area $\leq n^{-7/6+o(1)}$, a new bound for this problem.

Joint with Cosmin Pohoata and Dimitrii Zakharov.

ANGEL CRUZ, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 8:00 – R 3080]
Fourier Dimension and Trasnlation-Invariant Linear Equations

Sets of large Fourier dimension often contain certain configurations that their counterparts of the same Hausdorff dimension may miss. In this talk we present an application of the strategies introduced by Yiyu Liang and Malabika Pramanik to confirm

the intuition that any set of large Fourier dimension contains certain nontrivial patterns, in the form of solutions of translation-invariant linear equations with integer coefficients.

JACOB DENSON, University of Wisconsin, Madison
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 3080]
A Characterization of Boundedness For Multipliers of Spherical Harmonic Expansions

Any function on the sphere S^d has a unique orthogonal expansion of the form $f = \sum_{k=0}^{\infty} H_k f$, where $H_k f$ is a spherical harmonic of degree k. For a function $m : (0, \infty) \to \mathbb{C}$, define a family of operators T_R on S^d for each $R > 0$ by setting $T_R f = \sum m(k/R) H_k f$. Such operators are called 'multiplier operators for spherical harmonic expansions', or 'zonal convolution operators'. For $d \geq 4$, and a limited range of L^p spaces, we find necessary and sufficient conditions for the operators $\{T_R\}$ to be uniformly bounded on $L^p(S^d)$. As a consequence, we prove a 'transference principle', that the operators $\{T_R\}$ are uniformly bounded on $L^p(S^d)$ if and only if the radial Fourier multiplier operator on $\mathbb{R}^d$ with symbol $m(|\cdot|) : \mathbb{R}^d \to \mathbb{C}$ is bounded on $L^p(\mathbb{R}^d)$. Such necessary and sufficient conditions, and the resulting transference principle, are unknown for analogous spectral multipliers on any compact manifold and any $p \neq 2$. Our proof methods involve using the theory of Fourier integral operators to find variable-coefficient analogues of strategies for bounding radial Fourier multiplier operators on Euclidean space.

MEET FOR GROUP DINNER,
[Saturday November 30 / samedi 30 novembre, 17:30 – R 3080]

SEAN DOUGLAS, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 3080]
Chain Rule For Weighted Triebel-Lizorkin Spaces

In this talk, we establish a fractional chain rule in the context of weighted Triebel-Lizorkin spaces under various smoothness conditions. This result notably extends the fractional chain rule to weighted Sobolev spaces with an integrability index less than one. Additionally, we determine an explicit relationship between the smoothness index, the integrability index, and the choice of weights. Furthermore, the fractional chain rule for smoothness index $0 < s < 1$ is extended to a normed fractional Faà di Bruno inequality for $s > 0$ within the framework of Sobolev spaces.

IZABELLA ŁABA, UBC
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 3080]
A short survey of integer tilings

A set $A \subset \mathbb{Z}$ tiles the integers by translations if there is a set $T \subset \mathbb{Z}$ such that every integer $n \in \mathbb{Z}$ has a unique representation $n = a + t$ with $a \in A$ and $t \in T$. The main open question regarding integer tilings is the Coven-Meyerowitz conjecture, providing a tentative characterization of finite tiles. We will survey some of the recent developments and open questions in this area, including a recent joint result with Itay Londner where we prove the Coven-Meyerowitz tiling conditions for a new class of tilings.

AKOS MAGYAR, University of Georgia
[R 3080]

K.S. SENTHIL RAANI, IISER Berhampur
[R 3080]
Sets containing all sufficiently large distances

In 1986, Falconer-Marstrand, Furstenberg-Katznelson-Weiss and Bourgain improved Boardman results independently that the unbounded d-dimensional sets $A \subset \mathbb{R}^d$ with positive asymptotic density admits sufficiently all large distances. In this talk we introduce the notion of well-distributed sets with s-density ; an s-dimensional set is well distributed if its high density scales are not too sparsely located on $\mathbb{R}$. Suppose s is close to d. We prove that a well distributed set $A \subset \mathbb{R}^d$ with s-density, admits sufficiently all large distances. This is based on the joint work with Prof. Malabika Pramanik.

SHAHABODDIN SHAABANI, Concordia University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 3080]
The Operator Norm of Paraproducts on Bi-parameter Hardy Spaces

In this talk, we discuss the recent work on the operator norm of bi-parameter paraproducts on bi-parameter Hardy spaces. A paraproduct is a bi-linear form arising in the product of two functions both expanded in either a wavelet basis such as the Haar or in the Littlewood-Paley pieces. In the one-parameter theory, the frequency interactions in the product of two functions are divided into either low-low, low-high or high-high interactions, and each gives rise to a bi-linear form called a one parameter paraproduct. These forms behave much better than the product itself and for them the Holder's inequality extends to the full range of Hardy spaces.

In my recent work, it is shown that for $0 < p, q, r < \infty$, with $\frac{1}{q} = \frac{1}{p} + \frac{1}{r}$, the operator norm of the dyadic bi-parameter paraproduct of the form

$$\pi_g(f) := \sum_R \langle g, h_R \rangle \langle f \rangle_R h_R,$$

from the bi-parameter dyadic Hardy space $H^p_d(\mathbb{R} \otimes \mathbb{R})$ to $H^q_d(\mathbb{R} \otimes \mathbb{R})$ is comparable to $\|g\|_{H^r_d(\mathbb{R}\otimes\mathbb{R})}$. In the above, the some is taken over all dyadic rectangles in the plane, h_R is the bi-parameter Haar wavelet supported on R, and $\langle f \rangle_R$ is the average of f over R. It is also proved that for all $0 < p < \infty$, there holds

$$\|g\|_{BMO_d(\mathbb{R}\otimes\mathbb{R})} \simeq \|\pi_g\|_{H^p_d(\mathbb{R}\otimes\mathbb{R}) \to H^p_d(\mathbb{R}\otimes\mathbb{R})},$$

where $BMO_d(\mathbb{R} \otimes \mathbb{R})$, stands for the dyadic product BMO space. Similar results are obtained for bi-parameter Fourier paraproducts of the same form.

PABLO SHMERKIN, UBC
[Saturday November 30 / samedi 30 novembre, 10:00 – R 3080]
Restricted projections and self-similar sets

It is generally expected that "structured fractals" such as self-similar sets have regular geometric behaviour. In particular, one expects that projecting a self-similar set preserves dimension, unless there is some obvious obstruction. I will present joint work with Amir Algom in which we extend results of Hochman-Shmerkin and Falconer-Jin in this direction. Recent results on restricted projections play a key role.

KRYSTAL TAYLOR, Ohio State University
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 3080]
Projections and Favard length in a nonlinear setting

Projections detect information about the size, geometric arrangement, and dimension of sets. In recent years, there has been significant interest in determining the rates of decay of the classical Favard length (or average orthogonal projection length) for various fractal sets. For orthogonal projections, quantitative estimates rely on a separation condition: most points are well-differentiated by most projections. It turns out that this idea also applies to a broad class of nonlinear projection-type operators satisfying a transversality condition. This begs the question of obtaining quantitative upper and lower bounds for decay rates

for nonlinear variants of Favard length, including Favard curve length (as well as a new generalization to higher dimensions, called Favard surface length) and visibility measurements associated with radial projections. As one application, we consider the decay rate of the Favard curve length of generations of the four corner Cantor set. Our upper bound utilizes the seminal work of Nazarov, Peres, and Volberg, while energy techniques play a role in achieving a lower bound. This talk is based on joint works with Cladek and Davey and with Bongers.

RODOLFO TORRES, University of California, Riverside
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 3080]
EXTRAPOLATION OF COMPACTNESS FOR CERTAIN PSEUDODIFFERENTIAL OPERATORS

The extrapolation result of Rubio de Francia has become a powerful tool to extend the weighted boundedness of an operator from a particular weighted Lebesgue space into others. This classical theorem has been extended to many contexts over the years and found many useful application and, more recently, versions to extrapolate compactness have been studied by several authors too. We will provide a simple alternative version of such extrapolation of compactness results and present a novel application to a class of pseudodifferential operators, establishing their compactness on weighted Lebesgue spaces. This is joint work with María Jesús Carro and Javier Soria.

IGANCIO URIARTE-TURO, University of Toronto
[Saturday November 30 / samedi 30 novembre, 9:30 – R 3080]
Two weight norm inequalities for singular and fractional integral operators in $\mathbb{R}^n$

I will give an overview of the history and some applications, and report on some of the recent progress on the two weight problem for singular integral operators in $\mathbb{R}^n$. In particular, I will elaborate on the original Nazarov-Treil-Volberg conjecture, its proof for the Hilbert transform, partial results for other Calderón-Zygmund operators in higher dimensions, necessity (or lack thereof) of various conditions, extensions to Tb theorems, stability results of bump conditions vs testing conditions, etc.). The talk refers to joint works with Alexis, Grigoriadis, Lacey, Luna-Garcia, Paparizos, Sawyer, and Shen.

ALEXIA YAVICOLI, The University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 3080]
The Erdős similarity problem for non-small Cantor sets

The Erdős similarity conjecture posits that any infinite set of real numbers cannot be affinely embedded into every measurable set of positive Lebesgue measure. I will show that Cantor sets of "positive logarithmic dimension" satify the Erdős similarity conjecture. This talk is based on a work in progress with Pablo Shmerkin.

JOSH ZAHL, UBC
[Saturday November 30 / samedi 30 novembre, 17:00 – R 3080]
curve tangencies and maximal functions

I will discuss a class of maximal operators that arise from averaging functions over thin neighborhoods of curves in the plane. Examples of such operators are the Kakeya maximal function and the Wolff and Bourgain circular maximal functions. To understand the behavior of these operators, we need to study the possible intersection patterns for collections of curves in the plane: how often can these curves intersect, how often can they be tangent, and how often can they be tangent to higher order ?

JUNQIANG ZHANG, China University of Mining and Technology-Beijing
[R 3080]
On Odd Normal Numbers

A real number x is considered normal in an integer base $b \geq 2$ if its digit expansion in this base is "equitable", ensuring that for each $k \geq 1$, every ordered sequence of k digits from $\{0, 1, \ldots, b-1\}$ occurs in the digit expansion of x with the same limiting frequency. Borel's classical result asserts that Lebesgue-almost every $x \in [0, 1]$ is normal in every base $b \geq 2$. We consider the set $N(O, E)$ of reals that are normal in odd bases but not in even ones. It is known that this set has full Hausdorff dimension but zero Fourier dimension. The latter condition means that $N(O, E)$ cannot support a probability measure whose Fourier transform has power decay at infinity. Our main result is that $N(O, E)$ supports a Rajchman measure μ, whose Fourier transform $\widehat{\mu}(\xi)$ approaches 0 as $|\xi| \to \infty$ by definiton. Moreover, the decay rate of $\widehat{\mu}$ is essentially optimal, subject to the constraints of its support. The methods draw inspiration from the number-theoretic results of Schmidt and a construction of Lyons. As a consequence, $N(O, E)$ emerges as a set of multiplicity, in the sense of Fourier analysis. This addresses a question posed by Kahane and Salem in the special case of $N(O, E)$. This is a joint work with Professor Malabika Pramanik.

JUNJIE ZHU, University of British Columbia

[Sunday December 1 / dimanche 1er décembre, 16:30 – R 3080]

Hausdorff dimension and quadratic Roth

Many results in harmonic analysis and geometric measure theory ensure the existence of geometric configurations under the largeness of sets, which are sometimes specified using the ball condition and Fourier decay. Recently, Kuca, Orponen, Sahlsten, and Bruce, Pramanik proved a Sarkozy-like theorem, which removes the Fourier decay condition and shows that sets with large Hausdorff dimensions contain two-point patterns. The existence of a three-point configuration relying solely on the Hausdorff dimension remains intractable so far. I am reporting my ongoing work in this direction.

Incidence Problems in Analysis

Org: Ryan Bushling (University of Washington), **William O'Regan** (University of British Columbia) and/et **Bobby Wilson** (University of Washington)

We explore recent developments at the interface between real analysis and incidence geometry. Topics include Kakeya-type problems, projection problems, distance sets, sum-product phenomena, efficient coverings, finding and avoiding patterns in sets, and applications to other areas of analysis.

Schedule/Horaire — Room/Salle: R 1780

Sunday December 1 — dimanche 1er décembre

8:00 - 8:30	Alex McDonald (Kennesaw State University), *Prescribed projections and efficient coverings of sets by curves* (p. 162)
8:30 - 9:00	Alex Cohen (MIT), *Branching structure in phase space* (p. 161)
9:00 - 9:30	Yuveshen Mooroogen (UBC), *A large-scale variant of the Erdos similarity conjecture* (p. 163)
9:30 - 10:00	Raani K. S. Senthil (Indian Institute of Science Education and Research)), *Distribution of distances in quasi-regular sets* (p. 163)
15:00 - 15:30	Izabella Łaba (UBC), *Incidence questions in p-adic geometry* (p. 162)
15:30 - 16:00	Paige Bright (UBC), *Dual Furstenberg Sets* (p. 161)
16:00 - 16:30	Caleb Marshall (UBC), *Pinned Dot Product Set Estimates* (p. 162)
16:30 - 17:00	Donald M. Stull (University of Chicago), *Exceptional sets for orthogonal directions* (p. 163)
17:00 - 17:30	Jacob B. Fiedler (University of Wisconsin - Madison), *Universal sets for pinned distances* (p. 161)
17:30 - 18:00	Robert Fraser (Wichita State University), *A Framework for constructing large sets without configurations* (p. 162)

Abstracts/Résumés

PAIGE BRIGHT, Univeristy of British Columbia
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 1780]
Dual Furstenberg Sets

Recently, Ren and Wang resolved the Furstenberg set problem in the plane; a fractal version of the Kakeya problem. In the plane, via a tool known as point-line duality, the Furstenberg set problem is directly related to a problem often referred to as the dual Furstenberg set problem. The focus of this talk will be the dual Furstenberg set problem in higher dimensions, motivated by problems in/applications to projection theory. This is joint work with Yuqiu Fu and Kevin Ren.

ALEX COHEN, MIT
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 1780]
Branching structure in phase space

Let (p_j, ℓ_j) be a collection of point-line pairs with ℓ_j passing through p_j. We associate to this configuration a *branching function* $f(x, y, z)$ of three variables which measures how much the configuration concentrates in rectangles of various side ratios. Geometrical information about incidences can be phrased as algebraic information about f. This framework provides a new way to ask and answer questions about two dimensional continuous incidence geometry.

Joint with Cosmin Pohoata and Dimitrii Zakharov.

Incidence Problems in Analysis

JACOB B. FIEDLER, University of Wisconsin-Madison
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 1780]
Universal sets for pinned distances

An important problem in geometric measure theory is bounding the size of pinned distance sets $\Delta_x Y = \{|x-y| : y \in Y\}$. We discuss recent work on this problem in the plane which shows that, as long as the pin x satisfies certain properties, the pinned distance set of Y at x will be as large as possible. In particular we show that any compact AD-regular set X of dimension more than 1 has the property we call universality: for any Borel Y, there is an x in X such that the pinned distance set of Y at x has maximum Hausdorff dimension, i.e. $\min\{1, \dim_H(Y)\}$. We will also discuss improved bounds when no regularity assumption is made on the pin set. This is based on joint work with Don Stull.

ROBERT FRASER, Wichita State University
[Sunday December 1 / dimanche 1er décembre, 17:30 – R 1780]
A Framework for constructing large sets without configurations

We describe a framework introduced in 2020 for constructing subsets of $\mathbb{R}^n$ of large Hausdorff dimension that avoid certain kinds of configurations. We present some possible future directions for this framework.

IZABELLA ŁABA, UBC
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 1780]
Incidence questions in p-adic geometry

Let $R = \mathbb{Z}/p^k\mathbb{Z}$, where p is a prime. For $k = 1$, R is a finite field, and there is a significant body of work on incidence geometry in R^n in this case. For $k \geq 2$, R is only a ring and not a field. Incidence questions in this case have new features: for example, multiple scales are present, and two non-parallel lines may intersect in more than one point depending on their angle. Major recent advances include the results of Dhar, Dvir, and Arsovski on the Kakeya problem over rings $\mathbb{Z}/N\mathbb{Z}$. I will discuss some new work on incidence questions in this setting. (Based on joint work with Charlotte Trainor and with Hailong Dao, Manik Dhar, and Ben Lund.)

CALEB MARSHALL, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 1780]
Pinned Dot Product Set Estimates

Choosing a fractal subset $A \subset \mathbb{R}^n$ and points $a, x \in \mathbb{R}^n$, the Falconer pinned dot product set problem asks how large the associated pinned dot product sets

$$\Pi_x^a(A) := \{\alpha \in \mathbb{R} : (a-x)\cdot y = \alpha, \text{ for some } y \in A\},$$

must be, relative to the Hausdorff dimension of A and choice of points $a, x \in \mathbb{R}^n$.

We discuss our new method for studying this problem. In particular, we determine lower bounds on the Hausdorff dimension of A which guarantee that $\Pi_x^a(A)$ is large in some quantitative sense for many $a \in A$. Our proof method is robust enough to show that the set $\Pi_x^a(A)$ has large Hausdorff dimension, positive measure, or nonempty interior, so long as we assume that the dimension of A is large enough. The proof utilizes both classical and recent results on orthogonal and radial projection theory. We also discuss possible extensions and open questions raised by this method.

This talk is based on upcoming joint work with S. Senger (Missouri State) and P. Bright (UBC).

ALEX MCDONALD, Kennesaw State University
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 1780]
Prescribed projections and efficient coverings of sets by curves

A remarkable result of Davies shows that an arbitrary measurable set in the plane can be covered by lines "efficiently", in the sense that the parts of the lines not needed form a set of measure zero in the plane. This theorem has an equivalent dual formulation which says that one can find a single set in the plane with given "prescribed" projections in almost every direction, up to measure zero errors. We extend these results to a non-linear setting and prove that a set in the plane can be covered efficiently by translates of a single curve satisfying a mild curvature assumption.

YUVESHEN MOOROOGEN, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 1780]
A large-scale variant of the Erdos similarity conjecture

Consider a sequence of real numbers increasing to infinity. How large can a subset of the real line be before it is forced to contain some affine image of that sequence? This question fits into a huge body of work in analysis and number theory concerned with constructing large sets that fail to contain prescribed structures. I will discuss recent progress on this question and comment on its connections with a now 50-year old open problem of Erdos.

RAANI K. S. SENTHIL, IISER Berhampur
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 1780]
Distribution of distances in quasi-regular sets

In 1990, Strichartz introduced the notion of quasi regular sets. An $s-$dimensional set $E \subset [0,1]^d$ is said to be quasi-regular if there exists $\kappa > 0$ such that

$$\liminf_{r \to 0} \frac{1}{(2r)^s} \mathbb{H}^s(E \cap B(x;r)) \geq \kappa$$

for $\mathbb{H}^s-$almost every $x \in E$. Strichartz further studied the Fourier asymptotics of measures supported on these sets. In this talk we discuss the role of their Fourier asymptotics in determining the nature of the distances in quasi-regular sets. This is based on joint work with Prof. Malabika Pramanik.

DONALD M. STULL, University of Chicago
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 1780]
Exceptional sets for orthogonal directions

It is well known that if $A \subseteq \mathbb{R}^n$ is an analytic set of Hausdorff dimension a, then $\dim_H(\pi_V A) = \min\{a, k\}$ for a.e. $V \in G(n,k)$, where π_V is the orthogonal projection of A onto V. In this talk we discuss how large the exceptional set

$$\{V \in G(n,k) \mid \dim_H(\pi_V A) < s\}$$

can be for a given $s \leq \min\{a,k\}$. We improve previously known lower bounds on the dimension of the exceptional set, and we show that our estimates are sharp for $k = 1$ and for $k = n-1$. This is joint work with Peter Cholak, Marianna Csornyei, Neil Lutz, Patrick Lutz and Elvira Mayordomo.

Interplay between Discrete Geometry, Convexity, and Combinatorics

Org: Károly Bezdek (Department of Mathematics and Statistics, University of Calgary, Canada), **Márton Naszódi** (Alfréd Rényi Institute of Mathematics, Budapest, Hungary) and/et **Déborah Oliveros** (Instituto de Matemáticas Universidad Nacional Autónoma de México)

Discrete geometry studies configurations of geometric objects (such as packings and coverings, combinatorial and metric theory of polytopes, rigidity theory, and the geometry of numbers), which may often be studied by the theory of convex bodies. All this is further enhanced by methods from combinatorics. This scientific session is intended to be a meeting place for senior and junior experts of discrete geometry, convexity, and combinatorics in order to interact and share their ideas about current problems, recent advances and emerging directions.

Schedule/Horaire **Room/Salle: R 2620**

Saturday November 30 — samedi 30 novembre

15:00 - 15:30	Egon Schulte (Northeastern University), *Skeletal polyhedra, complexes, and their classification by symmetry* (p. 167)
15:30 - 16:00	Leah Wrenn Berman (University of Alaska Fairbanks), *Infinite classes of movable (n_4) configurations using Poncelet polygons* (p. 164)
16:00 - 16:30	Gordon Williams (University of Alaska Fairbanks), *On Prisms of Polytopes* (p. 168)
17:00 - 17:30	Silvia Fernandez (California State University), *Bounding Sylvester's four-point constant and the rectilinear crossing number of the complete graph* (p. 165)
17:30 - 18:00	Tamon Stephen (Simon Fraser University), *Hypergraph Transversal Pairs Near the Fredman-Khachiyan Bound* (p. 167)

Sunday December 1 — dimanche 1er décembre

8:00 - 8:30	Ferenc Fodor (University of Szeged), *Stability of mean width inequalities* (p. 166)
8:30 - 9:00	Peter van Hintum (Institute of Advanced Studies), *Discrete Brunn-Minkowski theory* (p. 168)
9:00 - 9:30	Zsolt Lángi (Budapest University of Technology and Economics), *Steiner symmetrization on the sphere* (p. 167)
9:30 - 10:00	Alexey Glazyrin (University of Texas Rio Grande Valley), *Illuminating constant width bodies* (p. 166)
10:00 - 10:30	Gyivan Lopez Campos (Instituto de Matemáticas, Universidad Nacional Autónoma de México), *0/1-Borsuk problem on matroids* (p. 165)
15:00 - 15:30	Alexey Garber (University of Texas Rio Grande Valley), *On spheres with k points inside* (p. 166)
15:30 - 16:00	Anouk Brose (University of California), *Computing Lattice Diameters of Lattice Polygons* (p. 165)
16:00 - 16:30	Antonio Torres Hernandez (University of California), *Counting Vertices on Hyperplane Slices of Polytopes* (p. 166)
17:00 - 17:30	Illya Ivanov (University of Calgary), *Counting C-polyhedra facets* (p. 167)
17:30 - 18:00	Federico Firoozi (University of Calgary), *Counting lattice paths with respect to a linear boundary of rational slope* (p. 165)

Abstracts/Résumés

LEAH WRENN BERMAN, University of Alaska Fairbanks
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2620]
Infinite classes of movable (n_4) configurations using Poncelet polygons

Interplay between Discrete Geometry, Convexity, and Combinatorics

An (n_k) geometric configuration is a collection of n points and n straight lines, typically in the Euclidean plane, so that every point lies at the intersection of k lines and every line passes through k points. The modern study of configurations began in 1990, when Branko Grünbaum and John Rigby published the first geometric realization of any (n_4) configuration. In particular, they realized a (21_4) configuration (previously studied as a combinatorial configuration by Felix Klein) using properties of regular heptagons. It had long been assumed that this configuration is not movable: it is impossible to fix four noncollinear points of the configuration and move a fifth point in such a way that all the other incidences of the configuration are retained. However, this assumption turns out to be false—the (21_4) Grünbaum-Rigby configuration is movable! Its movability relies on a deep relationship between the construction technique that produces the heptagonal realization, conics, and the structure of Poncelet polygons. Poncelet polygons provide a framework for showing that all trivial celestial configurations, of which the Grünbaum-Rigby configuration is the smallest example, are movable. This is joint work with Gábor Gévay, Jürgen Richter-Gebert, and Serge Tabachnikov.

ANOUK BROSE, University of California, Davis
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2620]
Computing Lattice Diameters of Lattice Polygons

Motivated to count the lattice points in the intersection of a lattice polytope with an affine hyperplane, we study the 2-dimensional case, where a hyperplane corresponds to a line. A lattice diameter (for a lattice polytope P), is a line whose interesection with P has maximally many lattice points among all lines. We present an algorithm that computes all lattice diameters of a lattice polygon in polynomial time. Further, computing lattice diameters of lattice polytopes P with $dimP > 2$ is NP-hard. This is joint work with J. A De Loera, G. Lopez, and A. Torres.

GYIVAN LOPEZ CAMPOS, National Autonomous University of Mexico (UNAM)
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2620]
0/1-Borsuk problem on matroids

The Borsuk partition problem or better known as the Borsuk Conjecture asks whether for all $S \subset \mathbb{R}^n$ with diameter d, there is a partition of S in at most $n+1$ subsets such that the diameter of each subset is less than d.

In 1993, the conjecture was proved false by J. Kahn and G. Kalai, with an astonishing finite conterexample, furthermore, the given set was made only by canonical vectors with the same weight. The Borsuk problem restricted to this type of sets is known today as the 0/1-Borsuk problem.

In this talk, we are going to analyze this counterexample and the 0/1-Borsuk problem when the set is the set of vertices of a matroid basis polytope.

SILVIA FERNANDEZ, California State University, Northridge
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2620]
Bounding Sylvester's four-point constant and the rectilinear crossing number of the complete graph

In 1865, Sylvester proposed a series of problems falling into a category he called form-probability. In particular, he asked for the chance of the quadrilateral formed by four points, taken arbitrarily within any assigned boundary, being convex. The infimum of these probabilities over all boundaries (open sets in the plane with finite Lebesgue measure) is known as Sylvester's four-point constant. The rectilinear crossing number of the complete graph on n vertices is the minimum number of edge-crossings over all drawings of this graph in the plane, where the vertices are in general position and the edges are straight line segments. In 1994, Scheinerman and Wilf proved a close relationship between Sylvester's four-point constant and the rectilinear crossing number of the complete graph. In this talk, we present the best known bounds for this crossing number, which in turn provide bounds on Sylvester's four-point constant. We focus on the structure of crossing optimal configurations and in particular on exact results for symmetric drawings.

FEDERICO FIROOZI, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 17:30 – R 2620]
Counting lattice paths with respect to a linear boundary of rational slope

There is a remarkable and well-known enumeration result regarding lattice paths with unit up and right steps: the number of paths from $(0,0)$ to (g,g) that contain $2k$ steps above the line $y=x$ does not depend on the integer k. This result — called the Chung-Feller theorem — has inspired numerous authors to search for similar patterns throughout the years. In this accessible talk, we discuss some of our recent findings regarding paths that end at (ga,gb) and respect the boundary line given by $y=\frac{b}{a}x$ for coprime integers a,b; these findings include a result similar to the Chung-Feller theorem and an enumeration formula that generalizes counts conducted by previous authors Grossman and Bizley. In addition to discussing these results, we explain (at a high level) the combinatorial methods we used to obtain them and reveal a connection between our formula and the study of symmetric functions.

This is joint work with Jonathan Jedwab and Amarpreet Rattan.

FERENC FODOR, University of Szeged, Hungary
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2620]
Stability of mean width inequalities

It was proved by Barthe, Schechtman and Schmuckenschläger that among origin-symmetric convex bodies, whose John ellipsoid is the unit ball, the cube has maximal mean width, and that the regular cross-polytope minimizes the mean with among origin-symmetric convex bodies whose Löwner ellipsoid is the unit ball. We prove stronger, stability forms of these inequalities that are close to optimal. This is joint work with K.J. Böröczky (Budapest, Hungary) and D. Hug (Karlsruhe, Germany).

ALEXEY GARBER, The University of Texas Rio Grande Valley
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2620]
On spheres with k points inside

A classical result of Delone claims that for a finite and generic point set A in $\mathbb{R}^d$, every generic point in the convex hull of A belongs to exactly one simplex with empty circumsphere. The collection of all these simplices is called the Delaunay triangulation of A. In the talk I will discuss a generalization of Delaunay's result to the case of simplices with k points inside their circumspheres. I will also talk about possible extensions to the case of weighted points sets and point sets in $\mathbb{S}^d$, and sketch a new geometric proof for the fact that volumes of hypersimplices are Eulerian numbers. The talk is based on a joint work with Herbert Edelsbrunner and Morteza Saghafian.

ALEXEY GLAZYRIN, The University of Texas Rio Grande Valley
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2620]
Illuminating constant width bodies

Recently, Arman, Bondarenko, and Prymak constructed a constant width body in $\mathbb{R}^n$ whose illumination number is exponential in n. In this talk, I will show how to improve their bound by generalizing the construction. In particular, I will explain how to find a constant width body in $\mathbb{R}^n$ whose illumination number is at least $(1.047+o(1))^n$.

ANTONIO TORRES HERNANDEZ, UC Davis
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2620]
Counting Vertices on Hyperplane Slices of Polytopes

The study of slicing convex sets, especially polytopes, has been an active area of research in geometry and combinatorics, inspiring numerous investigations. In this talk, we will focus on the number of vertices in slices of polytopes. We will define

the sequences of slices for a polytope and analyze the gaps within these sequences, providing new insights into their structure and properties.

ILLYA IVANOV, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2620]
Counting C-polyhedra facets

A translative (resp. homothetic) C-polyhedron $P \subset \mathbb{E}^d$ is an intersection of translates (resp. homothets) $C_1, C_2, \dots C_n$ of a convex body $C \subset \mathbb{E}^d$; the intersection is reduced and has an interior. If $F' \subset P \cap \mathrm{bd} C_i$ is connected, singularity-free and isn't a part of a larger connected singularity-free subset of $P \cap \mathrm{bd} C_i$, then $F = \mathrm{cl} F'$ is a facet of P contributed by C_i. I will talk about our joint work with Cameron Strachan, estimating number of facets for C-polygons in $\mathbb{E}^2$. I will also show that when $C \subset \mathbb{E}^d$ is a Euclidean ball, every translate C_i contributes exactly one facet to a translative C-polyhedron.

ZSOLT LÁNGI, Budapest University of Technology and Economics
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2620]
Steiner symmetrization on the sphere

Steiner symmetrization is an important tool to solve geometric extremum problems in Euclidean space. The aim of this talk is to introduce a generalization of Steiner symmetrization in Euclidean space for spherical space, which is the dual of the Steiner symmetrization in hyperbolic space introduced by Peyerimhoff in 2002. We show that this symmetrization preserves volume in every dimension, and investigate when it preserves convexity. In addition, we examine the monotonicity properties of the perimeter and diameter of a set under this process, and find conditions under which the image of a spherically convex disk under a suitable sequence of Steiner symmetrizations converges to a spherical cap. We talk about applications of our method to prove a spherical analogue of a theorem of Sas, and to confirm a conjecture of Besau and Werner about spherical floating bodies for centrally symmetric spherically convex disks. We also describe a spherical variant of a theorem of Winternitz. Joint work with Bushra Basit, Steven Hoehner and Jeff Ledford.

EGON SCHULTE, Northeastern University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2620]
Skeletal polyhedra, complexes, and their classification by symmetry

The study of highly symmetric polyhedral structures in Euclidean 3-space has a long and fascinating history tracing back to the early days of geometry. Much recent work has focused on skeletal polyhedra and complexes, and their classification by symmetry. A skeletal polyhedron is a finite or infinite discrete structure made up of finite or infinite polygons as faces, with two faces on each edge and a circular vertex-figure at each vertex. The faces can be planar or skew, finite polygons, or can be linear, zigzag, or helical, infinite polygons. These skeletal figures exhibit fascinating geometric, combinatorial, and algebraic properties and include many new finite and infinite polyhedral structures. We discuss approaches to the classification for some of the most prominent classes of skeletal figures including the regular, chiral, or uniform polyhedra, as well as regular skeletal complexes with more than two edges meeting at an edge.

TAMON STEPHEN, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2620]
Hypergraph Transversal Pairs Near the Fredman-Khachiyan Bound

The Fredman-Khachiyan algorithm generates the transversal of a hypergraph in incremental quasi-polynomial time. It is a recursive algorithm which focuses on the most frequent vertex in terms of the number of edges in either the hypergraph or its transversal. Hypergraphs where this maximum fre- quency is low are therefore of interest. This gives a group of related optimization questions for hypergraph-transversal pairs. Here we present some preliminary extremal results.

Besides using classic combinatorial constructions, we adapt Wagner's deep reinforcement learning scheme from graphs to hypergraphs to help find some unexpected examples.

This is joint work with Parsa Salimi.

PETER VAN HINTUM, Institute for Advanced Study
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2620]
Discrete Brunn-Minkowski theory

The Brunn-Minkowski inequality is a fundamental result in convex geometry asserting that for sets $A, B \subset \mathbb{R}^n$ of the same volume and a parameter $t \in (0,1)$, we have $|tA + (1-t)B| \geq |A|$ with equality iff A and B are essentially the same convex set up to translation. We will explore how the study of discrete sumsets, including e.g. Freiman's theorem, can provide insights into the stability of this continuous Brunn-Minkowski inequality.

GORDON WILLIAMS, University of Alaska Fairbanks
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2620]
On Prisms of Polytopes

The Tomotope provided the first well understood example of an abstract 4-polytope whose connection (monodromy) group was not a string C-group, and which also did not have a unique minimal regular cover. Conversely, we know that if the connection group of a polytope is a string C-group (if the polytope is *C-connected*), then the polytope will have a unique minimal regular cover. Since the discovery of the Tomotope, an active area of investigation has been determining which abstract d-polytopes are C-connected and the ways various constructions for abstract polytopes result in polytopes that do or do not possess unique minimal regular covers. In this talk we'll discuss recent work showing that the prism over every abstract polyhedron is C-connected, or equivalently, that it has a unique minimal regular cover. We will also describe a conjecture positing a general condition on the C-connectedness of prisms over polytopes that is independent of rank.

Mathematics in Business Modeling, Optimization, Risk, and Decision Making

Org: Anas Abdallah (McMaster), **Mahboobeh (Mary) Hosseinyazdi** (KPU) and/et **Mehdi Salimi** (KPU)

Mathematics is a powerful tool in business and actuarial science, providing essential techniques for modeling complex systems, optimizing resources, managing risk, and making strategic decisions. From financial analysis and supply chain management to marketing strategies and risk assessment, mathematical models describe real-world scenarios and help decision-makers forecast outcomes and find optimal solutions. Areas like operations research, game theory, financial mathematics, and actuarial science leverage optimization, statistical analysis, and stochastic models to address business challenges, drive innovation, and enhance decision-making. Join us to explore the latest mathematical techniques and tools that shape business success

Schedule/Horaire **Room/Salle: R 2510**

Saturday November 30 — samedi 30 novembre

15:00 - 15:30	Christoph Frei (University of Alberta), *Bayesian Clustering for Portfolio Credit Risk* (p. 170)
15:30 - 16:00	Matheus Grasselli (McMaster University), *From debt crisis to financial crashes (and back)* (p. 170)
16:00 - 16:30	Alexander Melnikov (University of Alberta), *On dual problem of imperfect hedging with life insurance applications* (p. 171)
16:30 - 17:00	Cody Hyndman (Concordia University), *Generative Ornstein-Uhlenbeck Markets via Geometric Deep Learning* (p. 170)
17:00 - 17:30	David Saunders (University of Waterloo), *Generalized Optimal Transport Problems in Finance* (p. 171)

Sunday December 1 — dimanche 1er décembre

8:30 - 9:00	Jean-François Bégin (Simon Fraser University), *Benefit volatility-targeting strategies in lifetime pension pools* (p. 169)
9:00 - 9:30	Mahboobeh (Mary) Hosseinyazdi (Kwantlen Polytechnic University), *The solution set of a system of max-min-product fuzzy relational inequalities* (p. 170)
9:30 - 10:00	Masomeh Jamshid-Nejad (Kwantlen Polytechnic University), *The Impact of Excel-Based Instruction on Business Students' Understanding of the Normal Distribution in Statistics* (p. 171)
10:00 - 10:30	Mehdi Salimi (Kwantlen Polytechnic University), *Decision-Making Strategies for Pursuers with Speed and Energy Constraints in a Pursuit-Evasion Differential Game* (p. 171)

Abstracts/Résumés

JEAN-FRANÇOIS BÉGIN, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2510]
Benefit volatility-targeting strategies in lifetime pension pools

Lifetime pension pools—also known as group self-annuitization plans, pooled annuity funds, and retirement tontines in the literature—allow retirees to convert a lump sum into lifelong income, with payouts linked to investment performance and the collective mortality experience of the pool. Existing literature on these pools has predominantly examined basic investment strategies like constant allocations and investments solely in risk-free assets. Recent studies, however, proposed volatility targeting, aiming to enhance risk-adjusted returns and minimize downside risk. Yet they only considered investment risk in the volatility target, neglecting the impact of mortality risk on the strategy. This study thus aims to address this gap by investigating volatility-targeting strategies for both investment and mortality risks, offering a solution that keeps the risk associated with benefit variation as constant as possible through time. Specifically, we derive a new asset allocation strategy that targets both investment and mortality risks, and we provide insights about it. Practical investigations of the strategy demonstrate the

effectiveness and robustness of the new dynamic volatility-targeting approach, ultimately leading to enhanced lifetime pension benefits.

CHRISTOPH FREI, University of Alberta
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2510]
Bayesian Clustering for Portfolio Credit Risk

In this work, we develop a Bayesian clustering approach to address the limitations of traditional credit risk models used in loan portfolios, which typically group loans into predefined homogeneous buckets based on observable characteristics like credit ratings or industries. Our method leverages time series data of predicted default probabilities to dynamically cluster loans, allowing for a more flexible assignment of loans to multiple buckets through weighted vectors, rather than restricting them to a single category.

By integrating Bayesian inference, we estimate posterior distributions for the weight matrices, correlations, and default probabilities, which provides a more nuanced understanding of portfolio risk. We demonstrate the feasibility of this approach through simulated data and real-world credit risk data, analyzing its impact on key risk measures such as value at risk and expected shortfall. The results indicate that our method improves the accuracy of portfolio loss simulations, providing a robust framework for managing credit risk.

The talk is based on joint work with Bohdan Horak (University of Alberta).

MATHEUS GRASSELLI, McMaster University
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2510]
From debt crisis to financial crashes (and back)

In this talk I review a model merging two previously proposed models by Steve Keen, namely a monetary model of debt-deflation and a version with Ponzi destabilization, and recall the equilibrium properties and local stability analysis of the merged model. I then add an auxiliary stochastic model of financial markets based on a jump-diffusion process with endogenous jump intensity. This model captures main characteristics of Hyman Minsky's Financial Instability Hypothesis (FIH), and the Quantitative Theory of Credit (QTC) of Richard Werner, with an asset price bubble fueled by pure speculative credit and market crashes impacting the real economy. I then develop and study the fundamental properties of this extended model, its suitability to explain financial crisis and the relationship between growth and private credit. This is joint work with A. Nguyen-Huu.

MAHBOOBEH (MARY) HOSSEINYAZDI, KPU
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2510]
The solution set of a system of max-min-product fuzzy relational inequalities

In this article we will find the solution set for an optimization problem with max-min-product inequalities to depict a data transmission mechanism using client-server layout. We need to find the solution set for each inequality and then find the solution set for the system which is not the intersection of the solution sets for individual inequalities. To do that, we will find the minimal solutions for each inequality and then the connection between a solution for the system and solutions of each inequality.

CODY HYNDMAN, Concordia University
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2510]
Generative Ornstein-Uhlenbeck Markets via Geometric Deep Learning

We consider the problem of simultaneously approximating the conditional distribution of market prices and their log returns with a single machine learning model. We show that an instance of the Geometric Deep Network (GDN) model solves this problem

without having prior assumptions on the market's "clipped" log returns, other than that they follow a generalized Ornstein-Uhlenbeck process with a priori unknown dynamics. We provide universal approximation guarantees for these conditional distributions and contingent claims with a Lipschitz payoff function.

MASOMEH JAMSHID-NEJAD, Kwantlen Polytechnic University
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2510]
The Impact of Excel-Based Instruction on Business Students' Understanding of the Normal Distribution in Statistics

Statistics is an indispensable field of study that plays a pivotal role in various academic disciplines and real-world applications. The ability to analyze, interpret, and draw meaningful conclusions from data is a fundamental skill for students pursuing degrees in science, social sciences, business, and many other fields. However, the intricate nature of statistical analysis often poses a formidable challenge for students, both novice and experienced, who grapple with complex mathematical concepts and intricate statistical methodologies. One key tool that has been increasingly integrated into statistics education is Microsoft Excel. Excel, a widely used spreadsheet software, offers a user-friendly platform for data entry, organization, and basic statistical analysis. Its ubiquity in both educational and professional settings has made it an attractive candidate for assisting students in their journey to comprehend and apply statistical concepts. The combination of Excel's user-friendliness and its powerful data analysis features provides an environment that bridges the gap between theoretical statistical concepts and practical implementation. This study investigates the impact of using Excel on students' understanding of statistics, with a focus on the fundamental concept of the normal distribution. We explore how integrating Excel into statistics education influences students' ability to comprehend and apply the normal distribution in practical contexts. By evaluating the benefits, limitations, and pedagogical strategies associated with Excel as an instructional tool, this research highlights its role in enhancing statistical learning and its potential implications for students' academic performance and future professional success.

ALEXANDER MELNIKOV, University of Alberta
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2510]
On dual problem of imperfect hedging with life insurance applications

There is a standard reference for imperfect (quantile and efficient) hedging like Foellmer and Leukert (1999 and 2000). Instead of these references we pay attention to the paper of Novikov (1999) where he developed a dual version of quantile hedging or hedging with given probability. His approach has a clear statistical flavor. It is based on the Neuman-Pearson lemma and leads to a closed form solution in the Black-Scholes case. We extend this approach to a two-dimensional diffusion model as well as to a jump-diffusion model. Our developments include also efficient hedging for the case of a power loss function. We provide applications of our results to equity-linked life insurance with illustrative numerical examples.

MEHDI SALIMI, Kwantlen Polytechnic University
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2510]
Decision-Making Strategies for Pursuers with Speed and Energy Constraints in a Pursuit-Evasion Differential Game

Pursuit-evasion differential games provide a mathematical framework for studying decision-making in dynamic scenarios involving two opposing agents: pursuers and evaders. Governed by differential equations, these games model the strategic decision processes of both sides, with pursuers aiming to capture evaders under specific constraints. This presentation focuses on the development of decision-making strategies for pursuers, particularly when faced with limitations such as speed and energy resources. A key element is the identification of admissible regions—areas where players can make feasible decisions and operate effectively. Additionally, the concept of parallel strategies, where pursuers adapt their decisions in real-time based on the movements of evaders, is explored as a way to enhance the capture process. By examining these decision-making strategies within complex constraints, this analysis provides deeper insights into pursuit-evasion dynamics and offers practical solutions for optimizing real-world applications.

DAVID SAUNDERS, University of Waterloo
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2510]
Generalized Optimal Transport Problems in Finance

We will discuss generalizations of the optimal transport problem and their applications in finance. In particular, we will consider the problem of determining bounds on a risk measure given the distributions of marginal risk factors, as well as a generalization of the newsvendor problem to include spatially distributed demand.

Mathematics of Machine Learning

Org: Ben Adcock (Simon Fraser University), **Elina Robeva** (UBC) and/et **Giang Tran** (University of Waterloo)

Despite the profound impact of machine learning on many different sectors including scientific research, industry, and policy-making, its mathematical foundations are still far from being well understood. By bringing together researchers with diverse backgrounds, this session explores emerging ideas aimed at reducing the gap between theory and practice in this fast-growing and exciting field.

Schedule/Horaire **Room/Salle: R 2300**

Saturday November 30 **samedi 30 novembre**

8:30 - 9:00	Rahul Parhi (University of California San Diego), *Deep Learning Meets Sparse Regularization* (p. 177)
9:00 - 9:30	Ozgur Yilmaz (University of British Columbia), *Generative compressed sensing with Fourier measurements* (p. 178)
9:30 - 10:00	Ricardo Baptista (California Institute of Technology), *Dynamics and Memorization Behaviour of Score-Based Diffusion Models* (p. 173)
10:00 - 10:30	Samuel Lanthaler (California Institute of Technology), *Generative AI for the statistical computation of fluids* (p. 175)
15:00 - 15:30	Wuyang Chen (Simon Fraser University), *Towards Data-Efficient and OOD Generalization of Scientific Machine Learning Models* (p. 174)
15:30 - 16:00	Hans De Sterck (University of Waterloo), *Fast Multipole Attention for Transformer Neural Networks* (p. 174)
16:00 - 16:30	Wenlong Mou (University of Toronto), *Continuous-time reinforcement learning: blessings of elliptic structures and high-order approximations* (p. 176)
16:30 - 17:00	Sharan Vaswani (Simon Fraser University), *Global Convergence of Softmax Policy Gradient for Stochastic Bandits* (p. 177)
17:00 - 17:30	Nick Harvey (University of British Columbia), *When Online Learning Meets Stochastic Calculus* (p. 175)
17:30 - 18:00	Andrew Warren (University of British Columbia), *Estimation of one-dimensional structures from noisy empirical observation* (p. 178)

Sunday December 1 **dimanche 1er décembre**

8:30 - 9:00	Christos Thrampoulidis (University of British Columbia), *Implicit Geometry of Next-token Prediction: From Language Sparsity Patterns to Model Representations* (p. 177)
9:00 - 9:30	Mathias Lecuyer (University of British Columbia), *Adaptive Randomized Smoothing: Certified Adversarial Robustness for Multi-Step Defences* (p. 176)
9:30 - 10:00	Miranda Holmes-Cerfon (University of British Columbia), *Programmable assembly: inverse design of materials from discrete components* (p. 175)
10:00 - 10:30	Benjamin Bloem-Reddy (University of British Columbia), *Causal Inference with Cocycles* (p. 174)
15:00 - 15:30	Danica Sutherland (University of British Columbia), *Expander Graphs and Low-Distortion Embeddings for Learning on Graphs* (p. 177)
15:30 - 16:00	Ke Li (Simon Fraser University), *Rethinking Regression: Insights from Machine Learning* (p. 176)
16:00 - 16:30	Yiming Xu (University of Kentucky), *Statistical Ranking with Dynamic Covariates* (p. 178)

Abstracts/Résumés

RICARDO BAPTISTA, California Institute of Technology
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2300]
Dynamics and Memorization Behaviour of Score-Based Diffusion Models

Diffusion models have emerged as a powerful framework for generative modeling that relies on score matching to learn gradients of the data distribution's log-density. A key element for the success of diffusion models is that the optimal score function is not identified when solving the denoising score matching problem. In fact, the optimal score in both unconditioned and conditioned settings leads to a diffusion model that returns to the training samples and effectively memorizes the data distribution. In this presentation, we study the dynamical system associated with the optimal score and describe its long-term behavior relative to the training samples. Lastly, we show the effect of two forms of score function regularization on avoiding memorization: restricting the score's approximation space and early stopping of the training process. These results are numerically validated using distributions with and without densities including image-based problems.

BENJAMIN BLOEM-REDDY, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2300]
Causal Inference with Cocycles

Many interventions in causal inference can be represented as transformations of the variables of interest. Abstracting interventions in this way allows us to identify a local symmetry property exhibited by many causal models under interventions. Where present, this symmetry can be characterized by a type of map called a cocycle, an object that is central to dynamical systems theory. We show that such cocycles exist under general conditions and are sufficient to identify interventional distributions and, under suitable assumptions, counterfactual distributions. We use these results to derive cocycle-based estimators for causal estimands and show that they achieve semiparametric efficiency under standard conditions. Since entire families of distributions can share the same cocycle, these estimators can make causal inference robust to mis-specification by sidestepping superfluous modelling assumptions. We demonstrate both robustness and state-of-the-art performance in several simulations, and apply our method to estimate the effects of 401(k) pension plan eligibility on asset accumulation using econometric data.

Based on joint work with Hugh Dance (UCL/Gatsby Unit): https://arxiv.org/abs/2405.13844

WUYANG CHEN, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2300]
Towards Data-Efficient and OOD Generalization of Scientific Machine Learning Models

In recent years, there has been growing promise in coupling machine learning methods with domain-specific physical insights to solve scientific problems based on partial differential equations (PDEs). However, there are two critical bottlenecks that must be addressed before scientific machine learning (SciML) can become practically useful. First, SciML requires extensive pretraining data to cover diverse physical systems and real-world scenarios. Second, SciML models often perform poorly when confronted with unseen data distributions that deviate from the training source, even when dealing with samples from the same physical systems that have only slight differences in physical parameters. In this line of work, we aim to address these challenges using data-centric approaches. To enhance data efficiency, we have developed the first unsupervised learning method for neural operators. Our approach involves mining unlabeled PDE data without relying on heavy numerical simulations. We demonstrate that unsupervised pretraining can consistently reduce the number of simulated samples required during fine-tuning across a wide range of PDEs and real-world problems. Furthermore, to evaluate and improve the out-of-distribution (OOD) generalization of neural operators, we have carefully designed a benchmark that includes diverse physical parameters to emulate real-world scenarios. By evaluating popular architectures across a broad spectrum of PDEs, we conclude that neural operators achieve more robust OOD generalization when pretrained on physical dynamics with high-frequency patterns rather than smooth ones. This suggests that data-driven SciML methods will benefit more from learning from challenging samples.

Mathematics of Machine Learning

HANS DE STERCK, University of Waterloo
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2300]
Fast Multipole Attention for Transformer Neural Networks

Transformer-based machine learning models have achieved state-of-the-art performance in many areas. However, the quadratic complexity of the self-attention mechanism in Transformer models with respect to the input length hinders the applicability of Transformer-based models to long sequences. To address this, we present Fast Multipole Attention (FMA), a new attention mechanism that uses a divide-and-conquer strategy to reduce the time and memory complexity of attention for sequences of length n from $\mathcal{O}(n^2)$ to $\mathcal{O}(n \log n)$ or $\mathcal{O}(n)$, while retaining a global receptive field. The hierarchical approach groups queries, keys, and values into $\mathcal{O}(\log n)$ levels of resolution, where groups at greater distances are increasingly larger in size and the weights to compute group quantities are learned. As such, the interaction between tokens far from each other is considered in lower resolution in an efficient hierarchical manner. This multi-level divide-and-conquer strategy is inspired by fast summation methods from n-body physics and the Fast Multipole Method. We perform evaluation on autoregressive and bidirectional language modeling tasks and compare our FMA model with other efficient attention variants on medium-size datasets. We find empirically that the Fast Multipole Transformer outperforms other efficient transformers in terms of memory size and accuracy. The FMA mechanism has the potential to empower large language models with greater sequence lengths, taking the full context into account in an efficient, naturally hierarchical manner during training and when generating long sequences.

NICK HARVEY, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2300]
When Online Learning Meets Stochastic Calculus

Online learning is a theoretical framework for learning and optimization without statistical assumptions on the data. Optimization methods developed in this setting are usually robust and have formal notions of worst-case or adaptive performance. A recent line of work has looked at online learning through the lens of differential equations and continuous-time analysis. This viewpoint has yielded new understanding of classical results, and has also led to new optimal results for several problems. In this talk I will discuss a few uses of stochastic calculus in the design and analysis of online learning methods, focusing on the classical problem of prediction with experts' advice.

Joint work with Chris Liaw (Google Research), Sikander Randhawa (UBC) and Victor Sanches Portella (University of São Paulo).

MIRANDA HOLMES-CERFON, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2300]
Programmable assembly: inverse design of materials from discrete components

Particles and discrete objects on the scale of nanometres to micrometres, such as colloids, DNA bricks, proteins, transistors, etc, are increasingly being used as building blocks for new materials, with a variety of applications such as in optics, drug delivery, energy harvesting, and nanorobotics. A goal for theory and simulation is to build algorithms and design principles to find the building blocks that assemble into a structure of interest. This is a challenge due to the high-dimensionality of the systems of interest, the presence of strong noise, and the sometimes far-from-equilibrium conditions, making standard optimization algorithms inapplicable and demanding new approaches. I will describe our group's progress on finding optimal conditions for "addressable self-assembly", a system of particles where each building block is distinct and has a specific location in the target structure, and that assembles spontaneously under thermal fluctuations. I will show how using tools derived from machine learning can generate novel solutions for small systems, and will point out challenges in extending these tools to more complex systems.

SAMUEL LANTHALER, Caltech
[Saturday November 30 / samedi 30 novembre, 10:00 – R 2300]
Generative AI for the statistical computation of fluids

In recent years, there has been growing interest in the use of neural networks for the data-driven approximation of PDE solution operators. This talk will focus on a recent application of neural networks to the statistical computation of fluid flows. In this application, the choice of training objective is observed to lead to stark differences in the empirically achieved results. I will argue that implicit constraints, related to limitations of what is practically achievable by deep learning, could provide a theoretical explanation of these observations.

MATHIAS LECUYER, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2300]
Adaptive Randomized Smoothing: Certified Adversarial Robustness for Multi-Step Defences

ML theory usually considers model behaviour in expectation. In practical deployments however, we often expect models to be robust to adversarial perturbations, in which a user applies deliberate changes to on input to influence the prediction a target model. For instance, such attacks have been used to jailbreak aligned foundation models out of their normal behaviour. Given the complex models that we now deploy, how can we enforce such robustness properties while keeping model flexibility and utility ?

I will present recent work on Adaptive Randomized Smoothing (ARS), an approach we developed to certify the predictions of test-time adaptive models against adversarial examples. ARS extends the analysis of randomized smoothing using f-Differential Privacy, to certify the adaptive composition of multiple steps during model prediction. We show how to instantiate ARS on deep image classification to certify predictions against adversarial examples of bounded ℓ_∞ norm.

KE LI, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2300]
Rethinking Regression: Insights from Machine Learning

Regression problems arise every time one would like to predict a continuous-valued variable, be it the colour of a pixel, a 3D position, a system configuration or a feature vector. It is well known that regression with square loss yields the conditional mean as the prediction. This is undesirable when there could be many predictions that are all correct, since the conditional mean would effectively average over these predictions and could be far from any of them. As an example, when the prediction takes the form of an image, the conditional mean tends to be blurry and desaturated. On the other hand, in classification problems, ambiguity in labels does not cause an issue because classifiers produce a distribution over class labels as output. Is it possible to get the best of both worlds ? In this talk, I will show how to do so using a simple technique, known as conditional Implicit Maximum Likelihood Estimation.

WENLONG MOU, University of Toronto
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2300]
Continuous-time reinforcement learning: blessings of elliptic structures and high-order approximations

Reinforcement learning (RL) for controlling continuous-time diffusion processes has attracted significant research interest in recent years. A key challenge is accurately estimating the value function for an unknown system, given only discretely observed trajectory data. While model-free RL methods offer the flexibility of advanced function approximations, they struggle with long effective horizons and lack the precision of model-based approaches.

In this talk, I present recent developments in the design of continuous-time policy evaluation algorithms, introducing a novel class of Bellman equations. These methods integrate the flexibility of RL techniques with the precision of high-order numerical

schemes. Among other results, I will highlight how the underlying elliptic structures provide strong theoretical guarantees, even as the effective horizon extends to infinity. Finally, I will discuss how these theoretical insights inform practical algorithmic design.

RAHUL PARHI, University of California, San Diego
[Saturday November 30 / samedi 30 novembre, 8:30 – R 2300]
Deep Learning Meets Sparse Regularization

Deep learning has been wildly successful in practice and most state-of-the-art artificial intelligence systems are based on neural networks. Lacking, however, is a rigorous mathematical theory that adequately explains the amazing performance of deep neural networks. In this talk, I present a new mathematical framework that provides the beginning of a deeper understanding of deep learning. This framework precisely characterizes the functional properties of trained neural networks. The key mathematical tools which support this framework include transform-domain sparse regularization, the Radon transform of computed tomography, and approximation theory. This framework explains the effect of weight decay regularization in neural network training, the importance of skip connections and low-rank weight matrices in network architectures, the role of sparsity in neural networks, and explains why neural networks can perform well in high-dimensional problems.

DANICA SUTHERLAND, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2300]
Expander Graphs and Low-Distortion Embeddings for Learning on Graphs

Graphs are a natural model for many domains we would like to learn on, and graph neural networks based on local message passing have seen success on various problems. In other areas of machine learning, however, Transformers (based on pairwise "attention") are the dominant recent machine learning model. Yet Graph Transformers have had significant scaling problems because of the quadratic full everything-to-everything attention. This talk presents a line of work addressing this problem: first, in Exphormer ("expander" + "transformer"), we exploit expander graphs to create a sparse graph to augment the original problem graph, for limited attention but good expansion properties across layers. Exphormer helps scale (computationally and statistically) graph Transformers to much larger graphs, obtaining state-of-the-art results on many kinds of graph problems. On many very large graphs (e.g. social networks or protein-protein interaction networks), though, even the original problem's graph is too large for practical learning ; we thus build an extension called Spexphormer ("sparse Exphormer"), which further constrains attention to "important" edges, dramatically reducing memory usage. We finally present a theoretical account of situations where Spexphormer's sparsification is possible, and where it is not.

CHRISTOS THRAMPOULIDIS, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2300]
Implicit Geometry of Next-token Prediction: From Language Sparsity Patterns to Model Representations

How do language models map linguistic patterns to their representations ? Specifically, can the geometry of context and word embeddings be characterized by the structure of the training data ? We demonstrate that, in a large-model regime trained sufficiently long, context and word embeddings emerge from matrix factorization of a logit matrix that decomposes into sparse and low-rank components. As training progresses, the low-rank component becomes dominant and can be computed solely from the sparsity pattern of the training data, determined by unique word-context pairings across the dataset.

SHARAN VASWANI, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2300]
Global Convergence of Softmax Policy Gradient for Stochastic Bandits

Though policy gradient (PG) methods have played a vital role in the achievements of reinforcement learning (RL), the theoretical understanding of these methods is quite limited. Consequently, we focus on stochastic bandit problems (the simplest RL setting)

and study the convergence of softmax policy gradient (SPG), a commonly used RL algorithm. Despite the non-concavity of the underlying objective function, recent research has leveraged the objective's smoothness and gradient domination properties to establish the convergence of SPG to an optimal policy. However, these results require setting the SPG parameters according to unknown problem-dependent quantities (e.g. the optimal action or the true reward vector in a bandit problem). We address this limitation by proposing to use SPG with exponentially decreasing step sizes. Specifically, we prove that the resulting algorithm offers similar theoretical guarantees as the state-of-the-art without requiring the knowledge of oracle-like quantities. However, using such decreasing step-sizes adversely affects the algorithm's empirical performance. Consequently, we analyze the algorithm from a different perspective and show that SPG with any constant step-size can asymptotically converge to a globally optimal policy almost surely.

ANDREW WARREN, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2300]
Estimation of one-dimensional structures from noisy empirical observation

Given a data distribution which is concentrated around a one-dimensional structure, can we infer that structure ? We consider versions of this problem where the distribution resides in a metric space and the 1d structure is assumed to either be the range of an absolutely continuous curve, a connected set of finite 1d Hausdorff measure, or a general 1-rectifiable set. In each of these cases, we relate the inference task to solving a variational problem where there is a tradeoff between data fidelity and simplicity of the inferred structure ; the variational problems we consider are closely related to the so-called "principal curve" problem of Hastie and Steutzle as well as the "average-distance problem" of Buttazzo, Oudet, and Stepanov. For each of the variational problems under consideration, we establish existence of minimizers, stability with respect to the data distribution, and consistency of a discretization scheme which is amenable to Lloyd-type numerical methods. Lastly, we consider applications to estimation of stochastic processes from partial observation, as well as the lineage tracing problem from mathematical biology.

YIMING XU, University of Kentucky
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2300]
Statistical Ranking with Dynamic Covariates

The Plackett-Luce model has been widely applied for rank aggregation in sports analytics and social sciences. In this presentation, we consider a covariate-assisted ranking model within the Plackett-Luce framework. Unlike existing approaches focusing solely on pure covariates or individual effects with fixed covariates, our model incorporates individual effects with dynamic covariates. This increased flexibility enhances model fitting by allowing for individualized dynamic ranking but also presents significant challenges in analysis. We address these challenges in the context of maximum likelihood estimation (MLE) under a general graph topology. Specifically, we provide conditions for model identifiability and the unique existence of the MLE, propose an alternating maximization algorithm to compute the MLE, and establish a uniform consistency result. Finally, we demonstrate an application of the proposed model by analyzing a large-scale ATP tennis dataset.

OZGUR YILMAZ, The University of British Columbia
[Saturday November 30 / samedi 30 novembre, 9:00 – R 2300]
Generative compressed sensing with Fourier measurements

In the recent years, it has been established that Deep Generative Models (DGMs) can be used as priors in inverse problems such as denoising, inpainting, medical and seismic imaging, and more. One inverse problem of tremendous interest since 2005 is compressed sensing (CS) – acquisition and provable recovery of sparse signals (or signals with low complexity) from a few, non-adaptive measurements. Recently DGMs have been proposed to replace the sparse signal model in CS, leading to theoretical guarantees and practical performance that improves on "classical compressed sensing" for classes of signals that can modelled well using DGMs when the measurement matrix and/or network weights follow a subgaussian distribution. We move beyond the subgaussian assumption, to measurement matrices that are derived by sampling rows of a unitary matrix (including

subsampled Fourier measurements as a special case). Specifically, we construct model-adapted sampling strategies and prove restricted isometry guarantee for generative compressed sensing with subsampled isometries, leading to recovery bounds with nearly order-optimal sample complexity.

Modeling, Analysis, and Computation of Variational Problems

Org: Xinyang Lu (Lakehead University) and/et **Chong Wang** (Washington and Lee University)

Variational problems are widespread in both the physical and biological sciences. This scientific session aims to bring together researchers to discuss recent advances in the analysis, and computation of variational problems, with applications in physics, biology, and materials science.

Schedule/Horaire **Room/Salle: R 2505**

Sunday December 1 **dimanche 1er décembre**

8:00 - 8:30	Bo Li (University of California San Diego), *The Legendre-Transformed Poisson-Boltzmann Electrostatics* (p. 181)
8:30 - 9:00	Theodore Kolokolnikov (Dalhousie University), *Agent-based models: examples from from bacterial aggregation and epidemic models* (p. 180)
9:00 - 9:30	Sookyung Joo (Old Dominion University), *stability of nematic state in periodically modulated nematic phases* (p. 180)
9:30 - 10:00	Guanying Peng (Worceser Polytechnic Institute), *A regularizing property of the 2D Eikonal equation* (p. 182)
10:00 - 10:30	Rossitza Marinova (Concordia University of Edmonton), *Variational Approach for Computing Solitary-Wave Solutions* (p. 181)
15:00 - 15:30	Hansol Park (Dalhousie University), *Emergent behavior of mathematical models on manifolds* (p. 181)
15:30 - 16:00	Zhichun Zhai (MacEwan University), *A nonlinear equation induced by fractional $p-$convexity* (p. 182)
16:00 - 16:30	Chong Wang (Washington and Lee Univeristy), *Core Shells, Double Bubbles, and Lens Clusters in Ternary Nonlocal Isoperimetric Problems* (p. 182)
16:30 - 17:00	Xin Yang Lu (Lakehead University), *Geometry of minima in co-polymer models* (p. 181)

Abstracts/Résumés

SOOKYUNG JOO, Old Dominion University
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2505]
stability of nematic state in periodically modulated nematic phases

Nematic liquid crystals composed of bent-core molecules may exhibit periodically modulated structure. One of these phases is the twist bend nematic phase where the molecules are arranged in a heliconical structure with a nanoscale pitch. This can be characterized when the bend elastic constant is much smaller than both splay and twist elastic ones. We study the model of the twist bend nematic phase that allows the bend elastic constant to be small but in the positive range and attain its minimizer in one dimensional setting. We also characterize the parameter regime for the stability of the global and local minimizers of the nematic phase under the homeotropic boundary condition. Numerical simulations based on the constrained minimization is used to illustrate the predictions of the analysis. This is a joint work with C. Garcia-Cervera, T. Giorgi, and Z. Li.

THEODORE KOLOKOLNIKOV, Dalhousie University
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2505]
Agent-based models: examples from from bacterial aggregation and epidemic models

Agent-based models are widely used in numerous applications. They have an advantage of being easy to formulate and to implement on a computer. On the other hand, to get any mathematical insight (motivated by, but going beyond computer

simulations) often requires looking at the continuum limit where the number of agents becomes large. In this talk I give two examples.

1. Consider the following model of bacterial motion. Bacteria moves at random, except that with some "switching rate", the bacteria will choose a random neighbour within its "sensing radius" and reorient itself towards it. For sufficiently large switching rate, aggregation patterns (clumps of bacteria) can form. Under reasonable assumptions, the continuum limit of this model results in a nonlinear fourth-order PDE. The resulting PDE gives further insights, including the clump profile and stability. 2. We present a simple model of disease spread that incorporates spatial variability in population density. Starting from first-principles ABM model, we derive a novel PDE with state-dependent diffusion. Consistent with observations, this model exhibit higher infection rates in the areas of higher population density. The model also exhibits an infection wave whose speed varies with population density. In addition, we demonstrate possibility of super-diffusive propagation of infection, whereby an infection can "jump" across areas of low population density towards the areas of high population density. Finally, a case study of coronavirus spread in Nova Scotia is presented with qualitatively similar features as our model, including density-dependent infection rates and infection that jumps across main population centers.

BO LI, University of California, San Diego
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2505]
The Legendre-Transformed Poisson-Boltzmann Electrostatics

The Poisson-Boltzmann (PB) equation for continuum electrostatics is the Euler-Lagrange equation of the PB electrostatic energy functional of electrostatic potentials. The Legendre-transformed PB (LTPB) electrostatic energy functional of all electric displacements is a convex functional dual to the PB functional. It is shown that both formulations are equivalent. A penalty model based on the LTPB electrostatics is constructed and applied to the dielectric variational solvation of charged molecules. The related numerical algorithms, computational results, and convergence analysis are presented.

XIN YANG LU, Lakehead University
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2505]
Geometry of minima in co-polymer models

Energies governing the behavior of copolymers often contain a local term, plus a long range interaction. Generally speaking, the former has a coagulating effect, preferring fewer but bigger components, while the latter has a splitting effect, preferring smaller, more numerous components. Therefore, optimal configurations must arrange themselves to strike a balance between those two competing forces. In this talk, we will present some recent results in this direction.

ROSSITZA MARINOVA, Concordia University of Edmonton
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2505]
Variational Approach for Computing Solitary-Wave Solutions

We present a variational approach for effectively identifying solitons within a specific mathematical framework. This method involves minimizing a functional to obtain solutions that exhibit solitonic behavior. To validate the approach, we provide numerical results that demonstrate its computational efficiency and effectiveness. Our findings show that this method achieves high accuracy in solving the relevant problems, highlighting its robustness in capturing key features of soliton dynamics. As a result, the approach proves to be both accurate and highly efficient across a range of soliton-related problems.

HANSOL PARK, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2505]
Emergent behavior of mathematical models on manifolds

In this talk, I consider a free energy functional on Cartan-Hadamard manifolds, and investigate the existence of its global minimizers. The energy functional consists of two components: an entropy (or internal energy) and an interaction energy

modelled by an attractive potential. The two components have competing effects, as they favour spreading by linear diffusion and blow-up by nonlocal attractive interactions, respectively. I introduce necessary and sufficient conditions for existence of ground states for manifolds with sectional curvatures bounded above and below, respectively. In particular, for general Cartan-Hadamard manifolds, superlinear growth at infinity of the attractive potential prevents the spreading. The behaviour can be relaxed for homogeneous manifolds, for which only linear growth of the potential is sufficient for this purpose.

GUANYING PENG, Worcester Polytechnic Institute
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2505]
A regularizing property of the 2D Eikonal equation

The 2D Eikonal equation is closely related to the variational analysis of a classical energy functional, namely, the Aviles-Giga functional in connection with smectic liquid crystals and thin film blisters. In the variational setting, significant effort has been devoted towards understanding solutions of the 2D Eikonal equation with low fractional Besov regularity. Notably, weak solutions under certain low regularity conditions exhibit automatic regularization. In this talk, I will present a new regularizing effect for weak solutions of the 2D Eikonal equation under a weak fractional Besov regularity. This regularity lies at the borderline between continuity and the presence of vortex singularities. This is joint work with Xavier Lamy and Andrew Lorent.

CHONG WANG, Washington and Lee University
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2505]
Core Shells, Double Bubbles, and Lens Clusters in Ternary Nonlocal Isoperimetric Problems

We study a two-dimensional inhibitory ternary system characterized by a free energy functional that combines a short-range interface interaction energy, which promotes micro-domain growth, with a Coulomb-type long-range interaction energy that prevents the unlimited spreading of micro-domains. We analyze two distinct scenarios. In the first scenario, two species are vanishingly small while one species is dominant. We investigate the global minimizers of the associated ternary local isoperimetric problem and demonstrate how the geometry of minimizers evolves as surface tensions vary. This transition progresses from symmetric double bubbles, through asymmetric double bubbles, to core-shell structures. We then examine the influence of nonlocal interactions, focusing particularly on a degenerate case where minimizers exhibit a core-shell geometry, as this phase configuration aligns with physical expectations for nonlocal ternary systems. In the second scenario, two species are dominant, and one species is vanishingly small. In this case, we distinguish two energy levels: the zeroth-order energy, which encodes the optimal arrangement of the dominant constituents, and the first-order energy, which determines the shape of the vanishing constituent. We also shows that, for any optimal configuration, the vanishing phase must lie at the boundary between the two dominant constituents, forming lens clusters or vesica piscis.

ZHICHUN ZHAI, MacEwan University
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2505]
A nonlinear equation induced by fractional $p-$convexity

In our study of the connection between fractional convexity and the fractional p-Laplace operator, we derive a nonlocal and nonlinear equation. We begin by proving the existence and uniqueness of the viscosity solution to this equation. Subsequently, we demonstrate that $u(x)$ is a viscosity sub-solution of the equation if and only if $u(x)$ possesses the property of $(\alpha, p)-$convexity. Finally, we characterize the viscosity solution of this equation as the envelope of an $(\alpha, p)-$convex sub-solution. Our approach leverages the attainability of the exterior data and a comparison principle for the nonlocal, nonlinear equation.

Operator Theory, Function Theory, and Geometry: Connections to Corona Problems and Geometric Analysis

Org: Alexander Brudnyi and/et **Mahishanka Withanachchi** (University of Calgary)

This session will explore the latest research in operator theory, function theory, and geometric analysis, with a special focus on the Corona problem and its variants. We invite submissions that highlight theoretical advancements and practical applications in scientific fields such as physics, engineering, computer science, and biology. Join us to share insights and foster interdisciplinary collaborations.

Schedule/Horaire **Room/Salle: R 2525**

Saturday November 30 **samedi 30 novembre**

15:00 - 15:30	Akram Aldroubi (Vanderbilt), *Dynamical sampling: source term recovery and frames* (p. 183)
15:30 - 16:00	Ilia Binder (University of Toronto), *Conformal Dimension of Planar fractals.* (p. 183)
16:00 - 16:30	Krystal Taylor (Ohio State), *Efficient Coverings of Fractal sets by curves* (p. 185)
16:30 - 17:00	Alex Brudnyi (University of Calgary), *Runge-Type Approximation Theorem for Banach-valued H^∞ Functions on a Polydisk* (p. 184)
17:00 - 17:30	Ludovick Bouthat (Université Laval), *Exploring Hadamard multipliers on weighted Dirichlet spaces through L-matrices* (p. 184)
17:30 - 18:00	Maria Pereyra (New Mexico) (p. 185)

Sunday December 1 **dimanche 1er décembre**

9:00 - 9:30	Damir Kinzebulatov (Université Laval), *Feller generators with singular drifts in the critical range* (p. 184)
9:30 - 10:00	Raphael Clouatre (Manitoba), *Joint spectra and annihilators in multivariate operator theory* (p. 184)
10:00 - 10:30	Eric Sawyer (McMaster), *Probabilistic and Deterministic Fourier Extension* (p. 185)
15:00 - 15:30	William Verreault (Toronto), *The Cesàro Operator on local Dirichlet spaces* (p. 185)
15:30 - 16:00	Pierre Olivier (UQTR) (p. 185)
16:00 - 16:30	Nina Zorboska (Manitoba), *Hankel measures and Hankel type operators on weighted Dirichlet spaces* (p. 186)
16:30 - 17:00	Zhichun Zhai (MacEwan University), *Stengthened Fractional Sobolev Inequalities and Geometric Inequalities* (p. 186)
17:00 - 17:30	Mahishanka Withanachchi (University of Calgary), *Vanishing Cohomology and the Corona Problem for the Algebra of Bounded Holomorphic Functions on the Polydisk* (p. 186)

Abstracts/Résumés

AKRAM ALDROUBI, Vanderbilt University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2525]
Dynamical sampling: source term recovery and frames

In this talk, I will address the problem of recovering a source terms in a discrete dynamical system represented by $x_{n+1} = Ax_n + w$, where x_n is the n-th state in a Hilbert space $\mathcal{H}$, A is a bounded linear operator in $\mathcal{B}(\mathcal{H})$, and w is a source term within a closed subspace W of $\mathcal{H}$. The focus is on the stable recovery of w using time-space sample measurements formed by inner products with vectors from a Bessel system $\mathcal{G} \subset \mathcal{H}$. These types of results may be relevant to applications such as environmental monitoring, where precise source identification is critical. This work is in collaboration with Rocio Diaz Martin Le Gong, Javad Mashreghi, and Ivan Medri.

Operator Theory, Function Theory, and Geometry: Connections to Corona Problems and Geometric Analysis

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ILIA BINDER, University of Toronto
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2525]
Conformal Dimension of Planar fractals.

The *conformal dimension* of a set is the minimal Hausdorff dimension of its quasisymmetric image. In this talk, I will discuss the conformal dimensions of various planar fractals, including Bedford-McMullen sets and self-affine fractal percolation clusters. I will also demonstrate that the Brownian graph is *minimal*, meaning its conformal dimension is $3/2$, which is also its Hausdorff dimension.

This work is a collaboration with Hrant Hakobyan from Kansas State University and Wenbo Li from Peking University.

LUDOVICK BOUTHAT, Université Laval
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2525]
Exploring Hadamard multipliers on weighted Dirichlet spaces through L-matrices

The Hadamard product of two power series is obtained by multiplying them coefficientwise. In 2020, Mashreghi and Ransford characterized those power series that act as Hadamard multipliers on all weighted Dirichlet spaces on the disk with super-harmonic weight. These power series correspond to those whose associated L-matrix defines a bounded operator on ℓ^2. An L-matrix is an infinite matrix $\mathcal{L}$ whose entries are of the form $\mathcal{L}_{i,j} = a_{\max\{i,j\}}$ for some complex sequence $(a_n)_{n\geq 0}$. In this talk, we present several conditions on the sequence $(a_n)_{n\geq 0}$ for $\mathcal{L}$ to be a bounded operator on ℓ^2 and we present a particular set of L-matrices for which we are able to exactly determine the norm.

This work is a collaboration with Javad Mashreghi.

ALEX BRUDNYI, University of Calgary
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2525]
Runge-Type Approximation Theorem for Banach-valued H^∞ Functions on a Polydisk

Let $\mathbb{D}^n \subset \mathbb{C}^n$ be the open unit polydisk, $K \subset \mathbb{D}^n$ be an n-ary Cartesian product of planar sets, and $\widehat{U} \subset \mathfrak{M}^n$ be an open neighbourhood of the closure $\bar{K}$ of K in $\mathfrak{M}^n$, where $\mathfrak{M}$ is the maximal ideal space of the algebra H^∞ of bounded holomorphic functions on $\mathbb{D}$. Let X be a complex Banach space and $H^\infty(V, X)$ be the space of bounded X-valued holomorphic functions on an open set $V \subset \mathbb{D}^n$. We show that any $f \in H^\infty(U, X)$, where $U = \widehat{U} \cap \mathbb{D}^n$, can be uniformly approximated on K by ratios h/b, where $h \in H^\infty(\mathbb{D}^n, X)$ and b is the product of interpolating Blaschke products such that $\inf_K |b| > 0$. Moreover, if $\bar{K}$ is contained in a compact holomorphically convex subset of $\widehat{U}$, then h/b above can be replaced by h for any f. The results follow from a new constructive Runge-type approximation theorem for Banach-valued holomorphic functions on open subsets of $\mathbb{D}$ and extend the fundamental results of Suarez on Runge-type approximation for analytic germs on compact subsets of $\mathfrak{M}$. They can also be applied to the long-standing corona problem which asks whether $\mathbb{D}^n$ is dense in the maximal ideal space of $H^\infty(\mathbb{D}^n)$ for all $n \geq 2$.

RAPHAEL CLOUATRE, University of Manitoba
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2525]
Joint spectra and annihilators in multivariate operator theory

For an appropriately regular, single Hilbert space contraction T, it is known that the spectrum can be described in terms of the annihilator, that is the ideal $\mathrm{Ann}(T)$ of bounded holomorphic functions f on the unit disc satisfying $f(T) = 0$. Indeed, the spectrum coincides with the so-called support of $\mathrm{Ann}(T)$. In this talk, we explore the extent to which a similar statement is valid for commuting tuples of operators $T = (T_1, T_2, \ldots, T_d)$. The corresponding multivariate notion of support for $\mathrm{Ann}(T)$ is rather subtle. We will give a more concrete description of the support in terms of the zero set of $\mathrm{Ann}(T)$ when it is assumed that the underlying space of holomorphic functions has the Corona property.

Operator Theory, Function Theory, and Geometry: Connections to Corona Problems and Geometric Analysis

DAMIR KINZEBULATOV, Université Laval
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2525]
Feller generators with singular drifts in the critical range

I will discuss recent progress on a long standing problem of describing admissible singular drifts of Brownian motion. The first part deals with a sharp result on the magnitude of drift singularities that separates well-posedness from a blow up. This requires us to work, not quite expectedly, in appropriate "critical" Orlicz space (a rather compelling instance of the Lp theory). Informally, it turned out that strengthening appropriately the topology of the space where the Kolmogorov backward equation is considered allows to handle stronger singularities of the drift. This leads to the second part of the talk (joint with Yu.A.Semenov) on the Feller semigroup and a detailed well-posedness theory of the corresponding martingale problem for the entire subcrticial range of the mangitudes of singularities of the drift. The proof uses in a crucial manner some operator-theoretric techniques, such as Trotter's approximation theorem.

PIERRE OLIVIER, UQTR
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2525]

MARIA PEREYRA, New Mexico
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2525]

ERIC SAWYER, McMaster University
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2525]
Probabilistic and Deterministic Fourier Extension

We discuss the proof of the probabilistic Fourier extension theorem, and possible applications to the deterministic conjecture.

KRYSTAL TAYLOR, Ohio State University
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2525]
Efficient Coverings of Fractal sets by curves

A classic theorem of Davies states that a set of positive Lebesgue measure can be covered by lines in such a way that the union of the set of lines has the same measure as the original set. This surprising and counter-intuitive result has a dual formulation in the form of a prescribed projection theorem. We investigate an analogue of these results in which lines are replaced by shifts of a fixed curve. In particular, we show that a measurable set in the plane can be covered by translations of a fixed open curve, obeying some mild curvature assumptions, in such a way that the union of the translated curves has the same measure as the original set. Our results rely on a Venetian blind construction and extend to transversal families of projections. As an application, we consider how duality between curves and points can be used to construct nonlinear Kakeya sets.

WILLIAM VERREAULT, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2525]
The Cesàro Operator on local Dirichlet spaces

The family of Cesàro operators σ_n^α, $n \geq 0$ and $0 \leq \alpha \leq 1$, consists of finite rank operators on Banach spaces of analytic functions on the open unit disc. We investigate these operators as they act on the local Dirichlet spaces $\mathcal{D}_\zeta$. It is well-established that they provide a linear approximation scheme when $\alpha > \frac{1}{2}$, with the threshold value $\alpha = \frac{1}{2}$ being optimal. We strengthen

this result by deriving precise asymptotic values for the norm of these operators when $\alpha \leq \frac{1}{2}$, corresponding to the breakdown of approximation schemes. Additionally, we establish upper and lower estimates for the norm when $\alpha > \frac{1}{2}$.

This is joint work with Eugenio Dellepiane, Javad Mashreghi, and Mostafa Nasri.

MAHISHANKA WITHANACHCHI, University of Calgary

[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2525]

Vanishing Cohomology and the Corona Problem for the Algebra of Bounded Holomorphic Functions on the Polydisk

In this talk, we study the Corona problem for the Banach algebra $H^\infty(\mathbb{D}^n)$ of bounded holomorphic functions on the polydisk $\mathbb{D}^n \subset \mathbb{C}^n$. In this setting, the Corona problem asks whether the polydisk $\mathbb{D}^n$ is dense in the Gelfand topology in the maximal ideal space of $H^\infty(\mathbb{D}^n)$. We present new necessary and sufficient conditions under which the problem can be solved. An important part of our work is a new result on the vanishing of the first cohomology of a sheaf of germs of holomorphic functions on the n-fold Cartesian product of the maximal ideal space of $H^\infty(\mathbb{D})$. Our method is based on a new important result on the solution of special $\overline{\partial}$ equations on a polydisk. This is a joint work with Alex Brudnyi.

ZHICHUN ZHAI, MacEwan University

[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2525]

Stengthened Fractional Sobolev Inequalities and Geometric Inequalities

This study has two primary objectives. The first is to enhance fractional Sobolev-type inequalities in Besov spaces using the framework of classical Lorentz spaces. In this process, we establish that the Sobolev inequality in Besov spaces is equivalent to the fractional Hardy inequality and an iso-capacitary-type inequality.

The second objective is to strengthen fractional Sobolev-type inequalities in Besov spaces through capacitary Lorentz spaces associated with Besov capacities. To achieve this, we first analyze the embedding of the associated capacitary Lorentz space into the classical Lorentz space. Subsequently, we establish the embedding of the Besov space into the capacitary Lorentz space. Additionally, we demonstrate that these embeddings are intricately connected to iso-capacitary-type inequalities, interpreted through a newly introduced fractional $(\beta, p, q)-$perimeter. Furthermore, we provide characterizations of more general Sobolev-type inequalities in Besov spaces.

NINA ZORBOSKA, University of Manitoba

[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2525]

Hankel measures and Hankel type operators on weighted Dirichlet spaces

I will talk about Hankel measures and the boundedness of measure induced Hankel type operators on weighted Dirichlet spaces, extending the known results for the cases of the classical Hardy and Dirichlet spaces. The approach relies on recent results on weak products of complete Nevanlinna-Pick reproducing kernel Hilbert spaces.

Optimization, control, dynamics and stochastics: interplay and applications

Org: Eric Foxall (University of British Columbia), **Jinniao Qiu** (University of Calgary) and/et **Zhongwei Shen** (UA)

Optimization, control, dynamics, and stochastics are fundamental concepts in applied mathematics and various scientific disciplines. Significant progress has been made in these fields, as well as in their interactions. The purpose of this session is to bring together researchers from related areas to share recent advancements, exchange ideas on future directions, and foster collaboration.

Schedule/Horaire **Room/Salle: WSOD 1950**

Sunday December 1 **dimanche 1er décembre**

8:00 - 8:30	Amy Hurford (Memorial University), *Optimal control strategies for community and traveler isolation under resource constraints* (p. 187)
8:30 - 9:00	Xiong Wang (Johns Hopkins University) (p. 189)
9:00 - 9:30	Pouria Ramazi (Brock University), *Towards Optimizing Vaccine Uptake Through Tailored Communication Strategies* (p. 189)
9:30 - 10:00	Siddharth Sabharwal (Texas A&M University), *Population Size in Stochastic Ecological Dynamics* (p. 189)
10:00 - 10:30	Eric Foxall (University of British Columbia Okanagan), *Optimal control of ribosome population for gene expression under periodic nutrient intake* (p. 187)
15:00 - 15:30	Kexue Zhang (Queen's University), *Impulsive Synchronization of Complex Networks: an Event-Triggered Pinning Algorithm* (p. 190)
15:30 - 16:00	Jiniao Qiu (University of Calgary), *A particle consensus approach to solving nonconvex-nonconcave min-max problems* (p. 188)
16:00 - 16:30	Tyler Meadows (Queen's University), *Optimizing biomass production in bioreactors* (p. 188)
16:30 - 17:00	Nhu Nguyen (University of Rhode Island), *Stochastic Approximation and Applications* (p. 188)
17:00 - 17:30	Zhongwei Shen (University of Alberta), *WKB Approximation of Quasi-stationary Distributions with Applications* (p. 189)
17:30 - 18:00	Yang Yang (University of Calgary), *Infinite dimensional optimal control differential systems with randomness and path-dependence* (p. 189)

Abstracts/Résumés

ERIC FOXALL, UBC Okanagan

[Sunday December 1 / dimanche 1er décembre, 10:00 – WSOD 1950]

Optimal control of ribosome population for gene expression under periodic nutrient intake

Ribosomes are molecular machines that build proteins out of available amino acid resources, and are largely made up of those resources. There is evidence that ribosomes are actively degraded when resources are scarce, and then reassembled once resources become more plentiful. In order to understand why, we formulate a model of protein production that allows for varying resource input and control over the ribosome population, and pose the following optimization problem: subject to periodically varying resource input, find the (time-dependent) rates of ribosome degradation and assembly that yield the highest, constant (with respect to time) rate of protein production. Using a quasi-static approximation that we justify analytically, we find that in optimal solutions, the ribosome population varies in response to the input, suggesting that the intense regulation observed in experiments occurs in order to maximize protein production. Joint work with Luca Ciandrini, Khanh Dao Duc and Clément Soubrier.

Optimization, control, dynamics and stochastics: interplay and applications

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AMY HURFORD, Memorial University
[Sunday December 1 / dimanche 1er décembre, 8:00 – WSOD 1950]
Optimal control strategies for community and traveler isolation under resource constraints

Health authorities allocate limited resources to support the isolation of infected community members and travelers to reduce infectious disease spread. We consider an epidemic model and characterize the optimal controls. When resources are not limiting, if the maximum daily isolation rate is high, the optimal control corresponds to an elimination strategy, which results in a small outbreak of short duration. However, if the maximum daily isolation rate is low, the optimal control corresponds to a mitigation strategy, which results in a large outbreak of short duration. When resources are limiting, the optimal control is any strategy that uses all available resources, including circuit breaker strategies of this type, which results in a large outbreak of a duration ranging from short to long. We recommend implementing control measures at the start of an outbreak, as this action is always optimal, and is consistent with the precautionary principle, which recommends action even when important information, such whether resources will be limiting, is unknown. The elimination strategy results in substantially smaller outbreaks of short duration, and increasing the maximum daily isolation rate, or increasing the total resources available so as to achieve elimination, is likely optimal in some circumstances. Our modelling could be reformulated to consider multiple outbreaks over a fixed period of time, and would then serve as a suitable framework to further explore the conditions for when travel measures are an optimal control.

TYLER MEADOWS, Queen's University
[Sunday December 1 / dimanche 1er décembre, 16:00 – WSOD 1950]
Optimizing biomass production in bioreactors

A chemostat is a simple bioreactor used to study microorganisms under controlled conditions. Similar bioreactors are used to mass produce microorganisms and harvest important metabolites, such as biofuels and antibiotics. In this talk, we consider a control problem in the chemostat where the flow rate is used to maximize the amount of biomass harvested from the fermentation vessel.

NHU NGUYEN, University of Rhode Island
[Sunday December 1 / dimanche 1er décembre, 16:30 – WSOD 1950]
Stochastic Approximation and Applications

This work develops new results for stochastic approximation algorithms. The emphases are on treating algorithms and limits with discontinuities. The main ingredients include the use of differential inclusions, set-valued analysis, and non-smooth analysis, and stochastic differential inclusions. Under broad conditions, it is shown that a suitably scaled sequence of the iterates has a differential inclusion limit. In addition, it is shown for the first time that a centered and scaled sequence of the iterates converges weakly to a stochastic differential inclusion limit. The results are then used to treat several application examples including Markov decision process, Lasso algorithms, Pegasos algorithms, support vector machine classification, and learning. Some numerical demonstrations are also provided.

JINIAO QIU, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 15:30 – WSOD 1950]
A particle consensus approach to solving nonconvex-nonconcave min-max problems

A zero-order optimization method is introduced for sequential min-max problems based interacting particles. The systems are coupled so that one population aims to solve the inner maximization problem, while the other aims to solve the outer minimization problem. The dynamics are characterized by a consensus-type interaction with additional stochasticity to promote exploration of the objective landscape. Without relying on convexity or concavity assumptions, theoretical convergence guarantees of the algorithm are established via a suitable mean-field approximation of the particle systems. Numerical experiments

illustrate the validity of the proposed approach. In particular, the algorithm is able to identify a global min-max solution, in contrast to gradient-based methods, which typically converge to possibly suboptimal stationary points. This talk is based on joint work with Giacomo Borghi and Hui Huang.

POURIA RAMAZI, Brock University
[Sunday December 1 / dimanche 1er décembre, 9:00 – WSOD 1950]
Towards Optimizing Vaccine Uptake Through Tailored Communication Strategies

In this talk, I will explore how decision-making strategies influence vaccine uptake, focusing on two key groups: evidence-based decision-makers, who prioritize immediate personal benefits, and social-based decision-makers, who rely on the experiences and behaviors of others. The proportions of these two types within a population are critical in determining vaccine uptake, a well-established theoretical insight. I will demonstrate that these proportions are both theoretically identifiable and practically estimable. By presenting fitting results from jurisdictions across the USA and Canada, I will show that these proportions can vary significantly. These findings pave the way for developing tailored communication strategies to influence each group's decisions, ultimately optimizing public health efforts and enhancing vaccine promotion effectiveness.

SIDDHARTH SABHARWAL, Texas A&M University
[Sunday December 1 / dimanche 1er décembre, 9:30 – WSOD 1950]
Population Size in Stochastic Ecological Dynamics

We study how environmental stochasticity influences the long-term population size in certain one- and two-species models. The difficulty is that even when one can prove that there is coexistence, it is usually impossible to say anything about the invariant probability measure which describes the coexisting species. We are able to circumvent this problem for some important ecological models by noticing that the per-capita growth rates at stationarity are zero, something which can sometimes yield information about the invariant probability measure. For more complicated models we use a recent result by Cuello to explore how small noise influences the population size. We are able to showcase that sometimes environmental fluctuations lead to an increase in the population sizes, contrary to the Cushing-Henson conjecture. Further we look at the interaction of dispersal and environmental stochasticity in an n-patch model. We are able to prove persistence and extinction results even in the setting when the the dispersal rates are stochastic.

ZHONGWEI SHEN, University of Alberta
[Sunday December 1 / dimanche 1er décembre, 17:00 – WSOD 1950]
WKB Approximation of Quasi-stationary Distributions with Applications

Quasi-stationary distribution (QSD) is a powerful tool in characterizing the local dynamics of a dynamical system under noise perturbations. Its WKB approximation can be used to extract essential dissipative and conservative structures, thus aiding in gaining a clearer understanding of the local dynamics under noise perturbations. This talk is dedicated to discussing recent mathematical advancements surrounding the WKB approximation of QSDs and their applications to the potential-landscape and flux framework and Helmholtz decomposition.

XIONG WANG, Johns Hopkins University
[Sunday December 1 / dimanche 1er décembre, 8:30 – WSOD 1950]

YANG YANG, University of Calgary
[Sunday December 1 / dimanche 1er décembre, 17:30 – WSOD 1950]
Infinite dimensional optimal control differential systems with randomness and path-dependence

Optimization, control, dynamics and stochastics: interplay and applications

This talk is devoted to the stochastic optimal control problem of infinite-dimensional differential systems allowing for both path-dependence and measurable randomness. As opposed to the deterministic path-dependent cases studied by Bayraktar and Keller [J. Funct. Anal. 275 (2018), 2096–2161], the value function turns out to be a random field on the path space and it is characterized by a stochastic path-dependent Hamilton-Jacobi (SPHJ) equation. A notion of viscosity solution is proposed and the value function is proved to be the unique viscosity solution to the associated SPHJ equation.

KEXUE ZHANG, Queen's University

[Sunday December 1 / dimanche 1er décembre, 15:00 – WSOD 1950]

Impulsive Synchronization of Complex Networks: an Event-Triggered Pinning Algorithm

Complex networks (CNs) consist of an extensive collection of nodes, which are usually modelled by dynamical systems, and these nodes are connected according to specific topological structures. As a typical collective behavior, the synchronization of CNs has been investigated extensively due to its wide applications in various scientific fields ranging from biology and engineering to physics and sociology. As a particular type of feedback control, impulsive control uses impulses, which are state abrupt changes or jumps at a sequence of discrete times, to achieve network synchronization. The impulsive control paradigm has proven robust and efficient in network synchronization.

In this talk, we discuss the synchronization problem for a class of CNs with a pinning impulsive control approach. We propose a novel event-triggering algorithm to determine the impulse times and then introduce sufficient conditions on the network topology, impulsive control gains, and parameters in the event-triggering conditions to guarantee network synchronization. Next, we introduce an adaptive tuning method on the network coupling strength to allow arbitrary pinning schemes for the event-triggered impulsive controller. With the adaptive coupling strength, the synchronization of CNs can be realized via the proposed control method with an arbitrary selection of the pinning nodes.

Recent Advances in Differential Equations and Applications

Org: Elena Braverman (University of Calgary) and/et **Kunquan Lan** (Toronto Metropolitan University)

The talks of the session will reflect recent progress in the area of ordinary, fractional, delay differential and partial differential equations, and their applications to Mathematical Biology and Medicine.

Schedule/Horaire **Room/Salle: R 2435**

Saturday November 30 samedi 30 novembre

8:00 - 8:30	Kunquan Lan (Toronto Metropolitan University), *Have the classical Riemann-Liouville fractional integrals been fully understood before ?* (p. 192)
8:30 - 9:00	Yuming Chen (Wilfrid Laurier University), *An algebraic approach to determining negative (semi-)definiteness in applying the Lyapunov direct method* (p. 192)
9:00 - 9:30	Hermann Eberl (University of Guelph), *A spatio-temporal model of blossom blight* (p. 192)
9:30 - 10:00	Qi Deng (York University), *Modeling the Interaction of Cytotoxic T-lymphocytes and Oncolytic Viruses in a Tumor Microenvironment* (p. 192)
15:00 - 15:30	Chongming Li (Queen's University), *Evolutionary Stability of Bacterial Persister Cells* (p. 193)
15:30 - 16:00	Olga Vasilyeva (Memorial University of Newfoundland, Grenfell Campus), *Steady states and evolution of dispersal in river networks* (p. 193)
16:00 - 16:30	Gail Wolkowicz (McMaster University), *Decay Consistent Models of Growth, Competition, and Predation* (p. 193)
16:30 - 17:00	Kexue Zhang (Queen's University), *Input-to-State Stability in Terms of Two Measures* (p. 194)
17:00 - 17:30	Elena Braverman (University of Calgary), *On logistic models incorporating various diffusion strategies with and without harvesting* (p. 191)

Sunday December 1 dimanche 1er décembre

8:30 - 9:00	Yuanxi Yue (Memorial University of Newfoundland), *Traveling wavefronts for the Belousov-Zhabotinsky system with non-local delayed interaction* (p. 194)
9:00 - 9:30	Zhisheng Shuai (University of Central Florida, USA), *Impact of Incidence Functions on Epidemiological Model Dynamics: Mass Action vs. Standard Incidence* (p. 193)
9:30 - 10:00	Sue Ann Campbell (University of Waterloo), *Time Delays, Symmetry and Hopf Bifurcation in Oscillator Networks* (p. 192)

Abstracts/Résumés

ELENA BRAVERMAN, University of Calgary
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2435]
On logistic models incorporating various diffusion strategies with and without harvesting

Defining a diffusion strategy as the tendency to have a distribution proportional to a certain positive prescribed function, once a diffusion coefficient grows infinitely. We explore the interplay of harvesting and dispersal strategies and their influence on the outcome of the competition for two resourse-sharing species. While achieving extinction by excessive culling of the undesired species in many cases is a simple and efficient strategy, keeping biodiversity is a more complicated task. Proposing such heterogeneous harvesting that the two managed populations become an ideal free pair allows to guarantee coexistence. The directed movement is modeled by the term which particular form is $\Delta(u/P)$, where P is the target distribution. However, when P is not aligned with the carrying capacity of the environment, a unique positive solution u^* of the Neumann problem

is different from P. Another conclusion that we manage to deduce is that, once an invading species manages to mimic the observed distribution of the host species and has some advantage in the carrying capacity, this guarantees successful invasion. However, the conditions under which the host species can sustain, other than targeted culling of invaders or trimming both populations, is still an open question.

SUE ANN CAMPBELL, University of Waterloo
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2435]
Time Delays, Symmetry and Hopf Bifurcation in Oscillator Networks

We consider networks of oscillator nodes with time delayed, global circulant coupling. We first study the existence of Hopf bifurcations induced by coupling time delay, and then use symmetric Hopf bifurcation theory to determine how these bifurcations lead to different patterns of phase-locked oscillations. We apply the theory to a variety of systems inspired by biological neural networks to show how Hopf bifurcations can determine the synchronization state of the network. Finally we show how interaction between two Hopf bifurcations corresponding to different oscillation patterns an induce complex torus solutions in the network.

YUMING CHEN, Wilfrid Laurier University
[Saturday November 30 / samedi 30 novembre, 8:30 – R 2435]
An algebraic approach to determining negative (semi-)definiteness in applying the Lyapunov direct method

In this talk, we first present a novel approach in determining the specific form of a Lyapunov function when the type of its candidate is given. Then we apply this approach to autonomous polynomial differential systems. Applications to some epidemic models described by polynomial differential systems indicate that the discussion on global stability can be greatly simplified.

QI DENG, York University
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2435]
Modeling the Interaction of Cytotoxic T-lymphocytes and Oncolytic Viruses in a Tumor Microenvironment

Oncolytic virotherapy has become a promising approach in treating cancer. In this talk, we will discuss a mathematical model, which is developed to understand the interaction among immune cells, Oncolytic viruses, and tumor cells. The basic reproductive number (R_0) is derived, and the local and global dynamics of the system are analyzed in terms of R_0 and another related threshold R_0^E. The theoretical results suggest that the system have periodic solutions and bifurcations. Numerical simulations further show that the immune response plays an obstructive role on virotherapy, and once the immune cell proliferation rate exceeds a threshold, the tumor will escape.

HERMANN EBERL, University of Guelph
[Saturday November 30 / samedi 30 novembre, 9:00 – R 2435]
A spatio-temporal model of blossom blight

Fireblight is a bacterial disease of apple and pear trees that can wipe out an entire orchard in one season. We present a model for fireblight during blooming season. It consists of two semi-linear PDEs that describe pathogen dispersal, which are coupled in each point of the domain to two ODEs that describe the host flowers. Numerical simulations suggest the existence of Travelling Waves which we then set out to prove using upper and lower solutions and a fix-point argument.

KUNQUAN LAN, Toronto Metropolitan University
[Saturday November 30 / samedi 30 novembre, 8:00 – R 2435]
Have the classical Riemann-Liouville fractional integrals been fully understood before ?

In this presentation, I shall present the new notion of a generalized Riemann-Liouville (R-L) fractional integral and properties including its domain and range. The new notion and properties provide new insight and understanding into the classical R-L fractional integral and its properties. Based on the new generalized R-L fractional integral, when one intends to employ the semigroup property involving the classical R-L fractional integral operator, derivative of a second order fractional R-L fractional integral or a variety of first order fractional integral equations, one should use the generalized R-L fractional integral operator instead of using the classical R-L fractional integral operator. Therefore, some previous well-known results are not precise.

CHONGMING LI, Queen's University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2435]
Evolutionary Stability of Bacterial Persister Cells

We model the switching process of bacteria between antibiotic dormant features and normal active replication using an integro-reaction-diffusion-advection partial differential equation (PDEs). The PDE captures the impacts of epigenetic inheritance of metabolic state by implementing a non-local term that models a birth jump process. We prove the well-posedness of the non-local PDE model followed by the corresponding stability analysis of the positive steady-state solutions. Of primary interest is an extension of the model to a wider scenario of biological evolution by examining the evolutionarily stable strategies (ESSs) of persister cells. The idea is that genetic mutations will occasionally occur, and these mutations can alter any of the parameters describing the persister cell dynamics. As a first step we prove that, in a finite dimensional version of the model, the ESS strain is one that optimizes resource consumption irrespective of its pattern of dormancy. The next step will be to apply semigroup methods to the infinite dimensional system.

ZHISHENG SHUAI, University of Central Florida
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2435]
Impact of Incidence Functions on Epidemiological Model Dynamics: Mass Action vs. Standard Incidence

The selection of incidence functions in epidemiological models plays a critical role in shaping the disease dynamics, particularly in populations of varying sizes. In this presentation, we examine a model that incorporates post-infection mortality and partial immunity, comparing the effects of mass-action and standard incidence functions. With the mass-action incidence, the model exhibits periodic solutions under certain parameter conditions. In contrast, applying the standard incidence reduces the likelihood of periodic solutions, potentially eliminating them entirely.

OLGA VASILYEVA, Memorial University of Newfoundland, Grenfell Campus
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2435]
Steady states and evolution of dispersal in river networks

Steady states of nonlinear reaction-diffusion-advection (RDA) models can be viewed as solutions of a system of two first order ODEs (subject to appropriate boundary conditions). Geometrically, they are represented by orbits in the phase plane, generated by the corresponding flow operator. In this talk, I will discuss applications of the phase plane technique in a logistic RDA model in a river network setting. Here, a steady state is represented by a configuration of orbits in the corresponding phase plane satisfying geometric constraints induced by junction and boundary conditions. While in a single river case the basic shape of the steady state is determined by the boundary conditions, in the case of a river network, it is significantly affected by the geometry of the network (lengths of the segments and their cross-section areas). In a joint work with F. Lutscher and D. Smith, we exploit this phenomenon in the context of evolution of dispersal in a Y-shaped network. Namely, we consider the possibility of invasion of a steady state of a resident species by a species with different diffusivity. It turns out that the outcome of this interaction depends on the geometry of the network as well.

GAIL WOLKOWICZ, McMaster University
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2435]
Decay Consistent Models of Growth, Competition, and Predation

Incorporating delay in various models of population interactions will be explored including competition and predation. In all of the models, any terms representing growth of a population take into consideration that individuals that do not survive, do not contribute to the growth of the population. The models are formulated so that survival is consistent with the decline terms in the model.

YUANXI YUE, Memorial university of Newfoundland
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2435]
Traveling wavefronts for the Belousov-Zhabotinsky system with non-local delayed interaction

This talk presents a novel investigation into propagation dynamics of the Belousov-Zhabotinsky system with non-local delayed interaction, which exhibits dynamical transition structure from bistable to monostable. We address the enduring open problem on the existence, uniqueness and the speed sign of the bistable traveling waves. In the monostable case, we introduce new results for the minimal wave speed selection, which, as an application, further improved the existing investigations on pushed and pulled wavefronts. Our results can provide new estimate to the minimal speed as well as to the determinacy of the transition parameters. Moreover, these results can be directly applied to standard localized models and delayed reaction diffusion models by choosing appropriate kernel functions.

KEXUE ZHANG, Queen's University
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2435]
Input-to-State Stability in Terms of Two Measures

Stability in terms of two measures encompasses a range of stability notions, such as partial stability, conditional stability, eventual stability, and practical stability. The concept of input-to-state stability (ISS) captures how external inputs affect the stability of control systems and has proven highly effective for stability analysis and control design in dynamical systems. This talk focuses on the two-measure version of ISS for nonlinear systems. We introduce various stability concepts for nonlinear systems and then explain the two-measure stability concept. This unified approach encourages us to examine ISS within the context of two measures, enabling analysis of external inputs' effects on entire states, partial states, periodic orbits, invariant sets, and more. Finally, we present sufficient conditions to ensure two-measure ISS for nonlinear systems and discuss potential applications of this approach.

Recent Progress of Stochastic Analysis and Related Fields

Org: Yu-Ting Chen (University of Victoria) and/et **Thomas Hughes** (University of Bath)

This special session will present recent results on stochastic analysis and the related fields of random walks and discrete spatial stochastic models. Topics of stochastic analysis welcome include, but are not limited to, heat kernels, SDEs with singular drift, Gaussian measure theory, SPDEs, and superprocesses.

Schedule/Horaire **Room/Salle: R 2960**

Saturday November 30 samedi 30 novembre

8:00 - 8:30	Damir Kinzebulatov (Université Laval), *Singular SDEs with critical and super-critical drifts* (p. 196)
8:30 - 9:00	Te-Chun Wang (University of Victoria), *Asymptotics and the sub-limit at L^2-criticality of higher moments for the SHE in dimension $d \geq 3$* (p. 198)
9:00 - 9:30	Kodjo Raphael Madou (McGill University), *Recent advances in non-local operators: singular SDEs and heat kernel bounds* (p. 197)
9:30 - 10:00	Jinniao Qiu (University of Calgary), *Viscosity solutions of a class of second-order Hamilton-Jacobi-Bellman Equations in the Wasserstein Space* (p. 197)
15:00 - 15:30	Zoe Huang (UNC Chapel Hill) (p. 196)
15:30 - 16:00	Lucas Teyssier (Univeristy of British Columbia) (p. 198)
16:00 - 16:30	Arturo Arellano Arias (McGill University), *A shape theorem for the convex hull of d-dimensional branching Brownian motion in periodic environments.* (p. 195)
16:30 - 17:00	Saraí Hernández-Torres (National Autonomous University of Mexico), *Minkowski content of the scaling limit of 3D loop-erased random walk* (p. 196)
17:00 - 17:30	Mathav Murugan (University of British Columbia), *Heat kernel for reflected diffusion and extension property on uniform domains* (p. 197)
17:30 - 18:00	Shuwen Lou (Loyola University of Chicago) (p. 197)

Sunday December 1 dimanche 1er décembre

8:00 - 8:30	Yaozhong Hu (University of Alberta) (p. 196)
8:30 - 9:00	Zachary Selk (Queen's University), *Rough Paths above Weierstrass Functions* (p. 197)
9:00 - 9:30	Brock Klippenstein (University of Manitoba), *Fast Analytical-Numerical Hybrid Methods for Solving the Cosmic Ray Fokker-Planck Equation* (p. 196)
9:30 - 10:00	Thomas Hughes (University of Bath), *Stochastic PDEs with the compact support property: the stable noise regime* (p. 196)
10:00 - 10:30	Xiaowen Zhou (Concordia University), *Speeds of coming down from infinity for Λ-Fleming-Viot supports* (p. 198)

Abstracts/Résumés

ARTURO ARELLANO ARIAS, McGill University

[Saturday November 30 / samedi 30 novembre, 16:00 – R 2960]

A shape theorem for the convex hull of d-dimensional branching Brownian motion in periodic environments.

We consider the long-time behaviour of a "heterogeneous" binary branching Brownian motion (BBM) in which the branching rate depends on where the branching event occurs. More precisely, for a positive function g, the instantaneous branching rate of a particle at location x is characterized by $g(x)$ (we refer to this as g-BBM). When g is periodic, we expect that the

microscopic effects of g average out on large scales, and the process should exhibit asymptotically homogeneous behaviour. Nevertheless, the heterogeneity of the branching rate introduces new technical challenges.

In this talk, I will prove a shape theorem for the convex hull of the g-BBM in all dimensions, namely that there exists a deterministic set $\mathcal{W}$ such that almost surely as $t \to \infty$, the convex hull of the g-BBM approximates $t\mathcal{W}$. This talk is based on joint work in progress with Louigi Addario-Berry (McGill) and Jessica Lin (McGill).

SARAÍ HERNÁNDEZ-TORRES, Instituto de Matemáticas, UNAM
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2960]
Minkowski content of the scaling limit of 3D loop-erased random walk

The loop-erased random walk (LERW) is a model for random self-avoiding curves. Since its introduction by Lawler in the early 1980s, the scaling limits of LERW have been thoroughly studied. While these limits are well-understood in dimensions 2 and 4 and higher, the three-dimensional case presents unique challenges.

This talk will present recent advances on the Minkowski content of the scaling limit of the three-dimensional LERW. Due to the absence of essential tools in the continuum in this dimension, key parts of the analysis are carried out in discrete space. Specifically, we establish sharp estimates for the one-point function and ball-hitting probabilities for the LERW on $\mathbb{Z}^3$. This talk is based on joint work with Xinyi Li and Daisuke Shiraishi.

YAOZHONG HU, University of Alberta
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2960]

ZOE HUANG, UNC Chapel Hill
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2960]

THOMAS HUGHES, University of Bath
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2960]
Stochastic PDEs with the compact support property: the stable noise regime

A solution to the heat equation with non-negative, non-zero initial data is strictly positive. This property generalizes to most parabolic PDEs, but not necessarily to stochastic PDEs. The solution to a heat equation with multiplicative noise may be a compactly supported function, depending on the regularity of the noise coefficient. I will first discuss some classical theorems of this type when the equation has white Gaussian noise, and then discuss a recent result which proves the compact support property for solutions to a class of stochastic heat equations with white stable noise. Along the way we will develop some heuristics for why this property holds, sketch some proof techniques, and discuss connections with superprocesses.

DAMIR KINZEBULATOV, Université Laval
[Saturday November 30 / samedi 30 novembre, 8:00 – R 2960]
Singular SDEs with critical and super-critical drifts

In this talk, I will discuss recent progress on weak and strong well-posedness of SDEs with critical and super-critical singularities in the drift. In particular, I will talk about the minimal value of thermal excitation needed to overcome blow ups due to the presence of attracting singularities in the drift that arise e.g. in the Keller-Segel type interacting particle systems immersed in a turbulent flow. The PDE and the probabilistic instruments include a variant of De Giorgi's method in Lp with p chosen in a way that allows to reach the critical magnitude of the singularities of the drift, and a modification of the approach of Rockner-Zhao needed to prove strong well-posedness. The talk is based in part on joint papers with K.R.Madou, Yu.A.Semenov and R.Vafadar.

BROCK KLIPPENSTEIN, University of Manitoba
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2960]
Fast Analytical-Numerical Hybrid Methods for Solving the Cosmic Ray Fokker-Planck Equation

When energetic particles such as cosmic rays travel through magnetized plasma, they encounter turbulent magnetic fields. This in turn renders the equation of motion very difficult to apply. Hence, we instead work with the Fokker-Planck partial differential equation, which gives us the probability of finding the particle at a certain time, position, and velocity. Here, we talk about methods which allow for fast solving the Fokker-Planck equation.

SHUWEN LOU, Loyola University of Chicago
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2960]

KODJO RAPHAEL MADOU, McGill University
[Saturday November 30 / samedi 30 novembre, 9:00 – R 2960]
Recent advances in non-local operators: singular SDEs and heat kernel bounds

I will survey recent developments in non-local operators, focusing on SDEs with weakly form-bounded drifts and heat kernel bounds in the supercritical case. The talk is based in part on joint papers with D.Kinzebulatov and Yu.A.Semenov.

MATHAV MURUGAN, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2960]
Heat kernel for reflected diffusion and extension property on uniform domains

We obtain heat kernel estimates for reflected diffusion on uniform domains where the underlying ambient space admits a diffusion that satisfies sub-Gaussian heat kernel bounds. A key novelty of our work is the use of an extension operator that extends functions from the domain of the Dirichlet form for the reflected diffusion to that of the diffusion in the ambient space.

JINNIAO QIU, University of Calgary
[Saturday November 30 / samedi 30 novembre, 9:30 – R 2960]
Viscosity solutions of a class of second-order Hamilton-Jacobi-Bellman Equations in the Wasserstein Space

The talk is about solving a class of second-order Hamilton-Jacobi-Bellman (HJB) equations in the Wasserstein space, arising from mean field control problems involving common noise. We provide the well-posedness of viscosity solutions to the HJB equation in the sense of Crandall-Lions' definition, under general assumptions on the coefficients. Our approach adopts the smooth metric developed by Bayraktar, Ekren, and Zhang [Proc. Amer. Math. Soc.(2023)] as our gauge function for the purpose of smooth variational principle used in the proof of comparison theorem. Subsequently, we derive further estimates and regularity of the metric, including a novel second-order derivative estimate with respect to the measure variable, in order to ensure its uniqueness and existence. The talk is based on joint work with Hang Cheung and Ho Man Tai.

ZACHARY SELK, Queen's University
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2960]
Rough Paths above Weierstrass Functions

Although rough paths theory is typically applied to differential equations driven by stochastic processes, it is not inherently a random theory. Weierstrass functions are examples of Hölder continuous yet nowhere differentiable functions. Surprisingly,

even though Weierstrass functions are the most classical example of the type of function rough paths theory was invented to handle, until recently no one has constructed a rough path above it. In this talk, we discuss the construction of a rough path above vector valued Weierstrass functions. Joint work with Francesco Cellarosi (arXiv:2304.11646, to appear in C. R. Math. Acad. Sci. Paris).

LUCAS TEYSSIER, Univeristy of British Columbia
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2960]

TE-CHUN WANG, University of Victoria
[Saturday November 30 / samedi 30 novembre, 8:30 – R 2960]
Asymptotics and the sub-limit at L^2-criticality of higher moments for the SHE in dimension $d \geq 3$

In this talk, we consider a renormalization of the d-dimensional stochastic heat equation (SHE) when the mollification parameter is turned off. Recently, the limiting higher moments of the two-dimensional mollified SHE have been established, and a phase transition is found at L^2-criticality. In particular, the non-Gaussianity of the limit is proved. By contrast, the above convergences in high dimensions ($d \geq 3$) still remain unknown. To this aim, we will prove this conjecture by showing a completely opposite phenomenon in high dimensions. Moreover, we will provide partial results for a conjecture about the critical coupling constants of the continuous directed polymer.

XIAOWEN ZHOU, Concordia University
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2960]
Speeds of coming down from infinity for Λ-Fleming-Viot supports

Λ-Fleming-Viot process is a probability-measure valued process that is dual to a Λ-coalescent involving multiple collisions. It is well known that such processes can have the compact support property, i.e. its support becomes finite as soon as $t > 0$ even though the initial measure has an unbounded support.

For Λ-Fleming-Viot processes with Brownian spatial motion and with the associated Λ-coalescents coming down from infinity, applying the lookdown representation we obtain asymptotic results characterizing how fast the supports become finite near time 0. Our results are expressed using the asymptotics of tail distribution of the initial measure and speed function of coming down from infinity for the associated Λ-coalescent.

This talk is based on joint work with Zenghu Li and Huili Liu.

Scalable learning analytics and feedback tools for large undergraduate classrooms

Org: **Lindsey Daniels** (University of British Columbia)

Large class sizes pose unique challenges in providing individualized, timely, and actionable feedback to instructors and students. Mathematical tools and techniques can assess and analyze student course work to bring the student voice into a more active role of teaching and learning in large scale courses.

Schedule/Horaire **Room/Salle: R 2500**

Sunday December 1 **dimanche 1er décembre**

8:30 - 9:00	Lindsey Daniels (University of British Columbia), *Utilizing text analytics, data visualizations, and regression to inform teaching and feedback in large enrollment courses* (p. 199)
9:00 - 9:30	Aden Chan (University of British Columbia), *A framework for utilizing online grading software to deliver efficient assessment and feedback to students* (p. 199)
9:30 - 10:00	Kenneth G. Monks (University of Scranton), *Proof Verification with Lurch* (p. 200)
10:00 - 10:30	Matt Coles and Kelly Paton (University of British Columbia), *Student experience of group work in a large first-year calculus course: measuring, facilitating, improving* (p. 199)

Abstracts/Résumés

ADEN CHAN, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2500]
A framework for utilizing online grading software to deliver efficient assessment and feedback to students

In large undergraduate classrooms, efficient assessment and feedback mechanisms are critical for supporting diverse student needs and maintaining instructional quality. However, collection and analysis of this data often requires a massive effort and insight into established data collection methods. This presentation will explore the use of a home-grown open-source software, which facilitates on-paper assessments while enabling marking online optimizing the marking process and generating detailed learning analytics. The software automatically tracks key metrics, including individual and aggregate student grades by question, marking times, question discrimination, and question difficulty providing valuable insights into student performance, question efficacy, and marking practices. Specifically, we will explore the use of the software in analyzing the data for a second year engineering course, and discuss the scalability of the methodology to large enrolment courses.

MATT COLES AND KELLY PATON, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2500]
Student experience of group work in a large first-year calculus course: measuring, facilitating, improving

We describe in-class group work and group homework assignments in a large (4000 student) both Calc 1 and 2. The scale of the course imposes constraints and challenges in delivery of the course but also in data gathering. We will explore how we frame, guide, and try to capture the student experience, as well as share what students have to say. With the third iteration of the course we address improvements and look to future directions.

LINDSEY DANIELS, The University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2500]
Utilizing text analytics, data visualizations, and regression to inform teaching and feedback in large enrollment courses

Scalable learning analytics and feedback tools for large undergraduate classrooms

Diagnostic tools are often utilized to gauge student mastery of prerequisite skills and preparedness for a given course. These tools often take the form of a multiple choice assessment, where information can be gleaned from both correct and incorrect choices. However, these tools do not allow for more nuanced information about student thought processes and activated mathematical tools in solutions. At the same time, in large enrollment courses, there is a high degree of heterogeneity, where students have a variety of backgrounds, skill sets, and motivations, and providing individualized action-oriented feedback is challenging. In this project, we propose a framework for a diagnostic tool designed to provide nuanced information about a student cohort's preparedness in a scalable way that can be leveraged to inform both teaching and student feedback.

KENNETH G. MONKS, University of Scranton
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2500]
Proof Verification with Lurch

Would your students benefit from an easy-to-use, open-source, web-based word processor that could check their assigned mathematical proofs? In this talk we introduce *Lurch*, our software project designed specifically for this purpose. We will explain how you can use this software and accompanying course materials, and customize it for your own purposes. While existing proof verification tools like Lean, Isabelle, Coq, and Mizar are powerful and effective, they often have steep additional learning curves and can be difficult to customize. We will explain how the custom *Lurch* validation algorithm overcomes these challenges, and pose some questions for future work. Additional information is available at lurch.plus.

Structure-Preserving Discretizations and their Applications

Org: Jingwei Hu (University of Washington), **Steven Ruuth** (Simon Fraser University) and/et **Andy Wan** (UC Merced)

Structure-preserving discretizations are numerical approximations that respect important properties of mathematical models at the discrete level. This special session aims to bring together leading experts working on structure-preserving methods and their applications to share their knowledge and foster potential future collaborations.

Schedule/Horaire **Room/Salle: R 2590**

Sunday December 1 **dimanche 1er décembre**

8:30 - 9:00	Chunyi Gai (University of Northern British Columbia), *Pattern Formation and Spike Dynamics in the Presence of Noise* (p. 202)
9:00 - 9:30	Yuzhe Qin (UBC), *A second-order accurate numerical scheme for the Poisson-Nernst-Planck-Navier-Stokes (PNPNS) system* (p. 202)
9:30 - 10:00	Mayya Tokman (UC Merced), *Exponential integration and applications* (p. 203)
10:00 - 10:30	Andy Wan (UC Merced), *Minimal ℓ^2 Norm Discrete Multiplier Method* (p. 203)
15:00 - 15:30	Vrushali Bokil (Oregon State), *Structure Preserving Discretizations for Magnetohydrodynamics* (p. 201)
15:30 - 16:00	John Bowman (University of Alberta), *Conservative, Symplectic, and Exponential Integrators* (p. 201)
16:00 - 16:30	Nilima Nigam (Simon Fraser), *Structure-preservation and the Steklov eigenfunctions* (p. 202)
16:30 - 17:00	Seth Taylor (McGill), *A functional discretization of the coadjoint action on the diffeomorphism group* (p. 203)
17:00 - 17:30	Daniel Venn (Simon Fraser), *Meshfree Integration Techniques for Scattered Data on Curves and Surfaces* (p. 203)
17:30 - 18:00	Siqi Wei (Saskatchewan), *Operator-splitting methods for qualitative property preservation of production-destruction systems* (p. 204)

Abstracts/Résumés

VRUSHALI BOKIL, Oregon State University
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2590]
Structure Preserving Discretizations for Magnetohydrodynamics

In this talk, we consider different models for magnetohydrodynamics (MHD) that incorporate linear (resistive MHD) or nonlinear (Hall MHD) Ohm's laws. We discuss finite difference and finite element methods for these models that preserve at the discrete level important continuum properties, such as the divergence free nature of magnetic and velocity fields. These are important structure preserving properties required in MHD simulations to avoid spurious or non-physical numerical solutions. We discuss recent computational techniques for MHD kinematics as well as full MHD simulations in two spatial dimensions that are based on the framework of the Virtual Element Method which is a generalization of the finite element method to general polygonal and polyhedral meshes.

JOHN BOWMAN, University of Alberta
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2590]
Conservative, Symplectic, and Exponential Integrators

Structure-Preserving Discretizations and their Applications

Novel integration algorithms for initial value problems can be formed by applying conventional explicit discretizations in a transformed space. One can devise integration methods that respect desired properties of ordinary differential equations such as first integrals, positivity, or unitary structure. For example, traditional numerical integration algorithms, which are polynomials in the time step, typically lead to systematic drifts of nonlinear first integrals. For a 4-body classical mechanics problem, we compare conservative integration with conventional symplectic discretization, which conserves only an approximate Hamiltonian.

One can also develop new numerical integration methods that preserve analytical structure by discretizing perturbations of exactly solvable differential equations. For example, exponential integrators are ideal for solving linearly stiff first-order ordinary differential equations, where the nonlinearity varies slowly on the time scale of the linearized equations.

We use the stiff-order criteria of Hochbruck and Ostermann [2005] to derive efficient embedded exponential pairs of high- and low-order estimates to support dynamic time-step adjustment. A key requirement is that the pair be robust: if the nonlinear source function has a nonzero total time derivative, the order of the low-order estimate should never exceed its design value. Robust exponential Runge–Kutta (3,2) and (4,3) embedded pairs that are well-suited to initial value problems with a dominant linearity are constructed.

CHUNYI GAI, University of Northern British Columbia
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2590]
Pattern Formation and Spike Dynamics in the Presence of Noise

Noise plays a crucial role in the formation and evolution of spatial patterns in various reaction-diffusion systems in mathematical biology and ecology. In this talk, I give two examples where noise significantly influences spatial patterning. The first example describes how patterned states can provide a refuge and prevent extinction under stressed conditions. It also illustrates the importance of not only the absolute level of climate change, but also the speed with which it occurs. The second example studies the effect of noise on dynamics of a single spike pattern for the classical Gierer-Meinhardt model on a finite interval.

NILIMA NIGAM, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2590]
Structure-preservation and the Steklov eigenfunctions

Spectral methods for elliptic and time-dependent PDE - in which the approximation space consists of eigenfunctions of the underlying operator - exhibit excellent accuracy properties and are naturally structure-preserving. Most spectral methods in practice use either Dirichlet or Neumann eigenfunctions for this purpose.

In this talk I'll motivate and describe the use of Steklov eigenfunctions as a spectral basis, particularly when solving boundary value problems with mixed data. This is joint work with K. Imeri.

YUZHE QIN, The University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2590]
A second-order accurate numerical scheme for the Poisson-Nernst-Planck-Navier-Stokes (PNPNS) system

In this talk, I will present a second order accurate (in both time and space) numerical scheme for the Poisson-Nernst-Planck-Navier-Stokes system, which describes the ion electro-diffusion in fluids. In particular, the Poisson-Nernst-Planck equation is reformulated as a non-constant mobility gradient flow in the Energetic Variational Approach. The marker and cell finite difference method is chosen as the spatial discretization, which facilitates the analysis for the fluid part. In the temporal discretization, the mobility function is computed by a second order extrapolation formula for the sake of unique solvability analysis, while a modified Crank-Nicolson approximation is applied to the singular logarithmic nonlinear term. Nonlinear artificial regularization terms are added in the chemical potential part, so that the positivity-preserving property could be theoretically proved. Meanwhile, a second order accurate, semi-implicit approximation is applied to the convective term in the PNP evolutionary equation, and the fluid momentum equation is similarly computed. In addition, an optimal rate convergence analysis is provided, based

on the higher order asymptotic expansion for the numerical solution, the rough and refined error estimate techniques. The following combined theoretical properties have been established for the second order accurate numerical method: (i) second order accuracy, (ii) unique solvability and positivity, (iii) total energy stability, and (iv) optimal rate convergence. A few numerical results are displayed to validate the theoretical analysis.

SETH TAYLOR, McGill University
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2590]
A functional discretization of the coadjoint action on the diffeomorphism group

The coadjoint orbits of a Lie group play a fundamental role in the geometry underlying many continuum mechanical systems. In this talk, we will present a geometric integrator designed to preserve this infinite-dimensional geometric structure under discretization without using a finite-dimensional analogue. The key idea behind the construction is the use of a functional discretization of the coadjoint action which avoids truncating the solution in the dual of the Lie algebra. We will present an analysis and numerical results of the application of this integrator, illustrating its unique resolution properties for invariant Hamiltonian systems on the space of diffeomorphisms of a compact manifold. The talk is based on joint work with Jean-Christophe Nave and Xi-Yuan Yin.

MAYYA TOKMAN, University of California, Merced
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2590]
Exponential integration and applications

In this talk we will discuss several ways in which the ideas of exponential integration can be used to construct accurate and efficient schemes for stiff systems of differential equations. We will present a new framework to develop and to analyze new class of schemes we call stiffness resilient methods. Previously proposed exponential integrators are typically derived using either classical or stiff order conditions. These order conditions are complex and difficult to solve to construct high order schemes. Classically derived methods can also suffer from the order reduction phenomenon. The new φ-order conditions we propose allow greatly simplified construction of exponential methods with favorable properties. The structure of the error of these methods is designed to prevent order reduction for many important stiff problems. At the same time stiffness resilient schemes are easy to derive using our proposed approach. In addition, we will discuss new exponential schemes for simulating particle dynamics in the presence of electromagnetic fields. We will show that these methods are highly competitive compared to the state-of-the-art integrators, such as Boris algorithm, which have been used extensively in particle-in-cell (PIC) plasma simulations.

DANIEL VENN, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2590]
Meshfree Integration Techniques for Scattered Data on Curves and Surfaces

We present high-order, meshfree methods for integration on curves and surfaces. Accurately integrating functions defined on surfaces is a challenging task, particularly for implicitly-defined surfaces and those without a readily-available mesh. Our approach is quite general and works as long as scattered points can be generated on the curve or surface of interest. We examine the methods for a variety of surfaces, including those with and without boundary and those defined by level sets. Also of note for our approach is that integration weights can be generated for any point arrangement ; this is useful in the case that function data is only given on a specific sample of points. Analytical convergence results are also presented. Lastly, we use the generated integration weights to impose constraints on partial differential equations on curves or surfaces.

ANDY WAN, University of California, Merced
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2590]
Minimal ℓ^2 Norm Discrete Multiplier Method

Structure-Preserving Discretizations and their Applications

Many dynamical systems possess multiple conserved quantities and preserving such quantities are fundamental for accurate long-term simulations. Well-known examples include energy and momentum for physical systems, but time-dependent conserved quantities may also exist for dissipative systems. Unfortunately, traditional integrators do not in general preserve such quantities, leading to recent developments on general conservative integrators, such as Discrete Gradient Method or Discrete Multiplier Method (DMM). While both approaches can lead to systematic derivation of conservative integrators, they can be difficult to apply in practice for large systems with multiple conserved quantities.

To alleviate such practical difficulty, we introduce the Minimal ℓ^2 Norm Discrete Multiplier Method (MN-DMM) to extend the practical applicability of DMM, where conservative schemes are constructed procedurally. In essence, MN-DMM utilizes a Moore-Penrose pseudoinverse of the discrete multiplier matrix leading to a unique consistent conservative scheme with the minimal ℓ^2 norm via a suitable fixed point iteration. We show the wide applicability of MN-DMM and its relative ease of implementation on various examples.

This is joint work with Erick Schulz (Plexim GmbH).

SIQI WEI, Kwantlen Polytechnic University

[Sunday December 1 / dimanche 1er décembre, 17:30 – R 2590]

Operator-splitting methods for qualitative property preservation of production-destruction systems

When solving a production-destruction system, the numerical solution should respect certain qualitative properties that reflect the physical reality of the system. The SIR model is an example of a production-destruction system. Based on suitable assumption, the solution of the SIR model should preserve the positivity of all variables, conserve the total population, and preserve the monotonicity of the S and R variables. When using operator-splitting methods, three aspects affect the quality of the numerical solution: the splitting strategy of the system, the splitting scheme used for time integration, and the choice of the sub-integration methods. In this talk, we will use the SIR model to discuss how these aspects affect the desired qualitative properties.

Student Research Session

Schedule/Horaire **Room/Salle: R 2155**

Sunday December 1 **dimanche 1er décembre**

8:30 - 9:00	Owen Sharpe (Waterloo) (p. 205)
9:00 - 9:30	Linh Dinh (Dalhousie) (p. 205)
9:30 - 10:00	Scott Wesley (Dalhousie) (p. 206)
10:00 - 10:30	Tanjima Akhter & Adriana-Stefania Ciupeanu (University of Alberta, University of Manitoba) (p. 205)
15:00 - 15:30	Khalil Besrour (Ottawa) (p. 205)
15:30 - 16:00	Aaron Tronsgard (University of Toronto) (p. 206)
16:00 - 16:30	Matt Spragge (Simon Fraser University) (p. 205)
16:30 - 17:00	Michael Astwood (Manitoba), *The Kepler Problem on Pseudo-Riemannian Surfaces* (p. 205)

Abstracts/Résumés

TANJIMA AKHTER & ADRIANA-STEFANIA CIUPEANU, University of Alberta, University of Manitoba
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2155]

MICHAEL ASTWOOD, University of Manitoba
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2155]
The Kepler Problem on Pseudo-Riemannian Surfaces

The generalized Kepler problem seeks to describe a Hamiltonian dynamical system determined by an arbitrary central potential. We introduce the classical Kepler problem as an instructive example and present original results on the generalized Kepler problem. We first demonstrate that the orbits of any Bertrand mechanical system on a pseudo-Riemannian surface of revolution are epitrochoids and provide explicit expressions for the orbital parameters. These results are complemented by numerical experiments using the recent symplectic integration methods of Tao and Pihajoki. We then construct analytic expressions for the super-integrals of the system, making explicit a result of Zagryadskii. Relevant concepts in differential geometry, geometric mechanics, and dynamical systems will be introduced.

KHALIL BESROUR, Ottawa
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2155]

LINH DINH, Dalhousie
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2155]

OWEN SHARPE, Waterloo
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2155]

Student Research Session

MATT SPRAGGE, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2155]

AARON TRONSGARD, University of Toronto
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2155]

SCOTT WESLEY, Dalhousie
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2155]

The Mathematics of Mathematics Education

Org: Egan Chernoff (University of Saskatchewan) and/et **Rina Zazkis** (Simon Fraser University)

As the field of mathematics education continues to expand and evolve, an argument has been made that mathematics is getting left behind in mathematics education. Trending research topics, for example, mathematics anxiety, social justice, classroom technology, pedagogical trends, assessment and evaluation, and many others, while important, are also beginning to eclipse mathematics education research that leans heavily on mathematics. However, a dedicated group of Canadian researchers continues to embrace the mathematics of mathematics education, that is, they further the focus on the teaching, learning and understanding (or understanding better what was understood previously) of various mathematical topics and ideas. Said work will be highlighted and explored in this Education Session of the 2024 Winter Meeting of the Canadian Mathematical Society . Please join us.

Schedule/Horaire **Room/Salle: R 2500**

Saturday November 30 **samedi 30 novembre**

15:00 - 15:30	Rebecca Carter (Queen's University), *Mathematical Inquiry with Concurrent Education Students* (p. 207)
15:30 - 16:00	Sean Chorney (Simon Fraser University), *Teaching Math for Social Insight: A Pedagogy of Mathematising* (p. 208)
16:00 - 16:30	Dan Krause (University of Saskatchewan), *On Assigning Meanings in Mathematics Education* (p. 208)
16:30 - 17:00	Wes Maciejewski (Red Deer Polytechnic), *Teaching Mathematical Practice* (p. 209)
17:00 - 17:30	Gleb Glebov (Simon Fraser University), *The Non-Uniqueness of Decimal Representations and the Modified Long Division* (p. 208)
17:30 - 18:00	Ami Mamolo (Ontario Tech University), *Mathematics in society – what is on the horizon ?* (p. 209)

Sunday December 1 **dimanche 1er décembre**

15:00 - 15:30	Edward Doolittle (First Nations University) (p. 208)
15:30 - 16:00	Egan Chernoff (University of Saskatchewan), *Popularizing the Mathematics of Mathematics Education* (p. 207)
16:00 - 16:30	Alan Pasos (Simon Fraser University), *Coping with Coercion in Logic* (p. 209)
16:30 - 17:00	Peter Taylor (Queen's University), *Discrete Optimization for school and university* (p. 209)
17:00 - 17:30	Nia Tzvetkova and Nahid Walji (UBC), *Incorporating student-perspective resources into a proofs course* (p. 210)
17:30 - 18:00	Rina Zazkis (Simon Fraser University), *Mathematical Incidents and resulting research* (p. 210)

Abstracts/Résumés

REBECCA CARTER, Queen's University
[Saturday November 30 / samedi 30 novembre, 15:00 – R 2500]
Mathematical Inquiry with Concurrent Education Students

In Math 181, concurrent education students engage in mathematical inquiry throughout the semester. The course is not designed to teach a specific set of technical skills; rather, its primary objective is to explore what students can do with mathematics. The focus is on their personal experiences with inquiry-based learning and how these experiences can enhance their ability to incorporate inquiry-driven approaches into future classroom practices. This presentation will offer a "snapshot" of this process, discussing a specific task the students worked on. Additionally, preliminary findings from the research project will be discussed.

The Mathematics of Mathematics Education

EGAN CHERNOFF, University of Saskatchewan
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2500]
Popularizing the Mathematics of Mathematics Education

Many of the areas/topics/branches of mathematics are well represented in the teaching and learning of mathematics, school mathematics, curricula, and mathematics education. For example, geometry, algebra, arithmetic, calculus, topology, trigonometry, number theory, probability and statistics, and more are steadfast staples of mathematics education. The same cannot be said, however, for what I deem a crucial area/topic/branch of mathematics and mathematics education: popularization. Taking my argument a step further, I would argue that the key aspect to popularizing geometry, algebra, arithmetic, calculus, topology, trigonometry, number theory, probability and statistics would be to popularize the teaching and learning of said areas/topics/branches. However, for some reason, this popularization is not happening to the same extent in mathematics as mathematics education. Embracing, then, the mathematics of mathematics education, the purpose of this presentation is to contribute to the betterment of the popularization of mathematics through mathematics education. Popularization of mathematics education, as I will detail, should be drawing upon the popularization of the teaching and learning of mathematics, school mathematics, curricula and mathematics education, which will help wine and dine regular readers, especially those who are and who are not reluctant to reading mathematics for the masses.

SEAN CHORNEY, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 15:30 – R 2500]
Teaching Math for Social Insight: A Pedagogy of Mathematising

In this talk, I will share a pedagogical approach that seeks to improve learning in mathematics. This approach involves asking students to explore a social phenomenon using a mathematical lens. The idea is that by using mathematics, they gain a better understanding of the social issue, what it is, how it functions, and what its limitations are. My research, which follows from this pedagogy, examines how students describe the social practice in mathematical terms as well as how they argue and reason about their stance on the issue. I will share a political districting activity I created to demonstrate how students have used mathematics to make sense of the districting process.

EDWARD DOOLITTLE, First Nations University
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2500]

GLEB GLEBOV, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 17:00 – R 2500]
The Non-Uniqueness of Decimal Representations and the Modified Long Division

This study investigates how students conceptualize the non-uniqueness of decimal representations of rational numbers. Prior mathematics education research has focused on repeating decimals, but this study examines students' conceptualization of a more general concept of the non-uniqueness of decimal representations of decimal fractions. This study analyzes students' conceptualization of the non-uniqueness of decimal representations of rational numbers and relates it to their understanding of repeating decimals and long division. As part of an instructional intervention, the participants saw how to do long division in fractional notation with the intentional underestimation of the quotient. The data consisted of responses to questions, including responses to examples of using the modified long division to rewrite decimal fractions as repeating decimals. Before the instructional intervention, most participants regarded repeating decimals as infinite processes that only approximated rational numbers. After the instructional intervention, the participants began to view repeating decimals as objects rather than processes. The study proposes that the modified long division was crucial in enabling the participants to move toward this conceptual shift.

The Mathematics of Mathematics Education

DAN KRAUSE, University of Saskatchewan
[Saturday November 30 / samedi 30 novembre, 16:00 – R 2500]
On Assigning Meanings in Mathematics Education

There are two broad categories of mathematics taught in school that differ in how meaning is assigned to them by researchers of mathematics. Mathematics that are discovered which possess inherent meaning, and mathematics that are collectively decided upon, i.e. decided meaning. Both inherent and decided meaning become the assigned meaning in the field, as determined by mathematics researchers. In contrast, researchers of mathematics education have additional factors to contend with as meanings are discovered, decided, and assigned within mathematics education. As math education researchers engage in both theoretical and empirical research within the field, particularly, external groups, organizations, and narratives have an influence on the process of assigning meaning to the discoveries and discussions in mathematics education. This talk will discuss the assignment of meaning in mathematics education and examine how some of the external influences are shaping the meaning of concepts in the field of mathematics education.

WES MACIEJEWSKI, Red Deer Polytechnic
[Saturday November 30 / samedi 30 novembre, 16:30 – R 2500]
Teaching Mathematical Practice

The rapid evolution of technology means the mathematics once valued by society has fallen into irrelevance. This is not a new trend ; any curricular topic serves the learner for just a brief period of human history. Acknowledging this, I ask: what might be a curriculum centred on mathematical practices rather than on typical mathematical topics ? Further, what mathematical practices are common across topics ? I'll identify some of these practices, discuss how they could be taught, and call on participants to imagine a transcendental, practice-based curriculum.

AMI MAMOLO, Ontario Tech University
[Saturday November 30 / samedi 30 novembre, 17:30 – R 2500]
Mathematics in society – what is on the horizon ?

Recently, the *Journal of Mathematical Behavior* published a Virtual Special Issue *Mathematics in Society: Exploring the mathematics that underpins social issues* (Eds. Mamolo and Thanheiser). The aim of the VSI was to highlight educational research into the variety of mathematical content, skills, reasoning, behaviours, and disciplinary values needed for, and used in, society. This presentation reflects on the VSI contributions and authors' interpretations of our aim, with an eye toward the mathematical horizon.

ALAN PASOS, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2500]
Coping with Coercion in Logic

The ability to make a logical inference is at the heart of mathematical experience. However, a personal reasoning does not always follow the rules of formal logic. In this study we focus on the responses of one participant to scenarios involving coercive logic (the construct will be defined and exemplified). This allows us to take a detailed look into what guides and what influences the participant's approaches to various scenarios. I will argue for the relevance of coercive logic to mathematics education, in particular, in exploring mathematical reasoning of students.

PETER TAYLOR, Queen's
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2500]
Discrete Optimization for school and university

The Mathematics of Mathematics Education

I am finding that my colleagues in the life-, social, and computer-sciences are less interested in calculus and gravitate more towards discrete processes and patterns in data. This is even reflected in the redesign of their majors—how much and exactly what math to require. That's an interesting trend which should ultimately have significant consequences for the types of problems we work with in both school and teacher education. The good news is that these topics (data-driven investigations, recursive thinking, pattern recognition) are more hands-on, more fun to work with, and support play and mathematical thinking much better than curricula whose sole purpose seems to be to prepare kids for university calculus. I will give a couple of examples.

NIA TZVETKOVA AND NAHID WALJI, University of British Columbia
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2500]
Incorporating student-perspective resources into a proofs course

The Mathematical Proof course at UBC is known amongst students to be a particularly challenging course, since many will have their first encounter with writing proofs. The main goal of our project was to bridge the gap between the perspective of the instructor and that of students currently in the course. This was achieved via the creative input of undergraduate student collaborators who had succeeded in the course in the past. As a team of student-faculty collaborators, we observed that the approach of building student intuition by discussing common misunderstandings and errors is sometimes underserved in mathematical materials, and we sought to redress this balance. This is a joint talk with Nia Tzvetkova.

RINA ZAZKIS, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 17:30 – R 2500]
Mathematical Incidents and resulting research

Mathematics teaching, at any level, involves some unforeseen incidents, which may include unexpected student ideas, solutions or questions. Occasionally, these serve as an inspiration for personal mathematical investigations, as well as for the development of research projects and instructional engagements. I will exemplify several of these "incidents" and describe the resulting research studies and teaching scenarios aimed at investigating and supporting students' mathematical knowledge.

The Theory of Pursuit-Evasion Games

Org: Rylo Ashmore (Memorial University of Newfoundland), **Danny Dyer** (Memorial University of Newfoundland) and/et **Erin Meger** (Queen's University)

The game of Cops and Robbers on graphs has been the flagship graph searching game for nearly four decades. Recently, there have been more developments in the field of graph searching, especially when it comes to deterministic and probabilistic games. In this session, we will highlight some of the most recent results in this highly diverse area. The theory of graph searching games often contains new and novel bounds on different games and their game variants based on the structure of the underlying graphs. In this session, we will highlight new variants of known games, as well as important improvements on long-standing theoretical results.

Schedule/Horaire **Room/Salle: R 2225**

Sunday December 1 **dimanche 1er décembre**

8:00 - 8:30	Melissa Huggan (Vancouver Island University), *Cops and Attacking Robbers: A Shift in Power* (p. 212)
8:30 - 9:00	Todd Mullen (University of Prince Edward Island), *An Empowered Robber* (p. 212)
9:00 - 9:30	Meagan Mann (Queen's University), *A Data-Centric Approach to Cops and Robbers* (p. 212)
9:30 - 10:00	Joy Morris (University of Lethbridge), *Cop numbers of generalised Petersen graphs* (p. 212)
10:00 - 10:30	Amanda Porter (University of Victoria), *Hyperopic Cops and Robbers: Cops with Vision Problems* (p. 213)
15:00 - 15:30	Rylo Ashmore (Memorial University of Newfoundland), *Herding logical cats with Rabin's Theorem* (p. 211)
15:30 - 16:00	Boting Yang (University of Regina), *Constrained Graph Searching on Trees* (p. 213)
16:00 - 16:30	Asiyeh Sanaei (Kwantlen Polytechnic University), *Damage Number of Small Graphs* (p. 213)
16:30 - 17:00	Alex Clow (Simon Fraser University), *Eternal Distance-k Domination in Trees* (p. 211)
17:00 - 17:30	Stephen Finbow (St. Francis Xavier University) (p. 212)

Abstracts/Résumés

RYLO ASHMORE, Memorial University of Newfoundland
[Sunday December 1 / dimanche 1er décembre, 15:00 – R 2225]
Herding logical cats with Rabin's Theorem

In the game of Cat Herding on a graph, one player (the herder) will omnipresently delete edges, while the other player (the cat) is on a vertex of the graph, and will move along any path to a new vertex. The cat's objective is to avoid capture, while the herder tries to hasten it. In an optimally played game on a finite graph, the number of cuts the herder made to isolate the cat is the cat number of the graph.

We discuss automata theory, formal logic, and how these ideas can be used to solve an infinite version of the cat herding game. In particular, we find an equivalence between certain logical sentences and cat-win struc- tures. Using this equivalence with Rabin's Theorem, we obtain a finite time algorithm for identifying cat-win infinite trees and an explicit (trans- finite) herder strategy for herder-win infinite trees. Time-permitting, we may also discuss applications of automatatic techniques to the firefighting problem.

ALEX CLOW, Simon Fraser University
[Sunday December 1 / dimanche 1er décembre, 16:30 – R 2225]
Eternal Distance-k Domination in Trees

The Theory of Pursuit-Evasion Games

This talk considers the eternal distance-k domination problem, a variant of the eternal domination problem where guards can move any distance $t \in \{0, 1, \ldots, k\}$ on their turn. We prove upper and lower bounds for the eternal distance-k domination number of a graph in terms of order, maximum degree, and k, before showing that both bounds are tight for trees. The rest of the talk will present open conjectures regarding the eternal distance-k domination number of trees, along with evidence to support these conjectures.

This is joint work with Christopher van Bommel (University of Guelph).

STEPHEN FINBOW, St. Francis Xavier University
[Sunday December 1 / dimanche 1er décembre, 17:00 – R 2225]

MELISSA HUGGAN, Vancouver Island University
[Sunday December 1 / dimanche 1er décembre, 8:00 – R 2225]
Cops and Attacking Robbers: A Shift in Power

The game of Cops and Attacking Robbers was first introduced in 2013 by Bonato, Finbow, Gordinowicz, Haidar, Kinnersley, Mitsche, Pralat and Stacho. In this Cops and Robbers game variant, the robber is empowered to attack a cop in the same way a cop can capture the robber. In a graph G, the number of cops required to capture a robber in the Cops and Attacking Robbers game is denoted by cc(G). In this talk, we will discuss new results for graphs with specific cycle constraints. We will conclude the talk with several open problems. This is joint work with Alex Clow and Margaret-Ellen Messinger.

MEAGAN MANN, Queen's University
[Sunday December 1 / dimanche 1er décembre, 9:00 – R 2225]
A Data-Centric Approach to Cops and Robbers

Meyniel (1985) conjectured that the cop number of any connected graph G of order n is bounded by $O(\sqrt{n})$. In this talk, I introduce a data-centric approach to explore this conjecture by analyzing key properties of graphs, such as genus, tree-width, and planarity. Using computational techniques and automated planning tools, we filter out trivial Meyniel satisfiable graphs to focus on more complex cases. I will walk through the algorithm we developed, which processes graphs into NETWORKX objects, accumulates properties, and calculates the cop number using a PDDL planner (PLANNING DOMAIN DEFINITION LANGUAGE). I will then discuss how we plan to scale this approach to handle larger datasets.

JOY MORRIS, University of Lethbridge
[Sunday December 1 / dimanche 1er décembre, 9:30 – R 2225]
Cop numbers of generalised Petersen graphs

It was previously proved by Ball et al. (2015) that the cop number of any generalised Petersen graph is at most 4. I will present results that determine the cop number for all of the known generalised Petersen graphs that actually have cop number 4, and that place them in the context of infinite families. The same proof techniques also show that any graph with girth at least 9 and minimum degree δ has cop number strictly greater than δ; this represents a minor improvement to this special case of Frankl's more general bound. My talk is based on joint work with Harmony Morris, Tigana Runte, and Adrian Skelton.

TODD MULLEN, University of Prince Edward Island
[Sunday December 1 / dimanche 1er décembre, 8:30 – R 2225]
An Empowered Robber

The Theory of Pursuit-Evasion Games

In this talk, multiple variants of Cops and Robber are discussed that empower the Robber to evade teams of cops on even very basic graphs. We discuss the rule changes required to increase the cop number of a given graph and also the reasons why one may favour a variant which empowers the Robber instead of the Cops. In particular, we focus on the Cops and Robber and Tunnels variant which gives the Robber the ability to make fundamental changes to the graph through creating or even destroying edges.

AMANDA PORTER, University of Victoria
[Sunday December 1 / dimanche 1er décembre, 10:00 – R 2225]
Hyperopic Cops and Robbers: Cops with Vision Problems

Hyperopic Cops and Robbers (introduced by Bonato, Clarke, Finbow, Mc Inerney, and Messinger in 2017) is a variant of the original game of Cops and Robbers. In this version, the cops are farsighted making the robber invisible if inside the common neighbourhood of all of the cops. In this talk, we investigate the hyperopic cop number of a graph which is the minimum number of hyperopic cops required to guarantee the capture of the robber. First, we will explore results that upperbound the hyperopic cop number of a general graph and move to consider graphs of diameter two. We will conclude with open questions that would improve upon known bounds. This is joint work completed with Nancy Clarke, Stephen Finbow, and Margaret-Ellen Messinger.

ASIYEH SANAEI, Kwantlen Polytechnic University
[Sunday December 1 / dimanche 1er décembre, 16:00 – R 2225]
Damage Number of Small Graphs

The damage variation in the game of Cops and Robber on graphs is a version of the game in which the robber damages each distinct vertex that he moves onto without capture. The parameter "damage number of a graph" is then the minimum number of unique vertices of the graph that can be damaged by the robber. It has been shown that in almost all graphs the damage number is less than $\frac{n}{2}$, where n is the order of the graph, and upper bounds on the damage number of the graphs with $n \leq 8$ are known. After introduction and a brief review of the existing results, recent developments on the damage number of the graphs of order nine will be presented.

BOTING YANG, University of Regina
[Sunday December 1 / dimanche 1er décembre, 15:30 – R 2225]
Constrained Graph Searching on Trees

In this talk, we consider edge search and fast search with constraints on vertices. These two graph search models were introduced by Megiddo et al. (1988) and Dyer et al. (2008), respectively. We give polynomial time algorithms for computing the minimum number of searchers to capture robber on trees under different constraints.

Variational Analysis: Theory and Applications

Org: Heinz Bauschke (UBC Okanangan) and/et **Xianfu Wang** (UBC Okanagan)

Variational Analysis lies at the heart of modern optimization and underlies the convergence analysis of several algorithms. The purpose of this session is to bring together selected experts from the Northamerican optimization and analysis communities to exchange ideas and present new results.

We will strike a balance between early-career researchers and experts.

Schedule/Horaire **Room/Salle: R 1690**

Saturday November 30 **samedi 30 novembre**

9:00 - 9:30	Shambhavi Singh (Waterloo), *Analysis of Chambolle-Pock through the lens of duality* (p. 215)
9:30 - 10:00	Yuan Gao (UBCO), *On a result by Baillon, Bruck, and Reich* (p. 214)
10:00 - 10:30	Ziyuan Wang (UBCO), *Level proximal subdifferential, variational convexity, and beyond.* (p. 215)
15:00 - 15:30	Henry Wolkowicz (Waterloo), *Regularized Nonsmooth Newton Algorithms for Best Approximation with Applications* (p. 215)
15:30 - 16:00	Ahmet Alacaoglu (UBCV), *Revisiting Inexact Fixed-Point Iterations for Min-Max Problems: Stochasticity and Structured Nonconvexity* (p. 214)
16:00 - 16:30	Xianfu Wang (UBCO), *On Bauschke-Bendit-Moursi modulus of averagedness and classifications of averaged nonexpansive operators* (p. 215)
16:30 - 17:00	Philip Loewen (UBCV), *Sensitivity Analysis for the Linear Quadratic Regulator* (p. 214)

Abstracts/Résumés

AHMET ALACAOGLU, UBCV
[Saturday November 30 / samedi 30 novembre, 15:30 – R 1690]
Revisiting Inexact Fixed-Point Iterations for Min-Max Problems: Stochasticity and Structured Nonconvexity

In this talk, we revisit the analysis of inexact Halpern and Krasnosel'skii-Mann (KM) iterations for solving constrained and stochastic min-max problems. We relax the inexactness requirement on the computation of the resolvent in stochastic Halpern iteration and modify stochastic KM iteration to work with biased samples of the resolvent. We present the consequences of these results for solving constrained and stochastic convex-concave min-max problems, such as improved last iterate convergence guarantees. Then, we apply our developments to solve constrained nonconvex-nonconcave min-max problems satisfying cohypomonotonicity assumption. Within this class of problems, we show how toexpand the limit of nonmonotonicity that can be handled by first-order methods. (Joint work with Donghwan Kim and Stephen J. Wright)

YUAN GAO, University of British Columbia Okanagan
[Saturday November 30 / samedi 30 novembre, 9:30 – R 1690]
On a result by Baillon, Bruck, and Reich

It is well known that the iterates of an averaged nonexpansive mapping may only converge weakly to fixed point. A celebrated result by Baillon, Bruck, and Reich from 1978 yields strong convergence in the presence of linearity. In this paper, we extend this result to allow for flexible relaxation parameters. Examples are also provided to illustrate the results.

PHILIP LOEWEN, UBC Vancouver
[Saturday November 30 / samedi 30 novembre, 16:30 – R 1690]
Sensitivity Analysis for the Linear Quadratic Regulator

I will discuss some analytic and computational aspects of the classic discrete-time linear quadratic regulator, paying special attention to the sensitivity of the minimizers to the various ingredients in the nominal problem, and suggesting applications for the methods provided.

SHAMBHAVI SINGH, University of Waterloo
[Saturday November 30 / samedi 30 novembre, 9:00 – R 1690]
Analysis of Chambolle-Pock through the lens of duality

We extensively analyze the operator associated with the primal-dual hybrid gradient algorithm (or the Chambolle-Pock algorithm) that is used to solve the composite monotone inclusion problem for maximally monotone operators. Through the lens of a dual structure on the underlying space of the operator, we obtain several properties of the underlying solution sets. We also recover known results for the Douglas-Rachford algorithm. On giving additional structure to the operators—such as being paramonotone, or subdifferentials of proper lower semicontinuous convex functions, the solution sets are further simplified.

XIANFU WANG, University of British Columbia
[Saturday November 30 / samedi 30 novembre, 16:00 – R 1690]
On Bauschke-Bendit-Moursi modulus of averagedness and classifications of averaged nonexpansive operators

Averaged operators are important in Convex Analysis and Optimization Algorithms. We propose classifications of averaged operators, firmly nonexpansive operators, and proximity operators by using the Bauschke-Bendit-Moursi modulus of averagedness. We show that if a resolvent has modulus of averagedness less than $1/2$, then it is a bi-Lipschitz homemorphism. Amazingly the proximity operator of a convex function has its modulus of averagedness less than $1/2$ if and only if the function is Lipschitz smooth. Joint work with Shuang Song.

ZIYUAN WANG, UBCO
[Saturday November 30 / samedi 30 novembre, 10:00 – R 1690]
Level proximal subdifferential, variational convexity, and beyond.

Discovered by Rockafellar in 2021, level proximal subdifferential has the pleasant feature that every proximal operator is the resolvent of a level proximal subdifferential operator. In this talk, we present a systematic study of the level proximal subdifferential, revealing its remarkable connections to the classic Fenchel subdifferential in convex analysis and to proximal hulls of proper, lsc, and prox-bounded functions. An interpretation of our results in view of the Φ-subdifferential in optimal transport will be discussed. Furthermore, we established a full equivalence between variational convex functions, local (firmly) nonexpansive proximal operators, and relative (maximal) monotone level proximal subdifferential operators, which unifies and extends recent advances by Rockafellar in 2021 and by Khanh, Mordukhovich, and Phat in 2023. A pointwise version of Lipschitz smoothness will be investigated through the lens of the level proximal subdifferential. The talk is based on joint works with Honglin Luo, Xianfu Wang, and Xinmin Yang, and with Andreas Themelis and Xianfu Wang.

HENRY WOLKOWICZ, University of Waterloo
[Saturday November 30 / samedi 30 novembre, 15:00 – R 1690]
Regularized Nonsmooth Newton Algorithms for Best Approximation with Applications

We consider the problem of finding the best approximation point from a polyhedral set, and its applications, in particular to solving large-scale linear programs. The classical best approximation problem has many various solution techniques as well as applications. We study a regularized nonsmooth Newton type solution method where the Jacobian is singular ; and we compare the computational performance to that of the classical projection method of Halpern-Lions-Wittmann-Bauschke (HLWB).

We observe empirically that the regularized nonsmooth method significantly outperforms the HLWB method. However, the HLWB method has a convergence guarantee while the nonsmooth method is not monotonic and does not guarantee convergence due in part to singularity of the generalized Jacobian.

Our application to solving large-scale linear programs uses a parametrized best approximation problem. This leads to a finitely converging stepping stone external path following algorithm. Other applications are finding triangles from branch and bound methods, and generalized constrained linear least squares. We include scaling methods and sensitivity analysis to improve the efficiency. (work with Y. Censor, W. Moursi, T. Weames)

AARMS-CMS Student Poster Session
Présentations par affiches des étudiants - AARMS-SMC

Room/Salle: KPU - WSOD Entrance

Abstracts/Résumés

ADRIANA-STEFANIA CIUPEANU, TANJIMA AKHTER, Universities of Manitoba and Alberta
[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]
Preventing HPV-Induced Cervical Cancer in Alberta, Canada: A Mathematical Modeling study

Human Papillomavirus (HPV) is a widespread sexually transmitted infection, responsible for nearly 99.7% of cervical cancer cases. Despite extensive public health efforts, controlling HPV transmission remains a challenge. This research applies a dynamic mathematical model to explore HPV infection and vaccination strategies in Alberta, Canada, aiming to identify the optimal vaccination program for both women and men to reduce infection prevalence.

A key challenge is the limited availability of reliable data for both sexes, particularly regarding prevalence. While female-specific data is abundant, male data is often overlooked in existing models, despite men playing a crucial role in HPV transmission. Addressing this gap could enhance the accuracy of models and lead to more effective public health interventions. Expanding data collection efforts to better represent males is essential for robust modelling.

The study will develop and calibrate an age- and sex-stratified mathematical model using Bayesian inference methods and MATLAB. This model will incorporate complex contact patterns and disease dynamics to simulate various vaccination scenarios and assess their long-term impacts on HPV transmission and health outcomes. The research will also estimate the potential reduction in cervical cancer cases resulting from the optimal vaccination strategy, providing quantitative evidence of its effectiveness.

Ultimately, this study aims to inform public health policy by identifying the most effective vaccination strategies for controlling HPV and preventing cervical cancer, while advocating for more comprehensive data collection to improve future modelling efforts.

Joint work with Tanjima Akhter and Michael Y Li from University of Alberta.

KYE EMOND, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]
Existence and Uniqueness for a System of a Solid in a Lorentz Gas

To accurately model the motion of an object immersed in a rarefied gas, one must construct a coupled system where the gas density evolves according to a partial differential equation with boundary conditions determined by the object motion, and the object evolves following Newton's Laws which depend on the gas density. The existence and uniqueness of solutions to this system of coupled equations is an open problem for all but one-dimensional non-interacting (ideal) gasses. We show the existence and uniqueness of a one-dimensional Lorentz gas density given arbitrary object motion. Furthermore, we show the same for the entire system of Lorentz gas and object motion assuming monotonically increasing object speed. This provides theoretical justification to the application of these models to make predictions about Lorentz gas-object interaction systems and develops strong foundations towards proving existence and uniqueness in more generality.

JAMES HOULE, Simon Fraser University
[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]
Schäffer's Conjecture and the Modular Method

Schäffer's conjecture predicts that the only natural solutions to $1^k+2^k+\cdots+x^k = y^n$ are $(x, y, k, n) = (1, 1, k, n), (24, 70, 2, 2)$, except when $(k, n) \in \{(1, 2), (3, 2), (3, 4), (5, 2)\}$ in which case there are infinitely many such solutions. Bennett-Győry-Pintér

have proved the conjecture for $1 \leq k \leq 11$ using a combination of methods including linear forms of logarithms and the modular method.

Our goal was to see how far we could push the modular method to avoid using linear forms of logarithms. By using only the modular method in combination with an expanded set of coupled generalized Fermat equations which are derived using descent, we explain how to asymptotically solve Schäffer's conjecture for select k, additionally using the multi-Frey technique and theorem of Darmon-Merel.

REX LI, Carleton University Math Enrichment Centre

[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]

Optimal Trajectories in Variable Speed Environments with Line Constraints

The research investigates optimal path selection in a 2-dimensional plane where an agent travels between two points, $A(x_1, y_1)$ and $B(x_2, y_2)$, considering variable speeds on distinct trajectories. With walking speeds defined as v off the lines and kv (where $k > 1$) on the lines, the presence of two lines—line m with a slope of 0, and line n with a slope of α, intersecting at point $Z(z, 0)$—adds complexity to the path optimization. This study methodically analyzes scenarios involving no use of the lines, utilization of one line, and navigation across both lines to derive travel time formulas. Each potential path's optimal entry and exit points on the lines are determined and they are later compared to each other to select the optimal path. Further exploration could be extended by increasing the number of lines available. The findings contribute to the strategic decision-making necessary for optimizing travel, with implications for applications in fields such as transportation planning, where the entrance and exit of the highway can be selected to minimize traveling time.

HAGGAI LIU, Simon Fraser University

[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]

Moduli Spaces of Weighted Stable Curves and their Fundamental Groups

The Deligne-Mumford compactification, $\overline{M_{0,n}}$, of the moduli space of n distinct ordered points on $\mathbb{P}^1$, has many well understood geometric and topological properties. For example, it is a smooth projective variety over its base field. Many interesting properties are known for the manifold $\overline{M_{0,n}}(\mathbb{R})$ of real points of this variety. In particular, its fundamental group, $\pi_1(\overline{M_{0,n}}(\mathbb{R}))$, is related, via a short exact sequence, to another group known as the cactus group. Henriques and Kamnitzer gave an elegant combinatorial presentation of this cactus group.

In 2003, Hassett constructed a weighted variant of $\overline{M_{0,n}}(\mathbb{R})$: For each of the n labels, we assign a weight between 0 and 1; points can coincide if the sum of their weights does not exceed one. We seek combinatorial presentations for the fundamental groups of Hassett spaces with certain restrictions on the weights. In particular, we express the Hassett space as a blow-down of $\overline{M_{0,n}}$ and modify the cactus group to produce an analogous short exact sequence. The relations of this modified cactus group involves extensions to the braid relations in S_n. To establish the sufficiency of such relations, we consider a certain cell decomposition of these Hassett spaces, which are indexed by ordered planar trees.

KIARA MCDONALD, University of Victoria

[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]

Broadcast Independence in Split Graphs

In Graph Theory, the well-known problems of domination, packing and independence are generalized by broadcast domination, broadcast packing and broadcast independence. As an analogy and application, consider a city, where one wants to place cell towers of different signal strengths subject to certain conditions. If every building in the city hears the signal from at least (respectively at most) one tower, then the broadcast is dominating (respectively packing). If no tower hears the signal from another tower, the broadcast is independent. The sum of the tower signal strengths is called the cost of the broadcast. The total cost of a maximum independent broadcast is called the broadcast independence number.

Our research was focused on determining explicit formulas and polynomial time algorithms for the broadcast independence

number of various types of graphs. This parameter is difficult to compute for graphs in general, so we restrict the problem to specific classes of graphs to make use of their special structural properties. One type of graph that we examined in our research was split graphs. Split graphs are defined to have a partition of its vertices into a clique and an independent set, a property which is specific to this class of graphs. Additionally, all split graphs have diameter two or three. Using these special properties, we determined explicit formulas for the broadcast independence number of special types of split graphs. We also showed that the broadcast independence number is polynomial time solvable for all split graphs.

ELISE MOZZAFFARI, Kwantlen Polytechnic University
[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]
A Procedure for Obtaining a $(2+c)$-Regular Graph from a Given Cycle Graph

In this project, we devise a procedure to obtain a $(2+c)$-regular graph of minimum order from a given cycle graph C_n, where $c, n \in \mathbb{Z}^+$ and $n \geq 3$. We employ the use of cases to determine the minimum number of vertices that must be added to C_n such that the resulting graph R is $(2+c)$-regular. The results of this project demonstrate that if $c \leq n-3$, then our desired graph R can be obtained by adding at most 1 vertex. Additionally, if $c > n-3$, our findings indicate that R can be obtained by adding $3+c-n$ vertices. Some additional results regarding the size and Hamiltonian property of R are also presented at the end of this project.

PRANGYA PARIDA, University of Ottawa
[Saturday November 30 / samedi 30 novembre, 9:30 – KPU - WSOD Entrance]
Cover-free families on graphs

A family of subsets of $[t]$ is called a *d-cover-free family* (d-CFF) if no subset is contained in the union of any d others. We denote by $t(d,n)$ the minimum t for which there exists a d-CFF of $[t]$ with n subsets. $t(1,n)$ is determined using Sperner's Theorem. For $d \geq 2$, we rely on bounds for $t(d,n)$. Using the probabilistic approach, Erdös, Frankl, and Füredi proved $3.106\log(n) < t(2,n) < 5.512\log(n)$. Porat and Rothschild provided a deterministic polynomial-time algorithm to construct d-CFFs achieving $t = O(d^2\log(n))$. Some upper bounds of $t(2,n)$(in some cases exact bounds) for some small values of n were provided by Li, van Rees, and Wei.

We extend the definition of 2-CFF to include a graph(G), called $\overline{G}$-CFF, where the edges of G specify the pair of subsets whose union must not cover any other subset. We denote by $t(G)$ as the minimum t for which there exists a $\overline{G}$-CFF. Thus, $t(K_n) = t(2,n)$. We will discuss some classical results on CFFs, along with constructions of $\overline{G}$-CFFs. We prove that for a graph G with n vertices, $t(1,n) \leq t(G) \leq t(2,n)$ and for an infinite family of star graphs with n vertices, $t(S_n) = t(1,n)$. We also provide constructions for $\overline{P_n}$-CFF and $\overline{C_n}$-CFF using a mixed-radix Gray code. This yields an upper bound for $t(P_n)$ and $t(C_n)$ that is smaller than the lower bound of $t(2,n)$ mentioned above.

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Canadian Journal of Mathematics (CJM) publishes original, high-quality research papers in all branches of mathematics. The Journal is a flagship publication of the Canadian Mathematical Society and has been published continuously since 1949. New research papers are published continuously online and collated into print issues six times each year.

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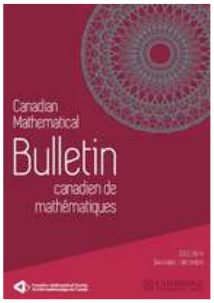

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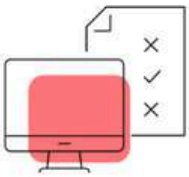

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Canadian Mathematical Society
Société mathématique du Canada

Call for Nominations
Appel de mises en candidature

2025 CMS

BLAIR SPEARMAN DOCTORAL PRIZE
PRIX DE DOCTORAT BLAIR SPEARMAN

de la SMC 2025

In recognition of an outstanding performance by a doctoral student who graduated from a Canadian university in the preceding year.

En reconnaissance d'une performance exceptionnelle d'un(e) doctorant(e) diplômé(e) d'une université canadienne au cours de l'année précédente.

Submit all documentation to docprize@cms.math.ca
no later than January 31, 2025

Soumettez tous les documents à prixdoc@smc.math.ca
au plus tard le 31 janvier 2025

Canadian Mathematical Society
Société mathématique du Canada

Call for Nominations
Appel de mises en candidature

2025 CMS

GRAHAM WRIGHT AWARD
PRIX GRAHAM WRIGHT

de la SMC 2025

In recognition of an individual who has made sustained and significant contributions to the Canadian mathematical community and, in particular, to the Canadian Mathematical Society.

En reconnaissance d'une personne ayant apporté une contribution soutenue et significative à la communauté mathématique canadienne et, en particulier, à la Société mathématique du Canada.

Submit all documentation to gwaward@cms.math.ca
no later than March 31, 2025

Soumettez tous les documents à prixgw@smc.math.ca
au plus tard le 31 mars 2025

Canadian Mathematical Society
Société mathématique du Canada

Call for Nominations
Appel de mises en candidature

2025

CMS FELLOWS
FELLOWS DE LA SMC

2025

In recognition of CMS members who have made excellent contributions to mathematical research, teaching, or exposition, as well as distinguished themselves in service to Canada's mathematical community.

En reconnaissance des membres de la SMC qui ont apporté d'excellentes contributions à la recherche, à l'enseignement ou à l'exposition en mathématiques, et qui se sont distingués par leurs services à la communauté mathématique du Canada.

Submit all documentation to awards-prizes@cms.math.ca
no later than March 31, 2025

Soumettez tous les documents à prix@smc.math.ca
au plus tard le 31 mars 2025

Canadian Mathematical Society
Société mathématique du Canada

Call for Nominations
Appel de mises en candidature

2025 CMS

ADRIEN POULIOT AWARD
PRIX ADRIEN POULIOT

de la SMC 2025

In recognition of an individual who has made sustained and significant contributions to the Canadian mathematical community and, in particular, to the Canadian Mathematical Society.

En reconnaissance d'une personne ayant apporté une contribution soutenue et significative à la communauté mathématique canadienne et, en particulier, à la Société mathématique du Canada.

Submit all documentation to apaward@cms.math.ca
no later than March 31, 2025

Soumettez tous les documents à prixap@smc.math.ca
au plus tard le 31 mars 2025

2025 CMS Summer Meeting | Québec, QC

Call for Sessions

The Canadian Mathematical Society (CMS) welcomes and invites **scientific session proposals** for the **2025 CMS Summer Meeting** in Québec, Québec from June 6 to June 9, 2025.

- The purpose of the scientific sessions is to share cutting edge research on a given mathematical topic, as suggested by the organizers.
- Sessions are scheduled in 2-hour blocks and take place from **June 1-3**. Typical scientific sessions have between 10 and 20 talks of 20 minutes each, with 10 minutes between talks, but 50-min talks are possible. Indeed, the organizers are welcome to suggest non-traditional usage of the block times and format.
- In accordance with the CMS mandate to propose conferences which are accessible and welcoming to all groups, diversity amongst organizers and speakers is strongly encouraged. To support organizers in their important work and in their efforts towards inclusivity and diversity, the CMS will host an open call for abstracts for all sessions, and asks organizers to consider all eligible abstract submissions for their session.
- Diversity includes topics of interest, career stages, geographic location, and demographics; designated underrepresented groups include, but are not limited to, women, Indigenous Peoples, persons with disabilities, members of visible minority/racialized groups, and members of LGBTQ2+ communities.
- Note that there will be a separate follow-up call for Education Sessions.
- All proposed sessions should be in line with the CMS Code of Conduct.

Proposals should be submitted online, and will require the following:
(1) Names, affiliations, and contact information for two or three organizers: A lead organizer and one or two co-organizer(s).
(2) A title and a two to three-sentence summary that will be posted on the website for potential speakers.
(3) The number of 2-2.5 hour blocks requested.
(4) A pdf file including a description of the topic and purpose of the session (1-2 paragraphs), for consideration by the Scientific Committee, not to be posted.
(5) A spreadsheet including list of possible speakers. Please have columns “Last Name”, “First Name”, “Affiliation”, “Career Stage”, and “Webpage”, with as much information filled out for potential speakers as possible.

Proposals will be selected by the Scientific Organizing Committee, limited by available classroom space, with priority for sessions that show intention to include a mix of senior and junior researchers, to make parts of their session accessible to graduate students, and to include speakers from designated underrepresented groups.

A note on Organizers
The lead organizer should hold a PhD or equivalent in the area of expertise relevant to the session’s subject. Having a senior researcher (e.g. Professor or tenured Associate Professor) paired with someone earlier in their career (e.g. tenure track Assistant Professor or Postdoctoral Fellow) would be ideal.

We place great value on your contributions as organizers. Our primary goal is to provide the best possible experience for all attendees, and this is often better achieved by dedicating your efforts to a single, impactful session. As such, we recommend that each potential organizer only propose a single session.

Submission Form and Deadlines:
Please submit proposals by filling out this form. There will be two rounds of submissions. Proposals submitted by **January 31, 2025**, will be considered in the first round, with responses ongoing. The deadline for the second round will be **March 14, 2025**.

Réunion d'été 2025 de la SMC | Québec, QC

Appel aux Sessions

La Société mathématique du Canada (SMC) accueille et invite les **propositions de sessions scientifiques** pour la **réunion d'été 2025 de la SMC** qui se tiendra à Québec (Québec) du 6 au 9 juin 2025.

- L'objectif des sessions scientifiques est de partager la recherche de pointe sur un sujet mathématique donné, tel que suggéré par les organisateurs.
- Les sessions sont programmées par blocs de 2 heures et se déroulent **du 1er au 3 juin**. Les sessions scientifiques typiques comportent entre 10 et 20 exposés de 20 minutes chacun, avec 10 minutes entre les exposés, mais des exposés de 50 minutes sont possibles. En effet, les organisateurs sont invités à suggérer une utilisation non traditionnelle des blocs de temps et du format.
- Conformément au mandat de la SMC de proposer des conférences accessibles et accueillantes pour tous les groupes, la diversité parmi les organisateurs et les orateurs est fortement encouragée. Afin de soutenir les organisateurs dans leur travail important et dans leurs efforts en faveur de l'inclusion et de la diversité, la SMC lancera un appel à résumés ouvert pour toutes les sessions, et demande aux organisateurs de prendre en considération toutes les soumissions de résumés éligibles pour leur session.
- La diversité comprend les sujets d'intérêt, les étapes de la carrière, la situation géographique et les données démographiques ; les groupes sous-représentés désignés comprennent, sans s'y limiter, les femmes, les peuples autochtones, les personnes handicapées, les membres des minorités visibles et des groupes raciaux, et les membres des communautés LGBTQ2+.
- Veuillez noter qu'il y aura un appel séparé pour les sessions d'éducation.
- Toutes les sessions proposées doivent être conformes au Code de conduite de la SMC.

Les propositions doivent être soumises en ligne et doivent comporter les éléments suivants :
(1) Les noms, affiliations et coordonnées de deux ou trois organisateurs : Un organisateur principal et un ou deux co-organisateurs.
(2) Un titre et un résumé de deux à trois phrases qui seront affichés sur le site Web à l'intention des orateurs potentiels.
(3) Le nombre de blocs de 2 à 2,5 heures demandés.
(4) Un fichier pdf comprenant une description du sujet et de l'objectif de la session (1 à 2 paragraphes), pour examen par le comité scientifique, qui ne sera pas affiché.
(5) Un tableur excel comprenant la liste des orateurs possibles. Les colonnes « Nom », « Prénom », « Affiliation », « Stade de carrière » et « Page Web » doivent contenir autant d'informations que possible sur les orateurs potentiels.

Les propositions seront sélectionnées par le comité d'organisation scientifique, dans la limite des places disponibles dans les salles de classe, avec une priorité pour les sessions qui montrent l'intention d'inclure un mélange de chercheurs seniors et juniors, de rendre certaines parties de leur session accessibles aux étudiants de troisième cycle, et d'inclure des orateurs issus de groupes sous-représentés désignés.

Note sur les organisateurs
L'organisateur principal doit être titulaire d'un doctorat ou d'un diplôme équivalent dans le domaine d'expertise correspondant au sujet de la session. L'idéal serait qu'un chercheur chevronné (par exemple, un professeur ou un professeur associé titulaire) soit associé à une personne en début de carrière (par exemple, un professeur assistant titulaire ou un boursier postdoctoral).

Nous accordons une grande importance à vos contributions en tant qu'organisateurs. Notre objectif principal est d'offrir la meilleure expérience possible à tous les participants, et il est souvent plus facile d'y parvenir en consacrant vos efforts à une seule session à fort impact. C'est pourquoi nous recommandons à chaque organisateur potentiel de ne proposer qu'une seule session.

Formulaire de soumission et délais :
Veuillez soumettre vos propositions en remplissant ce formulaire. Il y aura deux séries de soumissions. Les propositions soumises avant le **31 janvier 2025** seront examinées lors de la première série, et les réponses se poursuivront. La date limite pour le deuxième tour sera le **14 mars 2025**.

See you next year!

SAVE THE DATE

RÉSERVEZ LA DATE

À l'année prochaine

2025 CMS Summer Meeting
Réunion d'été 2025 de la SMC

June 6 to 9 | Du 6 au 9 juin

QUÉBEC, QC

Canadian Mathematical Society
Société mathématique du Canada

See you next year

SAVE THE DATE
RÉSERVEZ LA DATE

À l'année prochaine

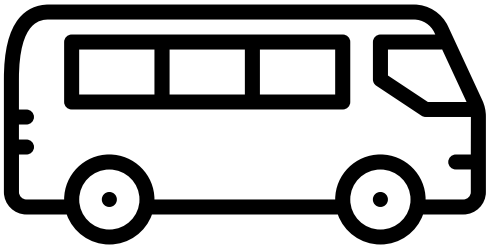
2025 CMS Winter Meeting
Réunion d'hiver 2025 de la SMC

December 5 to 8 | Du 5 au 8 décembre

TORONTO, ON

Canadian Mathematical Society
Société mathématique du Canada

SHUTTLE
NAVETTE



Transport between the hotel and KPU
Transport entre l'hôtel et KPU

A shuttle service will be available between the Sheraton Vancouver Airport Hotel and Kwantlen Polytechnic University from **Saturday, November 30th** to **Monday, December 2nd** at:
7:30am; 8:00am; 8:30am; 9:00am
5:00pm; 5:30pm; 6:00pm; 6:30pm

Un service de navette sera disponible entre l'hôtel Sheraton Vancouver Airport et l'Université polytechnique Kwantlen du **samedi 30 novembre** au **lundi 2 décembre** à :
7 h 30 ; 8 h ; 8 h 30 ; 9 h
17 h ; 17 h 30 ; 18 h ; 18 h 30

Transport between the airport and the hotel
Transport entre l'aéroport et l'hôtel

There is a shuttle from the Sheraton at the airport that you can take directly to the hotel. The Sheraton Hotel shuttles pick up and drop off areas are located outside of Departure Level 3 between International and US Departure Terminal. It is also available outside the Departure Level 3 Domestic Terminal. The Shuttle is available every half an hour at 10- and 40-minutes past.

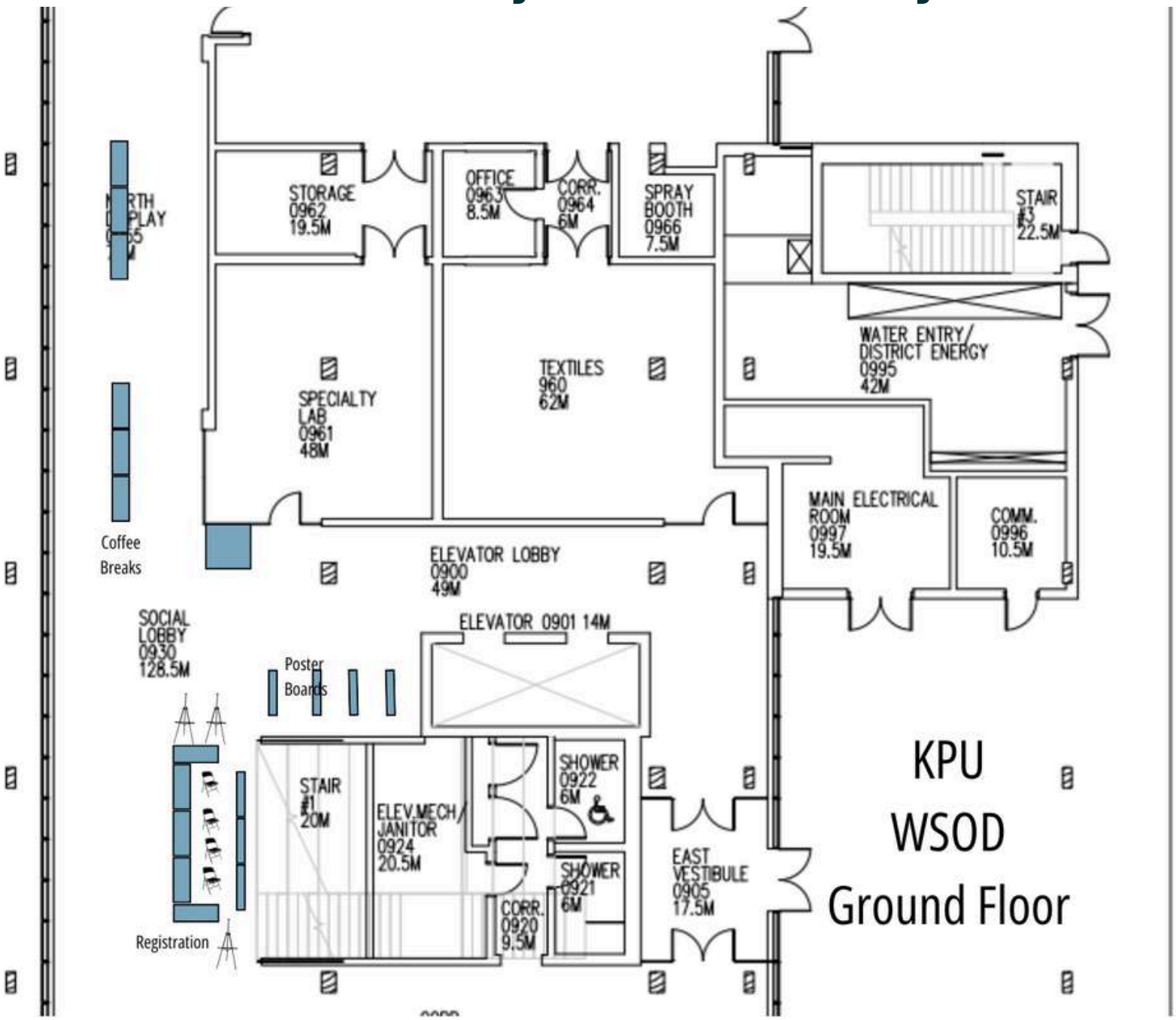
Une navette Sheraton est disponible à l'aéroport et vous pouvez la prendre directement pour vous rendre à l'hôtel. Les zones de prise en charge et de descente des navettes de l'hôtel Sheraton sont situées à l'extérieur du niveau 3 des départs, entre le terminal international et le terminal des départs américains. La navette est également disponible à l'extérieur du terminal des vols intérieurs, au niveau 3 des départs. La navette est disponible toutes les demi-heures à 10 et 40 minutes passées.

FLOORPLANS

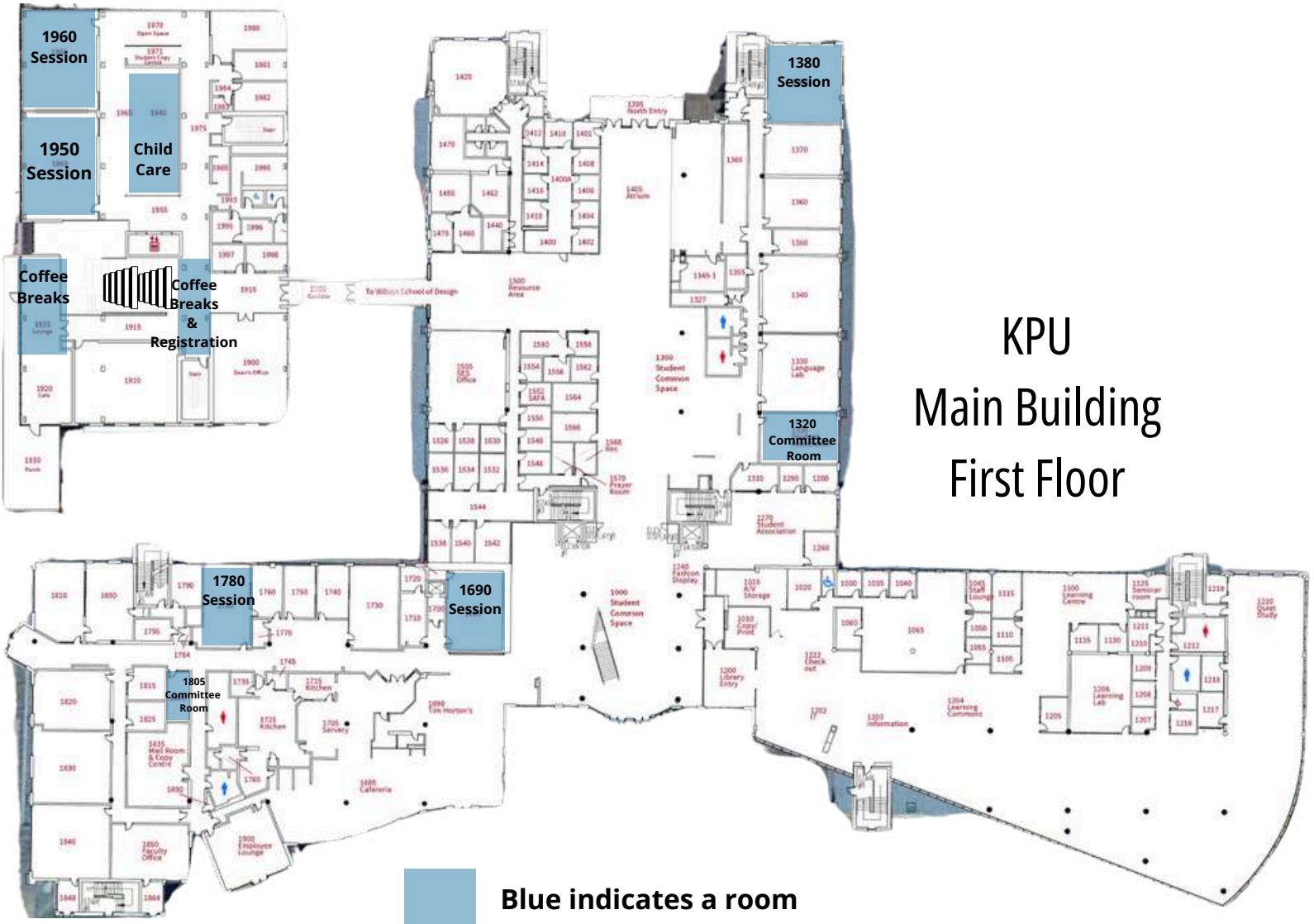
Sheraton Vancouver Airport Hotel

FLOORPLANS

Kwantlen Polytechnic University



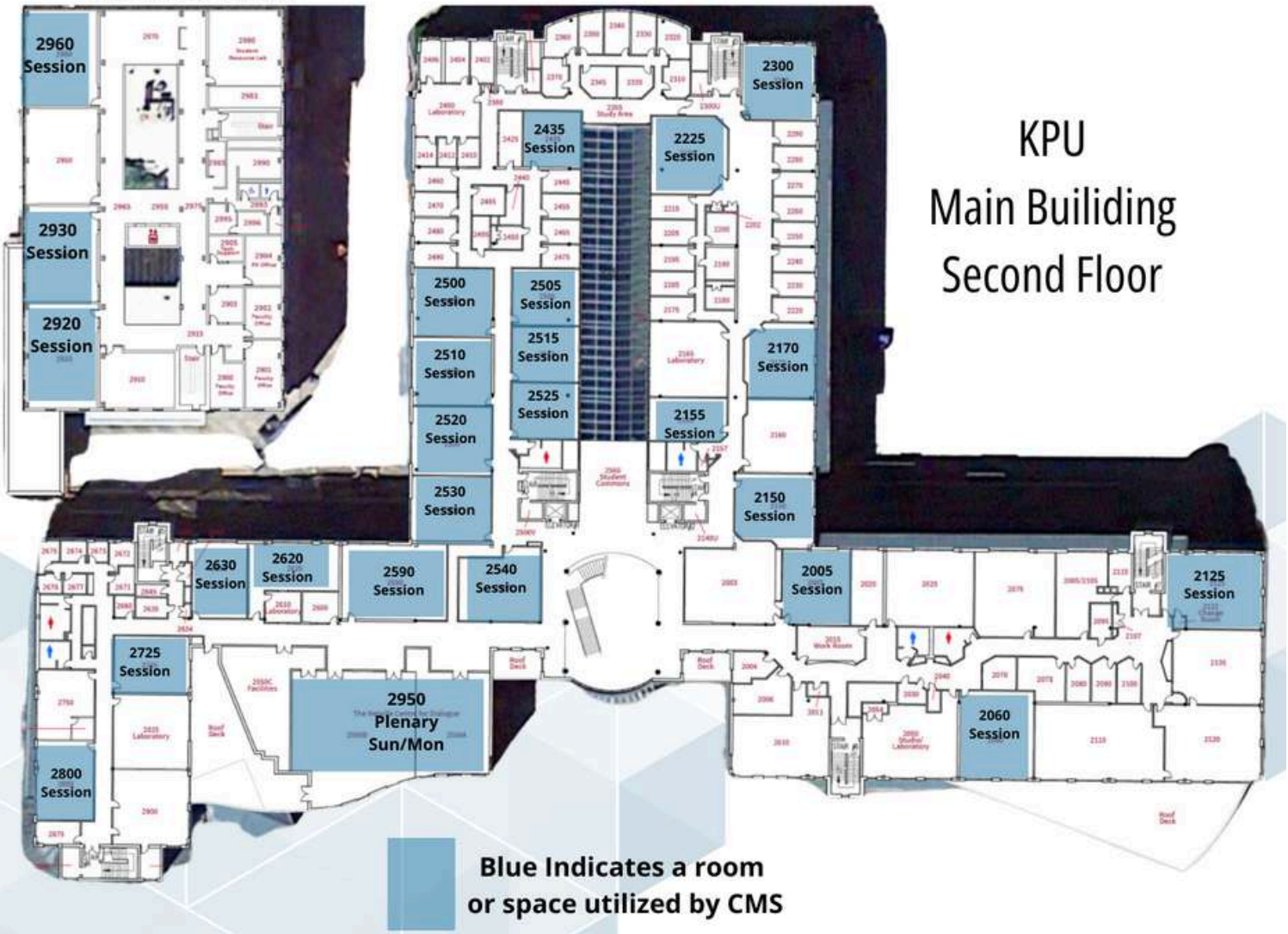
KPU
WSOD
First Floor



KPU
Main Building
First Floor

Blue indicates a room or space utilized by CMS

KPU
WSOD
Second Floor



KPU
Main Buiilding
Second Floor

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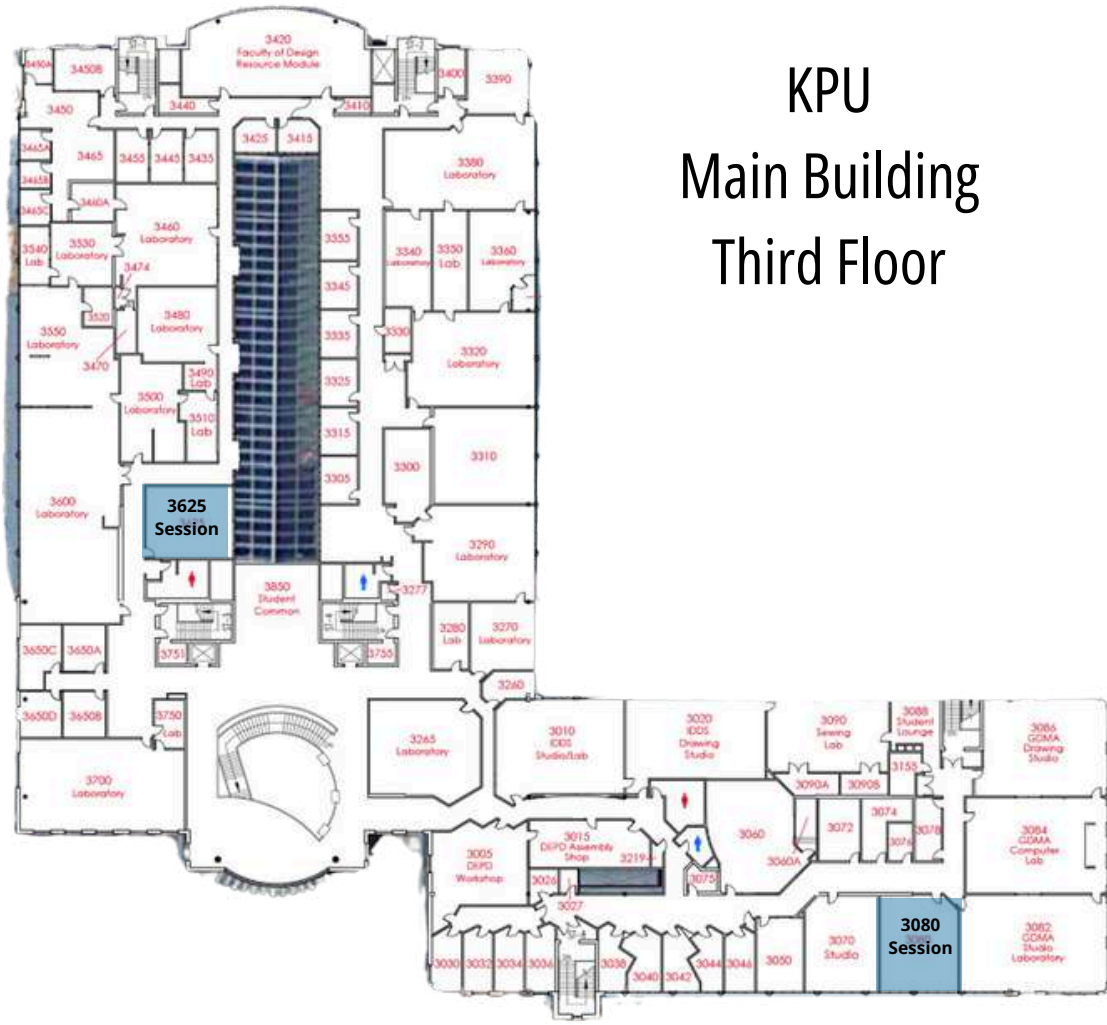
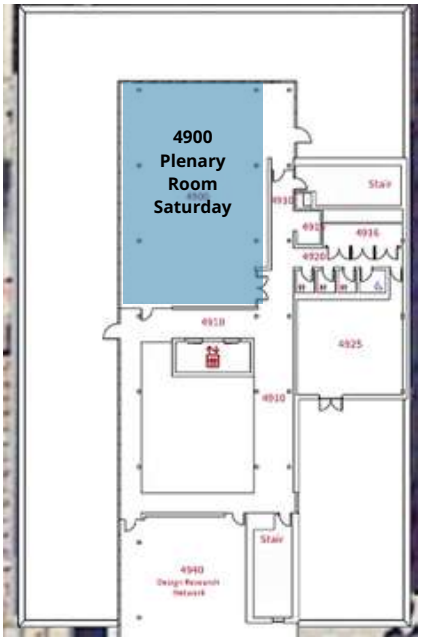
KPU
WSOD
Third Floor

KPU
Main Building
Third Floor



KPU
WSOD
Fourth Floor



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