Canadian Mathematical Society
Société mathématique du Canada

2019 Summer Meeting
Réunion d'été 2019

June 7 - 10 juin 2019

University of Regina | Université de Regina
Regina, Saskatchewan

Public Lecture | Conférence publique
Nilima Nigam (Simon Fraser University)

Plenary Lectures | Conférences plénières
Denis Auroux (University of California Berkeley/Harvard)
Caroline Colijn (Simon Fraser University)
Gregory Lawler (University of Chicago)
Grigoris Paouris (Texas A&M University)
Pham Huu Tiep (Rutgers University)

Prizes | Prix
Excellence in Teaching Award | Prix d'excellence en enseignement
Andrea Fraser (Dalhousie University)

Jeffery-Williams Prize | Prix Jeffery-Williams
Jeremy Quastel (University of Toronto)

Krieger-Nelson Prize | Prix Krieger-Nelson
Julia Gordon (University of British Columbia)

NEW Session Specific Mini-Courses will held June 7th before the meeting

NOUVEAU Des mini-cours sur le thème de certaines sessions se tiendront le 7 juin avant la Réunion

Scientific Directors | Directeurs scientifiques
Allen Herman (University of Regina)
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Karen Meagher (University of Regina)
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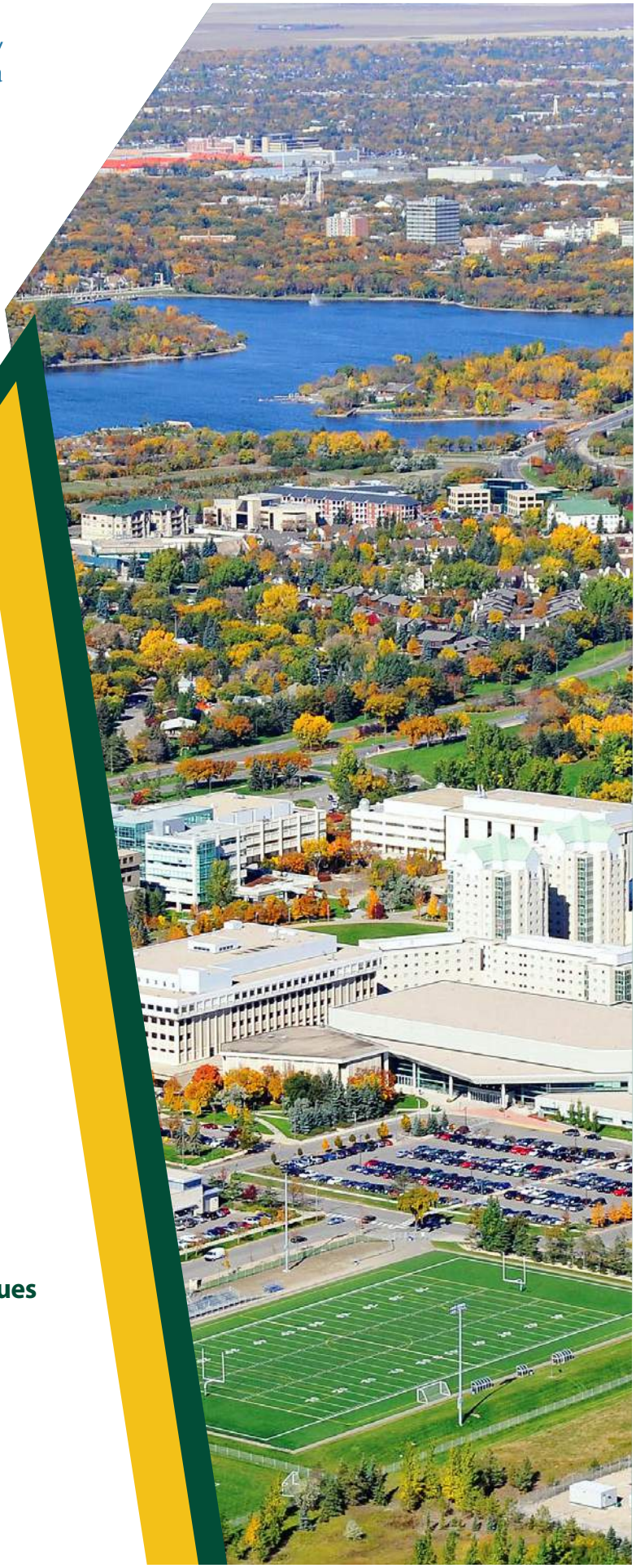
summer19.cms.math.ca
ete19.smc.math.ca



Schedule / horaire

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University of Regina, Regina, SK</th></tr>
<tr><th>Friday | Vendredi
June 7 juin</th><th>Saturday | Samedi
June 8 juin</th><th>Sunday | Dimanche
June 9 juin</th><th>Monday | Lundi
June 10 juin</th></tr>
<tr><td>8:00 - 19:30 - Registration | Inscription</td><td>7:30 - 18:00 - Registration | Inscription
8:30 - 16:30 - Poster Session Affiches
10:00 - 16:30 - Exhibits | Expositions</td><td>7:30 - 18:00 - Registration | Inscription
8:30 - 16:30 - Poster Session Affiches
10:00 - 16:30 - Exhibits | Expositions</td><td>7:30 - 18:00 - Registration | Inscription</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2"></td><td>8:00 – 10:30
Scientific Sessions scientifiques</td><td>8:00 – 10:30
Scientific Sessions scientifiques</td><td>8:00 – 10:30
Scientific Sessions scientifiques</td></tr>
<tr><td>10:30 – 11:00
Break | Pause</td><td>10:30 – 11:00
Break | Pause</td><td>10:30 – 11:00
Break | Pause</td></tr>
<tr><td rowspan="2">12:30 – 16:30
CMS Board of Directors Meeting | Réunion du Conseil d'administration SMC</td><td>11:00 – 12:00
Pham Huu Tiep
Plenary Lecture | Conférence plénière</td><td>11:00 – 12:00
Denis Auroux
Plenary Lecture | Conférence plénière</td><td>11:00 – 12:00
Julia Gordon
Krieger-Nelson Prize Lecture | Conférence de prix Krieger-Nelson</td></tr>
<tr><td>12:00 – 13:30
Break | Pause

Diversity and Equity in Math Luncheon</td><td>12:00 – 13:30
Break | Pause

CMS AGM | L'AGA de la SMC</td><td>12:00 – 13:30
Break | Pause</td></tr>
<tr><td>9:00 – 12:00
CMS Mini-Courses | Mini-cours de la SMC
13:00 – 16:00
CMS Mini-Courses | Mini-cours de la SMC</td><td>13:30 – 14:30
Caroline Colijn
Plenary Lecture | Conférence plénière</td><td>13:30 – 14:30
Gregory Lawler
Plenary Lecture | Conférence plénière</td><td>13:30 – 14:30
Walking tour of First Nations University of Canada</td></tr>
<tr><td>14:30 – 14:45
Break | Pause</td><td>14:30 – 15:30
Grigoris Paouris
Plenary Lecture | Conférence plénière</td><td>14:30 – 15:30
Jeremy Quastel
Jeffrey-Williams Prize Lecture | Conférence de prix Jeffrey-Williams</td><td>14:30 – 14:45
Break | Pause
14:45 - 16:45
Scientific Sessions scientifiques</td></tr>
<tr><td rowspan="2">17:00 – 18:00
Nilima Nigam (SFU)
Public Lecture | Conférence publique</td><td>15:30 – 16:00
Break | Pause</td><td>15:30 – 16:00
Break | Pause</td><td rowspan="3"></td></tr>
<tr><td>16:00 – 18:00
Scientific Sessions scientifiques</td><td>16:00 – 18:00
Scientific Sessions scientifiques</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>18:00 – 19:30
Opening and Welcome Reception | Ouverture et Réception de bienvenue
20:00 – 22:00
Student Social | Soirée étudiante</td><td>19:00 – 22:30
Reception and Awards Banquet | Réception et Banquet de prix</td><td></td></tr>
</table>

Sessions / Sessions

Session	Saturday | Samedi June 8 juin		Sunday | Dimanche June 9 juin		Monday | Lundi June 10 juin	
	8:00-10:30	16:00-18:30	8:00-10:30	16:00-18:00	8:00-10:30	16:00-18:00
Assessment in Mathematics | L'évaluation en mathématiques			ED 623	ED 623,		
Categorical Approaches to Topology and Geometry | Approches catégoriques de la topologie et de la géométrie		ED 314	ED 314	ED 314	CK 187	CK 187
Contributed Papers | Communications libres				CK 185		
Equivariant Methods in Differential and Algebraic Geometry | Méthodes équivariantes en géométrie différentielle et algébrique	ED 106.1	ED 106.1	ED 106.1	ED 106.1	ED 106.1	ED 106.1
Finite and Infinite Dimensional Structures in Non-Commutative Analysis | Structures dimensionnelles finies et infinies en analyse non commutative	ED 191	ED 191	ED 191	ED 191	ED 191	
Finite Geometry | Géométrie finie	CK 185	CK 185				
Functional and Complex Analysis | Analyse fonctionnelle et complexe	ED 315	ED 315				
High-Dimensional Problems in Finance and Quantitative Research | Problèmes de grande dimension en finance et en recherche quantitative	ED 438	ED 438				
Indigenization and Reconciliation in Mathematics | Autochtonisation et réconciliation en mathématiques	ED 558	ED 558	ED 558			
Mathematical Techniques for Analysing Quantum Structures and Materials | Techniques mathématiques pour l'analyse de structures et de matériaux quantiques	ED 106.2	ED 106.2				
Matrix Theory and its Applications | La théorie des matrices et ses applications			ED 106.2	ED 106.2	ED 106.2	ED 106.2
Probabilistic Methods in Geometric Functional Analysis and Convexity | Méthodes probabilistes en analyse et en convexité fonctionnelle géométrique	ED 193	ED 193	ED 193	ED 193		
Randomness and Limited Information in Graph Searching Problems | Problèmes liés au caractère aléatoire et à l'information limitée dans la recherche en graphe	CK 187					
Recent Advances in Probability and Stochastics | Progrès récents en probabilité et en stochastique	ED 623	ED 623				
Representation Theory of Groups Defined Over Local Fields | Théorie des représentations de groupes définis sur des champs locaux	ED 312	ED 312	ED 312			
STUDC Research Session | Session de recherche du Comité des étudiants			CK 185			
The Mathematics behind Quantum Information Science | Les mathématiques derrière la science de l'information quantique	ED 230	ED 230	ED 230	ED 230		
Topology | Topologie	ED 318	ED 318	ED 318			

CMS
SMC

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FIELDS

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University of Regina

Bus Schedule

Friday June 7th

Bus	Time	Departure	Destination
Bus #1	11:30am	Hotel Sask	Kïšik Tower – UofR
Bus #1	12:10pm	Hotel Sask	Kïšik Tower – UorR
Bus #1	12:30pm	Hotel Sask	Kïšik Tower – UorR
Bus #1	12:45pm	Hotel Sask	Kïšik Tower – UofR
Bus #1	4:10pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	4:15pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	4:30pm	Hotel Sask	Kïšik Tower – UorR
Bus #2	4:40pm	Hotel Sask	Kïšik Tower – UorR Sask
Bus #1	5:40pm	Hotel Sask	Kïšik Tower – UorR Sask
Bus #2	5:50pm	Hotel Sask	Kïšik Tower – UofR
Bus #1	7:00pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	7:10pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	7:20pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	7:30pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	7:40pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	7:50pm	UofR	Kïšik Tower – Hotel Sask

Saturday June 8th

Bus	Time	Departure	Destination
Bus #1	7:20am	Hotel Sask	UofR
Bus #2	7:30am	Hotel Sask	UofR
Bus #1	7:45am	Hotel Sask	UofR
Bus #2	7:50am	Kïšik Tower	UofR
Bus #1	3:40pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	5:35pm	UofR	Kïšik Tower
Bus #2	5:35pm	UofR	Hotel Sask
Bus #1	5:40pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	5:50pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	6:00pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	6:30pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	6:50pm	Kïšik Tower	Hotel Sask
Bus #1	9:45pm	Hotel Sask	Kïšik Tower
Bus #1	10:10pm	Hotel Sask	Kïšik Tower
Bus #1	10:30pm	Hotel Sask	Kïšik Tower
Bus #1	10:45pm	Hotel Sask	Kïšik Tower

Sunday June 9th

Bus	Time	Departure	Destination
Bus #1	7:20am	Hotel Sask	UofR
Bus #2	7:30am	Hotel Sask	UofR
Bus #1	7:45am	Hotel Sask	UofR
Bus #2	7:50am	Kïšik Tower	UofR
Bus #1	5:45pm	UofR	Kïšik Tower
Bus #2	5:45pm	UofR	Hotel Sask
Bus #1	6:10pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	6:15pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	6:30pm	UofR	Kïšik Tower – Hotel Sask

Monday June 10th

Bus	Time	Departure	Destination
Bus #1	7:20am	Hotel Sask	UofR
Bus #2	7:30am	Hotel Sask	UofR
Bus #1	7:45am	Hotel Sask	UofR
Bus #2	7:50am	Kïšik Tower	UofR
Bus #1	2:40pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	4:15pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	4:50pm	UofR	Kïšik Tower – Hotel Sask
Bus #2	5:00pm	UofR	Kïšik Tower – Hotel Sask
Bus #1	5:10pm	UofR	Kïšik Tower – Hotel Sask

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Welcome to the 2019 CMS Summer Meeting!

Message from Mark Lewis, President, CMS

Bienvenue à la Réunion d'été 2019 de la SMC!

Message de Mark Lewis, Président, SMC

On behalf of the Canadian Mathematical Society, it is my great pleasure to welcome you to the 2019 CMS Summer Meeting. This conference, hosted by the University of Regina will cover a wide variety of topics reflecting the scope and diversity of the Canadian mathematical sciences community. There will be tremendous opportunities for collaboration and renewal of contacts with colleagues from Canada and around the world.

The meeting program features five plenary lectures, by Denis Auroux (Harvard), Caroline Colijn (Simon Fraser University), Gregory Lawler (University of Chicago), Grigoris Paouris (Texas A&M University) and Pham Huu Tiep (Rutgers Univeristy), as well as a public lecture by Nilima Nigam.

The Summer Meeting's program features over 20 sessions and mini-courses with talks relating to all aspects of mathematical sciences, including a number of sessions on mathematics education and a scientific session organized and delivered entirely by graduate and undergraduate students.

The meeting will also provide further opportunities for celebrating excellence in mathematics by honouring the recipients of the Jeffery-Williams award, Jeremy Quastel (University of Toronto), and the Krieger-Nelson prize, Julia Gordon (University of British Columbia). All prizes will be awarded at the awards banquet on Saturday, June 8th at the Hotel Saskatchewan in Regina.

On behalf of the CMS, I would like to express the gratitude of the CMS to all the sponsors of the Sumer Meeting: AARMS, CRM, Fields, PIMS and the University of Regina.

Allen Herman (University of Regina), Alexander Litvak (University of Alberta) and Karen Meagher (University of Regina), the Scientific Directors, have put a tremendous amount of hard work into bringing you an attractive and varied program and greatly deserve our thanks. Putting on such a meeting requires much dedication and hard work and would not be possible without the efforts of the scientific directors, the session organizers, volunteers, and the CMS staff.

Finally, to all participants, I would like to wish you a very productive and pleasurable meeting. Welcome to Regina!

Au nom de la Société mathématique du Canada, c'est avec grand plaisir que je vous souhaite la bienvenue à la Réunion d'été 2019 de la SMC. Ce congrès, dont l'hôte est l'Université de Regina, propose un large éventail de sujets témoignant de la portée et de la diversité de la communauté mathématique canadienne. Les possibilités de collaborer et de renouer avec des collègues du Canada et du monde entier y seront nombreuses.

Le programme de la Réunion comprend cinq conférences plénières : Denis Auroux (Harvard), Caroline Colijn (Université Simon Fraser), Gregory Lawler (Université de Chicago), Grigoris Paouris (Université A & M du Texas) et Pham Huu Tiep (Université Rutgers), ainsi qu'une conférence publique de Nilima Nigam.

Aussi au programme, plus de 20 sessions et mini-cours sur tous les aspects des sciences mathématiques, dont quelques-unes sur l'enseignement des mathématiques et une session scientifique entièrement organisée et donnée par des étudiants diplômés et de premier cycle.

La Réunion sera également l'occasion de célébrer l'excellence en mathématiques en rendant hommage au lauréat du prix Jeffery-Williams, Jeremy Quastel (Université de Toronto), et à la lauréate du prix Krieger-Nelson, Julia Gordon (Université de la Colombie-Britannique). Tous les prix seront remis lors du banquet du samedi 8 juin à l'Hôtel Saskatchewan, à Regina.

Au nom de la SMC, j'aimerais exprimer ma gratitude à tous les commanditaires de la Réunion d'été : l'AARMS, le CRM, les instituts Fields et PIMS et l'Université de Regina.

Allen Herman (Université de Regina), Alexander Litvak (Université de l'Alberta) et Karen Meagher (Université de Regina), nos directeurs scientifiques, ont travaillé très fort pour vous offrir un programme attrayant et varié; ils méritent grandement nos remerciements. L'organisation d'un tel congrès exige beaucoup de dévouement et de travail, et ne serait pas possible sans la précieuse contribution des directeurs scientifiques, des organisateurs de sessions, des bénévoles et du personnel de la SMC.

Enfin, je souhaite à tous les participants une Réunion très productive et agréable. Bienvenue à Regina!

Allen Herman
University of Regina

Alexander Litvak
University of Alberta

Karen Meagher
University of Regina

We are pleased to welcome you to the 2019 Summer Meeting of the Canadian Mathematical Society, hosted by the University of Regina.

C'est avec grand plaisir que nous vous accueillons à la Réunion d'été 2019 de la Société mathématique du Canada, à l'Université de Regina.

This meting is an opportunity to showcase accomplishments, share developments and discover new mathematical insights. We hope that you will benefit from the connections you build here, and that the scientific program widens your view of mathematics and advances your research program.

We are very excited about two initiatives at this meeting. For the first time, the CMS is hosting a series of mini-courses on the first day of the conference. The opening mini-course is targeted to career building for younger mathematicians. The afternoon mini-courses are designed to give the attendees a stronger background in the specialized topics represented in our scientific program. The mini-courses will be more informal than the scientific sessions, so will provide an excellent opportunity to make connections with other young researchers. We are also looking forward to our session on Indigenization and Reconciliation in Mathematics as well as a lunch panel on Equity and Diversity in Mathematics. These are important and timely issues for our society.

We are grateful to everyone that helped make this event happen, particularly the scientific organizing committee who were essential in developing the program for this meeting. We also want to thank the local organizing committee, the CMS, the Department of Mathematics and Statistics, the Faculty of Science and the University of Regina for their support and hard work.

Finally, we wish to thank you for being part of this event.

We hope that this will be a rewarding meeting.

Sincerely,

Karen Meagher
Allen Herman
Alexander Litvak

Cette rencontre est l'occasion parfaite pour présenter des réalisations, faire connaître les nouveautés et découvrir de nouvelles connaissances mathématiques. Nous espérons que vous tirerez profit des liens que vous tisserez ici et que le programme scientifique élargira votre vision des mathématiques tout en faisant progresser votre programme de recherche.

Nous sommes très enthousiastes à propos de deux nouveautés dans le cadre de cette Réunion. Pour la première fois, la SMC organise une série de mini-cours le premier jour. Le mini-cours d'ouverture porte sur le développement de carrière pour les plus jeunes mathématiciens. Les mini-cours de l'après-midi visent pour leur part à approfondir la connaissance des participants dans des domaines spécialisés à l'horaire de notre programme scientifique. Les mini-cours étant plus informels que les sessions scientifiques, ils seront l'occasion parfaite de nouer des liens avec d'autres jeunes chercheurs. Nous attendons également avec intérêt notre session sur l'autochtonisation et la réconciliation en mathématiques, ainsi qu'un panel de discussion sur l'équité et la diversité en mathématiques. Ce sont des enjeux importants et opportuns pour notre société.

Nous remercions toutes les personnes qui ont contribué à la réalisation de cet événement, en particulier le comité d'organisation scientifique, qui a joué un rôle essentiel dans l'élaboration du programme de cette Réunion. Merci également au comité organisateur local, à la SMC, au Département de mathématiques et de statistique, à la Faculté des sciences et à l'Université de Regina pour leur soutien et leur travail acharné.

Enfin, nous souhaitons vous remercier de participer à cette Réunion, que nous souhaitons des plus enrichissantes.

Cordialement,

Karen Meagher
Allen Herman
Alexander Litvak

CMS Membership *Counts!*

L'adhésion à la SMC *...c'est important!*

Become a new Member today!

Did you know that CMS Membership have several benefits including discounts?

- Math departments can sponsor membership for their students
- Dues are an eligible expense from NSERC Discovery Grants
- Reduced registrations fees at CMS meetings
- Substantial savings for Canadian residents who also wish to join other societies holding reciprocal agreements with the CMS, such as the AMS, MAA, etc.
- Up to 50% off publications
- Includes CMS newsletter: *CMS Notes*

Did you know that CMS offers a 2-year membership for the price of one when you sign up as a new CMS Member? Join us today!

Visit the Registration Booth for more information.

Devenez un nouveau membre aujourd'hui!

Saviez-vous que l'adhésion à la SMC offre plusieurs avantages, notamment des réductions?

- Les départements de mathématiques peuvent parrainer l'adhésion de leurs étudiants
- Les frais sont une dépense admissible pour les Subventions à la découverte du CRSNG
- Réductions sur les frais d'inscription aux Réunions de la SMC
- Économies substantielles pour les résidents canadiens qui souhaitent également se joindre à d'autres sociétés ayant un accord de réciprocité avec la SMC - AMS, MAA, etc.
- Jusqu'à 50 % de réduction sur les publications
- Abonnement inclus à notre bulletin, les *Notes de la SMC*

Saviez-vous que la SMC offrait l'**adhésion à** deux ans pour un an aux nouveaux membres? Adhérez dès aujourd'hui* et vous recevrez un t-shirt gratuit de votre choix!

Passez au kiosque d'inscriptions pour plus d'informations.

OFFICE OF THE MAYOR
THE CITY OF REGINA

MESSAGE FROM THE MAYOR

On behalf of my colleagues on City Council and the citizens of Regina, I am pleased to welcome you to the spring/summer meeting of the Canadian Mathematical Society.

Regina is Canada's second fastest-growing city by population and, with the country's highest rate of international immigration, a beacon to new Canadians coming from all over the globe. A truly welcoming city, we have become increasingly diverse over the last decade and our community reflects the myriad cultures that make up our population.

Despite our incredible growth in recent years, Regina retains a small-town friendliness and a welcoming nature that you will see in your interactions with our residents, organizers, volunteers and service industry employees.

While your meetings will no doubt keep you busy, I invite you to explore our city and see everything it has to offer. The RCMP Heritage Centre, the Saskatchewan Science Centre, the Kramer IMAX Theatre, the Royal Saskatchewan Museum and the Saskatchewan Sports Hall of Fame and Museum offer the chance to learn more about Saskatchewan and its history. There is a wide range of unique local shops, restaurants, and bars that have sprung forth from our burgeoning entrepreneurial sector that are sure to impress as well.

What it all adds up to is a formula for a successful gathering! Best wishes for an enjoyable stay and a safe journey home!

Sincerely,

Michael Fougere
Mayor

2019 Excellence in Teaching Award

Andrea Fraser (Dalhousie)

The Excellence in Teaching Award recognizes sustained and distinguished contributions in mathematics education at the post-secondary undergraduate level at a Canadian institution. The award was established in 2004 to recognize teaching excellence as exemplified by effectiveness in the classroom and/or commitment and dedication to teaching students. The Canadian Mathematical Society (CMS) is pleased to announce that Professor Andrea Fraser (Dalhousie) has been named the 2019 recipient of the CMS Excellence in Teaching Award.

Prix d'excellence en enseignement 2019

Andrea Fraser (Dalhousie)

Le Prix d'excellence en enseignement souligne au niveau national une contribution soutenue et exceptionnelle à l'enseignement des mathématiques au premier cycle postsecondaire dans un établissement d'enseignement canadien. Il a été créé en 2004 pour récompenser l'excellence d'un enseignant ou d'une enseignante telle qu'illustrée par son efficacité en classe ou son engagement et son dévouement envers l'enseignement et les étudiants. La Société mathématique du Canada (SMC)

There is an overwhelming amount of positive student feedback that speaks to Dr. Fraser's dedication and commitment to student success, and to the originality and exceptional clarity of her presentation. Students praise her ability to make difficult concepts easy and intuitive, and her lecturing style, which makes students feel they are "discovering" the material. Her colleagues write that "she very clearly cares and nurtures her students, and she embraces the weak students as well as challenges the strong".

Dr. Fraser's innovation in designing courses extends to the development of textbooks that contain stimulating visuals and clear explanations, and sets her apart as an outstanding instructor of mathematics.

Dr. Malabika Pramanik from the Department of Mathematics at UBC speaks of Andrea's "passion for teaching mathematics and her total dedication in making mathematics accessible to all students, from the weakest to the strongest. In a discipline which is rooted in learning from peers, yet where teaching is often much maligned, I found her approach truly inspiring."

Andrea Fraser earned her undergraduate and Master's degrees from the University of Toronto, and her PhD from Princeton University in 1997 under Elias M. Stein. After a four year lecturer position at the University of New South Wales in Australia, she returned to Canada, where she has been a faculty member at Dalhousie University since 2001.

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est fière d'annoncer qu'elle remettra son Prix d'excellence en enseignement 2019 à Andrea Fraser (Université Dalhousie).

Les étudiants ne tarissent pas d'éloges à l'égard de cette enseignante, tant sur son dévouement et son engagement envers la réussite des étudiants que sur l'originalité et la qualité exceptionnelle de ses cours. Ils apprécient sa capacité à simplifier les concepts difficiles, mais aussi ses cours magistraux qui leur donnent l'impression de « découvrir » la matière. Ses collègues la décrivent comme une personne qui se préoccupe vraiment de ses étudiants et qui encourage ceux qui éprouvent des difficultés, tout en poussant les plus avancés à se surpasser.

Le côté innovateur d'Andrea Fraser se manifeste dans la conception de ses cours et l'élaboration de manuels aux explications claires et au visuel stimulant, ce qui fait d'elle une enseignante émérite.

Malabika Pramanik, qui travaille au Département de mathématiques de l'Université de la Colombie-Britannique, évoque la passion d'Andrea Fraser à enseigner les mathématiques et son total dévouement à rendre cette matière accessible à tous les étudiants, peu importe leur niveau. Selon elle, dans une discipline enracinée dans l'apprentissage par les pairs où l'enseignement est pourtant souvent décrié, l'approche de la professeure représente une source d'inspiration.

Titulaire d'un baccalauréat et d'une maîtrise de l'Université de Toronto, Andrea Fraser a obtenu son doctorat de Princeton en 1997 sous la direction d'Elias M. Stein. Après avoir occupé un poste de chargée de cours pendant quatre ans à l'Université de New South Wales en Australie, elle est revenue au Canada où elle enseigne désormais à l'Université Dalhousie depuis 2001.

2019 Jeffery-Williams Prize

Jeremy Quastel
(University of Toronto)

The Jeffery-Williams Prize was inaugurated to recognize mathematicians who have made outstanding contributions to mathematical research. The first award was presented in 1968 and is named after Ralph Jeffery and Lloyd Williams, who were two influential CMS Board members. The Canadian Mathematical Society (CMS) is pleased to announce that Jeremy Quastel (Toronto) has been named the recipient of the 2019 CMS Jeffery-Williams Prize for his exceptional contributions to mathematics research.

prix Jeffery-Williams 2019

Jeremy Quastel
(University of Toronto)

Le prix Jeffery-Williams rend hommage aux mathématiciens qui se sont distingués par l'excellence de leur contribution à la recherche mathématique. Il a été décerné pour la première fois en 1968. Le prix porte le nom de Ralph Jeffery et de Lloyd Williams, deux anciens membres influents du conseil d'administration de la SMC. La Société mathématique du Canada (SMC) est heureuse d'annoncer que Jeremy Quastel (Toronto) est le lauréat 2019 du prix Jeffery-Williams de la SMC pour sa contribution exceptionnelle à la recherche mathématique.

Dr. Jeremy Quastel is one of the world's leading researchers in both probability and statistical physics. He received his undergraduate degree from McGill University and his PhD from the Courant Institute in 1990 under the direction of S.R.S. Varadhan. He is Professor and Chair of the Department of Mathematics at the University of Toronto where he has taught since 1998.

One of his most spectacular results is the first analytic solution of a non-linear stochastic partial differential equation-the Kardar-Parisi-Zhang equation (KPZ), which has become fundamental objects in mathematical physics. These are partial differential equations perturbed by noise. They are used in sciences to provide realistic models, taking into account natural randomness. This Fields has grown tremendously in both Mathematics and Physics in the last 15 years. The influence of Jeremy Quastel in both mathematics and physics was recognized early as he was an invited lecture on the subject at the International Congress of Mathematicians (2010) and a plenary lecture at the International Congress of Mathematical Physics (2012). Since then he has contribute a large body of papers related to KPZ theory with tremendous impact.

Dr. Quastel is awarded the 2019 Jeffery-Williams prize for his ground-breaking results in probability and non-equilibrium statistical mechanics, in particular, his recent discovery with Matetski and Remenik of the complete integrability of TASEP, and through a scaling limit, the strong coupling fixed point of the KPZ universality class. The class contains random interface growth models and directed polymer free energies. An example is the famous Kardar-Parisi-Zhang non-linear stochastic partial differential equation, which gives the class its name; TASEP is its most popular discretization. The KPZ fixed point is expected to describe the universal long time large scale fluctuations for all such systems.

Jeremy Quastel est l'un des plus éminents chercheurs au monde en physique statistique et en physique des probabilités. Il a obtenu son baccalauréat à l'Université McGill et son doctorat à l'Institut Courant en 1990, sous la direction de S.R.S. Varadhan. Il est directeur du Département de mathématiques de l'Université de Toronto, où il enseigne depuis 1998.

L'un de ses résultats les plus spectaculaires est la première solution analytique d'une équation différentielle aux dérivées partielles non linéaire et stochastique de Kardar-Parisi-Zhang (KPZ), devenue un objet fondamental de la physique mathématique. Il s'agit d'équations différentielles partielles perturbées par le bruit. On les utilise dans plusieurs domaines scientifiques pour produire des modèles réalistes qui tiennent compte du caractère aléatoire naturel. Ce domaine a énormément évolué en mathématiques et en physique au cours des 15 dernières années. L'influence de Jeremy Quastel dans les domaines des mathématiques et de la physique a été reconnue très tôt : il a en effet été invité à prononcer une conférence sur le sujet au Congrès international des mathématiciens de 2010 et une conférence plénière au Congrès international de physique mathématique de 2012. Il a depuis rédigé de nombreux articles sur la théorie de la KPZ qui ont eu une influence marquante.

Le prix Jeffery-Williams 2019 lui est remis pour ses résultats novateurs en étude des probabilités et en mécanique statistique hors d'équilibre, en particulier pour sa récente découverte, avec Matetski et Remenik, de l'intégrabilité complète du processus d'exclusion simple totalement asymétrique (TASEP en anglais) et, à travers une limite à l'échelle, du point fixe de couplage fort de la classe d'universalité de KPZ. La classe contient des modèles de croissance à interface aléatoire et des énergies dirigées sans polymère, par exemple la célèbre équation différentielle aux dérivées partielles non linéaire et stochastique de Kardar-Parisi-Zhang (d'où le nom de la classe), dont le TASEP est la discrétisation la plus populaire. Le point fixe KPZ devrait décrire les fluctuations universelles à grande échelle et à long terme de tous ces systèmes.

2019 Krieger-Nelson Prize

Julia Gordon
(University of British Columbia)

The Krieger-Nelson Prize, jointly named for Cecilia Krieger and Evelyn Nelson was first awarded in 1995. It was inaugurated to recognize outstanding contributions in the area of mathematical research by a female mathematician. The Canadian Mathematical Society (CMS) is pleased to announce that Dr. Julia Gordon (UBC) has been named the recipient of the 2019 Krieger-Nelson Prize for her exceptional contributions to mathematics research.

prix Krieger-Nelson 2019

Julia Gordon
(University of British Columbia)

Décerné pour la première fois en 1995, le prix Krieger-Nelson a été nommé en l'honneur de Cecilia Krieger et d'Evelyn Nelson. Il souligne la contribution exceptionnelle de mathématiciennes en recherche mathématique. La Société mathématique du Canada (SMC) est heureuse d'annoncer que la professeure Julia Gordon (UBC)

Dr. Julia Gordon works in representation theory of p-adic groups related to Langlands Program, and motivic integration. In many of her results, she applies model theory (specifically, motivic integration) to arithmetic questions. In rough terms, motivic integrations makes it possible to do integration on p-adic fields uniformly in p. With Raf Cluckers and Immanuel Halupczok, Gordon used this technique to prove uniform estimates on orbital integrals that have an application in the study of L-functions.

Julia Gordon earned her doctorate at the University of Michigan in 2003 under the supervision of Thomas Hales. She has been recognized by several appointments and awards including: Fields Institute Postdoctoral Fellow in 2003; University of Toronto Postdoctoral Fellow 2004-2006; NSERC Accelerator award 2015-2018; and the Michler Prize (AWM and Cornell University), 2017.

Currently, Dr. Gordon is an Associate Professor at the University of British Columbia, where she has been since 2006.

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est la lauréate 2019 du prix Krieger-Nelson pour sa contribution exceptionnelle à la recherche mathématique.

Les travaux de Julia Gordon portent sur la théorie de la représentation des groupes p-adiques en lien avec le programme de Langlands et sur l'intégration motivique. Dans bon nombre de ses résultats, elle applique la théorie des modèles (en particulier, l'intégration motivique) à des questions arithmétiques. En gros, les intégrations motiviques permettent d'intégrer uniformément les champs p-adiques dans p. Avec Raf Cluckers et Immanuel Halupczok, elle a utilisé cette technique pour prouver des estimations uniformes sur les intégrales orbitales ayant une application dans l'étude des fonctions-L.

Julia Gordon a obtenu son doctorat de l'Université du Michigan en 2003 sous la direction de Thomas Hales. Elle a été récompensée de plusieurs prix et titres, notamment : boursière postdoctorale de l'institut Fields en 2003; boursière postdoctorale de l'Université de Toronto en 2004-2006; récipiendaire d'une subvention d'accélération à la découverte du CRSNG en 2015-2018; lauréate du prix Michler (AWM et Cornell) en 2017.

Julia Gordon est professeure agrégée à l'Université de la Colombie-Britannique, où elle enseigne depuis 2006.

CALL FOR NOMINATIONS

2020 Excellence in Teaching Award

The CMS Excellence in Teaching Award Selection Committee invites nominations for the *2020 Excellence in Teaching Award*.

The Excellence in Teaching Award focuses on the recipient's proven excellence as a teacher at the undergraduate level, including at universities, colleges and cégeps, as exemplified by unusual effectiveness in the classroom and/or commitment and dedication to teaching and to students. The dossier should provide evidence of the effectiveness and impact of the nominee's teaching. The prize recognizes sustained and distinguished contributions in teaching at the post-secondary undergraduate level at a Canadian institution. Only full-time teachers or professors who have been at their institution for at least five years will be considered. The nomination will remain active for three years, with a possibility to update.

The CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues regardless of race, gender, ethnicity or sexual orientation.

Nomination letters, *including at least three letters of reference*, should list the chosen referees and include a recent curriculum vitae for the nominee, if available.

Nominations and reference letters should be submitted electronically, preferably in PDF format, to: etaward@cms.math.ca no later than the deadline of **November 15, 2019**.

APPEL À CANDIDATURES

Prix d'excellence en enseignement 2020

La Comité de sélection du Prix d'excellence en enseignement de la SMC sollicite des mises en candidature pour le *Prix d'excellence en enseignement 2020*.

Le Prix d'excellence en enseignement de la SMC récompense l'excellence reconnue d'un enseignant ou d'un professeur de niveau postsecondaire (universités, collèges et cégeps), telle qu'illustrée par son efficacité exceptionnelle en classe et/ou son engagement et son dévouement envers l'enseignement et les étudiants. Le dossier de candidature doit montrer l'efficacité et les effets de l'enseignement du candidat ou de la candidate. Ce prix récompense des contributions exceptionnelles et soutenues en enseignement collégial et de premier cycle universitaire dans un établissement canadien. Seules les candidatures d'enseignants et de professeurs à temps plein qui travaillent dans le même établissement depuis au moins cinq ans seront retenues. Une candidature peut être mise à jour et demeure active pendant 3 ans.

La SMC a pour but de promouvoir et de célébrer la diversité au sens le plus large. Nous encourageons fortement les directeurs et les directrices de département et les comités de mise en candidature à proposer des collègues exceptionnels sans distinction de race, de genre, d'appartenance ethnique ou d'orientation sexuelle.

Le dossier de candidature, *comprenant au moins trois lettres de référence*, doit comprendre le nom des personnes données à titre de référence ainsi qu'un curriculum vitae récent du candidat ou de la candidate, dans la mesure du possible.

Veuillez faire parvenir les mises en candidature et lettres de référence par voie électronique, de préférence en format PDF, à : prixee@smc.math.ca avant la date limite du **15 novembre 2019**.

CALL FOR NOMINATIONS

CMS Research Prizes

The CMS Research Committee is inviting nominations for three prize lectureships. These prize lectureships are intended to recognize members of the Canadian mathematical community.

The **Coxeter-James Prize** Lectureship recognizes young mathematicians who have made outstanding contributions to mathematical research. The recipient shall be a member of the Canadian mathematical community. Nominations may be made up to ten years from the candidate's Ph.D. A nomination can be updated and will remain active for a second year unless the original nomination is made in the tenth year from the candidate's Ph.D. For more information, visit: https://cms.math.ca/Prizes/cj-nom

The **Jeffery-Williams Prize** Lectureship recognizes mathematicians who have made outstanding contributions to mathematical research. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for three years. For more information: https://cms.math.ca/Prizes/jw-nom

The **Krieger-Nelson Prize** Lectureship recognizes outstanding research by a female mathematician. The recipient shall be a member of the Canadian mathematical community. A nomination can be updated and will remain active for two years. For more information: https://cms.math.ca/Prizes/kn-nom

CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues for research in the mathematical sciences regardless of race, gender, ethnicity or sexual orientation. A candidate can be nominated for more than one research prize in the applicable categories; several candidates from the same institution can be nominated for the same research prize.

CMS research prizes are gender-neutral, except for the Krieger-Nelson prize, which is awarded to women only. Nominations of eligible women for the general research prizes in addition to the Krieger-Nelson Prize are strongly encouraged.

The deadline for nominations, including at least three letters of reference, is **September 30, 2019.** Nomination letters should list the chosen referees and include a recent curriculum vitae for the nominee. Some arms-length referees are strongly encouraged. Nominations and the reference letters from the chosen referees should be submitted electronically, preferably in PDF format, to the corresponding email address and **no later than September 30, 2019:**

Coxeter-James: cjprize@cms.math.ca
Jeffery-Williams: jwprize@cms.math.ca
Krieger-Nelson: knprize@cms.math.ca

APPEL À CANDIDATURES

Prix de recherche de la SMC

Le Comité de recherche de la SMC lance un appel de mises en candidatures pour trois de ses prix de conférence. Ces prix ont tous pour objectif de souligner l'excellence de membres de la communauté mathématique canadienne.

Le **Prix Coxeter-James** rend hommage aux jeunes mathématiciens qui se sont distingués par l'excellence de leur contribution à la recherche mathématique. Cette personne doit etre membre de la communauté mathématique canadienne. Les candidats sont admissibles jusqu'à dix ans après l'obtention de leur doctorat. Toute mise en candidature est modifiable et demeurera active l'année suivante, à moins que la mise en candidature originale ait été faite la 10 année suivant l'obtention du doctorat. Pour les renseignements, voir : **https://cms.math.ca/Prix/cj-nom**

Le **Prix Jeffery-Williams** rend hommage aux mathématiciens ayant fait une contribution exceptionnelle à la recherche mathématique. Cette personne doit être membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant trois ans. Pour les renseignements, voir : https://cms.math.ca/Prix/jw-nom

Le **Prix Krieger-Nelson** rend hommage aux mathématiciennes qui se sont distinguées par l'excellence de leur contribution à la recherche mathématique. La laureate doit etre membre de la communauté mathématique canadienne. Toute mise en candidature est modifiable et demeurera active pendant deux ans. Pour les renseignements, voir : https://cms.math.ca/Prix/kn-nom

La SMC a pour but de promouvoir et de célébrer la diversité au sens le plus large. Nous encourageons fortement les directeurs et les directrices de département et les comités de mise en candidature à proposer des collègues exceptionnels pour la recherche dans les sciences mathématiques sans distinction de race, de genre, d'appartenance ethnique ou d'orientation sexuelle. Une personne peut être mise en candidature pour plus d'un prix de recherche dans les catégories applicables ; plusieurs candidats d'un même institut peuvent être nommés pour le même prix de recherche.

Les prix de recherche de la SMC sont non sexistes, à l'exception du prix Krieger-Nelson, qui est décerné uniquement aux femmes. Les candidatures de femmes éligibles pour les prix de recherche généraux en plus du prix Krieger-Nelson sont fortement encouragées.

La date limite pour déposer une candidature, qui comprendra au moins trois lettres de référence, est **le 30 septembre 2019.** Le dossier de candidature doit comprendre le nom des personnes données à titre de référence ainsi qu'un curriculum vitae récent du candidat ou de la candidate. Veuillez faire parvenir les mises en candidature et lettres de référence par voie électronique, de préférence en format PDF, avant la date limite, à l'adresse électronique correspondante et **au plus tard le 30 septembre 2019 :**

Coxeter-James : prixcj@smc.math.ca
Jeffery-Williams : prixjw@smc.math.ca
Krieger-Nelson : prixkn@smc.math.ca

List of Abbreviations / Liste des abbréviations

Assess	Assessment in Mathematics L'évaluation en mathématiques
CatApp	Categorical Approaches to Topology and Geometry Approches catégoriques de la topologie et de la géométrie
Contrib	Contributed Papers Communications libres
EquivM	Equivariant Methods in Differential and Algebraic Geometry Méthodes équivariantes en géométrie différentielle et algébrique
FIDStr	Finite and Infinite Dimensional Structures in Non-Commutative Analysis Structures dimensionnelles finies et infinies en analyse non commutative
FinGeom	Finite Geometry Géométrie finie
FunCxAn	Functional and Complex Analysis Analyse fonctionnelle et complexe
GrSProb	Randomness and Limited Information in Graph Searching Problems Problèmes liés au caractère aléatoire et à l'information limitée dans la recherche en graphe
HDProb	High-Dimensional Problems in Finance and Quantitative Research Problèmes de grande dimension en finance et en recherche quantitative
IRMath	Indigenization and Reconciliation in Mathematics Autochtonisation et réconciliation en mathématiques
JWPrize	Jefferey-Williams Prize Prix Jefferey-Williams
KNPrize	Krieger-Nelson Prize Prix Krieger-Nelson
MatTheo	Matrix Theory and its Applications La théorie des matrices et ses applications
MiniC	Mini-Courses Mini-cours
Plenary	Plenary Lectures Conférences plénières
Poster	AARMS-CMS Student Poster Session Présentations par affiches des étudiants - AARMS-SMC
ProbMet	Probabilistic Methods in Geometric Functional Analysis and Convexity Méthodes probabilistes en analyse et en convexité fonctionnelle géométrique
PrStoch	Recent Advances in Probability and Stochastics Progrès récents en probabilité et en stochastique
PubLec	Public Lecture Conférence publique
QuantIS	The Mathematics behind Quantum Information Science Les mathématiques derrière la science de l'information quantique
QuantSM	Mathematical Techniques for Analysing Quantum Structures and Materials Techniques mathématiques pour l'analyse de structures et de matériaux quantiques
ReprTh	Representation Theory of Groups Defined Over Local Fields Théorie des représentations de groupes définis sur des champs locaux
StudRes	STUDC Research Session Session de recherche du Comité des étudiants
Topol	Topology Topologie

Schedule for Business Meetings
Horaire pour Séances de travail

Thursday June 6	**jeudi 6 juin**
18:00 - 22:00	CMS Executive Committee / Comité exécutif SMC, Heritage Boardroom, Hotel Saskatchewan

Friday June 7	**vendredi 7 juin**
12:30 - 16:30	CMS Board of Directors Meeting / Réunion du Conseil d'administration SMC, ED 114, Education Building
19:30 - 20:30	Education Committee / Comité d'éducation, ED 192, Education Building

Saturday June 8	**samedi 8 juin**
11:00 - 15:00	Publications Committee / Comité des publications, ED 192, Education Building

Sunday June 9	**dimanche 9 juin**
10:30 - 12:00	Student Committee / Comité des étudiants, CK 187, Centre for Kinesiology
12:00 - 13:30	CMS AGM / L'AGA de la SMC, ED191, Education Building
13:30 - 16:00	Mathematical Competitions Committee / Comité des concours mathématiques, ED 192, Education Building

Schedule for Related Activities
Horaire pour Activités sociales

Friday June 7	**vendredi 7 juin**
8:00 - 19:30	Registration / Inscription, ED 101.1 Corridor, Education Building
14:15 - 14:30	Break / Pause, ED 101.1 Corridor, Education Building
20:00 - 22:00	Student Social / Soirée étudiante

Saturday June 8	**samedi 8 juin**
7:30 - 18:00	Registration / Inscription, ED 101.1 Corridor, Education Building
8:30 - 16:30	AARMS-CMS Student Poster Session / Session de présentation par affiches pour étudiants AARMS-SMC, ED 101.1 Corridor, Education Building
10:00 - 16:30	Exhibits / Expositions, ED 101.1 Corridor, Education Building
10:30 - 11:00	Break / Pause, ED 101.1 Corridor, Education Building
15:30 - 16:00	Break / Pause, ED 101.1 Corridor, Education Building
19:00 - 22:30	Reception and Awards Banquet / Réception et Banquet de prix, Regency Ballroom, Hotel Saskatchewan

Sunday June 9	**dimanche 9 juin**
7:30 - 18:00	Registration / Inscription, ED 101.1 Corridor, Education Building
8:30 - 16:30	AARMS-CMS Student Poster Session / Session de présentation par affiches pour étudiants AARMS-SMC, ED 101.1 Corridor, Education Building
10:00 - 16:30	Exhibits / Expositions, ED 101.1 Corridor, Education Building
10:30 - 11:00	Break / Pause, ED 101.1 Corridor, Education Building
15:30 - 16:00	Break / Pause, ED 101.1 Corridor, Education Building

Monday June 10	**lundi 10 juin**
7:30 - 18:00	Registration / Inscription, ED 101.1 Corridor, Education Building
10:30 - 11:00	Break / Pause, ED 101.1 Corridor, Education Building
13:30 - 14:30	Walking Tour of First Nations University of Canada, First Nations University of Canada

Schedule
Horaire

Friday June 7	**vendredi 7 juin**
8:00 - 19:30	Registration / Inscription, ED 101.1 Corridor, Education Building
9:00 - 12:00	Allen Herman and Karen Meagher (University of Regina), *Minicourse on Building Your Career in Mathematics*, MiniC (p. 47), ED 191, Education Building
13:00 - 16:00	Chris Fisher, Brett Stevens and Tim Alderson (University of Regina, Carleton University and University of New Brunswick), *Geometry Workshop*, MiniC (p. 47), ED 191, Education Building
13:00 - 16:00	Krystal Guo, *Using the Sage Mathematics Software System in Algebra and Discrete Math*, MiniC (p. 47), CW 317.37, College West Building
13:00 - 16:00	Sarah Plosker and Nathaniel Johnston (CRC Chair, University of Brandon and Mount Allison University), *Basics of Quantum Information Theory*, MiniC (p. 47), CK 185, Centre for Kinesiology
13:00 - 16:00	Hadi Salmasian (University of Ottawa), *Interpolation polynomials and representation theory: transcending the classical Capelli identity*, MiniC (p. 48), ED 312, Education Building
13:00 - 16:00	Jonathan Scott (Cleveland State University), *Category Theory in Topological Data Analysis*, MiniC (p. 48), ED 438, Education Building
13:00 - 16:00	Ryan Tifenbach and Danny Dyer (Mount Allison University and Memorial University), *Introduction to Graph Searching*, MiniC (p. 48), CK 187, Centre for Kinesiology
13:00 - 16:00	Konstantin Tikhomirov (Georgia Tech), *Convex-Geometric Methods in Random Matrix Theory*, MiniC (p. 48), ED 193, Education Building
14:15 - 14:30	Break / Pause, ED 101.1 Corridor, Education Building
17:00 - 18:00	Nilima Nigam (Simon Fraser University), *When mathematicians play the drums*, PubLec (p. 49), RI 119, Research and Innovation Centre
20:00 - 22:00	Student Social / Soirée étudiante

7:30 - 18:00	Registration / Inscription, ED 101.1 Corridor, Education Building
8:00 - 8:30	Anthony Bonato (Ryerson), *Limited information Cops and Robbers games*, GrSProb (p. 100), CK 187, Centre for Kinesiology
8:00 - 8:30	Anders Buch (Rutgers University), *Positivity of minuscule quantum K-theory*, EquivM (p. 65), ED 106.1, Education Building
8:00 - 8:30	Damir Kinzebulatov (Université Laval), *A new look at the KLMN theorem*, FunCxAn (p. 78), ED 315, Education Building
8:00 - 8:30	Alexander Melnikov (University of Alberta), *On Option Pricing Methods in Modern Mathematical finance*, HDProb (p. 81), ED 438, Education Building
8:00 - 8:30	Paul Mezo (Carleton University), *Equivalent definitions of Arthur-packets for real classical groups*, ReprTh (p. 106), ED 312, Education Building
8:00 - 8:30	Vern Paulsen (University of Waterloo), *Constant Gap for Self-embezzlement*, QuantIS (p. 113), ED 230, Education Building
8:00 - 8:30	Keith Taylor (Dalhousie University), *What can the CMS do about reconciliation ?*, IRMath (p. 86), ED 558, Education Building
8:00 - 8:30	Elisabeth Werner (Case Western Reserve University), *Entropy inequalities for log concave functions*, ProbMet (p. 98), ED 193, Education Building
8:00 - 8:30	Dilian Yang (University of Windsor), *KMS states of self-similar k-graph C*-algebras*, FIDStr (p. 76), ED 191, Education Building
8:00 - 8:30	Alex Zagoskin (Loughborough University), *Towards the qualitative theory of large quantum coherent structures*, QuantSM (p. 89), ED 106.2, Education building
8:30 - 16:30	AARMS-CMS Student Poster Session / Session de présentation par affiches pour étudiants AARMS-SMC, ED 101.1 Corridor, Education Building
8:30 - 9:00	Nicolas Arancibia (Carleton University), *A(rthur)-Packets of Cohomological Representations*, ReprTh (p. 104), ED 312, Education Building
8:30 - 9:00	Andrea Burgess (University of New Brunswick St. John), *Cops that surround a robber*, GrSProb (p. 100), CK 187, Centre for Kinesiology
8:30 - 9:00	Brian Forrest (University of Waterloo), *Expanding Mathematics Educational Opportunites for Indigenous Teachers*, IRMath (p. 85), ED 558, Education Building
8:30 - 9:00	Xuemiao Hao (University of Manitoba), *Sharp Tail Estimate for Aggregate Critical Illness Claims in a Large Population*, HDProb (p. 81), ED 438, Education Building
8:30 - 9:00	Robin Koytcheff (University of Louisiana at Lafayette), *Operadic decompositions of spaces of string links*, Topol (p. 116), ED 318, Education Building
8:30 - 9:00	Galyna Livshyts (Georgia Institute of Technology), *Smallest singular value of inhomogeneous random square matrices via double counting and random rounding*, ProbMet (p. 96), ED 193, Education Building
8:30 - 9:00	Matthias Neufang (Carleton University), *Solution to several problems regarding tensor products and crossed products of C^*- and von Neumann algebras*, FIDStr (p. 75), ED 191, Education Building
8:30 - 9:00	Cihan Okay (University of British Columbia), *Topology of quantum contextuality*, QuantSM (p. 88), ED 106.2, Education building
8:30 - 9:00	Mizanur Rahaman (University of Waterloo), *A new bound on quantum Wielandt inequality*, QuantIS (p. 113), ED 230, Education Building
8:30 - 9:00	Mohammad Shirazi (University of Manitoba), *Grunsky and Faber Operators for Riemann Surfaces with One Border*, FunCxAn (p. 79), ED 315, Education Building
8:50 - 9:20	Jenna Rajchgot (University of Saskatchewan), *Grobner bases for certain type C Kazhdan-Lusztig ideals*, EquivM (p. 67), ED 106.1, Education Building
9:00 - 9:30	Tim Alderson (University of New Brunswick Saint John), *t-Extensions of Linear Codes*, FinGeom (p. 70), CK 185, Centre for Kinesiology
9:00 - 9:30	Ed Belk (University of British Columbia), *The Local Trace Formula as a Motivic Identity*, ReprTh (p. 104), ED 312, Education Building
9:00 - 9:30	Christian Benes (Brooklyn College), *Rates of Convergence for the Simple Random Walk Green's Function*, PrStoch (p. 102), ED 623, Education Building

9:00 - 9:30	Yangho Choi (Hanyang University), *Macroscopic Modeling of Data Breach Risk with Spatial and Temporal Autocorrelation*, HDProb (p. 81), ED 438, Education Building
9:00 - 9:30	Ryan Hayward (University of Alberta), *Searching for Winning Strategies in Hex*, GrSProb (p. 100), CK 187, Centre for Kinesiology
9:00 - 9:30	Nathaniel Johnston (Mount Allison University), *Pairwise Completely Positive Matrices and Quantum Entanglement*, QuantIS (p. 111), ED 230, Education Building
9:00 - 9:30	Veselin Jungic (Simon Fraser University), *Changing Lives or Scratching the Surface: Five Years of the SFU Academic Summer Camp for Aboriginal Students*, IRMath (p. 85), ED 558, Education Building
9:00 - 9:30	Marcelo Laca (University of Victoria), *Reconstructing directed graphs*, FIDStr (p. 74), ED 191, Education Building
9:00 - 9:30	Joseph Maciejko (University of Alberta), *Strongly interacting topological phases of matter*, QuantSM (p. 87), ED 106.2, Education building
9:00 - 9:30	Christopher Ramsey (Grant MacEwan University), *What is and is not a Tensor algebra*, FunCxAn (p. 78), ED 315, Education Building
9:00 - 9:30	Laura Scull (Fort Lewis College), *Transitive Groupoids with Interesting Topological Properties*, Topol (p. 118), ED 318, Education Building
9:00 - 9:30	Konstantin Tikhomirov (Georgia Institute of Technology), *Small ball probability for the condition number of random matrices*, ProbMet (p. 98), ED 193, Education Building
9:30 - 10:00	Darja Barr (University of Manitoba), *The Impact of Working Together*, IRMath (p. 84), ED 558, Education Building
9:30 - 10:00	Jeffrey Carlson (University of Toronto), *Local integration in equivariant cobordism theory*, Topol (p. 115), ED 318, Education Building
9:30 - 10:00	Jason Crann (Carleton University), *An equivariant weak expectation property and amenable actions*, FIDStr (p. 73), ED 191, Education Building
9:30 - 10:00	Robert Green (University of Saskatchewan), *Numerical Many Body Models for Synchrotron Spectroscopy of Quantum Materials*, QuantSM (p. 87), ED 106.2, Education building
9:30 - 10:00	Shahin Kamali (University of Manitoba), *On the complexity of burning and broadcasting problems*, GrSProb (p. 101), CK 187, Centre for Kinesiology
9:30 - 10:00	Daniel Le (University of Toronto), *mod p representations of p-adic* GL_2, ReprTh (p. 106), ED 312, Education Building
9:30 - 10:00	Arnaud Marsiglietti (University of Florida), *Hyperplane conjecture and central limit theorem*, ProbMet (p. 97), ED 193, Education Building
9:30 - 10:00	James McQuillan (Western Illinois University), *Desargues configurations with self-conjugate points*, FinGeom (p. 70), CK 185, Centre for Kinesiology
9:30 - 10:00	Shanoja Naik (Registered Nurses Association of Ontario), *On Wishart Process and Sovereign Credit Risk Modelling*, HDProb (p. 82), ED 438, Education Building
9:30 - 10:00	Sarah Plosker (Brandon University), *The robustness of k-coherence*, QuantIS (p. 113), ED 230, Education Building
9:30 - 10:00	Larissa Richards (University of Toronto), *The polynomial rate of convergence of critical interfaces.*, PrStoch (p. 102), ED 623, Education Building
9:30 - 10:00	Ryan Tessier (University of Regina), *Purity of the Identity Map on the Operator System generated by the Free Group*, FunCxAn (p. 79), ED 315, Education Building
9:40 - 10:10	Matthias Franz (University of Western Ontario), *The number of connected orbit types in a G-manifold*, EquivM (p. 66), ED 106.1, Education Building
10:00 - 16:30	Exhibits / Expositions, ED 101.1 Corridor, Education Building
10:00 - 10:30	Melania Alvarez (University of British Columbia), *Engaging Indigenous communities through math outreach*, IRMath (p. 84), ED 558, Education Building
10:00 - 10:30	Naeima Ashleik (University of Saskatchewan), *Learning for Contingency Tables and Survival Data Using Imprecise Probabilities*, HDProb (p. 80), ED 438, Education Building
10:00 - 10:30	Arno Berger (University of Alberta), *Best Kantorovich and Levy approximations on the real line*, PrStoch (p. 102), ED 623, Education Building
10:00 - 10:30	Aiden Bruen (Carleton University), *An extension of Desargues Theorem*, FinGeom (p. 70), CK 185, Centre for Kinesiology

10:00 - 10:30	Eric Chitambar (University of Illinois Urbana-Champaign), *Playing Mermin's Game with Nonlocal Resources*, QuantIS (p. 110), ED 230, Education Building
10:00 - 10:30	Raphael Clouatre (University of Manitoba), *Uniform quotients and C^*-envelopes on the Drury-Arveson space*, FunCxAn (p. 77), ED 315, Education Building
10:00 - 10:30	Boaz Elazar (University of British Columbia), *Schwartz Functions And Tempered Distributions On Singular Quasi-Nash Varieties*, ReprTh (p. 105), ED 312, Education Building
10:00 - 10:30	Rachel Hardeman (University of Calgary), *An Introduction to A-Homotopy Theory: A Discrete Homotopy Theory for Graphs*, Topol (p. 116), ED 318, Education Building
10:00 - 10:30	Piotr Nayar (University of Warsaw), *The log-concave moment problem*, ProbMet (p. 97), ED 193, Education Building
10:00 - 10:30	David Pike (Memorial University of Newfoundland), *The Firebreak Problem*, GrSProb (p. 101), CK 187, Centre for Kinesiology
10:00 - 10:30	Paul Skoufranis (York University), *Majorization, Convexity, and Expectations*, FIDStr (p. 76), ED 191, Education Building
10:00 - 10:30	Ray Spiteri (University of Saskatchewan), *Quantum control for high-fidelity multi-qubit gates*, QuantSM (p. 89), ED 106.2, Education building
10:30 - 11:00	Break / Pause, ED 101.1 Corridor, Education Building
11:00 - 12:00	Pham Huu Tiep (Rutgers University), *Finite groups, representations, character values, and applications*, Plenary (p. 51), EA 106, Education Building
13:30 - 14:30	Caroline Colijn (Simon Fraser University), *The forests and the trees: new metrics on some flavours of trees*, Plenary (p. 50), EA 106, Education Building
14:30 - 15:30	Grigoris Paouris (Texas A&M University), *The interplay of Probability and Geometry*, Plenary (p. 51), EA 106, Education Building
15:30 - 16:00	Break / Pause, ED 101.1 Corridor, Education Building
16:00 - 16:30	Alejandro Adem (University of British Columbia), *Twisted equivariant K-theory of compact Lie group actions with maximal rank isotropy*, EquivM (p. 64), ED 106.1, Education Building
16:00 - 16:30	Syed Ejaz Ahmed (Brock University), *Implicit Bias in Big Data Analytics*, HDProb (p. 80), ED 438, Education Building
16:00 - 16:30	Adele Bourgeois (University of Ottawa), *On the Multiplicities in the Restriction of a Supercuspidal Representation*, ReprTh (p. 105), ED 312, Education Building
16:00 - 16:30	Edward Doolittle (First Nations University of Canada), IRMath (p. 84), ED 558, Education Building
16:00 - 16:30	Rupert Levene (University College Dublin), *Schur multipliers and mixed unitary maps*, QuantIS (p. 112), ED 230, Education Building
16:00 - 16:30	Mokshay Madiman (University of Delaware), *Sharp moment-entropy inequalities for log-concave distributions*, ProbMet (p. 96), ED 193, Education Building
16:00 - 16:30	Abdel Rahman (University of Regina), *Homogeneous Levi Foliations*, FunCxAn (p. 78), ED 315, Education Building
16:00 - 16:30	Neil J. Ross (Dalhousie University), *Number-Theoretic Methods in Quantum Compiling*, QuantSM (p. 88), ED 106.2, Education building
16:00 - 16:30	Yinon Spinka (University of British Columbia), *A short proof of the discontinuity of phase transition in the planar random-cluster model with $q > 4$*, PrStoch (p. 103), ED 623, Education Building
16:00 - 16:30	Nico Spronk (University of Waterloo), *Fixed points of contractive measures acting by convolution*, FIDStr (p. 76), ED 191, Education Building
16:00 - 16:30	Brett Stevens (Carleton University), *Affine planes with ovals for blocks*, FinGeom (p. 71), CK 185, Centre for Kinesiology
16:00 - 16:30	Ben Williams (University of British Columbia), *$\mathbb{A}^1$-homotopy and a conjecture of Suslin*, Topol (p. 118), ED 318, Education Building
16:30 - 17:00	Kasun Fernando Akurugodage (University of Toronto), PrStoch (p. 102), ED 623, Education Building
16:30 - 17:00	Gilad Gour (University of Calgary), *Mathematical structures and features of quantum resource theories*, QuantSM (p. 87), ED 106.2, Education building
16:30 - 17:00	Shakhawat Hossain (University of Winnipeg), *Estimation strategy of multilevel model for ordinal longitudinal data*, HDProb (p. 81), ED 438, Education Building

16:30 - 17:00 Masoud Khalkhali (Western University), *Von Neumann information entropy, second quantization, and spectral action*, FIDStr (p. 74), ED 191, Education Building

16:30 - 17:00 Jeremy Levick (University of Cape Town), *Factorizable Quantum Channels and Linear Matrix Inequalities*, QuantIS (p. 112), ED 230, Education Building

16:30 - 17:00 Kathy Nolan (University of Regina), *A Reframing of Mathematics through Critical and Culturally Responsive Pedagogies*, IRMath (p. 85), ED 558, Education Building

16:30 - 17:00 Steven Rayan (University of Saskatchewan), *The quiver at the bottom of the twisted nilpotent cone on* $\mathbb{P}^1$, Topol (p. 117), ED 318, Education Building

16:30 - 17:00 David Roe (Massachusetts Institute of Technology), *A database of p-adic tori*, ReprTh (p. 106), ED 312, Education Building

16:30 - 17:00 Jonathan Scott (Cleveland State University), *Wasserstein distance for generalized persistence modules and abelian categories*, CatApp (p. 60), ED 314, Education Building

16:30 - 17:00 John Sheekey (University College Dublin), *Finite Geometry and Rank-Metric Codes*, FinGeom (p. 70), CK 185, Centre for Kinesiology

16:30 - 17:00 Yair Shenfeld (Princeton University), *Extremals in Minkowski's quadratic inequality*, ProbMet (p. 97), ED 193, Education Building

16:30 - 17:00 Ed Timko (University of Manitoba), *Row Contractions Constrained by Higher Order Vanishing Ideals.*, FunCxAn (p. 79), ED 315, Education Building

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16:40 - 17:10 Chi-Kwong Fok (University of Auckland), *Twisted K-theory and extended Verlinde algebra*, EquivM (p. 66), ED 106.1, Education Building

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17:00 - 17:30 Bruce Gilligan (University of Regina), *Pseudoconvex homogeneous manifolds*, FunCxAn (p. 77), ED 315, Education Building

17:00 - 17:30 Nicole Kitt (University of Calgary), *An ABV-packet for a General Linear Group with Two Representations*, ReprTh (p. 105), ED 312, Education Building

17:00 - 17:30 Thuntida Ngamkham (University of Calgary), *Confidence intervals for a ratio of binomial proportions*, HDProb (p. 82), ED 438, Education Building

17:00 - 17:30 Cihan Okay (University of British Columbia), *Mod-ℓ homotopy type of the classifying space for commutativity*, Topol (p. 117), ED 318, Education Building

17:00 - 17:30 Rajesh Pereira (University of Guelph), *Quasiorthogonal algebras*, QuantIS (p. 113), ED 230, Education Building

17:00 - 17:30 Volker Runde (University of Alberta), *Amenability of the Fourier algebra in the completely bounded multiplier norm*, FIDStr (p. 75), ED 191, Education Building

17:00 - 17:30 Gale Russell (University of Regina), *Truth before Reconciliation in Mathematics and Mathematics Education: An Invitation to Action*, IRMath (p. 85), ED 558, Education Building

17:00 - 17:30 Artur Sowa (University of Saskatchewan), *Qubits, wavelets, fractals, bands*, QuantSM (p. 88), ED 106.2, Education building

17:00 - 17:30 Kateryna Tatarko (University of Alberta), *On the solution to the reverse isoperimetric problem*, ProbMet (p. 98), ED 193, Education Building

17:00 - 17:30 Sarai Hernandez Torres (University of British Columbia), *Scaling limits of uniform spanning trees in three dimensions*, PrStoch (p. 103), ED 623, Education Building

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17:20 - 17:50 Jeffrey Carlson (University of Toronto), *The equivariant K-theory of a cohomogeneity-one action*, EquivM (p. 65), ED 106.1, Education Building

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17:30 - 18:00 Anthony Bahri (Rider University), *Polyhedral products and their applications*, Topol (p. 115), ED 318, Education Building

17:30 - 18:00 Sabine Burgdorf (University of Konstanz), *Quantum correlations and optimization*, QuantIS (p. 110), ED 230, Education Building

17:30 - 18:00 Susanna Dann (Universidad de los Andes), *Affine isoperimetric inequalities on flag manifolds.*, ProbMet (p. 95), ED 193, Education Building

17:30 - 18:00 Richard Fournier (Dawson College), *A Schwarz lemma for locally univalent meromorphic functions*, FunCxAn (p. 77), ED 315, Education Building

17:30 - 18:00 Open Discussion, IRMath, ED 558, Education Building

17:30 - 18:00 Salma Saad (University of Regina), *Asymptotic Analysis of Method of Moments Estimators of Parameters p and m for the Binomial Distribution*, HDProb (p. 82), ED 438, Education Building

17:30 - 18:00	Loren Spice (Texas Christian University), *New developments in the construction of tame, supercuspidal representations*, ReprTh (p. 107), ED 312, Education Building
17:30 - 18:00	David Wehlau (Royal Military College of Canada), *Planes, Division Sequences and ZZ-topes*, FinGeom (p. 71), CK 185, Centre for Kinesiology
17:30 - 18:00	Seth Wolbert (University of Manitoba), *Fibrations as presentations of actions on stacks*, CatApp (p. 61), ED 314, Education Building
18:00 - 18:30	Javad Mashreghi (Université Laval), *Approximation schemes in function spaces*, FunCxAn (p. 78), ED 315, Education Building
19:00 - 22:30	Reception and Awards Banquet / Réception et Banquet de prix, Regency Ballroom, Hotel Saskatchewan

7:30 - 18:00	Registration / Inscription, ED 101.1 Corridor, Education Building
8:00 - 8:30	Darja Barr (University of Manitoba), *Taking Math Students from 'Blah' to 'Aha': How Can Assessment Help ?*, Assess (p. 53), ED 623, Education Building
8:00 - 8:30	Murray R. Bremner (University of Saskatchewan), *Computing a short basis for the nullspace of a modular matrix*, MatTheo (p. 91), ED 106.2, Education building
8:00 - 8:30	Robin Cockett (University of Calgary), *Hyperconnections*, CatApp (p. 57), ED 314, Education Building
8:00 - 8:30	Curran McConnell (Dalhousie University), *Combinatorics of spaces of trees: an application of topology to phylogenetics*, StudRes (p. 109), CK 185, Centre for Kinesiology
8:00 - 8:30	Vern Paulsen (University of Waterloo), *Preservation of the joint essential matricial range*, FIDStr (p. 75), ED 191, Education Building
8:00 - 8:30	Steven Rayan (University of Saskatchewan), *Linearizations of character varieties of curves: geometry and mirror symmetry*, EquivM (p. 68), ED 106.1, Education Building
8:00 - 8:30	Jie Xiao (Memorial University of Newfoundland), *Gaussian BV Capacity*, ProbMet (p. 98), ED 193, Education Building
8:30 - 16:30	AARMS-CMS Student Poster Session / Session de présentation par affiches pour étudiants AARMS-SMC, ED 101.1 Corridor, Education Building
8:30 - 9:00	Heath Emerson (University of Victoria), *Transversals and Connes' duality for the irrational rotation algebra*, FIDStr (p. 73), ED 191, Education Building
8:30 - 9:00	Tyrone Ghaswala (University of Manitoba), *Promoting circle actions to actions on the real line*, Topol (p. 116), ED 318, Education Building
8:30 - 9:00	Gilad Gour (University of Calgary), *Theories of Dynamical Quantum Resources*, QuantIS (p. 111), ED 230, Education Building
8:30 - 9:00	Chris Kapulkin (Western University), *Cubical models of higher category theory*, CatApp (p. 59), ED 314, Education Building
8:30 - 9:00	Rebecca Milley (Grenfell Campus, Memorial University), *Reading, Writing, Arithmetic: Assessment Strategies for Readings and Written Work in Mathematics*, Assess (p. 54), ED 623, Education Building
8:30 - 9:00	Pietro Paparella (University of Washington Bothell), *Matricial Proofs of Some Classical Results about Critical Point Location*, MatTheo (p. 93), ED 106.2, Education building
8:30 - 9:00	Arzu Sardarli (First Nations University of Canada), *Use of Indigenous elements in teaching introductory Statistics courses*, IRMath (p. 86), ED 558, Education Building
8:30 - 9:00	Asmita Sodhi (Dalhousie University), *Integer-valued polynomials and a game called p-ordering*, StudRes (p. 109), CK 185, Centre for Kinesiology
8:30 - 9:00	Deping Ye (Memorial University of Newfoundland), *The polar Orlicz-Minkowski problem*, ProbMet (p. 99), ED 193, Education Building
8:30 - 9:00	Qing Zhang (University of Calgary), *local converse theorems for unitary groups*, ReprTh (p. 107), ED 312, Education Building
8:50 - 9:20	Evan Sundbo (University of Saskatchewan), *The Geometry of Twisted Cyclic Quiver Varieties*, EquivM (p. 68), ED 106.1, Education Building
9:00 - 9:30	Lauren DeDieu (University of Calgary), *Using Assessments to Boost Motivation in a Second-Year Linear Algebra Class*, Assess (p. 53), ED 623, Education Building
9:00 - 9:30	Doug Farenick (University of Regina), *Acts of Reconciliation – A Scientist's Experience*, IRMath (p. 85), ED 558, Education Building
9:00 - 9:30	Francesco Fidaleo (University of Rome Tor Vergata), *Uniquely Ergodic C^*-Dynamical Systems for the noncommutative 2-torus*, FIDStr (p. 73), ED 191, Education Building
9:00 - 9:30	Qingzhong Huang (Memorial University of Newfoundland), *The L_p John ellipsoid for Sobolev functions*, ProbMet (p. 96), ED 193, Education Building
9:00 - 9:30	Nicole Kitt (University of Calgary), *How to calculate perverse sheaves on quiver representation varieties of type A*, StudRes (p. 108), CK 185, Centre for Kinesiology
9:00 - 9:30	Joshua Lansky (American University), *Explicit liftings of conjugacy classes in finite reductive groups*, ReprTh (p. 105), ED 312, Education Building
9:00 - 9:30	Zach Lindsey (Western University), *Cubical models of higher category theory*, CatApp (p. 59), ED 314, Education Building

9:00 - 9:30	Keivan Monfared (University of Victoria), *An Analog of Matrix Tree Theorem for Signless Laplacians*, MatTheo (p. 92), ED 106.2, Education building
9:00 - 9:30	Patrick Naylor (University of Waterloo), *Trisections and twists of 4-manifolds*, Topol (p. 116), ED 318, Education Building
9:00 - 9:30	Carlo Maria Scandolo (University of Calgary), *Necessary and Sufficient Conditions on Measurements of Quantum Channels*, QuantIS (p. 114), ED 230, Education Building
9:30 - 10:00	Raphael Clouatre (University of Manitoba), *Residual finite-dimensionality for general operator algebras*, FIDStr (p. 73), ED 191, Education Building
9:30 - 10:00	Hellen Colman (Wilbur Wright College), *Equivariant motion planning*, CatApp (p. 57), ED 314, Education Building
9:30 - 10:00	Jason Crann (Carleton University), *State convertibility in the von Neumann algebra framework.*, QuantIS (p. 111), ED 230, Education Building
9:30 - 10:00	Anne Dranowski (Univeristy of Toronto), *MV cycles from generalized orbital varieties*, StudRes (p. 108), CK 185, Centre for Kinesiology
9:30 - 10:00	Christopher Eagle (University of Victoria), *In-class formative assessment in proof-heavy courses*, Assess (p. 53), ED 623, Education Building
9:30 - 10:00	Colin Garnett (Black Hills State University), *Non-sparse Companion Matrices*, MatTheo (p. 91), ED 106.2, Education building
9:30 - 10:00	Open Discussion, IRMath, ED 558, Education Building
9:30 - 10:00	Kate Poirier (New York City College of Technology), *Directed planar trees, V-infinity algebras, and string topology*, Topol (p. 117), ED 318, Education Building
9:30 - 10:00	Wan-Yu Tsai (University of Ottawa), *The orbit philosophy for Spin groups*, ReprTh (p. 107), ED 312, Education Building
9:30 - 10:00	Sudan Xing (Memorial University of Newfoundland), *The general dual-polar Orlicz-Minkowski problem*, ProbMet (p. 98), ED 193, Education Building
9:40 - 10:10	Jordan Watts (Central Michigan University), *Classifying Spaces for Diffeological Groups*, EquivM (p. 68), ED 106.1, Education Building
10:00 - 16:30	Exhibits / Expositions, ED 101.1 Corridor, Education Building
10:00 - 10:30	Peter Bradshaw (Simon Fraser University), *Cops and robbers on Cayley graphs*, StudRes (p. 108), CK 185, Centre for Kinesiology
10:00 - 10:30	Berndt Brenken (University of Calgary), *Partial isometries implementing cpc C*- dynamical systems*, FIDStr (p. 72), ED 191, Education Building
10:00 - 10:30	Victor Glasgo (Case Western Reserve University), *Gravitational illumination bodies (Preliminary report)*, ProbMet (p. 95), ED 193, Education Building
10:00 - 10:30	Rory Lucyshyn-Wright (Brandon University), CatApp (p. 60)
10:00 - 10:30	Rebecca McKay (University of New Brunswick, Saint John), *Active Assessment*, Assess (p. 54), ED 623, Education Building
10:00 - 10:30	Comfort Mintah (University of Guelph), *Operator algebras and quantum one-way LOCC state distinguishability*, QuantIS (p. 112), ED 230, Education Building
10:00 - 10:30	Open Discussion, IRMath, ED 558, Education Building
10:00 - 10:30	Hadi Salmasian (University of Ottawa), *The minimal faithful dimension of finite p-groups: an application of the orbit method to the essential dimension*, ReprTh (p. 106), ED 312, Education Building
10:00 - 10:30	Krishanu Sankar (University of British Columbia), *Mod 2 cohomology and the braid group*, Topol (p. 117), ED 318, Education Building
10:00 - 10:30	Xiaohong Zhang (University of Manitoba), *Perfect state transfer on weighted paths*, MatTheo (p. 94), ED 106.2, Education building
10:30 - 11:00	Break / Pause, ED 101.1 Corridor, Education Building
11:00 - 12:00	Denis Auroux (Harvard University), *An Invitation to Homological Mirror Symmetry*, Plenary (p. 50), EA 106, Education Building
13:30 - 14:30	Gregory Lawler (University of Chicago), *Random fractals from statistical physics*, Plenary (p. 50), EA 106, Education Building
14:30 - 15:30	Jeremy Quastel (University of Toronto), JWPrize (p. 52), EA 106, Education Building

15:30 - 16:00	Break / Pause, ED 101.1 Corridor, Education Building
16:00 - 16:30	Daniel Drimbe (University of Regina), *Prime II_1 factors arising from actions of product groups*, FIDStr (p. 73), ED 191, Education Building
16:00 - 16:30	Alexander Litvak (University of Alberta), *On the volume ratio between convex bodies*, ProbMet (p. 96), ED 193, Education Building
16:00 - 16:30	Lon Mitchell (University of South Florida St. Petersburg), *Optimal Colin de Verdière Matrices for Complete Multipartite Graphs*, MatTheo (p. 92), ED 106.2, Education building
16:00 - 16:30	A. Sarobidy Razafimahatratra (University of Regina), *Erdős–Ko–Rado Theorem for permutation groups*, Contrib (p. 62), CK 185, Centre for Kinesiology
16:00 - 16:30	Scott Rodney (Cape Breton University), *Student Success and Logical Assessment/Intervention*, Assess (p. 54), ED 623, Education Building
16:00 - 16:30	Neil J. Ross (Dalhousie University), *A Characterization of Integral, Real, and Gaussian Clifford+T Operators*, QuantIS (p. 114), ED 230, Education Building
16:00 - 16:30	Laura Scull (Fort Lewis College), *Defining Bicategories of Fractions with Small Hom Sets*, CatApp (p. 61), ED 314, Education Building
16:00 - 16:30	Kirill Zanoulline (University of Ottawa), *Localized Landweber-Novikov operations on generalized cohomology*, EquivM (p. 68), ED 106.1, Education Building
16:30 - 17:00	Danny Dyer (Memorial University of Newfoundland), Assess (p. 53), ED 623, Education Building
16:30 - 17:00	Sam Harris (University of Waterloo), *Separating the matrix-valued bipartite correlation sets*, QuantIS (p. 111), ED 230, Education Building
16:30 - 17:00	Cristian Ivanescu (MacEwan University), *Pedersen ideals of tensor products of nonunital C*-algebras*, FIDStr (p. 74), ED 191, Education Building
16:30 - 17:00	Paata Ivanisvili (University of California, Irvine), *Weissler's conjecture on the Hamming cube*, ProbMet (p. 96), ED 193, Education Building
16:30 - 17:00	Sivaram K. Narayan (Central Michigan University), *Graph Complement Conjecture for Classes of Shadow Graphs*, MatTheo (p. 92), ED 106.2, Education building
16:30 - 17:00	Dorette Pronk (Dalhousie University), *Nice properties of the bicategory of orbigroupoids*, CatApp (p. 60), ED 314, Education Building
16:30 - 17:00	Zhenyuan Zhang (University of Waterloo), *On discrete-time self-similar processes with stationary increments*, Contrib (p. 63), CK 185, Centre for Kinesiology
16:40 - 17:10	Changlong Zhong (SUNY Albany), *On the K-theoretic stable bases*, EquivM (p. 69), ED 106.1, Education Building
17:00 - 17:30	Sergii Myroshnychenko (University of Alberta), ProbMet (p. 97), ED 193, Education Building
17:00 - 17:30	Hossein Pourali (Brandon University), *ALGEBRAIC AND GRAPH THEORETIC ASPECTS IN LATTICES AND POSETS*, Contrib (p. 62), CK 185, Centre for Kinesiology
17:00 - 17:30	Patrick Reynolds (University of New Brunswick), *Assessing and Grading with Crowdmark*, Assess (p. 54), ED 623, Education Building
17:00 - 17:30	Jamie Sikora (Perimeter Institute), *Shadow Probabilities*, QuantIS (p. 114), ED 230, Education Building
17:00 - 17:30	Jordan Watts (Central Michigan University), *Bredon Cohomology for Transitive Groupoids*, CatApp (p. 61), ED 314, Education Building
17:00 - 17:30	Harmony Zhan (Université de Montréal), *Quantum state transfer in the algebra of the Johnson scheme*, MatTheo (p. 94), ED 106.2, Education building
17:20 - 17:50	Tom Baird (Memorial University of Newfoundland), *E-polynomials of character varieties associated to a real curve*, EquivM (p. 65), ED 106.1, Education Building
17:30 - 18:00	Marie Langlois (Cornell University), *Using Free Online Software to Efficiently Assess Students*, Assess (p. 54), ED 623, Education Building
17:30 - 18:00	Saleh Mustafa (University of Regina), *Higher Rank Numerical Ranges for Certain Non-normal Matrices*, Contrib (p. 62), CK 185, Centre for Kinesiology
17:30 - 18:00	Satish Pandey (Technion), QuantIS (p. 112), ED 230, Education Building
17:30 - 18:00	Boaz Slomka (Weizmann Institute of Science), *On Hadwiger's covering problem*, ProbMet (p. 97), ED 193, Education Building

17:30 - 18:00	Kerry Tarrant (University of Iowa), *The Good, The Bad, and The Ugly: Minimally Cop Win and Maximally Robber Win Graphs*, MatTheo (p. 93), ED 106.2, Education building
17:30 - 18:00	Joel Villatoro (KU Leuven), *Geometric structures on differentiable stacks*, CatApp (p. 61), ED 314, Education Building

7:30 - 18:00	Registration / Inscription, ED 101.1 Corridor, Education Building
8:00 - 8:30	Robert Bailey (Memorial University of Newfoundland - Grenfell Campus), *Orthogonal matrices with zero diagonal*, MatTheo (p. 90), ED 106.2, Education building
8:00 - 8:30	Kristine Bauer (University of Calgary), *The Kleisli category of a pseudomonad for chain complexes*, CatApp (p. 57), CK 187, Centre for Kinesiology
8:00 - 8:30	Derek Krepski (University of Manitoba), *An analogue of Kostant's formula for Lie group-valued moment maps*, EquivM (p. 67), ED 106.1, Education Building
8:00 - 8:30	Jiun-Chau Wang (University of Saskatchewan), *Probability measures in bi-free probability*, FIDStr (p. 76), ED 191, Education Building
8:30 - 9:00	Chun-Hua Guo (University of Regina), *Explicit convergence region of Newton's method for the matrix pth root*, MatTheo (p. 92), ED 106.2, Education building
8:30 - 9:00	JS Lemay (Oxford University), *The Poincaré Lemma for Codifferential Categories with Antiderivatives*, CatApp (p. 59), CK 187, Centre for Kinesiology
8:30 - 9:00	Anamaria Savu (University of Alberta), *Conservative Restricted Solid-on-Solid Model*, FIDStr (p. 75), ED 191, Education Building
8:50 - 9:20	Yiannis Loizides (Penn State University), *Quasi-polynomials, asymptotics and [Q,R]=0*, EquivM (p. 67), ED 106.1, Education Building
9:00 - 9:30	Ben McAdam (University of Calgary), *Involution Algebroids*, CatApp (p. 60), CK 187, Centre for Kinesiology
9:00 - 9:30	Rajesh Pereira (University of Guelph), *The real joint numerical range and the real higher rank numerical range*, MatTheo (p. 93), ED 106.2, Education building
9:00 - 9:30	Edward Timko (University of Manitoba), *The Spectrum of Constrained Model d-tuples*, FIDStr (p. 76), ED 191, Education Building
9:30 - 10:00	Samuel Cole (University of Manitoba), *Spectral recovery of stochastic block models on graphs and hypergraphs*, MatTheo (p. 91), ED 106.2, Education building
9:30 - 10:00	Geoff Cruttwell (Mount Allison University), *Curvature and torsion without negatives*, CatApp (p. 58), CK 187, Centre for Kinesiology
9:40 - 10:10	Mark Hamilton (Mount Allison University), *Integral integral affine geometry, quantization, and Riemann-Roch.*, EquivM (p. 66), ED 106.1, Education Building
10:00 - 10:30	Marzieh Bayeh (Dalhousie University), *Orbit Category and The Category of Orbit Classes*, CatApp (p. 57), CK 187, Centre for Kinesiology
10:00 - 10:30	Mahsa Nasrollahi Shirazi (University of Regina), *Erdős-Ko-Rado theorem for t-intersecting families of perfect matchings*, MatTheo (p. 93), ED 106.2, Education building
10:30 - 11:00	Break / Pause, ED 101.1 Corridor, Education Building
11:00 - 12:00	Julia Gordon (University of British Columbia), *Quantifier elimination and uniform bounds for oscillatory integrals*, KNPrize (p. 52), EA 106, Education Building
13:30 - 14:30	Walking Tour of First Nations University of Canada, First Nations University of Canada
14:45 - 15:15	Darien Dewolf (St. Francis Xavier University), *The equivalence of ordered groupoids and left cancellative categories using double categories*, CatApp (p. 58), CK 187, Centre for Kinesiology
14:45 - 15:15	Jeremy Lane (University of Geneva), *Volume exhausting, T-equivariant symplectic embeddings of toric manifolds into regular coadjoint orbits*, EquivM (p. 67), ED 106.1, Education Building
14:45 - 15:15	Gurmail Singh (University of Regina), *Encoding the vertices of a hyper cube*, MatTheo (p. 93), ED 106.2, Education building
15:15 - 15:45	Eugene Bilokopytov (University of Manitoba), *From Principal Minor Assignment problem for matrices to characterization of the isometries on Hilbert Spaces*, MatTheo (p. 91), ED 106.2, Education building
15:15 - 15:45	Curran McConnell (Dalhousie University), *Combinatorics of spaces of trees: an application of topology to phylogenetics*, CatApp (p. 60), CK 187, Centre for Kinesiology
15:25 - 15:55	Peter Crooks (Northeastern University), *Kostant-Toda lattices and invariant theory*, EquivM (p. 65), ED 106.1, Education Building
15:45 - 16:15	Robert Craigen (University of Manitoba), MatTheo (p. 91), ED 106.2, Education building
15:45 - 16:15	Michael Lambert (Dalhousie University), *A Site for Continuous 2-Group Actions*, CatApp (p. 59), CK 187, Centre for Kinesiology

16:05 - 16:35	Rebecca Goldin (George Mason University), *Schubert Calculus, Schubert Operators, and Positivity*, EquivM (p. 66), ED 106.1, Education Building
16:15 - 16:45	Jonathan Gallagher (Dalhousie University), *Etale Subobject classifiers in SDG and tangent categories*, CatApp (p. 58), CK 187, Centre for Kinesiology
16:15 - 16:45	Nathan Krislock (Northern Illinois University), MatTheo (p. 92), ED 106.2, Education building

Talk List

A

Adem, Alejandro, *Twisted equivariant K-theory of compact Lie group actions with maximal rank isotropy*, EquivM (p. 64), Saturday June 8, 16:00 - 16:30, ED 106.1, Education Building

Ahmed, Syed Ejaz, *Implicit Bias in Big Data Analytics*, HDProb (p. 80), Saturday June 8, 16:00 - 16:30, ED 438, Education Building

Akurugodage, Kasun Fernando, PrStoch (p. 102), Saturday June 8, 16:30 - 17:00, ED 623, Education Building

Alderson, Tim, Chris Fisher & Brett Stevens, *Geometry Workshop*, MiniC (p. 47), Friday June 7, 13:00 - 13:00, ED 191, Education Building

Alderson, Tim, t*-Extensions of Linear Codes*, FinGeom (p. 70), Saturday June 8, 9:00 - 9:30, CK 185, Centre for Kinesiology

Alvarez, Melania, *Engaging Indigenous communities through math outreach*, IRMath (p. 84), Saturday June 8, 10:00 - 10:30, ED 558, Education Building

Ankai, Liu, *A Generalization of the Compression Cone Method for Integral Equations with Changing Sign Green's Functions*, Poster (p. 119)

Anwar, Mehwish, *A Connection Between Graphs and the Quantum Group* $U_q(\mathfrak{sl}_2(\mathbb{C}))$, Poster (p. 119)

Arancibia, Nicolas, A*(rthur)-Packets of Cohomological Representations*, ReprTh (p. 104), Saturday June 8, 8:30 - 9:00, ED 312, Education Building

Ashleik, Naeima, *Learning for Contingency Tables and Survival Data Using Imprecise Probabilities*, HDProb (p. 80), Saturday June 8, 10:00 - 10:30, ED 438, Education Building

Auroux, Denis, *An Invitation to Homological Mirror Symmetry*, Plenary (p. 50), Sunday June 9, 11:00 - 12:00, EA 106, Education Building

B

Bahri, Anthony, *Polyhedral products and their applications*, Topol (p. 115), Saturday June 8, 17:30 - 18:00, ED 318, Education Building

Bailey, Robert, *Orthogonal matrices with zero diagonal*, MatTheo (p. 90), Monday June 10, 8:00 - 8:30, ED 106.2, Education building

Baird, Tom, *E-polynomials of character varieties associated to a real curve*, EquivM (p. 65), Sunday June 9, 17:20 - 17:50, ED 106.1, Education Building

Barr, Darja, *The Impact of Working Together*, IRMath (p. 84), Saturday June 8, 9:30 - 10:00, ED 558, Education Building

Barr, Darja, *Taking Math Students from 'Blah' to 'Aha': How Can Assessment Help ?*, Assess (p. 53), Sunday June 9, 8:00 - 8:30, ED 623, Education Building

Bauer, Kristine, *The Kleisli category of a pseudomonad for chain complexes*, CatApp (p. 57), Monday June 10, 8:00 - 8:30, CK 187, Centre for Kinesiology

Bayeh, Marzieh, *Orbit Category and The Category of Orbit Classes*, CatApp (p. 57), Monday June 10, 10:00 - 10:30, CK 187, Centre for Kinesiology

Belk, Ed, *The Local Trace Formula as a Motivic Identity*, ReprTh (p. 104), Saturday June 8, 9:00 - 9:30, ED 312, Education Building

Benes, Christian, *Rates of Convergence for the Simple Random Walk Green's Function*, PrStoch (p. 102), Saturday June 8, 9:00 - 9:30, ED 623, Education Building

Berger, Arno, *Best Kantorovich and Levy approximations on the real line*, PrStoch (p. 102), Saturday June 8, 10:00 - 10:30, ED 623, Education Building

Bilokopytov, Eugene, *From Principal Minor Assignment problem for matrices to characterization of the isometries on Hilbert Spaces*, MatTheo (p. 91), Monday June 10, 15:15 - 15:45, ED 106.2, Education building

Bonato, Anthony, *Limited information Cops and Robbers games*, GrSProb (p. 100), Saturday June 8, 8:00 - 8:30, CK 187, Centre for Kinesiology

Bourgeois, Adele, *On the Multiplicities in the Restriction of a Supercuspidal Representation*, ReprTh (p. 105), Saturday June 8, 16:00 - 16:30, ED 312, Education Building

Bradshaw, Peter, *Cops and robbers on Cayley graphs*, StudRes (p. 108), Sunday June 9, 10:00 - 10:30, CK 185, Centre for Kinesiology

Bremner, Murray R., *Computing a short basis for the nullspace of a modular matrix*, MatTheo (p. 91), Sunday June 9, 8:00 - 8:30, ED 106.2, Education building

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Zanoulline, Kirill, *Localized Landweber-Novikov operations on generalized cohomology*, EquivM (p. 68), Sunday June 9, 16:00 - 16:30, ED 106.1, Education Building

Zhan, Harmony, *Quantum state transfer in the algebra of the Johnson scheme*, MatTheo (p. 94), Sunday June 9, 17:00 - 17:30, ED 106.2, Education building

Zhang, Qing, *local converse theorems for unitary groups*, ReprTh (p. 107), Sunday June 9, 8:30 - 9:00, ED 312, Education Building

Zhang, Xiaohong, *Perfect state transfer on weighted paths*, MatTheo (p. 94), Sunday June 9, 10:00 - 10:30, ED 106.2, Education building

Zhang, Zhenyuan, *On discrete-time self-similar processes with stationary increments*, Contrib (p. 63), Sunday June 9, 16:30 - 17:00, CK 185, Centre for Kinesiology

Zhong, Changlong, *On the K-theoretic stable bases*, EquivM (p. 69), Sunday June 9, 16:40 - 17:10, ED 106.1, Education Building

Schedule/Horaire

Friday June 7	**vendredi 7 juin**
9:00 - 12:00	Allen Herman and Karen Meagher (University of Regina), *Minicourse on Building Your Career in Mathematics* (p. 47), ED 191, Education Building
13:00 - 16:00	Chris Fisher, Brett Stevens and Tim Alderson (University of Regina, Carleton University and University of New Brunswick), *Geometry Workshop* (p. 47), ED 191, Education Building
13:00 - 16:00	Krystal Guo, *Using the Sage Mathematics Software System in Algebra and Discrete Math* (p. 47), CW 317.37, College West Building
13:00 - 16:00	Sarah Plosker and Nathaniel Johnston (CRC Chair, University of Brandon and Mount Allison University), *Basics of Quantum Information Theory* (p. 47), CK 185, Centre for Kinesiology
13:00 - 16:00	Hadi Salmasian (University of Ottawa), *Interpolation polynomials and representation theory: transcending the classical Capelli identity* (p. 48), ED 312, Education Building
13:00 - 16:00	Jonathan Scott (Cleveland State University), *Category Theory in Topological Data Analysis* (p. 48), ED 438, Education Building
13:00 - 16:00	Ryan Tifenbach and Danny Dyer (Mount Allison University and Memorial University), *Introduction to Graph Searching* (p. 48), CK 187, Centre for Kinesiology
13:00 - 16:00	Konstantin Tikhomirov (Georgia Tech), *Convex-Geometric Methods in Random Matrix Theory* (p. 48), ED 193, Education Building

Abstracts/Résumés

CHRIS FISHER, BRETT STEVENS AND TIM ALDERSON, University of Regina, Carleton University and University of New Brunswick

[Friday June 7 / vendredi 7 juin, 13:00 – ED 191, Education Building]

Geometry Workshop

This is a tutorial for people who might know little or nothing about finite geometry to give them an understanding of the basic definitions and objects (planes, spreads, ovals, pencils, nets . . .). The goal of this session is not to try to get to latest developments in the field, but to give a conference attendee the background needed to understand the research talks presented in the Geometry Session.

KRYSTAL GUO

[Friday June 7 / vendredi 7 juin, 13:00 – CW 317.37, College West Building]

Using the Sage Mathematics Software System in Algebra and Discrete Math

Whether doing research or course work, computations software can be a useful tool. This is a focused session on using SageMath with examples motivated from algebra, graph theory and geometry.

ALLEN HERMAN AND KAREN MEAGHER, University of Regina

[Friday June 7 / vendredi 7 juin, 9:00 – ED 191, Education Building]

Minicourse on Building Your Career in Mathematics

This will be a general interest minicourse for graduate students and early-career mathematical scientists.

There will be facilitated discussions on (i) New technologies in Math (such as SAGE); (ii) Preparing a good CV; and (iii) Non-academic Mathematics Job Hunting

SARAH PLOSKER AND NATHANIEL JOHNSTON, CRC Chair, Brandon and Mount Allison
[Friday June 7 / vendredi 7 juin, 13:00 – CK 185, Centre for Kinesiology]
Basics of Quantum Information Theory

An introduction to quantum information theory, including important mathematical concepts and physical motivation.

This minicourse will be related to the special session in Quantum Information Science.

HADI SALMASIAN, University of Ottawa
[Friday June 7 / vendredi 7 juin, 13:00 – ED 312, Education Building]
Interpolation polynomials and representation theory: transcending the classical Capelli identity

This self-contained mini-course will cover recent progress on connections between interpolation symmetric polynomials and Lie theory. It will be accessible to all graduate students and advanced undergraduate students, and is tuned for those who are interested in algebra or combinatorics.

JONATHAN SCOTT, Cleveland State University
[Friday June 7 / vendredi 7 juin, 13:00 – ED 438, Education Building]
Category Theory in Topological Data Analysis

We explore how a category-theoretical perspective informs and unifies various notions of persistence and proximity in topological data analysis. Only elementary knowledge of category theory (namely, functors and natural transformations) will be assumed.

RYAN TIFENBACH AND DANNY DYER, Mount Allison University and Memorial University
[Friday June 7 / vendredi 7 juin, 13:00 – CK 187, Centre for Kinesiology]
Introduction to Graph Searching

Attendees to this workshop will learn about some of the most common graph searching problems and their complexities. This workshop will provide the background for the Graph Searching session.

KONSTANTIN TIKHOMIROV, Georgia Tech
[Friday June 7 / vendredi 7 juin, 13:00 – ED 193, Education Building]
Convex-Geometric Methods in Random Matrix Theory

This course's primary focus is covering arguments which have been very efficient in estimating the condition number and, more generally, the singular values of random matrices and found applications in numerical analysis and compressed sensing. No previous research experience in the random matrix theory is required for the course.

Schedule/Horaire **Room/Salle: RI 119, Research and Innovation Centre**

Friday June 7 **vendredi 7 juin**

17:00 - 18:00 Nilima Nigam (Simon Fraser University), *When mathematicians play the drums* (p. 49)

Abstract/Résumé

NILIMA NIGAM, Simon Fraser University

[Friday June 7 / vendredi 7 juin, 17:00 – RI 119, Research and Innovation Centre]

When mathematicians play the drums

By now it is almost a cliché that mathematics and music are deeply entertwined human endeavours. Humans are naturally drawn to patterns, and patterns are fundamental to both music and mathematics. We think of notes and chord progressions ; we think of how our favorite music reveals intricate and beautiful mathematical structures.

In this talk, we'll explore another facet of this relationship: how the use of mathematics can help with the design of instruments, and how the misuse of mathematical tools leads to a mess ! Why are the drums in the percussion section of an orchestra shaped the way they are ? How can mathematics help us construct instruments with particular musical characteristics ? What is meant in this setting by the 'misuse' of mathematical tools, and how can we prevent a cacaphony ?

Along the way, we'll learn a bit about geometry, numerical analysis and spectral theory. Above all, we'll hopefully learn a bit about designing a drum.

Schedule/Horaire **Room/Salle: EA 106, Education Building**

Saturday June 8	**samedi 8 juin**
11:00 - 12:00	Pham Huu Tiep (Rutgers University), *Finite groups, representations, character values, and applications* (p. 51)
13:30 - 14:30	Caroline Colijn (Simon Fraser University), *The forests and the trees: new metrics on some flavours of trees* (p. 50)
14:30 - 15:30	Grigoris Paouris (Texas A&M University), *The interplay of Probability and Geometry* (p. 51)

Sunday June 9	**dimanche 9 juin**
11:00 - 12:00	Denis Auroux (Harvard University), *An Invitation to Homological Mirror Symmetry* (p. 50)
13:30 - 14:30	Gregory Lawler (University of Chicago), *Random fractals from statistical physics* (p. 50)

Abstracts/Résumés

DENIS AUROUX, Harvard University
[Sunday June 9 / dimanche 9 juin, 11:00 – EA 106, Education Building]
An Invitation to Homological Mirror Symmetry

We will give a gentle introduction to some recent developments in the area of mirror symmetry, focusing on two key conjectures in the field: Kontsevich's homological mirror symmetry (1994), which relates the Fukaya category of a symplectic manifold to the derived category of coherent sheaves of a mirror space, and the Strominger-Yau-Zaslow (SYZ) conjecture (1996), which gives a geometric underpinning for the construction of mirror spaces. We will use simple examples to illustrate these conjectures and their extension beyond the Calabi-Yau setting in which they were first formulated. Specifically, we will focus on two one-dimensional examples, the cylinder and the pair of pants, to give a flavor of the geometric concepts involved in a general formulation of homological mirror symmetry.

CAROLINE COLIJN, Simon Fraser University
[Saturday June 8 / samedi 8 juin, 13:30 – EA 106, Education Building]
The forests and the trees: new metrics on some flavours of trees

Trees are discrete, tractable objects that arise in many applications, from biology to machine learning. These naturally give rise to several distinct kinds of trees: trees labelled at the tips, trees labelled uniquely or non-uniquely at all nodes, trees labelled at some nodes, unlabelled trees, bifurcating trees and so on. Comparing large-scale trees can help researchers to explore the dimension and shape of a suitably-defined space of trees, to characterize the behaviour of a simulation model or to analyze data. As the number of trees rises combinatorially with the number of leaves, for larger trees it makes sense to explore representing sets of trees with metrics and embedding them in simpler (Euclidean) spaces. We have developed metrics, in the sense of distance functions, on several of the above flavours of trees. For rooted, tip-labelled and partly-labelled trees, we embed the tree in a high-dimensional Euclidean space and use the Euclidean metric. Metrics on unlabelled trees are not easily obtained the same way ; we describe two different approaches to comparing unlabelled trees. The second of these can be generalized to obtain polynomials that distinguish a quite general class of trees.

GREGORY LAWLER, University of Chicago
[Sunday June 9 / dimanche 9 juin, 13:30 – EA 106, Education Building]
Random fractals from statistical physics

I will survey a number of interesting fractal subsets arising as scaling limit of models in statistical physics. There will be a focus on the recent interest in Minkowski content as the appropriate fractal measure on random sets.

GRIGORIS PAOURIS, Texas A&M University
[Saturday June 8 / samedi 8 juin, 14:30 – EA 106, Education Building]
The interplay of Probability and Geometry

In many applications of high-dimensional probability it is essential to efficiently quantify how unlikely it is that a random vector falls in a neighborhood of a given point (say the origin). Providing sharp bounds for these "small ball probabilities" under various assumptions is a task that usually requires completely different ideas and techniques than those used for large deviation or concentration inequalities. In this talk I will present examples of small ball probabilities in various settings and explain how high-dimensional geometry is an essential tool to obtain sharp results.

PHAM HUU TIEP, Rutgers University
[Saturday June 8 / samedi 8 juin, 11:00 – EA 106, Education Building]
Finite groups, representations, character values, and applications

We discuss some basic problems and long-standing conjectures in representation theory of finite groups, and recent progress on some of these problems. We will also outline some applications of these and other results in representation theory of finite groups to various problems in group theory, number theory, and algebraic geometry.

Prize Lectures
Conférence des lauréats

Schedule/Horaire **Room/Salle: EA 106, Education Building**

Sunday June 9 **dimanche 9 juin**

14:30 - 15:30 Jeremy Quastel (University of Toronto) (p. 52)

Monday June 10 **lundi 10 juin**

11:00 - 12:00 Julia Gordon (University of British Columbia), *Quantifier elimination and uniform bounds for oscillatory integrals* (p. 52)

Abstract/Résumé

Jefferey-Williams Prize
Prix Jefferey-Williams

JEREMY QUASTEL, University of Toronto
[Sunday June 9 / dimanche 9 juin, 14:30 – EA 106, Education Building]

Krieger-Nelson Prize
Prix Krieger-Nelson

JULIA GORDON, University of British Columbia
[Monday June 10 / lundi 10 juin, 11:00 – EA 106, Education Building]
Quantifier elimination and uniform bounds for oscillatory integrals

This talk will be largely about the recent work of R. Cluckers and I. Halupczok (and our completed long-term joint project), which gives a new way to use model theory to get uniform bounds for families of oscillatory integrals, both over the p-adic fields and over the reals. I will give an introduction to the relevant results from model theory (the so-called "quantifier elimination" and "cell decomposition" theorems which go back to the work of Tarski in the 1930s and Jan Denef in the 80s), and then focus on less known applications that lead to uniform bounds for various functions that arise in representation theory.

Assessment in Mathematics
L'évaluation en mathématiques

Org: Shannon Ezzat (Winnipeg) and/et **Rebecca McKay** (UNB)

Schedule/Horaire **Room/Salle: ED 623, Education Building**

Sunday June 9	**dimanche 9 juin**
8:00 - 8:30	Darja Barr (University of Manitoba), *Taking Math Students from 'Blah' to 'Aha': How Can Assessment Help ?* (p. 53)
8:30 - 9:00	Rebecca Milley (Grenfell Campus, Memorial University), *Reading, Writing, Arithmetic: Assessment Strategies for Readings and Written Work in Mathematics* (p. 54)
9:00 - 9:30	Lauren DeDieu (University of Calgary), *Using Assessments to Boost Motivation in a Second-Year Linear Algebra Class* (p. 53)
9:30 - 10:00	Christopher Eagle (University of Victoria), *In-class formative assessment in proof-heavy courses* (p. 53)
10:00 - 10:30	Rebecca McKay (University of New Brunswick, Saint John), *Active Assessment* (p. 54)
16:00 - 16:30	Scott Rodney (Cape Breton University), *Student Success and Logical Assessment/Intervention* (p. 54)
16:30 - 17:00	Danny Dyer (Memorial University of Newfoundland) (p. 53)
17:00 - 17:30	Patrick Reynolds (University of New Brunswick), *Assessing and Grading with Crowdmark* (p. 54)
17:30 - 18:00	Marie Langlois (Cornell University), *Using Free Online Software to Efficiently Assess Students* (p. 54)

Abstracts/Résumés

DARJA BARR, University of Manitoba
[Sunday June 9 / dimanche 9 juin, 8:00 – ED 623, Education Building]
Taking Math Students from 'Blah' to 'Aha': How Can Assessment Help ?

This talk will focus on several assessment experiments that have gone on at the University of Manitoba, both on a large (120 student class) and larger (1800 student course) basis. Some of these include Assessment For and As Learning, Outcome-Based Assessment, and some different approaches to exam grading schemes and exam questions.

LAUREN DEDIEU, University of Calgary
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 623, Education Building]
Using Assessments to Boost Motivation in a Second-Year Linear Algebra Class

How can we convince non-math majors that vector spaces are cool ? ! My second-year linear algebra course is a proof-based class for science students who have not necessarily seen proofs before. Helping students see value in this abstract course can be difficult. In this talk, I will discuss the assessments I have used to help boost student motivation.

DANNY DYER, Memorial University of Newfoundland
[Sunday June 9 / dimanche 9 juin, 16:30 – ED 623, Education Building]

CHRISTOPHER EAGLE, University of Victoria
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 623, Education Building]
In-class formative assessment in proof-heavy courses

Low-stakes formative assessments are a common feature of many lower-level mathematics courses. In proof-intensive courses, such assessments are less widespread. In this talk I will share some of my successes (both intentional and unintentional!) at incorporating collaborative in-class exercises into my proof-heavy courses. While designed as learning opportunities for the students, these exercises have also provided me with useful insight into unexpected sources of confusion for my students. I will describe some of the features that my more successful exercises have had in common, as well as student feedback about the inclusion of these exercises. Examples will be drawn from an upper-level linear algebra course and an introductory real analysis course.

MARIE LANGLOIS, Cornell University
[Sunday June 9 / dimanche 9 juin, 17:30 – ED 623, Education Building]
Using Free Online Software to Efficiently Assess Students

The main Calculus I course at Cornell is undergoing an active learning restructure. As a part of this we have redesigned homework assignments to have two components: online (WeBWorK) and more involved presentation problems. We hope to get the students exploring with the materials, as opposed to only performing calculations. I will show examples of online questions for calculus and linear algebra that encourage students to reflect on the concepts. By reducing the amount of graded questions and by using a grading tool we manage to give feedback to students that better prepares them for exams and future mathematical endeavors.

REBECCA MCKAY, University of New Brunswick, Saint John
[Sunday June 9 / dimanche 9 juin, 10:00 – ED 623, Education Building]
Active Assessment

Active learning is generally thought of as learning activities that have students doing things with an opportunity to reflect on what they are doing. These learning activities can include assessment both formal and informal. I have been considering ways of implementing these ideas to make assessment/evaluation more active to include a development of a broader set of skills together with an aspect of reflection. I will discuss examples from my classroom and plans for future innovations.

REBECCA MILLEY, Grenfell Campus, Memorial University of NL
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 623, Education Building]
Reading, Writing, Arithmetic: Assessment Strategies for Readings and Written Work in Mathematics

When students read course material before class, they come prepared with basic background knowledge and can dive right into deeper, active learning in class; but how can we "make" them read, and how can we assess that work? This talk will present effective strategies for assigning readings in math courses. Separately, we will discuss assessment of written work in mathematics, including suggestions for a fair and constructive rubric to evaluate students' technical writing projects.

PATRICK REYNOLDS, UNB
[Sunday June 9 / dimanche 9 juin, 17:00 – ED 623, Education Building]
Assessing and Grading with Crowdmark

This past year we used Crowdmark (an online, collaborative grading platform) extensively with our Calculus I and II courses. In total 24 assessments were administered and graded (online) by a team of up to 15 people, and we experimented with multiple choice questions. I also used Crowdmark extensively in my smaller classes. I will share my reflections on the benefits of Crowdmark, for small as well as large class sizes, as well as some implications for how we assess learning in mathematics, how we give feedback, and the design of assessments to allow for equitable marking among a team of graders.

SCOTT RODNEY, Cape Breton University
[Sunday June 9 / dimanche 9 juin, 16:00 – ED 623, Education Building]
Student Success and Logical Assessment/Intervention

In this talk I will describe a study conducted in 2017 with S. Ezzat (U. Winnipeg) and continuing where we investigate connections between logical skill development and successful course outcomes for students in a one-size-fits-all calculus environment. I will also discuss the effectiveness of certain problem types and their capacity to identify struggling students.

Categorical Approaches to Topology and Geometry
Approches catégoriques de la topologie et de la géométrie

Org: Marzieh Bayeh (Dalhousie), **Darien DeWolf** (St Francis Xavier) and/et **Dorette Pronk** (Dalhousie)

Schedule/Horaire Rooms/Salles: CK 187, Centre for Kinesiology ; ED 314, Education Building

Saturday June 8 — samedi 8 juin

16:30 - 17:00	Jonathan Scott (Cleveland State University), *Wasserstein distance for generalized persistence modules and abelian categories* (p. 60), ED 314, Education Building
17:30 - 18:00	Seth Wolbert (University of Manitoba), *Fibrations as presentations of actions on stacks* (p. 61), ED 314, Education Building

Sunday June 9 — dimanche 9 juin

8:00 - 8:30	Robin Cockett (University of Calgary), *Hyperconnections* (p. 57), ED 314, Education Building
8:30 - 9:00	Chris Kapulkin (Western University), *Cubical models of higher category theory* (p. 59), ED 314, Education Building
9:00 - 9:30	Zach Lindsey (Western University), *Cubical models of higher category theory* (p. 59), ED 314, Education Building
9:30 - 10:00	Hellen Colman (Wilbur Wright College), *Equivariant motion planning* (p. 57), ED 314, Education Building
10:00 - 10:30	Rory Lucyshyn-Wright (Brandon University) (p. 60)
16:00 - 16:30	Laura Scull (Fort Lewis College), *Defining Bicategories of Fractions with Small Hom Sets* (p. 61), ED 314, Education Building
16:30 - 17:00	Dorette Pronk (Dalhousie University), *Nice properties of the bicategory of orbigroupoids* (p. 60), ED 314, Education Building
17:00 - 17:30	Jordan Watts (Central Michigan University), *Bredon Cohomology for Transitive Groupoids* (p. 61), ED 314, Education Building
17:30 - 18:00	Joel Villatoro (KU Leuven), *Geometric structures on differentiable stacks* (p. 61), ED 314, Education Building

Monday June 10 — lundi 10 juin

8:00 - 8:30	Kristine Bauer (University of Calgary), *The Kleisli category of a pseudomonad for chain complexes* (p. 57), CK 187, Centre for Kinesiology
8:30 - 9:00	JS Lemay (Oxford University), *The Poincaré Lemma for Codifferential Categories with Antiderivatives* (p. 59), CK 187, Centre for Kinesiology
9:00 - 9:30	Ben McAdam (University of Calgary), *Involution Algebroids* (p. 60), CK 187, Centre for Kinesiology
9:30 - 10:00	Geoff Cruttwell (Mount Allison University), *Curvature and torsion without negatives* (p. 58), CK 187, Centre for Kinesiology
10:00 - 10:30	Marzieh Bayeh (Dalhousie University), *Orbit Category and The Category of Orbit Classes* (p. 57), CK 187, Centre for Kinesiology
14:45 - 15:15	Darien Dewolf (St. Francis Xavier University), *The equivalence of ordered groupoids and left cancellative categories using double categories* (p. 58), CK 187, Centre for Kinesiology
15:15 - 15:45	Curran McConnell (Dalhousie University), *Combinatorics of spaces of trees: an application of topology to phylogenetics* (p. 60), CK 187, Centre for Kinesiology
15:45 - 16:15	Michael Lambert (Dalhousie University), *A Site for Continuous 2-Group Actions* (p. 59), CK 187, Centre for Kinesiology
16:15 - 16:45	Jonathan Gallagher (Dalhousie University), *Etale Subobject classifiers in SDG and tangent categories* (p. 58), CK 187, Centre for Kinesiology

Abstracts/Résumés

KRISTINE BAUER, University of Calgary
[Monday June 10 / lundi 10 juin, 8:00 – CK 187, Centre for Kinesiology]
The Kleisli category of a pseudomonad for chain complexes

The construction of the Kleisli category of a 2-monad acting on a 2-category is well known and mostly harmless. For each structure or axiom needed to produce such a Kleisli category, it is possible to consider a weak version. For example, one could consider bicategories rather than 2-categories, a pseudo- or lax version of the monad, or simply a weakening of axioms like associativity. Many authors have studied Kleisli constructions in the presence of one sort of weakening or another (Cheng, Gordon, Hyland, Lack, Marmolejo, Niefeld, Powers, Street are a few examples amongst many). In this expository talk, I will consider various weak constructions with an eye towards a particular example arising from the category of all abelian categories, and the chain complex monad. This example is related to joint work with Brenda Johnson and Sarah Yeakel.

MARZIEH BAYEH, Dalhousie University
[Monday June 10 / lundi 10 juin, 10:00 – CK 187, Centre for Kinesiology]
Orbit Category and The Category of Orbit Classes

For a group G, the orbit category of G, denoted by $\mathcal{O}_G$, is the category of orbit types and equivariant maps. In this talk I will introduce the category of orbit classes for a G-space X, and will study the relation between this category and the orbit category.

ROBIN COCKETT, University of Calgary
[Sunday June 9 / dimanche 9 juin, 8:00 – ED 314, Education Building]
Hyperconnections

Functors between join restriction categories admit a factorization into localic functors (bijective on objects and meet preserving) followed by hyperconnected functors (bijective on the locales of restriction idempotents) - for the basic localic/hyperconnected factorization on mere restriction categories.

A partite category (a *partite* internal category has its objects and arrow partitioned into many objects) internal to a join restriction category $\mathbb{B}$ induces, by considering partial sections of the domain maps, an external join restriction category which sits over $\mathbb{B}$ by a hyperconnected functor. Conversely an external join restriction category over $\mathbb{B}$ (where the latter must be assumed to have all gluings) induces a source étale partite category internal to $\mathbb{B}$. This correspondence may be completed to a Galois adjunction between join restriction categories over $\mathbb{B}$ and partite categories internal to $\mathbb{B}$ with cofunctors. The adjunction specializes to an equivalence between hyperconnections over $\mathbb{B}$ and source étale partite categories internal to $\mathbb{B}$.

This phenomenon occurs in many different places in mathematics (often specialized to groupoids). In particular, as all join restriction categories have a hyperconnected fundamental functor to the category of locales (with partial maps) one can conclude that join restriction categories (with join functors) correspond precisely to source étale partite categories internal to locales (with cofunctors). From algebraic geometry, considering schemes as a join restriction category with gluings, the identity functor on schemes induces an internal partite category: the object of morphisms from the affine scheme R to $\mathbb{Z}[x]$ is then exactly the structure sheaf of R.

HELLEN COLMAN, Wright College
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 314, Education Building]
Equivariant motion planning

Consider the space X of all possible configurations of a mechanical system. A motion planning algorithm assigns to each pair of initial and final states $(a, b) \in X \times X$, a continuous motion of the system starting at a and ending at b.

Topological complexity is an integer $TC(X)$ reflecting the complexity of motion planning algorithms for all systems having X as their configuration space. Roughly, $TC(X)$ is the minimal number of continuous rules which are needed in a motion planning algorithm. This invariant was introduced by Farber in 2002 and is closely related to the classical Lusternik-Schnirelmann category.

In recent years, several versions of topological complexity aimed at exploiting the presence of a group G acting on the configuration space have appeared. We will present several approaches to describing equivariant topological complexity variants in the context of the bicategory of orbifold translation groupoids and will show that $TC^G(X)$ is invariant under Morita equivalence.

GEOFF CRUTTWELL, Mount Allison University
[Monday June 10 / lundi 10 juin, 9:30 – CK 187, Centre for Kinesiology]
Curvature and torsion without negatives

A tangent category abstracts settings in which each object has an associated "tangent bundle". Examples range from standard settings for differential geometry (smooth manifolds, infinite-dimensional manifolds, synthetic differential geometry) to algebraic geometry (schemes) to computer science (Cartesian differential categories) and to homotopy theory (Abelian functor calculus, potentially Goodwillie functor calculus). One advantage of this abstraction is that it captures settings which have a tangent bundle but may not have negation of tangent vectors.

In the past several years, there has been a lot of development of differential geometric ideas within a tangent category: definitions have been given for the Lie bracket, vector bundles, connections, differential forms, and de Rham cohomology. However, in a few cases, these definitions have required the assumption that one could negate tangent vectors, reducing the applicability of those definitions from the full range of settings mentioned above.

In particular, the previously given definitions of curvature and torsion in this setting required negatives. In this talk, I'll show how to define curvature and torsion in this abstract setting without requiring the existence of negatives, leading to their applicability in a wider variety of examples.

DARIEN DEWOLF, St. Francis Xavier University
[Monday June 10 / lundi 10 juin, 14:45 – CK 187, Centre for Kinesiology]
The equivalence of ordered groupoids and left cancellative categories using double categories

Lawson gave a correspondence between left cancellative categories and ordered groupoids (groupoids equipped with a partial order on its arrows and that have a notion of restricting/corestricting to a smaller domain/codomain). Lawson and Steinberg then introduce Ehresmann topologies and give a correspondence between Ehresmann topologies on ordered groupoids and Grothendieck topologies on left cancellative categories, and prove that any etendue is equivalent to the category of sheaves on some Ehresmann site (an ordered groupoid equipped with an Ehresmann topology).

By considering ordered groupoids as double categories, we are able to extend Lawson's correspondence to an adjoint equivalence of 2-categories between the 2-category of left cancellative categories and the 2-category of ordered groupoids. Making use of this equivalence, we can then state a comparison lemma for Ehresmann sites, which classifies functors between Ehresmann sites that induce an equivalence between their categories of sheaves.

This is joint work with Dorette Pronk.

JONATHAN GALLAGHER, Dalhousie University
[Monday June 10 / lundi 10 juin, 16:15 – CK 187, Centre for Kinesiology]
Etale Subobject classifiers in SDG and tangent categories

One aspect of the success of topos theory in geometry is the ability to use a rich internal language to describe geometric constructions. The power of the internal logic of a topos stems from existence of a subobject classifier. However, in settings for abstract differential geometry, tangent categories, one often does not have a subobject classifier.

This talk will discuss work to understand a weaker condition for tangent categories called an étale subobject classifier. Indeed, having an étale subobject classifier in a tangent category is weaker than being a quasitopos. We will explore the logic required to obtain an étale partial map classifier from an étale subobject classifier. We will also explore the resulting logic in the étale subobject fibration which has connectives $\wedge, \top, \exists, \vee, \bot$.

We will then discuss more generally the coherence of partial cartesian closed tangent categories, making use of recent work on tangent categories to characterize tangent bundles abstractly. We will discuss what it means for partial maps to be classified in this setting. To provide a less SDG example, we will discuss partial maps between convenient vector spaces.

CHRIS KAPULKIN, University of Western Ontario
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 314, Education Building]
Cubical models of higher category theory

Cubical sets provide an alternative to simplicial sets as a combinatorial model for spaces a.k.a. ∞-groupoids. Joyal showed that simplicial sets also carry a model structure presenting $(\infty, 1)$-categories. However, the cubical counterpart of his result has not been established.

The goal of this project is to develop workable foundations of $(\infty, 1)$-category theory in the category of cubical sets. To this end, in joint work with Christian Sattler and Liang Ze Wong, we define four model structures on categories of (marked and unmarked) cubical sets and explore some of their properties.

This part 2 of a 2-part series given by Chris Kapulkin and Zach Lindsey.

MICHAEL LAMBERT, Dalhousie University
[Monday June 10 / lundi 10 juin, 15:45 – CK 187, Centre for Kinesiology]
A Site for Continuous 2-Group Actions

The category of continuous group actions for a fixed topological group is well-known to be Grothendieck topos. In this talk, we shall outline our work on constructing an appropriate higher site for continuous actions of topological 2-groups.

JS LEMAY, University of Oxford
[Monday June 10 / lundi 10 juin, 8:30 – CK 187, Centre for Kinesiology]
The Poincaré Lemma for Codifferential Categories with Antiderivatives

The Poincaré Lemma, named after the french mathematician Henri Poincaré, states that for a contractible manifold: a closed differential form is exact. In particular this implies that the de Rham complex of $\mathbb{R}^n$ is contractible (or equivalently split exact). Similarly, the algebraic version of the Poincaré Lemma states that the algebraic de Rham complex (the one built from Kähler differentials) of a polynomial ring $\mathbb{R}[x_1, ..., x_n]$ is contractible. In this talk we provide a Poincaré Lemma for codifferential categories with antiderivatives by showing that the de Rham complex of a free S-algebra is contractible, where S is the monad of the codifferential category. Taking S to be the free symmetric algebra monad results in the algebraic Poincaré Lemma, while taking S to be the free $\mathcal{C}^\infty$-ring monad gives the classical Poincaré Lemma.

ZACH LINDSEY, University of Western Ontario
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 314, Education Building]
Cubical models of higher category theory

Cubical sets provide an alternative to simplicial sets as a combinatorial model for spaces a.k.a. ∞-groupoids. Joyal showed that simplicial sets also carry a model structure presenting $(\infty, 1)$-categories. However, the cubical counterpart of his result has not been established.

The goal of this project is to develop workable foundations of $(\infty, 1)$-category theory in the category of cubical sets. To this end, in joint work with Christian Sattler and Liang Ze Wong, we define four model structures on categories of (marked and unmarked) cubical sets and explore some of their properties.

This part 1 of a 2-part series given by Chris Kapulkin and Zach Lindsey.

RORY LUCYSHYN-WRIGHT, Brandon University
[Sunday June 9 / dimanche 9 juin, 10:00]

BEN MCADAM, University of Calgary
[Monday June 10 / lundi 10 juin, 9:00 – CK 187, Centre for Kinesiology]
Involution Algebroids

We define involution algebroids which generalize Lie algebroids to the abstract setting of tangent categories. As a part of this generalisation, the Jacobi identity which appears in classical Lie theory is replaced by an identity similar to the Yang-Baxter equation. Every classical Lie algebroid has the structure of an involution algebroid and every involution algebroid in a tangent category admits a Lie bracket on the sections of its underlying bundle.

This is joint work with Matthew Burke.

CURRAN MCCONNELL, Dalhousie University
[Monday June 10 / lundi 10 juin, 15:15 – CK 187, Centre for Kinesiology]
Combinatorics of spaces of trees: an application of topology to phylogenetics

Various metrics are used in phylogenetics to study sets of evolutionary trees generated from gene sequences. We want to use some of these metrics to consider what persistent homology might be able to contribute to the study of these trees. Our "data points" are points in the space of all trees with n leaves, where n is the number of species considered. We will consider the family of edge complexes, indexed by a sequence of real numbers ϵ_i, obtained by adding an edge between two data points if their distance is less than or equal to ϵ_i. This gives us a filtration of the $((2n-3)!!-1)$-simplex with interesting homological properties, in particular for the quartet distance. Any given data set will give rise to a subsimplex of this $((2n-3)!!-1)$-simplex and a subfiltration. Understanding the properties of the surrounding simplicial complex and its filtration will be important in understanding which features are truly features of the data set we are considering. In this talk I will discuss the features of these simplicial complexes for low values of n and I will present some conjectures for what this means for higher values of n.

DORETTE PRONK, Dalhousie University
[Sunday June 9 / dimanche 9 juin, 16:30 – ED 314, Education Building]
Nice properties of the bicategory of orbigroupoids

Based on the presentation of orbigroupoids as a bicategory with small Hom-categories and canonical representatives for its 2-cells as discussed in Laura Scull's talk, I will present a continuous version of the assumptions required. For instance, where listings of certain arrows are required, I show that these listings can be chosen in a continuous way. I will use this to prove properties of the mapping groupoids for orbigroupoids. This is joint work with Laura Scull from Fort Lewis College.

JONATHAN SCOTT, Cleveland State University
[Saturday June 8 / samedi 8 juin, 16:30 – ED 314, Education Building]
Wasserstein distance for generalized persistence modules and abelian categories

In persistence theory and practice, measuring distances between modules is central. The Wasserstein distances are the standard family of L^p distances (with $1 \leq p \leq \infty$) for persistence modules. We give an algebraic formulation of these distances.

For $p = 1$ the distance generalizes to abelian categories and for arbitrary p it generalizes to Krull-Schmidt categories. These distances may be useful for the computation of distance between generalized persistence modules. This is joint work with Peter Bubenik and Donald Stanley.

LAURA SCULL, Fort Lewis College
[Sunday June 9 / dimanche 9 juin, 16:00 – ED 314, Education Building]
Defining Bicategories of Fractions with Small Hom Sets

This work grew out of the question of building a mapping object for orbifolds. The bicategory of orbifolds is a bicategory of fractions of proper etale groupoids with respect to the class of essential equivalences. A priori, the hom categories in this category are extremely large and somewhat mysterious, since the essential equivalences over a given groupoid form a proper class.

I will discuss categorical conditions which allow us to better understand constructions like these. We develop weaker conditions for a bicalulus of fractions to exist, and show how this can be used to pass to a small subclass of arrows to be inverted. Time permitting, I will talk about how to use pseudo pullbacks to simplify the 2-cell constructions and compositions in the resulting bicategory of fractions.

This is joint work with D. Pronk at Dalhousie University.

JOEL VILLATORO, KU Leuven
[Sunday June 9 / dimanche 9 juin, 17:30 – ED 314, Education Building]
Geometric structures on differentiable stacks

Differentiable stacks are a formalism for studying geometric objects which arise as singular quotients of smooth manifolds. These categorical objects can be studied concretely via their associated Lie groupoids. In this talk I will explain a general approach to studying differentiable stacks which are associated to Lie groupoids that come with additional structure (such as symplectic or analytic structures).

JORDAN WATTS, Central Michigan University
[Sunday June 9 / dimanche 9 juin, 17:00 – ED 314, Education Building]
Bredon Cohomology for Transitive Groupoids

Given a topological group G acting on a space X, Bredon cohomology is a useful tool for picking out the cohomology of the quotient X/G, as well as fixed sets X^H, where H is a subgroup of G. In this talk, we extend Bredon cohomology to actions of transitive groupoids. [Joint work with Carla Farsi and Laura Scull.]

SETH WOLBERT, University of Manitoba
[Saturday June 8 / samedi 8 juin, 17:30 – ED 314, Education Building]
Fibrations as presentations of actions on stacks

Given a Lie group G and a stack $\mathcal{X}$ over the site of smooth manifolds, *an action of G on $\mathcal{X}$* is a map of stacks $a : G \times \mathcal{X} \to \mathcal{X}$ for which the standard action axiom diagrams are required only to commute up to 2-isomorphism. One may define the action of a Lie groupoid G on $\mathcal{X}$ similarly as a weakened version of a standard groupoid action.

In this talk, I will explain how if $\mathcal{X}$ is a differentiable stack presented by some Lie groupoid H, the data of an action of G on $\mathcal{X}$ can be repackaged as a Lie groupoid fibration $\pi : A \to G$ with kernel groupoid H. As fibrations are relatively common in the study of Lie groupoids, I will (time permitting) be able to give plenty of examples of the transition between Lie groupoid fibrations and stack actions, including examples related to gerbes, VB-groupoids, and flows of vector fields on stacks.

Org: Allen Herman (Regina), **Alexander Litvak** (Alberta) and/et **Karen Meagher** (Regina)

Schedule/Horaire **Room/Salle: CK 185, Centre for Kinesiology**

Sunday June 9 **dimanche 9 juin**

16:00 - 16:30	A. Sarobidy Razafimahatratra (University of Regina), *Erdős–Ko–Rado Theorem for permutation groups* (p. 62)
16:30 - 17:00	Zhenyuan Zhang (University of Waterloo), *On discrete-time self-similar processes with stationary increments* (p. 63)
17:00 - 17:30	Hossein Pourali (Brandon University), *ALGEBRAIC AND GRAPH THEORETIC ASPECTS IN LATTICES AND POSETS* (p. 62)
17:30 - 18:00	Saleh Mustafa (University of Regina), *Higher Rank Numerical Ranges for Certain Non-normal Matrices* (p. 62)

Abstracts/Résumés

SALEH MUSTAFA, University of Regina
[Sunday June 9 / dimanche 9 juin, 17:30 – CK 185, Centre for Kinesiology]
Higher Rank Numerical Ranges for Certain Non-normal Matrices

The concept of higher numerical range was introduced by Choi, Kribs, and Zyczkowski in 2006, as a matrix-analysis tool to find correctable codes for a quantum channel. Concretely, given $T \in M_n(\mathbb{C})$ its k^{th} higher numerical range is the set

$$\Lambda_k(T) = \{\lambda \in \mathbb{C} : \ \exists P \in \mathcal{P}_k(n) : \ PTP = \lambda P\},$$

where $\mathcal{P}_k(n)$ is the set of projections of rank k (i.e., $P \in M_n(\mathbb{C})$ such that $P^2 = P = P^*$ and $\mathrm{Tr}(P) = k$).

The higher numerical ranges of normal matrices are well-understood, but little is known in general, other than the fact that $\Lambda_k(T)$ is always compact and convex. In this talk I will show how to calculate $\Lambda_k(T)$ for certain non-normal matrices T, namely direct sums of Jordan blocks $T = \bigoplus_{j=1}^{m} J_{n_j}(\alpha)$, and direct sums of the form $T = J_n(\alpha) \oplus \beta I_m$.

HOSSEIN POURALI, DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE, BRANDON UNIVERSITY
[Sunday June 9 / dimanche 9 juin, 17:00 – CK 185, Centre for Kinesiology]
ALGEBRAIC AND GRAPH THEORETIC ASPECTS IN LATTICES AND POSETS

In this paper, we introduce the generalized ideal based zero divisor graph of a poset P, denoted by $\widehat{G_I(P)}$. A representation theorem is obtained for generalized zero divisor graphs. Then, we introduce the concepts of primal and weakly primal ideals in lattices. Further, the characterizations of the diameter of the zero divisor graph of a lattice with respect to a non-primal ideal is obtained. Finally, we introduce the equivalence relation $\sim$ on a meet semi-lattice L with 0, $x \sim y$ if and only if $ann(x) = ann(y)$ for $x, y \in L$ and introduce a simple undirected graph $G_E(L)$ of equivalence classes of zero divisors of L whose vertices are the equivalence classes of non-zero zero divisors of L in which two vertices $[x]$ and $[y]$ are adjacent if and only if $[x] \wedge [y] = [0]$.

A. SAROBIDY RAZAFIMAHATRATRA, University of Regina
[Sunday June 9 / dimanche 9 juin, 16:00 – CK 185, Centre for Kinesiology]
Erdős–Ko–Rado Theorem for permutation groups

The *Erdős-Ko-Rado* theorem asserts that if $\mathcal{F}$ is a family of k-subsets of $[n]$ where $n > 2k$, then $|\mathcal{F}| \leq \binom{n-1}{k-1}$. Moreover, this bound is sharp and is only attained by families of k-subsets containing a specific element. This theorem can be extended to groups. Two permutations $\sigma, \tau \in \mathrm{Sym}(n)$ are *intersecting* if there exists $i \in [n]$, such that $\sigma(i) = \tau(i)$. A group G, viewed as a permutation group of the set $[n]$, is said to have the *Erdős-Ko-Rado* (EKR) property if families of intersecting permutations are no larger than the size of the stabilizer of a point. Moreover, if only cosets of a stabilizer of a point are the intersecting families that attain this bound, then G is said to have the *strict* EKR property. I will talk about the EKR property and the strict property for 2-transitive and transitive groups.

ZHENYUAN ZHANG, University of Waterloo

[Sunday June 9 / dimanche 9 juin, 16:30 – CK 185, Centre for Kinesiology]

On discrete-time self-similar processes with stationary increments

We study the self-similar processes with stationary increments in a discrete-time setting. Different from the continuous-time case, it is shown that the scaling function of such a process may not take the form of a power function $b(a) = a^H$. More precisely, its scaling function has an Ostrowski-type classification. We then focus on the processes with a p-adic type scaling function, give a class of examples, and prove a special spectral representation result for the processes of this type in L^2.

Equivariant Methods in Differential and Algebraic Geometry
Méthodes équivariantes en géométrie différentielle et algébrique

Org: Lisa Jeffrey (Toronto), **Liviu Mare** (Regina) and/et **Leonardo Mihalcea** (Virginia Tech)

Schedule/Horaire **Room/Salle: ED 106.1, Education Building**

Saturday June 8 — samedi 8 juin

8:00 - 8:30	Anders Buch (Rutgers University), *Positivity of minuscule quantum K-theory* (p. 65)
8:50 - 9:20	Jenna Rajchgot (University of Saskatchewan), *Grobner bases for certain type C Kazhdan-Lusztig ideals* (p. 67)
9:40 - 10:10	Matthias Franz (University of Western Ontario), *The number of connected orbit types in a G-manifold* (p. 66)
16:00 - 16:30	Alejandro Adem (University of British Columbia), *Twisted equivariant K-theory of compact Lie group actions with maximal rank isotropy* (p. 64)
16:40 - 17:10	Chi-Kwong Fok (University of Auckland), *Twisted K-theory and extended Verlinde algebra* (p. 66)
17:20 - 17:50	Jeffrey Carlson (University of Toronto), *The equivariant K-theory of a cohomogeneity-one action* (p. 65)

Sunday June 9 — dimanche 9 juin

8:00 - 8:30	Steven Rayan (University of Saskatchewan), *Linearizations of character varieties of curves: geometry and mirror symmetry* (p. 68)
8:50 - 9:20	Evan Sundbo (University of Saskatchewan), *The Geometry of Twisted Cyclic Quiver Varieties* (p. 68)
9:40 - 10:10	Jordan Watts (Central Michigan University), *Classifying Spaces for Diffeological Groups* (p. 68)
16:00 - 16:30	Kirill Zanoulline (University of Ottawa), *Localized Landweber-Novikov operations on generalized cohomology* (p. 68)
16:40 - 17:10	Changlong Zhong (SUNY Albany), *On the K-theoretic stable bases* (p. 69)
17:20 - 17:50	Tom Baird (Memorial University of Newfoundland), *E-polynomials of character varieties associated to a real curve* (p. 65)

Monday June 10 — lundi 10 juin

8:00 - 8:30	Derek Krepski (University of Manitoba), *An analogue of Kostant's formula for Lie group-valued moment maps* (p. 67)
8:50 - 9:20	Yiannis Loizides (Penn State University), *Quasi-polynomials, asymptotics and [Q,R]=0* (p. 67)
9:40 - 10:10	Mark Hamilton (Mount Allison University), *Integral integral affine geometry, quantization, and Riemann-Roch.* (p. 66)
14:45 - 15:15	Jeremy Lane (University of Geneva), *Volume exhausting, T-equivariant symplectic embeddings of toric manifolds into regular coadjoint orbits* (p. 67)
15:25 - 15:55	Peter Crooks (Northeastern University), *Kostant-Toda lattices and invariant theory* (p. 65)
16:05 - 16:35	Rebecca Goldin (George Mason University), *Schubert Calculus, Schubert Operators, and Positivity* (p. 66)

Abstracts/Résumés

ALEJANDRO ADEM, University of British Columbia
[Saturday June 8 / samedi 8 juin, 16:00 – ED 106.1, Education Building]
Twisted equivariant K-theory of compact Lie group actions with maximal rank isotropy

We consider twisted equivariant K–theory for actions of a compact Lie group G on a space X where all the isotropy subgroups are connected and of maximal rank. We show that the associated rational spectral sequence à la Segal has a simple E_2-term expressible as invariants under the Weyl group of G. Namely, if T is a maximal torus of G, they are invariants of the $\pi_1(X^T)$-equivariant Bredon cohomology of the universal cover of X^T with suitable coefficients. In the case of the inertia stack ΛY this term can be expressed using the cohomology of Y^T and algebraic invariants associated to the Lie group and the twisting. A number of calculations will be provided ; in particular, we recover the rational Verlinde algebra when Y is a point. This is joint work with José Manuel Gómez and José María Cantarero.

TOM BAIRD, Memorial University of Newfoundland
[Sunday June 9 / dimanche 9 juin, 17:20 – ED 106.1, Education Building]
E-polynomials of character varieties associated to a real curve

Given a Riemann surface Σ denote by $M_n(\mathbb{F}) := Hom_\xi(\pi_1(\Sigma), GL_n(\mathbb{F}))/GL_n(\mathbb{F})$ the ξ-twisted character variety for $\xi \in \mathbb{F}$ an n-th root of unity. An anti-holomorphic involution τ on Σ induces an involution on $M_n(\mathbb{F})$ such that the fixed point variety $M_n^\tau(\mathbb{F})$ can be identified with the character variety of "real representations" for the orbifold fundamental group $\pi_1(\Sigma, \tau)$. When $\mathbb{F} = \mathbb{C}$, $M_n^\tau(\mathbb{C})$ is a complex Lagrangian submanifold, a.k.a an ABA-brane.

The E-polynomial of $M_n(\mathbb{C})$ was determined by Hausel and Rodriguez-Villegas by counting points in $M_n(\mathbb{F}_q)$ for finite fields $\mathbb{F}_q$. I will show how the same methods can be used to calculate a generating function for the E-polynomial of $M_n^\tau(\mathbb{C})$ using the representation theory of $GL_n(\mathbb{F}_q)$. This is part of an ongoing collaboration with Michael Lennox Wong.

ANDERS BUCH, Rutgers
[Saturday June 8 / samedi 8 juin, 8:00 – ED 106.1, Education Building]
Positivity of minuscule quantum K-theory

Positivity of minuscule quantum K-theory

The quantum K-theory ring of a flag variety is a generalization of the quantum cohomology ring that encodes information about the arithmetic genera of Gromov-Witten varieties in its structure constants. I will speak about a proof that these structure constants have alternating signs for minuscule flag varieties, including Grassmannians of type A, maximal orthogonal Grassmannians, even dimensional quadrics, and two exceptional flag varieties. This is joint work with Chaput, Mihalcea, and Perrin.

JEFFREY CARLSON, University of Toronto
[Saturday June 8 / samedi 8 juin, 17:20 – ED 106.1, Education Building]
The equivariant K-theory of a cohomogeneity-one action

We compute the equivariant K-theory ring of a cohomogeneity-one action of a compact, connected Lie group on a smooth manifold. This being by definition the case when the orbit space is one-dimensional, it can be seen as a natural next case after that of a transitive action.

Concrete expressions analogous to the cohomological case (due to the speaker, Goertsches, He, and Mare) only arise in the case when the fundamental group of a stabilizer is free abelian. The computation of the additive structure is mainly representation theory and Lie theory, and the multiplicative structure, surprisingly, follows from the Mayer–Vietoris sequence.

PETER CROOKS, Northeastern University
[Monday June 10 / lundi 10 juin, 15:25 – ED 106.1, Education Building]
Kostant-Toda lattices and invariant theory

Toda lattices play a distinguished role in both the classical and modern theories of completely integrable systems, and they are fruitfully studied at the interface of symplectic geometry and representation theory. One crucial aspect of this study

is Kostant's Lie-theoretic realization of the open Toda lattice, which one sometimes calls the Kostant-Toda lattice. This construction invokes Kostant's prior works on invariant theory, especially his results on regular Slodowy slices and the structure of the adjoint quotient.

I will discuss invariant-theoretic aspects of the Kostant-Toda lattice, emphasizing two recent developments. The first is a partial compactification of the Kostant-Toda lattice by means of Hessenberg varieties, Slodowy slices, and Mishchenko-Fomenko algebras, and it represents joint work with Hiraku Abe. The second development concerns a Toda-type integrable system on the *universal centralizer*, a hyperkähler manifold arising in certain representation-theoretic contexts.

CHI-KWONG FOK, The University of Auckland
[Saturday June 8 / samedi 8 juin, 16:40 – ED 106.1, Education Building]
Twisted K-theory and extended Verlinde algebra

In a series of recent papers, Freed, Hopkins and Teleman put forth a deep result which identifies the twisted K-theory of a compact Lie group G with the representation theory of its loop group LG. Under suitable conditions, both objects can be enhanced to the Verlinde algebra, which appears in mathematical physics as the Frobenius algebra of a certain topological quantum field theory, and in algebraic geometry as the algebra encoding information of moduli spaces of G-bundles over Riemann surfaces. The Verlinde algebra for G with nice connectedness properties has been well-known. However, explicit descriptions of such for disconnected G are lacking. In this talk, I will discuss various aspects of the Freed-Hopkins-Teleman Theorem and partial results on an extension of the Verlinde algebra of a simply-connected compact Lie group arising from a disconnected Lie group. The talk is based on work in progress joint with David Baraglia and Varghese Mathai.

MATTHIAS FRANZ, University of Western Ontario
[Saturday June 8 / samedi 8 juin, 9:40 – ED 106.1, Education Building]
The number of connected orbit types in a G-manifold

The orbits of a compact Lie group G acting on a manifold X are classified by conjugacy classes of closed subgroups of G. The slice theorem implies that there are only finitely many orbit types if X is compact. Mann showed in 1962 that the same conclusion holds if X is orientable and of finite type.

I will present an analogous theorem for connected orbit types, where one only looks at the isotropy Lie algebras: The number of connected orbit types is finite if X has finite Betti numbers. The proof rests on fundamental properties of a suitably defined equivariant homology theory.

REBECCA GOLDIN, George Mason University
[Monday June 10 / lundi 10 juin, 16:05 – ED 106.1, Education Building]
Schubert Calculus, Schubert Operators, and Positivity

Schubert calculus is the study has "positivity properties" in several rings associated to the homogeneous spaces, notably equivariant cohomology and equivariant K-theory. We show how one can get new and old formulas for the structure constants in these rings. We introduce new operators whose coefficients compute Schubert structure constants (in a manifestly polynomial, but not positive, way), resulting in a formula that generalizes the positive AJS/Billey formula. Our proof involves Bott-Samelson manifolds and in particular, the cohomology basis dual to the homology basis of classes of sub-Bott-Samelson manifolds.

MARK HAMILTON, Mount Allison University
[Monday June 10 / lundi 10 juin, 9:40 – ED 106.1, Education Building]
Integral integral affine geometry, quantization, and Riemann-Roch.

Let B be a compact integral affine manifold. If the coordinate changes are not only affine but also preserve the lattice $\mathbb{Z}^n$, then there is a well-defined notion of "integral points" in B, and we call B an *integral integral affine manifold*. I will discuss

the relation of integral integral affine structures to quantization and some associated results, in particular the fact that for a regular Lagrangian fibration $M \to B$, the Riemann-Roch number of M is equal to the number of "integral points" in B. Along the way we encounter the fact that the volume of B is equal to the number of integral points, a simple claim from "integral integral affine geometry" whose proof turns out to be surprisingly tricky. This is joint work with Yael Karshon and Takahiko Yoshida.

DEREK KREPSKI, University of Manitoba
[Monday June 10 / lundi 10 juin, 8:00 – ED 106.1, Education Building]
An analogue of Kostant's formula for Lie group-valued moment maps

Let $P \to M$ be a prequantum circle bundle with connection over a symplectic manifold M. Let G be a compact Lie group. Given a Hamiltonian G-action on M, Kostant gave a formula for lifting the infinitesimal $\mathfrak{g}$-action on M to one on P that preserves the connection. This talk presents an analogue of Kostant's formula in the setting of quasi-Hamiltonian G-spaces with G-valued moment map. This is joint work with Jennifer Vaughan.

JEREMY LANE, University of Geneva
[Monday June 10 / lundi 10 juin, 14:45 – ED 106.1, Education Building]
Volume exhausting, T-equivariant symplectic embeddings of toric manifolds into regular coadjoint orbits

Let K be a compact connected Lie group and let $\mathcal{O}_\lambda$ denote the coadjoint orbit of K parameterized by an element λ in the positive Weyl chamber. In several cases, it is known that there exist dense symplectic embeddings of symplectic toric manifolds into $\mathcal{O}_\lambda$. If $K = U(n)$, then, for all λ, one obtains such embeddings from action-angle coordinates for the Gelfand-Zeitlin integrable systems. For arbitrary K compact and connected, if λ is a scalar multiple of an integral weight, then such embeddings can be constructed by toric degeneration and gradient-Hamiltonian flow (cf. Harada and Kaveh). It remains to study the case where λ is not a scalar multiple of an integral weight.

In current work with Anton Alekseev, Benjamin Hoffman, and Yanpeng Li, we show that for K semisimple and any regular coadjoint orbit $\mathcal{O}_\lambda$, one can construct a family of volume exhausting symplectic embeddings of toric manifolds into $\mathcal{O}_\lambda$. Moreover, these embeddings are equivariant with respect to a Hamiltonian action of a maximal torus of K. Our construction combines elements of Poisson-Lie theory, cluster algebras, and a scaling limit of Poisson structures called "tropicalization." In this talk I will endeavour to explain these results as well as our hopes for future work.

YIANNIS LOIZIDES, Pennsylvania State University
[Monday June 10 / lundi 10 juin, 8:50 – ED 106.1, Education Building]
Quasi-polynomials, asymptotics and [Q,R]=0

We study families (parametrized by a positive integer, k) of distributions associated to a class of piecewise quasi-polynomial functions on a lattice. These distributions admit an asymptotic expansion in k, and we study to what extent the original family can be recovered from its asymptotic expansion. This is joint work with P-E. Paradan and M. Vergne. I will discuss some applications to symplectic geometry, where the piecewise quasi-polynomial functions arise as multiplicity functions for the equivariant index of a Dirac operator twisted by the k^{th} power of a pre-quantum line bundle.

JENNA RAJCHGOT, University of Saskatchewan
[Saturday June 8 / samedi 8 juin, 8:50 – ED 106.1, Education Building]
Grobner bases for certain type C Kazhdan-Lusztig ideals

A Kazhdan-Lusztig variety is an intersection of a Schubert variety with an opposite Schubert cell in a flag variety. By a theorem of Kazhdan and Lusztig, it is essentially equivalent to study certain local questions on Schubert varieties by studying the corresponding questions on Kazhdan-Lusztig varieties.

Alexander Woo and Alexander Yong carried out a computational-algebraic study of Kazhdan-Lusztig varieties in type A. They produced Grobner bases for their defining ideals, obtained singularity results, and produced combinatorial formulas for their K-polynomials (equivariant K-classes).

After recalling some background, I will discuss work in progress with Laura Escobar, Alex Fink, and Alexander Woo on computational-algebraic properties of certain type C Kazhdan-Lusztig varieties.

STEVEN RAYAN, University of Saskatchewan
[Sunday June 9 / dimanche 9 juin, 8:00 – ED 106.1, Education Building]
Linearizations of character varieties of curves: geometry and mirror symmetry

To a tamely-punctured algebraic curve with generic positive real weights, one can attach a character variety that can be identified with a multiplicative Nakajima variety of a certain shape. The linearization of this character variety is an ordinary Nakajima quiver variety, called a "hyperpolygon space" in certain instances. The weights, which are stability parameters (equivalently, levels sets of moment maps), produce a singular hyperkaehler variety when driven to zero. This variety at infinity is stratified in a particular way by "edge collapse". Natural questions include the following: Can the singular hyperkaehler metric be written explicitly ? Does this variety arise from a finite subgroup of a Lie group (in the sense of McKay) ? Is the mirror of this variety well understood as, say, a Coulomb branch and what are its "branes" (in the sense of Kapustin-Witten) ? I will comment on all of these, as part of joint work with each of Laura Schaposnik and Hartmut Weiss.

EVAN SUNDBO, University of Saskatchewan
[Sunday June 9 / dimanche 9 juin, 8:50 – ED 106.1, Education Building]
The Geometry of Twisted Cyclic Quiver Varieties

Cyclic Higgs bundles find uses in various aspects of non-abelian Hodge theory (where they are manageable enough to do examples with) and have proven to be potent problem-solving tools in other areas as well. Starting from the world of twisted quiver representations, we investigate the geometry of moduli spaces of L-twisted cyclic Higgs bundles, being particularly concrete when the underlying Riemann surface is the projective line $\mathbb{P}^1$.

This is joint work with Steven Rayan.

JORDAN WATTS, Central Michigan University
[Sunday June 9 / dimanche 9 juin, 9:40 – ED 106.1, Education Building]
Classifying Spaces for Diffeological Groups

Fix an irrational number A, and consider the action of the group of pairs of integers on the real line defined as follows: the pair (m, n) sends a point x to $x + m + nA$. Since the orbits of this action are dense, the quotient topology on the orbit space is trivial, and continuous real-valued functions are constant. Can we give the space any type of useful "smooth" group structure ?

The answer is "yes": its natural diffeological group structure. It turns out this group is not just some pathological example, but has many interesting associated structures, and is of interest to many areas of mathematics. In particular, it shows up in geometric quantisation and the integration of certain Lie algebroids as the structure group of certain principal bundles, the main topic of this talk.

We will perform Milnor's construction in the realm of diffeology to obtain a diffeological classifying space for a diffeological group G, such as the irrational torus. After mentioning a few hoped-for properties, we then construct a connection 1-form on the G-bundle $EG \to BG$, which will naturally pull back to a connection 1-form on sufficiently nice principal G-bundles. We then look at what this can tell us about irrational torus bundles.

KIRILL ZANOULLINE, University of Ottawa
[Sunday June 9 / dimanche 9 juin, 16:00 – ED 106.1, Education Building]
Localized Landweber-Novikov operations on generalized cohomology

Cohomological operations on generalized algebraic cohomology theories (e.g. Steenrod, Adams, Landweber-Novikov) have been extensively studied during the past decade (Brosnan, Levine, Merkurjev, Vishik). They turned out to be extremely useful in generating interesting rational cycles in higher codimension (e.g. idempotents or 0-cycles on twisted flag varieties), hence, in computing various geometric invariants of torsors (incompressibility, canonical dimension, torsion, motivic decomposition type, etc.).

In the present talk, we explain how to extend the Landweber-Novikov operations on algebraic cobordism to the setup of equivariant generalized cohomology theories via the localization techniques of Kostant-Kumar. The operations we obtain we call localized operations. These operations can be viewed as operations on global sections of the so called structure sheaves on moment graphs (corresponding to arbitrary Coxeter groups). They satisfy several natural properties, e.g. they commute with characteristic map and restrict to usual Landweber-Novikov operations.

CHANGLONG ZHONG, SUNY-Albany
[Sunday June 9 / dimanche 9 juin, 16:40 – ED 106.1, Education Building]
On the K-theoretic stable bases

In this talk I will recall Maulik-Okounkov's definition of K-theoretic stable bases. I will then talk about their restriction formulas. Note that stable bases depend on the alcoves of the group of characters of the torus. Stable bases in terms of different alcoves are related by the so-called wall crossing R-matrices, studied by Okounkov. I will also talk about such matrices. This is joint work with Changjian Su and Gufang Zhao.

Org: Tim Alderson (UNB) and/et **Brett Stevens** (Carleton)

Schedule/Horaire **Room/Salle: CK 185, Centre for Kinesiology**

Saturday June 8 **samedi 8 juin**

9:00 - 9:30	Tim Alderson (University of New Brunswick Saint John), *t-Extensions of Linear Codes* (p. 70)
9:30 - 10:00	James McQuillan (Western Illinois University), *Desargues configurations with self-conjugate points* (p. 70)
10:00 - 10:30	Aiden Bruen (Carleton University), *An extension of Desargues Theorem* (p. 70)
16:00 - 16:30	Brett Stevens (Carleton University), *Affine planes with ovals for blocks* (p. 71)
16:30 - 17:00	John Sheekey (University College Dublin), *Finite Geometry and Rank-Metric Codes* (p. 70)
17:30 - 18:00	David Wehlau (Royal Military College of Canada), *Planes, Division Sequences and ZZ-topes* (p. 71)

Abstracts/Résumés

TIM ALDERSON, University of New Brunswick Saint John
[Saturday June 8 / samedi 8 juin, 9:00 – CK 185, Centre for Kinesiology]
t-Extensions of Linear Codes

For $n \geq k$, an $(n, k, d)_q$-*code* C is a collection of q^k n-tuples (or *codewords*) over an alphabet $\mathcal{A}$ of size q such that the minimum (Hamming) distance between any two codewords of C is d. For such a code, the Singleton bound $\left(|C| \leq |\mathcal{A}|^{n-d+1}\right)$ gives $d \leq n - k + 1$. The *Singleton defect of* C, $S(C)$, is defined by $S(C) = n - k + 1 - d$. A code C' obtained by deleting some fixed t coordinates from each codeword of C is called a t-punctured code of C. In the case that $S(C') = S(C)$, C is said to be a t-extension of C', equivalently, C' is said to be *extendable* to the code C. A code is *maximal* if it admits no extensions.

In this talk I shall discuss the question of non-linear t-extendability of linear codes, and describe some recent progress obtained by utilizing the Alderson-Bruen-Silverman (ABS) model of linear codes. Some open problems will also be presented.

AIDEN BRUEN, Carleton University
[Saturday June 8 / samedi 8 juin, 10:00 – CK 185, Centre for Kinesiology]
An extension of Desargues Theorem

The celebrated theorem of Desargues asserts that if two triangles are in perspective the intersections of corresponding sides are collinear. Here we outline a new result on the intersections of the non-corresponding sides.

Time permitting a connection between Desargues and graph theory is described [joint work with Dr. Trevor Bruen and Professor McQuillan].

JAMES MCQUILLAN, Western Illinois University
[Saturday June 8 / samedi 8 juin, 9:30 – CK 185, Centre for Kinesiology]
Desargues configurations with self-conjugate points

Desargues theorem states that, if two triangles are in perspective from a point, then the intersections of the corresponding sides are collinear. The associated 10 points and 10 lines form a Desargues configuration. We consider Desargues configurations in a projective plane over a field, and the unique polarity associated with a Desargues configuration. We focus on self-conjugate points in a Desargues configuration. Interestingly, fields of characteristic 2 and 3 both play special roles. This is joint work with Professor Aiden Bruen, Carleton University.

JOHN SHEEKEY, University College Dublin
[Saturday June 8 / samedi 8 juin, 16:30 – CK 185, Centre for Kinesiology]
Finite Geometry and Rank-Metric Codes

It is well known that there is a correspondence between codes in the hamming metric and sets of points in a projective space, where weights of codewords correspond to intersection properties of this set with hyperplanes. In the extremal case, we have the classical correspondence between MDS codes and arcs.

Codes in the rank-metric have been studied since Delsarte (1978) and Gabidulin (1985), but have had increased attention in recent years due to potential applications in Network Coding and Code-based Cryptography.

In this talk we outline a natural correspondence between codes in the rank-metric and linear sets in a projective space. Linear sets have been studied in finite geometry for the past 20 years. These two topics have developed independently until recently, so there are various results and techniques in each which translate to interesting and non-trivial results in the other. We will present recent results and open problems arising from this new correspondence.

BRETT STEVENS, Carleton University
[Saturday June 8 / samedi 8 juin, 16:00 – CK 185, Centre for Kinesiology]
Affine planes with ovals for blocks

A beautiful theorem states that the reverse of a line in the Singer Cycle presentation of a projective plane is an oval. This implies that for every Desarguesian projective plane there is a companion plane all of whose blocks are ovals in the first. This fact has been exploited to construct a family of very efficient strength 3 covering arrays. We show that there exist pairs of Desarguesian affine planes whose blocks are ovals in the other plane for any order a power of 2. These can also be used to construct efficient covering arrays.

DAVID WEHLAU, Royal Military College
[Saturday June 8 / samedi 8 juin, 17:30 – CK 185, Centre for Kinesiology]
Planes, Division Sequences and ZZ-topes

We consider the algebraic closure F of the field of order p as an infinite dimensional vector space over the prime field. A natural problem in representation theory leads to the question of describing the two dimensional subspaces of F. In particular, we wish to describe the orbits of these planes under the natural action of the non-zero scalars F^*. The solution to this problem leads to an infinite sequence of polynomials for each prime p. These polynomials have a number of remarkable properties. Studying these polynomials reveals deep connections with number theory and combinatorics.

Joint work with H.E.A. Campbell, University of New Brunswick

Org: Martin Argerami and/et **Remus Floricel** (Regina)

Schedule/Horaire **Room/Salle: ED 191, Education Building**

Saturday June 8 — samedi 8 juin

8:00 - 8:30	Dilian Yang (University of Windsor), *KMS states of self-similar k-graph C*-algebras* (p. 76)
8:30 - 9:00	Matthias Neufang (Carleton University), *Solution to several problems regarding tensor products and crossed products of C^*- and von Neumann algebras* (p. 75)
9:00 - 9:30	Marcelo Laca (University of Victoria), *Reconstructing directed graphs* (p. 74)
9:30 - 10:00	Jason Crann (Carleton University), *An equivariant weak expectation property and amenable actions* (p. 73)
10:00 - 10:30	Paul Skoufranis (York University), *Majorization, Convexity, and Expectations* (p. 76)
16:00 - 16:30	Nico Spronk (University of Waterloo), *Fixed points of contractive measures acting by convolution* (p. 76)
16:30 - 17:00	Masoud Khalkhali (Western University), *Von Neumann information entropy, second quantization, and spectral action* (p. 74)
17:00 - 17:30	Volker Runde (University of Alberta), *Amenability of the Fourier algebra in the completely bounded multiplier norm* (p. 75)

Sunday June 9 — dimanche 9 juin

8:00 - 8:30	Vern Paulsen (University of Waterloo), *Preservation of the joint essential matricial range* (p. 75)
8:30 - 9:00	Heath Emerson (University of Victoria), *Transversals and Connes' duality for the irrational rotation algebra* (p. 73)
9:00 - 9:30	Francesco Fidaleo (University of Rome Tor Vergata), *Uniquely Ergodic C^*-Dynamical Systems for the noncommutative 2-torus* (p. 73)
9:30 - 10:00	Raphael Clouatre (University of Manitoba), *Residual finite-dimensionality for general operator algebras* (p. 73)
10:00 - 10:30	Berndt Brenken (University of Calgary), *Partial isometries implementing cpc C*- dynamical systems* (p. 72)
16:00 - 16:30	Daniel Drimbe (University of Regina), *Prime II_1 factors arising from actions of product groups* (p. 73)
16:30 - 17:00	Cristian Ivanescu (MacEwan University), *Pedersen ideals of tensor products of nonunital C*-algebras* (p. 74)

Monday June 10 — lundi 10 juin

8:00 - 8:30	Jiun-Chau Wang (University of Saskatchewan), *Probability measures in bi-free probability* (p. 76)
8:30 - 9:00	Anamaria Savu (University of Alberta), *Conservative Restricted Solid-on-Solid Model* (p. 75)
9:00 - 9:30	Edward Timko (University of Manitoba), *The Spectrum of Constrained Model d-tuples* (p. 76)

Abstracts/Résumés

BERNDT BRENKEN, University of Calgary
[Sunday June 9 / dimanche 9 juin, 10:00 – ED 191, Education Building]
Partial isometries implementing cpc C- dynamical systems*

Associate with a completely positive contractive (cpc) map $\varphi : A \to A$ of a C*-algebra A a crossed product algebra $C^*(A, \varphi)$; namely a universal C*-algebra generated by A and a contraction implementing φ. One can dilate φ to a cpc map $\widetilde{\varphi}$ of an

augmented C*-algebra A_q of A. The associated crossed product algebra $C^*(A_q, \widetilde{\varphi})$ is generated by A_q and a partial isometry implementing $\widetilde{\varphi}$, and is Morita equivalent to $C^*(A, \varphi)$.

RAPHAEL CLOUATRE, University of Manitoba
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 191, Education Building]
Residual finite-dimensionality for general operator algebras

Finite-dimensional approximation properties have proven to be a fruitful idea in the realm of C^*-algebras. It is thus natural to hope that similar ideas can elucidate the structure of general (not necessarily self-adjoint) operator algebras. In this talk we will study residual finite-dimensionality from that perspective. The departure from the self-adjoint world involves some interesting subtleties. For instance, it is well-known that finite-dimensional operator algebras cannot necessarily be represented completely isometrically inside of an algebra of matrices, in contrast with the situation for C^*-algebras. As such, it it not immediately obvious what the "natural" definition of this more general notion of residual finite-dimensionality should be. After clarifying this issue, we will explore the extent to which the residual finite-dimensionality of an operator algebra carries over to its C^*-envelope or its maximal C^*-algebra. This is joint work with Christopher Ramsey.

JASON CRANN, Carleton University
[Saturday June 8 / samedi 8 juin, 9:30 – ED 191, Education Building]
An equivariant weak expectation property and amenable actions

We introduce an equivariant version of the weak expectation property (WEP) at the level of operator modules over completely contractive Banach algebras. This yields a natural notion of group covariant WEP, related to recent work of Buss–Echterhoff–Willett, but also a dual notion of the $A(G)$-WEP for operator modules over the Fourier algebra of a locally compact group G. These dual notions are related in the setting of C^*-dynamical systems, where we show that an action $G \curvearrowright X$ of an exact locally compact group is topologically amenable if and only if $C_0(X)$ has the $L^1(G)$-WEP if and only if the reduced crossed product $C_0(X) \rtimes G$ has the $A(G)$-WEP. Along the way, we answer a question of Anantharaman-Delaroche and generalize the equivalence between topological amenability and Zimmer amenability of the bidual action to the locally compact setting. This is joint work with Alex Bearden and Mehrdad Kalantar.

DANIEL DRIMBE, University of Regina
[Sunday June 9 / dimanche 9 juin, 16:00 – ED 191, Education Building]
Prime II_1 factors arising from actions of product groups

In this talk we show that any II_1 factor arising from a free ergodic probability measure preserving action $\Gamma \curvearrowright X$ of a product $\Gamma = \Gamma_1 \times \cdots \times \Gamma_n$ of $n \geq 1$ icc hyperbolic, free product or wreath product groups is prime, provided $\Gamma_i \curvearrowright X$ is ergodic, for any $1 \leq i \leq n$. Moreover, we prove a unique prime factorization result for any II_1 factor associated to a free ergodic probability measure preserving action of a product of icc, hyperbolic, property (T) groups.

HEATH EMERSON, University of Victoria
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 191, Education Building]
Transversals and Connes' duality for the irrational rotation algebra

In this talk we explain how transversals to Kronecker foliations of the 2-torus can be used to invert Connes' Poincaré duality map for the irrational rotation algebra. Connes' map, which uses a well-known spectral triple similar to the Dolbeault cycle for the ordinary 2-torus, gave the first example of a noncommutative C*-algebra exhibiting Poincaré duality in K-theory, but the result was (arguably) not quite complete until now as no cycle has ever been described representing the Poincaré dual of Connes' spectral triple. We rectify this with our constructions with transversals and re-prove duality for the irrational rotation algebra by verifying the zig-zag equations for Connes' class, and ours.

FRANCESCO FIDALEO, University of "Tor Vergata", Rome
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 191, Education Building]
Uniquely Ergodic C^*-Dynamical Systems for the noncommutative 2-torus

Consider a uniquely ergodic C^*-dynamical system $(\mathfrak{A}, \Phi)$ based on a identity-preserving $*$-endomorphism Φ of the unital C*-algebra $\mathfrak{A}$. We can prove the uniform convergence of Cesaro averages

$$M_{a,\lambda}(n) := \frac{1}{n}\sum_{k=0}^{n-1} \lambda^{-k}\Phi^k(a), \quad a \in \mathfrak{A},$$

for all values λ in the unit circle $\mathbb{T}$, which are not eigenvalues corresponding to "measurable non-continuous" eigenfunctions. This result generalizes an analogous one, known in commutative ergodic theory, which turns out to be a combination of the Wiener-Wintner theorem and the uniformly convergent ergodic theorem of Krylov and Bogolioubov. We also present counterexamples based on the tensor product construction, for which the above average does not converge even in the $*$-weak topology, for some $a \in \mathfrak{A}$ and $\lambda \in \mathbb{T}$.

It would however be desirable to produce more general examples than those (perhaps non trivial) based on the tensor product construction, for which the average $M_{a,\lambda}$ corresponding to some peripheral eigenvalue $\lambda \in \mathbb{T}$ fails to converge for some element $a \in \mathfrak{A}$. It is done as in the classical case, by defining the noncommutative extension of the Anzai skew product on the noncommutative 2-torus $\mathbb{A}_\alpha$ ($2\pi\alpha$ being the deformation angle), and show that, still in these cases, there exist elements $a \in \mathbb{A}_\alpha$ and $\lambda \in \mathbb{T}$ for which the average $M_{a,\lambda}$ does not converge.

CRISTIAN IVANESCU, MacEwan University
[Sunday June 9 / dimanche 9 juin, 16:30 – ED 191, Education Building]
Pedersen ideals of tensor products of nonunital C-algebras*

We show that positive elements of Pedersen ideal of tensor product can be approximated in a strong sense by sums of tensor products of positive elements. This has a range of applications to the structure of tracial cones and related topics, such as the Cuntz semigroups. This is a joint work with Dan Kucerovsky.

MASOUD KHALKHALI, University of Western Ontario
[Saturday June 8 / samedi 8 juin, 16:30 – ED 191, Education Building]
Von Neumann information entropy, second quantization, and spectral action

We show that by incorporating chemical potentials one can extend the formalism of spectral action principle to Bosonic second quantization. In fact we show that the von Neumann information entropy, the average energy, and the negative free energy of the state defined by the Bosonic, or Fermionic, grand partition function can be expressed as spectral actions, and all spectral action coefficients can be given in terms of the modified Bessel functions.In the Fermionic case, we show that the spectral coefficients for the von Neumann entropy, in the limit when the chemical potential μ approaches to 0, can be expressed in terms of the Riemann zeta function. This recovers a recent result of Chamseddine-Connes-van Suijlekom (joint work with Rui Dong, arXiv:1903.09624).

MARCELO LACA, University of Victoria
[Saturday June 8 / samedi 8 juin, 9:00 – ED 191, Education Building]
Reconstructing directed graphs

We show how to reconstruct a finite directed graph E from its Toeplitz algebra, its gauge action, and the canonical finite-dimensional abelian subalgebra generated by the vertex projections. If E has no sinks, then we can recover E from its Toeplitz algebra and the generalised gauge action that has, for each vertex, an independent copy of the circle acting on the generators

corresponding to edges emanating from that vertex. We also show by example that it is not possible to recover E from its Toeplitz algebra and the gauge action alone. This is joint work with Nathan Brownlowe, David Robertson and Aidan Sims.

MATTHIAS NEUFANG, Carleton University and University of Lille
[Saturday June 8 / samedi 8 juin, 8:30 – ED 191, Education Building]
Solution to several problems regarding tensor products and crossed products of C^*- and von Neumann algebras

We present solutions to several problems concerning crossed products and tensor products of operator algebras. The common theme is our use of completely bounded module maps.

We prove that a locally compact group G has the approximation property (AP) if and only if a non-commutative Fejér theorem holds for the associated C^*- or von Neumann crossed products. We deduce that the AP always implies exactness. This generalizes a result of Haagerup–Kraus, and answers a question by Li. We also answer a problem of Bédos–Conti on discrete C^*-dynamical systems, and a question by Anoussis–Katavolos–Todorov on bimodules over the group von Neumann algebra $VN(G)$ for all locally compact groups G with the AP. In our approach, we develop a notion of Fubini crossed product for locally compact groups, and a dynamical version of the AP for actions. (Joint work with J. Crann.)

It has been open for almost 40 years to characterize when the projective Banach tensor square $\mathcal{A} \otimes_\gamma \mathcal{A}$ of a C^*-algebra $\mathcal{A}$ is Arens regular. We solve this problem for arbitrary C^*-algebras: Arens regularity is equivalent to $\mathcal{A}$ having the Phillips property ; hence, it is encoded in the geometry of $\mathcal{A}$. For a von Neumann algebra $\mathcal{A}$, we conclude that $\mathcal{A} \otimes_\gamma \mathcal{A}$ is Arens regular only if $\mathcal{A}$ is finite-dimensional. We also show that this does not generalize to non-selfadjoint operator algebras. For commutative C^*-algebras $\mathcal{A}$, we prove that the centre of $(\mathcal{A} \otimes_\gamma \mathcal{A})^{**}$ is Banach algebra isomorphic to the extended Haagerup tensor product $\mathcal{A}^{**} \otimes_{eh} \mathcal{A}^{**}$.

VERN PAULSEN, University of Waterloo
[Sunday June 9 / dimanche 9 juin, 8:00 – ED 191, Education Building]
Preservation of the joint essential matricial range

In this talk we present generalizations of several results of R. Smith and J. Ward about the essential matricial ranges of a single operator to d-tuples of operators. Given a d-tuple of operators, their joint k-th matricial range is the set of all d-tuples of the kxk matrices that can be obtained as their image under all unital completely positive maps into the kxk matrices. Their joint k-th essential matrix range is defined similarly, but using maps that factor through the Calkin algebra. We prove that one also obtains the joint k-th essential matricial range by taking the intersection of the k-th matrix ranges of all compact pertubations of the original d-tuple and that as long as k is fixed, this set can be attained by a single compact perturbation.

This talk is based on joint work with Chi-Kwon Lee and Yiu-Tung Poon.

VOLKER RUNDE, University of Alberta
[Saturday June 8 / samedi 8 juin, 17:00 – ED 191, Education Building]
Amenability of the Fourier algebra in the completely bounded multiplier norm

Let G be a locally compact group containing a copy of the free group on two generators as a closed subgroup, and let $A_{Mcb}(G)$ denote the closure of the Fourier algebra of G in the completely bounded multiplier norm. I will show that $A_{Mcb}(G)$ is not amenable.

ANAMARIA SAVU, University of Alberta
[Monday June 10 / lundi 10 juin, 8:30 – ED 191, Education Building]
Conservative Restricted Solid-on-Solid Model

We introduce a new interacting particle system for dynamics of interfaces. The model is conservative in the sense that the total number of particles is preserved. In addition, the model is restricted in the sense that possible interface configurations

are restricted to have a gradient that is bounded in absolute value by 1, $|h(x+1) - h(x)| \leq 1$. The model allows particles to climb, fall, jump, and slide. Mean-field approximations of this model will be discussed.

PAUL SKOUFRANIS, York University
[Saturday June 8 / samedi 8 juin, 10:00 – ED 191, Education Building]
Majorization, Convexity, and Expectations

The notion of majorization of spectral distributions yields a partial ordering on the collection of self-adjoint $n \times n$ matrices that has a wide variety of uses such as describing convex hulls of unitary orbits and describing expectations onto maximal abelian self-adjoint subalgebras. In this talk, extensions of these structures and results will be discussed in the context of C*-algebras. In particular, a notion of majorization of self-adjoint operators in any C*-algebra will be described that characterizes the norm closed convex hull of the unitary orbit of any self-adjoint operator in any C*-algebra. Furthermore, expectations of these convex hulls will be discussed in the context of von Neumann algebras.
(Based on joint work with Matthew Kennedy, Ping Wong Ng, and Leonel Roberts)

NICO SPRONK, University of Waterloo
[Saturday June 8 / samedi 8 juin, 16:00 – ED 191, Education Building]
Fixed points of contractive measures acting by convolution

The classical Choquet-Deny theorem tells us, for a locally compact abelian group, that the fixed points of a probability measure acting as a convolution operator are elements constant on cosets of the group generated by the support of the measure. Over the years this theorem has been extended to various classes of locally compact groups, and even studied in the context of quantum groups. We consider the case of a measure of norm 1. We explore some of the results in the context of locally compact quantum groups. This is joint work with M. Neufang (Carleton & Lille 1), A. Skalski (IMPAN), and P. Salmi (Oulu).

EDWARD TIMKO, University of Manitoba
[Monday June 10 / lundi 10 juin, 9:00 – ED 191, Education Building]
The Spectrum of Constrained Model d-tuples

In this talk we give a few descriptions of the Taylor spectrum for compressions $Z^{(\mathfrak{a})}$ of the d-tuple of coordinate multiplication operators to co-invariant subspaces $H^2_d \ominus [\mathfrak{a}H^2_d]$ of the Drury-Arveson space H^2_d. We then discuss connections between the spectrum and some properties of the C*-algebra generated by $Z^{(\mathfrak{a})}$. This is joint work with Raphael Clouatre.

JIUN-CHAU WANG, University of Saskatchewan
[Monday June 10 / lundi 10 juin, 8:00 – ED 191, Education Building]
Probability measures in bi-free probability

We report a list of important distributions in Voiculescu's bi-free probability, including infinitely divisible measures and extreme value measures.

DILIAN YANG, University of Windsor
[Saturday June 8 / samedi 8 juin, 8:00 – ED 191, Education Building]
KMS states of self-similar k-graph C-algebras*

Let G be a discrete amenable group, and Λ be a strongly connected finite k-graph. In this talk, we will describe the structure of the KMS simplex of the C*-algebra $\mathcal{O}_{G,\Lambda}$ associated to (G, Λ) when (G, Λ) is a pseudo free and locally faithful self-similar action. This is joint work with Hui Li.

Functional and Complex Analysis
Analyse fonctionnelle et complexe

Org: Douglas Farenick (Regina) and/et **Javad Mashreghi** (Laval)

Schedule/Horaire **Room/Salle: ED 315, Education Building**

Saturday June 8 **samedi 8 juin**

8:00 - 8:30	Damir Kinzebulatov (Université Laval), *A new look at the KLMN theorem* (p. 78)
8:30 - 9:00	Mohammad Shirazi (University of Manitoba), *Grunsky and Faber Operators for Riemann Surfaces with One Border* (p. 79)
9:00 - 9:30	Christopher Ramsey (Grant MacEwan University), *What is and is not a Tensor algebra* (p. 78)
9:30 - 10:00	Ryan Tessier (University of Regina), *Purity of the Identity Map on the Operator System generated by the Free Group* (p. 79)
10:00 - 10:30	Raphael Clouatre (University of Manitoba), *Uniform quotients and C^*-envelopes on the Drury-Arveson space* (p. 77)
16:00 - 16:30	Abdel Rahman (University of Regina), *Homogeneous Levi Foliations* (p. 78)
16:30 - 17:00	Ed Timko (University of Manitoba), *Row Contractions Constrained by Higher Order Vanishing Ideals.* (p. 79)
17:00 - 17:30	Bruce Gilligan (University of Regina), *Pseudoconvex homogeneous manifolds* (p. 77)
17:30 - 18:00	Richard Fournier (Dawson College), *A Schwarz lemma for locally univalent meromorphic functions* (p. 77)
18:00 - 18:30	Javad Mashreghi (Université Laval), *Approximation schemes in function spaces* (p. 78)

Abstracts/Résumés

RAPHAEL CLOUATRE, University of Manitoba
[Saturday June 8 / samedi 8 juin, 10:00 – ED 315, Education Building]
Uniform quotients and C^*-envelopes on the Drury-Arveson space

Quotient modules of the Drury-Arveson space serve as concrete functional models in multivariate operator theory. We explore some of the operator algebraic properties of the canonical generators of these modules. We show how the "approximate" zero set of the associated annihilating ideal can detect whether certain operator algebras are uniform algebras. In turn, this information determines the C^*-envelope of these algebras. This is joint work in progress with Edward Timko.

RICHARD FOURNIER, Dawson College (Montreal)
[Saturday June 8 / samedi 8 juin, 17:30 – ED 315, Education Building]
A Schwarz lemma for locally univalent meromorphic functions

We prove a sharp Schwarz type lemma for meromorphic functions with spherical derivative uniformly bounded away from zero. As a consequence we deduce an improved quantitative version of a recent normality criterion due to Grahl and Nevo and also to Steinmetz, which is asymptotically best possible. This is joint work with Daniela Kraus and Oliver Roth from Germany.

BRUCE GILLIGAN, University of Regina
[Saturday June 8 / samedi 8 juin, 17:00 – ED 315, Education Building]
Pseudoconvex homogeneous manifolds

Assume G is a connected complex Lie group with H a closed complex subgroup of G. Then there exists a closed complex subgroup J of G containing H such that the homogeneous fibration $\pi : G/H \to G/J$ is the **holomorphic reduction** of G/H, i.e., G/J is holomorphically separable and $\mathcal{O}(G/H) \cong \pi^*\mathcal{O}(G/J)$.

In this talk we will discuss what happens if G/H is pseudoconvex, i.e, admits a continuous plurisubharmonic exhaustion function. It turns out that in this setting one is in the best of all possible worlds: G/J is Stein and $\mathcal{O}(J/H) \cong \mathbb{C}$.

DAMIR KINZEBULATOV, Université Laval
[Saturday June 8 / samedi 8 juin, 8:00 – ED 315, Education Building]
A new look at the KLMN theorem

The Kato-Lions-Lax-Milgram-Nelson (KLMN) theorem plays a central role in the theory of operators and the PDEs. When applied to the (formal) Kolmogorov operator $-\Delta + b \cdot \nabla$, the KLMN theorem allows to construct its realization in L^2 as the generator of a holomorphic semigroup. We will demonstrate a new approach to the L^2 theory of $-\Delta + b \cdot \nabla$, using the old ideas of Hille, Lions and Trotter. Compared to the KLMN theorem, this approach admits a considerably wider class of vector fields b while providing a greater regularity of solutions to the corresponding elliptic equation. Joint with Yu.A.Semenov (Toronto).

JAVAD MASHREGHI, Laval University
[Saturday June 8 / samedi 8 juin, 18:00 – ED 315, Education Building]
Approximation schemes in function spaces

Let X be a Banach holomorphic function space on the unit disk. A linear polynomial approximation scheme for X is a sequence of bounded linear operators $T_n : X \to X$ with the property that, for each $f \in X$, the functions $T_n(f)$ are polynomials converging to f in the norm of the space. We completely characterize those spaces X that admit a linear polynomial approximation scheme. In particular, we show that it is not sufficient merely that polynomials be dense in X.

Joint work with T. Ransford.

ABDEL RAHMAN, University of Regina
[Saturday June 8 / samedi 8 juin, 16:00 – ED 315, Education Building]
Homogeneous Levi Foliations

Let G_0 be a closed, connected subgroup of a connected complex Lie group G with H a closed complex subgroup of G and set $H_0 := G_0 \cap H$. Further assume that the (real) orbit $\Sigma := G_0/H_0$ is compact in the homogeneous complex manifold $X := G/H$, that $W_x := T_x\Sigma \cap iT_x\Sigma$ has constant dimension for all $x \in \Sigma$, and that the subbundle $W := \bigsqcup W_x$ is integrable. Then Σ is foliated by maximal connected complex submanifolds, called the leaves of the **Levi foliation** of Σ, that turn out to be homogeneous themselves under a complex subgroup of G contained in G_0 and whose tangent space at each $x \in \Sigma$ is W_x.

If Σ is an orbit in a complex projective space, then the leaves are flag manifolds, i.e., they are closed in Σ. Perhaps, more surprisingly, is the fact that if the isotropy H is discrete, then the basic building blocks that can occur are compact homogeneous complex manifolds and fiber bundles involving powers of S^1, the unit circle, lying inside corresponding powers of $\mathbb{C}^*$-bundles in X. We will outline how this happens, even in the setting where the leaves are dense - so no reasonable (i.e., Hausdorff) leaf space exists. This gives a rather explicit description of the structure even in this setting.

CHRISTOPHER RAMSEY, MacEwan University
[Saturday June 8 / samedi 8 juin, 9:00 – ED 315, Education Building]
What is and is not a Tensor algebra

A C*-correspondence is a generalization of Hilbert space where the inner product takes values in a C*-algebra. To such a space one constructs the so-called Tensor algebra. Because this construction is so abstract it is not obvious whether a given operator algebra has a Tensor algebra description or not.

MOHAMMAD SHIRAZI, University of Manitoba
[Saturday June 8 / samedi 8 juin, 8:30 – ED 315, Education Building]
Grunsky and Faber Operators for Riemann Surfaces with One Border

Consider a Riemann surface Σ of genus $g > 0$ with one border Γ which can be described as a compact Riemann surface $\mathcal{R}$ of the same genus g, from which a simply connected domain Ω is removed. That is $\Sigma = \mathcal{R} \backslash cl(\Omega)$, $\partial\Omega = \Gamma$. Let f be a conformal map from the unit disc $\mathbb{D}$ to Ω.

We aim to characterize the Dirichlet holomorphic space $\mathcal{D}(\Sigma)$ and its boundary values on Γ, in terms of the Fourier series of the pull-back of $\mathcal{D}(\Sigma)$ by f, by generalizing the classical *Faber* and *Grunsky* operators associated to f on planar domains to $\mathcal{R}$.

Joint work with E. Schippers and W. Staubach.

RYAN TESSIER, Mr.
[Saturday June 8 / samedi 8 juin, 9:30 – ED 315, Education Building]
Purity of the Identity Map on the Operator System generated by the Free Group

If $\mathcal{S}_n$ is the operator system of the free group $\mathbb{F}_n$, then the identity map $\iota_N : \mathcal{S}_n \to \mathcal{S}_n$ is shown to be a pure completely positive map in the cone of all completely positive linear maps $\phi : \mathcal{S}_n \to \mathcal{S}_n$.

ED TIMKO, University of Manitoba
[Saturday June 8 / samedi 8 juin, 16:30 – ED 315, Education Building]
Row Contractions Constrained by Higher Order Vanishing Ideals.

In this talk we look at similarity classes of commuting row contractions annihilated by what we call higher order vanishing ideals of interpolating sequences. We demonstrate a Jordan-type direct sum decomposition for these row contractions and discuss a few connected results. This is based on joint work with Raphael Clouatre.

High-Dimensional Problems in Finance and Quantitative Research
Problèmes de grande dimension en finance et en recherche quantitative

Org: Taehan Bae and/et **Andrei Volodin** (Regina)

Schedule/Horaire **Room/Salle: ED 438, Education Building**

Saturday June 8	**samedi 8 juin**
8:00 - 8:30	Alexander Melnikov (University of Alberta), *On Option Pricing Methods in Modern Mathematical finance* (p. 81)
8:30 - 9:00	Xuemiao Hao (University of Manitoba), *Sharp Tail Estimate for Aggregate Critical Illness Claims in a Large Population* (p. 81)
9:00 - 9:30	Yangho Choi (Hanyang University), *Macroscopic Modeling of Data Breach Risk with Spatial and Temporal Autocorrelation* (p. 81)
9:30 - 10:00	Shanoja Naik (Registered Nurses Association of Ontario), *On Wishart Process and Sovereign Credit Risk Modelling* (p. 82)
10:00 - 10:30	Naeima Ashleik (University of Saskatchewan), *Learning for Contingency Tables and Survival Data Using Imprecise Probabilities* (p. 80)
16:00 - 16:30	Syed Ejaz Ahmed (Brock University), *Implicit Bias in Big Data Analytics* (p. 80)
16:30 - 17:00	Shakhawat Hossain (University of Winnipeg), *Estimation strategy of multilevel model for ordinal longitudinal data* (p. 81)
17:00 - 17:30	Thuntida Ngamkham (University of Calgary), *Confidence intervals for a ratio of binomial proportions* (p. 82)
17:30 - 18:00	Salma Saad (University of Regina), *Asymptotic Analysis of Method of Moments Estimators of Parameters p and m for the Binomial Distribution* (p. 82)

Abstracts/Résumés

SYED EJAZ AHMED, Brock university
[Saturday June 8 / samedi 8 juin, 16:00 – ED 438, Education Building]
Implicit Bias in Big Data Analytics

Nowadays a large amount of data is available, and the need for novel statistical strategies to analyze such data sets is pressing. In this talk, my emphasis is on the development of statistical and computational strategies for a sparse regression model in the presence of mixed signals using machine and statistical learnings. The existing methods have often ignored contributions from weak signals and are subject unignorably bias. The amount of such information in a single predictor might be modest but helps in prediction accuracy in a meaningful way. The search for such signals, sometimes called networks or pathways, is for instance an important topic for those working on personalized medicine. We propose and implement a new "post selection shrinkage estimation/prediction strategy" that takes into account the joint impact of both strong and weak signals to improve the prediction accuracy, and opens pathways for further research in such scenarios.

NAEIMA ASHLEIK, University of Saskatchewan
[Saturday June 8 / samedi 8 juin, 10:00 – ED 438, Education Building]
Learning for Contingency Tables and Survival Data Using Imprecise Probabilities

Imprecise probability theory is a generalization of the classical probability theory. A comprehensive collection of the foundations of imprecise probabilities theory is provided by Walley (1991), where the name of "imprecise probability" was proposed. The upper and lower posterior expectations of log-odds ratio are estimated and the degree of imprecision is calculated in this work.

Survival data with right-censored observations are considered and represented in a sequence of 2×2 contingency tables, one at each observed death time. A re-parametrization of odds ratio is assumed based on the feature that non-central hypergeometric distribution. Two choices (normal and beta) of imprecise priors are given to the parameters. The findings show that small values of the degree of imprecision appear when the sample size is large and the number of censored observations is small. In contrast, the large values of the degree of imprecision are observed when sample size is small and the number of censored observations is large. In short, the degree of imprecision of the parameter of interest is reduced by having more information, more data, and less censored observations as the results of this work displayed, which is intuitively what one would expect.

YANGHO CHOI, Hanyang University
[Saturday June 8 / samedi 8 juin, 9:00 – ED 438, Education Building]
Macroscopic Modeling of Data Breach Risk with Spatial and Temporal Autocorrelation

Data breach risk caused by leak of private information has attracted considerable attention recently and insurers face rising necessity for predictive models to manage its risk. However, the job of modeling the risk is mainly discussed on a microscopic level in perspective of information technologies, partially due to statistically insufficient data, and it has been impeded by its unique characteristic of high correlation. This study, however, models data breach losses on a macroscopic scale in perspective of statistics, and we perform empirical analysis on their collective structure of mutual dependence in the dimension of space and time, based on the samples of data breaches in the United States during the recent decade. We discover that for data breach risk, an individual establishment or firm can be a candidate for a risk exposure unit, and we present an evidence of a medium-to-low spatial and temporal autocorrelation in the data breach events. We also find that time series of data breach events might have a covariate characterized by a market capital such as the S&P 500 index or the total private non-profit credit capitalization in the United States.

XUEMIAO HAO, University of Manitoba
[Saturday June 8 / samedi 8 juin, 8:30 – ED 438, Education Building]
Sharp Tail Estimate for Aggregate Critical Illness Claims in a Large Population

Health insurance has become an essential component in our society. In most advanced countries, health insurance is jointly provided by the government and private parties through universal insurance and voluntary insurance, respectively. A fundamental question is which treatments should be covered by universal basic insurance and which by private voluntary insurance. In health economics literature, discussions focus on maximizing a population's total welfare, which is defined as the expected utility. In our research, we study the effect of variation of aggregate health claims for the population. In particular, we estimate quantities related with the tail of the aggregate critical illness claims for the population. The idea is motivated by a newly proposed credit risk model for large portfolio.

SHAKHAWAT HOSSAIN, University of Winnipeg.ca
[Saturday June 8 / samedi 8 juin, 16:30 – ED 438, Education Building]
Estimation strategy of multilevel model for ordinal longitudinal data

This paper considers the shrinkage estimation of multilevel models that are appropriate for ordinal longitudinal data. These models can accommodate multiple random effects and, additionally, allow for a general form of model covariates that are related to the overall level of the responses and changes to the response over time. The likelihood inference for multilevel models is computationally burdensome due to intractable integrals. A maximum marginal likelihood (MML) method with Fisher's scoring procedure is therefore followed to estimate the random and fixed effects parameters. In real life data, researchers may have collected many covariates for the response. Some of these covariates may satisfy certain constraints which can be used to produce a restricted estimate from the unrestricted likelihood function. The unrestricted and restricted MMLs can then be combined optimally to form the pretest and shrinkage estimators. Asymptotic properties of these estimators including biases and risks will be discussed. A simulation study is conducted to assess the performance of the estimators with respect to the unrestricted MML estimator. Finally the relevance of the proposed estimators will be illustrated with a real data set.

ALEXANDER MELNIKOV, University of Alberta
[Saturday June 8 / samedi 8 juin, 8:00 – ED 438, Education Building]
On Option Pricing Methods in Modern Mathematical finance

Option pricing is one of the main research areas of modern Mathematical Finance. Hence, new valuable developments in this area remain well-motivated and highly desirable. The aim of the talk is to present some comprehensive issues that can be interesting also for a wider audience besides beside those experts who are directly working in Mathematical Finance. Moreover, the developments in option pricing can be considered as a reasonable source of new problems for further studies and research. In the talk a dual theory of option pricing will be developed by means of market completions as an alternative of the well-known option price characterization via martingale measures. Beside that we present another approach in option pricing which is based on comparison theorems for solutions of stochastic differential equations. It will be shown also how to use in option pricing the so-called partial/imperfect hedging technique that is concentrated around a statistical notion of "loss functions" and a financial notion of "risk measures". Finally, we will pay an attention to extensions of probability distributions of stock returns using orthogonal polynomials techniques. Going in this way we get a possibility to see what can happen beyond the Black-Scholes model.

SHANOJA NAIK, RNAO, Toronto
[Saturday June 8 / samedi 8 juin, 9:30 – ED 438, Education Building]
On Wishart Process and Sovereign Credit Risk Modelling

The Wishart Process has got attention in financial modeling due to its specific characteristics. In this talk, I will explain the Cox-Ingersoll-Ross (CIR) process and its matrix variate extension as Wishart process. Application of Wishart process in Sovereign Credit Risk model will be discussed. Additionally, the calibration of the model using the exponential matrix variate form will be explained with challenges and future directions to expand the theory of matrix variate Wishart model.

THUNTIDA NGAMKHAM, University of Calgary
[Saturday June 8 / samedi 8 juin, 17:00 – ED 438, Education Building]
Confidence intervals for a ratio of binomial proportions

A general problem of the interval estimation for a ratio of two proportions according to data from two independent samples is considered. Each sample may be obtained in the framework of direct or inverse binomial sampling. Asymptotic confidence intervals are constructed in accordance with different types of sampling schemes with an application, where it is possible, of unbiased estimations of success probabilities and also their logarithms. Since methods of constructing confidence intervals in the situations when values for the both samples are obtained for identical sample schemes are already developed and well known, the main purpose of this paper is the investigation of constructing confidence intervals in two cases that correspond to different sampling schemes. In this situation it is possible to plan the sample size for the second sample according to the number of successes in the first sample. This, as it is shown by the results of statistical modeling, provides the intervals with confidence level which closer to the nominal value.

My goal is to show that the normal approximations for estimates of the ratio of proportions and their logarithms are reliable for a construction of confidence intervals. The main criterion of our judgment is the closeness of the confidence coefficient to the nominal confidence level. It is proved theoretically and shown by statistically modeled data that the scheme of inverse binomial sampling with planning of the size in the second sample is preferred.

SALMA SAAD, University of Regina
[Saturday June 8 / samedi 8 juin, 17:30 – ED 438, Education Building]
Asymptotic Analysis of Method of Moments Estimators of Parameters p and m for the Binomial Distribution

An estimation of parameters of the Binomial distribution by a sample of fixed size n, when both parameters m and p are

unknown, has remained an important statistical problem for more than three quarters of a century. Known estimates of m usually underestimate the true value. We consider only the Method of Moments and its modifications for estimation of parameters m and p of the Binomial distribution. We also apply the delta method is for the proof of asymptotic normality of the joint distribution of the estimators of m and p by the Method of Moments. The main difficulty here is that the estimators do not have moments of all orders and hence the parameters of asymptotic normality do not have direct interpretations as characteristics of accuracy properties of these estimators. We are mostly interested in the bias and variance of the Method of Moments and its modifications estimators. To achieve these goals it is necessary to solve the following problems:

1. Derivation of estimates of parameters of Binomial distribution by the Method of Moments ;
2. Derivation of the parameters of asymptotic normality by the delta-method ;
3. Comparison of the derived asymptotic with the true probabilistic characteristics of the estimators by the method of statistical simulations

Indigenization and Reconciliation in Mathematics
Autochtonisation et réconciliation en mathématiques

Org: Douglas Farenick (Regina) and/et **Keith Taylor** (Dalhousie)

Schedule/Horaire **Room/Salle: ED 558, Education Building**

Saturday June 8	**samedi 8 juin**
8:00 - 8:30	Keith Taylor (Dalhousie University), *What can the CMS do about reconciliation ?* (p. 86)
8:30 - 9:00	Brian Forrest (University of Waterloo), *Expanding Mathematics Educational Opportunites for Indigenous Teachers* (p. 85)
9:00 - 9:30	Veselin Jungic (Simon Fraser University), *Changing Lives or Scratching the Surface: Five Years of the SFU Academic Summer Camp for Aboriginal Students* (p. 85)
9:30 - 10:00	Darja Barr (University of Manitoba), *The Impact of Working Together* (p. 84)
10:00 - 10:30	Melania Alvarez (University of British Columbia), *Engaging Indigenous communities through math outreach* (p. 84)
16:00 - 16:30	Edward Doolittle (First Nations University of Canada) (p. 84)
16:30 - 17:00	Kathy Nolan (University of Regina), *A Reframing of Mathematics through Critical and Culturally Responsive Pedagogies* (p. 85)
17:00 - 17:30	Gale Russell (University of Regina), *Truth before Reconciliation in Mathematics and Mathematics Education: An Invitation to Action* (p. 85)
17:30 - 18:00	Open Discussion

Sunday June 9	**dimanche 9 juin**
8:30 - 9:00	Arzu Sardarli (First Nations University of Canada), *Use of Indigenous elements in teaching introductory Statistics courses* (p. 86)
9:00 - 9:30	Doug Farenick (University of Regina), *Acts of Reconciliation – A Scientist's Experience* (p. 85)
9:30 - 10:00	Open Discussion
10:00 - 10:30	Open Discussion

Abstracts/Résumés

MELANIA ALVAREZ, UBC Department of Mathematics/PIMS
[Saturday June 8 / samedi 8 juin, 10:00 – ED 558, Education Building]
Engaging Indigenous communities through math outreach

I will talk about my experiences working with several Indigenous communities and will describe outreach programs specifically designed and implemented to support Indigenous students' mathematics education.

DARJA BARR, University of Manitoba
[Saturday June 8 / samedi 8 juin, 9:30 – ED 558, Education Building]
The Impact of Working Together

This talk will highlight some of the programs run at the University of Manitoba (Math Mania, Path2Math, The PIMS Summer Academy) that focus on supporting Indigenous students' post-secondary mathematics journey. Data on these students' success in mathematics (and other) courses and the impact on various programs throughput the university will be shared, as well as some ideas on how to get started for those who would like to begin doing Indigenous outreach.

EDWARD DOOLITTLE, First Nations University of Canada
[Saturday June 8 / samedi 8 juin, 16:00 – ED 558, Education Building]

DOUG FARENICK, University of Regina
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 558, Education Building]
Acts of Reconciliation – A Scientist's Experience

In this lecture I will discuss some concrete measures and personal experiences, as a mathematician and a science-faculty dean, in meaningfully addressing the TRC's Calls to Action.

BRIAN FORREST, University of Waterloo
[Saturday June 8 / samedi 8 juin, 8:30 – ED 558, Education Building]
Expanding Mathematics Educational Opportunites for Indigenous Teachers

In 2010 the Faculty of Mathematics launched the Master of Mathematics for Teachers (MMT) program. This is a fully online professional Master degree targeted at in-service teachers. In addition to providing a deeper understanding of mathematical foundations relating to core secondary school curricula, MMT students are also exposed to areas of applications of modern mathematics. The program currently has an enrolment of more than 200 teachers around the world.

As part its commitment to reconciliation the Faculty of Mathematics will offer up to 15 full scholarships for the MMT to indigenous teachers wanting to expand their subject matter knowledge base. Our hope is that through this program we can begin to help build a national cohort of leaders in mathematics education.

In this talk I will give a brief outline of the program and our vision with respect to its role in Indigenization and Reconciliation in Mathematics.

VESELIN JUNGIC, Simon Fraser University
[Saturday June 8 / samedi 8 juin, 9:00 – ED 558, Education Building]
Changing Lives or Scratching the Surface: Five Years of the SFU Academic Summer Camp for Aboriginal Students

In this presentation I will share with the CMS community my experience gained through five years, 2014 – 2018, of running the Simon Fraser University Academic Summer Camp for Aboriginal High School Students. I will talk about the goals and objectives of this initiative and its history. Details about the camp components, including staffing, budgeting, recruiting, and scheduling will be provided. In addition, I will highlight testimonials by students, parents, and teachers.

KATHY NOLAN, University of Regina
[Saturday June 8 / samedi 8 juin, 16:30 – ED 558, Education Building]
A Reframing of Mathematics through Critical and Culturally Responsive Pedagogies

In responding to the TRC's call to develop culturally appropriate curricula and to educate new teachers in these curricula, the research described in this presentation asks the question of how school mathematics and mathematics teacher education might be reframed through critical and culturally responsive pedagogies. In doing so, it seeks to challenge that which (re)produces injustices with regard to participation in mathematics. The research begins from the premise that classroom pedagogies impact student learning in significant ways, thus making teachers' pedagogical choices a social justice issue. Research suggests, however, that, with increased forms of educational accountability, pedagogies more often seek to repress and regulate, rather than challenge and disrupt injustices. Drawing on a three-dimensional approach to social justice and the concept of participatory parity, this presentation introduces a critique of dominant school mathematics paradigms through a new (disruptive) form of culturally responsive pedagogy (CRdP). In essence, the research claims that reframing school mathematics through CRdP is a first step toward decolonizing it— toward noticeably disrupting the relations and functions of school mathematics.

GALE RUSSELL, University of Regina
[Saturday June 8 / samedi 8 juin, 17:00 – ED 558, Education Building]
Truth before Reconciliation in Mathematics and Mathematics Education: An Invitation to Action

This session considers where I am in my journey to understand and implement decolonizing practices in thinking, doing, and teaching mathematics. Through my mathematics and mathematics education academic lenses, the Truth and Reconciliation Commission of Canada: Calls to Action (2015) often seems to belong to someone else, that it is their problem, not mine – after all, mathematics, being abstract and rational, should be immune to colonialism, hegemony, and oppression. One might even ask, other than dropout rates, what else is there to reconcile from a mathematics or school mathematics perspective? Are treaty-based activities, such as the calculation and comparison of reserve and non-reserve population densities, leading to meaningful reconciliation or are they potentially destructive acts of tokenism? Land-based learning is often promoted and supported by Indigenous scholars, as well as embraced by teachers, but does only pedagogy need to be questioned and changed in the seeking of mathematics-based reconciliation? These questions have ruminated in, even dominated, my thinking for some time, until two encounters, a comment from a colleague and a title of an opinion piece in Maclean's, challenged me to scrutinize my truths before attempting reconciliation. Both encounters asked, that as Canadians, we examine what we hold to be true from a perspective beyond ourselves, and challenge the power and privilege that those truths are given. Accepting this challenge, I now ask "what mathematical and mathematics education truth(s) need to be challenged and disrupted so that reconciliation can be enacted?" This is the question grounding this session.

ARZU SARDARLI, First Nations University of Canada
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 558, Education Building]
Use of Indigenous elements in teaching introductory Statistics courses

Introductory level Statistics courses, "Elementary Statistics for Applications" (STAT 100) and "Introductory Statistics" (STAT 160) have been taught within a large number of programs offered by University of Regina and First Nations University of Canada. These courses cover the introductory topics of Statistics, such as The Empirical Rule, basics of probability, correlation and simple linear regression. Within the presented project, we have developed Indigenous knowledge-based examples for the following topics of Statistics, (i) Empirical Research, (ii) Correlation and Linear Regression Analysis, (iii) Probability. The project has been carried out in three phases: Phase I. Work with Elders. Phase II. Data analysis Phase III. Developing examples Within the Phase I, we interviewed two Elders. They told us about the Indigenous way of observation of environmental processes and making forecasts. The Knowledge Keepers were interviewed about the Indigenous Games. They provided materials about the Indigenous Games and demonstrated some elements of games. Within the Phase II, we analyzed the interviews and developed the list of examples, which could be used in Statistics classes. Within the Phase III, we developed examples on empirical studies, correlation and probability containing Indigenous elements. Two undergraduate students were trained and participated in this project. The project was supported by University of Regina within the President's Teaching and Learning Scholars grant.

KEITH TAYLOR, Dalhousie University
[Saturday June 8 / samedi 8 juin, 8:00 – ED 558, Education Building]
What can the CMS do about reconciliation?

I will provide some of my own thoughts, based on experiences at two institutions, on possible ways in which the CMS can play a role in the reconciliation process in Canada.

Mathematical Techniques for Analysing Quantum Structures and Materials
Techniques mathématiques pour l'analyse de structures et de matériaux quantiques

Org: Steven Rayan and/et **Artur Sowa** (Saskatchewan)

Schedule/Horaire **Room/Salle: ED 106.2, Education building**

Saturday June 8	**samedi 8 juin**
8:00 - 8:30	Alex Zagoskin (Loughborough University), *Towards the qualitative theory of large quantum coherent structures* (p. 89)
8:30 - 9:00	Cihan Okay (University of British Columbia), *Topology of quantum contextuality* (p. 88)
9:00 - 9:30	Joseph Maciejko (University of Alberta), *Strongly interacting topological phases of matter* (p. 87)
9:30 - 10:00	Robert Green (University of Saskatchewan), *Numerical Many Body Models for Synchrotron Spectroscopy of Quantum Materials* (p. 87)
10:00 - 10:30	Ray Spiteri (University of Saskatchewan), *Quantum control for high-fidelity multi-qubit gates* (p. 89)
16:00 - 16:30	Neil J. Ross (Dalhousie University), *Number-Theoretic Methods in Quantum Compiling* (p. 88)
16:30 - 17:00	Gilad Gour (University of Calgary), *Mathematical structures and features of quantum resource theories* (p. 87)
17:00 - 17:30	Artur Sowa (University of Saskatchewan), *Qubits, wavelets, fractals, bands* (p. 88)

Abstracts/Résumés

GILAD GOUR, University of Calgary
[Saturday June 8 / samedi 8 juin, 16:30 – ED 106.2, Education building]
Mathematical structures and features of quantum resource theories

A common theme in Chemistry, Thermodynamics, and Information Theory is how one type of resource – be it chemicals, heat baths, or communication channels – can be used to produce another. These processes of conversion and their applications are studied under the general heading of "resource theories". While resource theories use a wide range of sophisticated and apparently unrelated mathematical techniques, there is also an emerging general mathematical framework which seems to underpin all of them. In this talk, I will give an overview on the mathematical techniques and structure of quantum resource theories, with examples from resource theories of entanglement, asymmetry, quantum coherence, and quantum thermodynamics. I will end with several open problems.

ROBERT GREEN, University of Saskatchewan
[Saturday June 8 / samedi 8 juin, 9:30 – ED 106.2, Education building]
Numerical Many Body Models for Synchrotron Spectroscopy of Quantum Materials

Significant research efforts are currently directed at the field of quantum materials, as many of these materials exhibit remarkable properties which may be suitable for next-generation device technologies. Synchrotron facilities, like the Canadian Light Source, are often utilized to study the properties of quantum materials via various forms of x-ray spectroscopy. However, interpreting the obtained spectroscopy data is often a significant challenge, as the connection from the fundamental quantum properties to the emergent spectral functions can be highly nontrivial. To this end, we design many-body quantum models which aim to capture the key properties of the materials while also having computable spectral functions which can be compared to experiment. In this talk, I'll introduce the models used and discuss strategic basis transformations and the numerical methods we employ. I will include recent results from studies of several highly interesting materials, including those exhibiting two-dimensional electron liquids and metal-insulator transitions. The concerted approach of synchrotron experiments and quantum many body models promises to be a key component of future work toward widespread quantum devices and other technologies utilizing quantum materials.

JOSEPH MACIEJKO, University of Alberta
[Saturday June 8 / samedi 8 juin, 9:00 – ED 106.2, Education building]
Strongly interacting topological phases of matter

The discovery of topological band insulators in the mid-2000s, recognized in part by the 2016 Nobel Prize in Physics, has revolutionized condensed matter physics. In these materials, global properties of the quantum wavefunction are characterized by nontrivial topological invariants which distinguish homotopy classes of maps from momentum space to spaces of single-particle quantum Hamiltonians. This description however ignores interparticle interactions such as the electrostatic repulsion between electrons, which is nonetheless present in real materials. While weak interactions are not expected to significantly affect the topological classification of quantum materials, strong interactions have the potential to lead to novel topological phases beyond topological band insulators. In this talk I will discuss two examples of strongly interacting topological phases in 2+1 dimensions: a topologically nontrivial antiferromagnetic phase, and a symmetry-protected topological phase of fermions with no free-fermion counterpart.

CIHAN OKAY, University of British Columbia
[Saturday June 8 / samedi 8 juin, 8:30 – ED 106.2, Education building]
Topology of quantum contextuality

Contextuality is a special feature of quantum systems. Originally it is expressed in the form of no-go theorems of Kochen-Specker, and violation of Bell inequalities. This fundamental property of quantum systems, which turns out to be responsible for speed-up in quantum computers, has been under intense investigation by the quantum computing community. In this work, joint with Daniel Sheinbaum, I will describe a topological approach to contextuality that uses classifying spaces, fundamental objects in algebraic topology. Physically relevant quantities are interpreted as classes in the cohomology and the twisted K-theory of the space.

NEIL J. ROSS, Dalhousie University
[Saturday June 8 / samedi 8 juin, 16:00 – ED 106.2, Education building]
Number-Theoretic Methods in Quantum Compiling

Quantum compiling is concerned with the representation of general unitary operations by circuits built from some chosen set of quantum gates. The circuit representation of a unitary U is exact if the product of the gates composing the circuit is equal to U. The representation is approximate up to $\epsilon > 0$ if this product is at distance ϵ of U in the operator norm. In the last few years, the field of quantum compiling was rejuvenated by the introduction of methods from algebraic number theory. In particular, such number-theoretic methods were used to provide an optimal solution to the problem of approximating single-qubit unitaries using Clifford+T circuits. In this talk, I will present an efficient algorithm for the optimal approximation of single-qubit unitaries using Clifford+T circuits and discuss open problems in the field of quantum compiling.

ARTUR SOWA, University of Saskatchewan
[Saturday June 8 / samedi 8 juin, 17:00 – ED 106.2, Education building]
Qubits, wavelets, fractals, bands

The traditional focus of Quantum Information Theory is structures comprising a finite number of qubits. However, it is also rewarding to study transfinite objects, such as infinite arrays of qubits. Most research on the physics of such structures relies upon one approximate technique or another. At the same time, it is desirable to collect examples of exactly solvable models, which rigorously capture how the functional properties of arrays (e.g. how they interact with modes of light) depend on their quantum state.

In the first part of my talk, I will discuss such a model (joint work with A. Zagoskin, ref.1). Our analysis directly involves multiresolution analysis, specifically the Haar basis. While applications of the Fourier transform in studies of spin systems are

already classical, a quantum application of the Haar transform is, to our best knowledge, unprecedented. Also intriguing is an unexpected emergence of fractals in this very context. In the time remaining I will discuss some other connections between classical harmonic analysis and modern quantum theory, ref.2, and implications. In particular, I will demonstrate that band gaps can arise in a qubit-array Hamiltonian via a mechanism that does not involve a periodic potential.

References:

1. A. Sowa and A. Zagoskin, An exactly solvable quantum-metamaterial type model, Preprint, available via https://arxiv.org/abs/1902.05324

2. A. Sowa, Encoding spatial data into quantum observables, Preprint, available via http://arxiv.org/abs/1609.01712

RAY SPITERI, University of Saskatchewan

[Saturday June 8 / samedi 8 juin, 10:00 – ED 106.2, Education building]

Quantum control for high-fidelity multi-qubit gates

Quantum control for error correction is critical for the practical use of quantum computers. We address quantum optimal control for single-shot multi-qubit gates by framing it as a feasibility problem for the Hamiltonian model that is then solved with standard global optimization software. Our approach yields faster high-fidelity (>99.99%) single-shot three-qubit-gate control than obtained previously, and it has also enabled us to solve the quantum-control problem for a fast high-fidelity four-qubit gate.

ALEX ZAGOSKIN, Loughborough University

[Saturday June 8 / samedi 8 juin, 8:00 – ED 106.2, Education building]

Towards the qualitative theory of large quantum coherent structures

The impossibility of an efficient simulation of large enough quantum coherent systems by classical means, independently recognized by Feynman and Manin in early 1980s, launched the development of quantum computing and, more generally, the Second Quantum Revolution. It also remains the major obstacle for the development of quantum technologies 2.0, since the multiqubit structures which are being designed and fabricated at the moment are already too big to allow an efficient classical simulation, characterization and optimization, but too small and imperfect to serve as quantum computers capable of performing such a task. The situation is somewhat reminiscent of the aircraft development in the 20th century prior to the creation of computers powerful enough to solve the equations of hydrodynamics in realistic cases. I will use the analogy to discuss a possible strategy for circumventing the roadblock, which is based on the conjecture that there exist qualitatively different regimes of operation of large quantum coherent structures governed by a set of universal dimensionless parameters.

Matrix Theory and its Applications
La théorie des matrices et ses applications

Org: Shaun Fallat (Regina) and/et **Shahla Naserasr** (Brandon)

Schedule/Horaire **Room/Salle: ED 106.2, Education building**

Sunday June 9 — dimanche 9 juin

8:00 - 8:30	Murray R. Bremner (University of Saskatchewan), *Computing a short basis for the nullspace of a modular matrix* (p. 91)
8:30 - 9:00	Pietro Paparella (University of Washington Bothell), *Matricial Proofs of Some Classical Results about Critical Point Location* (p. 93)
9:00 - 9:30	Keivan Monfared (University of Victoria), *An Analog of Matrix Tree Theorem for Signless Laplacians* (p. 92)
9:30 - 10:00	Colin Garnett (Black Hills State University), *Non-sparse Companion Matrices* (p. 91)
10:00 - 10:30	Xiaohong Zhang (University of Manitoba), *Perfect state transfer on weighted paths* (p. 94)
16:00 - 16:30	Lon Mitchell (University of South Florida St. Petersburg), *Optimal Colin de Verdière Matrices for Complete Multipartite Graphs* (p. 92)
16:30 - 17:00	Sivaram K. Narayan (Central Michigan University), *Graph Complement Conjecture for Classes of Shadow Graphs* (p. 92)
17:00 - 17:30	Harmony Zhan (Université de Montréal), *Quantum state transfer in the algebra of the Johnson scheme* (p. 94)
17:30 - 18:00	Kerry Tarrant (University of Iowa), *The Good, The Bad, and The Ugly: Minimally Cop Win and Maximally Robber Win Graphs* (p. 93)

Monday June 10 — lundi 10 juin

8:00 - 8:30	Robert Bailey (Memorial University of Newfoundland - Grenfell Campus), *Orthogonal matrices with zero diagonal* (p. 90)
8:30 - 9:00	Chun-Hua Guo (University of Regina), *Explicit convergence region of Newton's method for the matrix pth root* (p. 92)
9:00 - 9:30	Rajesh Pereira (University of Guelph), *The real joint numerical range and the real higher rank numerical range* (p. 93)
9:30 - 10:00	Samuel Cole (University of Manitoba), *Spectral recovery of stochastic block models on graphs and hypergraphs* (p. 91)
10:00 - 10:30	Mahsa Nasrollahi Shirazi (University of Regina), *Erdős-Ko-Rado theorem for t-intersecting families of perfect matchings* (p. 93)
14:45 - 15:15	Gurmail Singh (University of Regina), *Encoding the vertices of a hyper cube* (p. 93)
15:15 - 15:45	Eugene Bilokopytov (University of Manitoba), *From Principal Minor Assignment problem for matrices to characterization of the isometries on Hilbert Spaces* (p. 91)
15:45 - 16:15	Robert Craigen (University of Manitoba) (p. 91)
16:15 - 16:45	Nathan Krislock (Northern Illinois University) (p. 92)

Abstracts/Résumés

ROBERT BAILEY, Grenfell Campus, Memorial University
[Monday June 10 / lundi 10 juin, 8:00 – ED 106.2, Education building]
Orthogonal matrices with zero diagonal

Motivated by work of the Discrete Mathematics Research Group at the University of Regina on the question of determining the minimum number of distinct eigenvalues of graphs, we consider real orthogonal $n \times n$ matrices where the diagonal entries are all zero and the off-diagonal entries are all non-zero. We show that such matrices exist if and only if $n \notin \{1, 3\}$, and that symmetric examples exist if and only if n is even and $n \neq 4$. We also give a complete solution to the existence of orthogonal matrices with partially-zero diagonal.

This is joint work with Robert Craigen (University of Manitoba).

EUGENE BILOKOPYTOV, University of Manitoba
[Monday June 10 / lundi 10 juin, 15:15 – ED 106.2, Education building]
From Principal Minor Assignment problem for matrices to characterization of the isometries on Hilbert Spaces

We generalize a theorem by Engel and Schneider on matrices diagonally similar to a symmetric matrix to the case of infinite matrices. Geometric interpretation of this result allows us to obtain a new characterization of isometries of Hilbert spaces using volumes of parallelepipeds.

MURRAY R. BREMNER, University of Saskatchewan
[Sunday June 9 / dimanche 9 juin, 8:00 – ED 106.2, Education building]
Computing a short basis for the nullspace of a modular matrix

Given a vector X over the field with p elements, define its length to be the sum of the squares of the symmetric representatives of its components. Define the length of a finite set of vectors to be the base 10 logarithm of the product of the lengths of the vectors. I will present an evolutionary algorithm which attempts to determine the shortest basis of the nullspace of a modular matrix A. To begin, compute M, the matrix in RREF whose k rows form a basis for the null space of A. One generation consists of six steps. Step 1 (mutation): Randomly permute the columns of A to obtain B. Step 2: Compute C, the matrix in RREF whose k rows form a basis for the null space of B. Step 3: Unpermute the columns of C to obtain N. Step 4 (recombination): Stack M and N and sort the $2k$ rows by increasing length to obtain D. Step 5 (selection): Determine the lexicographically minimal subset of the rows of D which forms a basis of the nullspace of A. Step 6 (reproduction): Replace M by the matrix consisting of these k rows of D. I will present experimental results showing the behavior of this algorithm over thousands of generations.

SAMUEL COLE, University of Manitoba
[Monday June 10 / lundi 10 juin, 9:30 – ED 106.2, Education building]
Spectral recovery of stochastic block models on graphs and hypergraphs

The stochastic block model is a random graph model in which n fixed vertices are partitioned into k clusters, and edges are added independently between each pair of verices with probability p if they are in the same cluster and q if they are in different clusters, where $0 \leq q < p \leq 1$. Given only a random graph from this distribution, can one recover the partition of the vertices w.h.p ? We will discuss a simple algorithm that accomplishes this using spectral properties of the random graph's adjacency matrix, and a generalization to a hypergraph setting. While there have been many results for the sparse case, in which $p, q = o(1)$ and the number of clusters k is fixed, we will focus on the dense case, in which p, q are fixed and k grows with n.

ROBERT CRAIGEN, University of Manitoba
[Monday June 10 / lundi 10 juin, 15:45 – ED 106.2, Education building]

COLIN GARNETT, Black Hills State University
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 106.2, Education building]
Non-sparse Companion Matrices

Given a polynomial $p(z)$, a companion matrix can be thought of as a simple template for placing the coefficients of $p(z)$ in a matrix such that the characteristic polynomial of this matrix is $p(z)$. The Frobenius companion matrix and the more recently discovered Fiedler companion matrices are examples. Both the Frobenius and Fiedler companion matrices have the maximum possible number of zero entries, and in that sense are sparse. In this presentation we will discuss the Frobenius and Fiedler companion matrices and explore the question of finding non-sparse companion matrices with more nonzero entries. We will also give some bounds on the minimum number of zeros that must appear in a companion matrix.

CHUN-HUA GUO, University of Regina
[Monday June 10 / lundi 10 juin, 8:30 – ED 106.2, Education building]
Explicit convergence region of Newton's method for the matrix pth root

For a square matrix with all eigenvalues in a suitable region in the complex plane, its principal pth root exists and can be approximated by the quadratically convergent sequence generated by Newton's method (starting from the identity matrix). Such a region is called a convergence region for Newton's method. In this talk, we present an explicit convergence region that drastically expands all existing ones.

NATHAN KRISLOCK, Northern Illinois University
[Monday June 10 / lundi 10 juin, 16:15 – ED 106.2, Education building]

LON MITCHELL, University of South Florida St. Petersburg
[Sunday June 9 / dimanche 9 juin, 16:00 – ED 106.2, Education building]
Optimal Colin de Verdière Matrices for Complete Multipartite Graphs

We find matrices that are optimal for the Colin de Verdière invariant μ in the case of complete multipartite graphs and show how, for any graph G, $\mu(G)$ can be bounded using μ of a related complete multipartite graph.

KEIVAN MONFARED, University of Victoria
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 106.2, Education building]
An Analog of Matrix Tree Theorem for Signless Laplacians

The number of spanning trees in a graph G is given by Matrix Tree Theorem in terms of principal minors of Laplacian matrix of G. We show a similar combinatorial interpretation for principal minors of signless Laplacian Q. We also prove that $\frac{\det(Q)}{4}$ is greater than or equal to the number of odd cycles in G, where the equality holds if and only if G is a bipartite graph or an odd-unicyclic graph.

SIVARAM K. NARAYAN, Central Michigan University
[Sunday June 9 / dimanche 9 juin, 16:30 – ED 106.2, Education building]
Graph Complement Conjecture for Classes of Shadow Graphs

The real minimum semidefinite rank of a graph G, denoted $mr_+^{\mathbb{R}}(G)$, is the minimum rank among all real symmetric positive semidefinite matrices whose zero/nonzero pattern corresponds to the graph G. The graph complement conjecture, denoted GCC_+, is the inequality $mr_+^{\mathbb{R}}(G) + mr_+^{\mathbb{R}}(\overline{G}) \leq |G| + 2$. Given a graph G, the shadow graph $S(G)$ is obtained from G by

adding for each vertex u of G, a new vertex v, called the shadow vertex of u, and joining v to the neighbors of u in G. Also, a variant of $S(G)$, denoted Shad(G), will be given. It is shown that $S(G)$ and Shad(G) satisfies GCC_+ when G is a tree or a unicyclic graph or a complete graph.

PIETRO PAPARELLA, University of Washington Bothell
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 106.2, Education building]
Matricial Proofs of Some Classical Results about Critical Point Location

The Gauss–Lucas and Bôcher–Grace–Marden theorems are classical results in the geometry of polynomials. Proofs of the these results are available in the literature, but the approaches are seemingly different. In this work, we show that these theorems can be proven in a unified theoretical framework utilizing matrix analysis (in particular, using the field of values and the differentiator of a matrix). In addition, we provide a useful variant of a well-known result due to Siebeck.

RAJESH PEREIRA, University of Guelph
[Monday June 10 / lundi 10 juin, 9:00 – ED 106.2, Education building]
The real joint numerical range and the real higher rank numerical range

We study properties of the real analogs of the joint numerical range and the higher rank numerical ranges and discuss both similarities and differences with the usual complex case. Applications to cross sections of ellipsoids and open questions will also be discussed. This is joint work with Matthew Kazakov and David Kribs.

MAHSA NASROLLAHI SHIRAZI, University of Regina
[Monday June 10 / lundi 10 juin, 10:00 – ED 106.2, Education building]
Erdős-Ko-Rado theorem for t-intersecting families of perfect matchings

An interesting way to answer some questions arising in design theory is to use both graph theory and matrix theory, which is the approach I employ to find extensions of the famous Erdős-Ko-Rado theorem to t-intersecting families of objects. Such a result would give the size and structure of the largest set of the t-intersecting objects. In this approach we define a graph so that finding the largest set of t-intersecting perfect matchings is equivalent to finding the largest coclique of this graph. Bounds on the size of max cocliques can be found if we can determine the least eigenvalue of the adjacency matrix of our graph. In this talk I will present the progress I have made in determining these eigenvalues.

GURMAIL SINGH, University of Regina
[Monday June 10 / lundi 10 juin, 14:45 – ED 106.2, Education building]
Encoding the vertices of a hyper cube

A concept class $\mathcal{C}$ over a finite domain $\mathcal{X}$ is a subset of the powerset of $\mathcal{X}$. The elements of $\mathcal{C}$ are called concepts. A concept class $\mathcal{C}$ over a domain $\mathcal{X}$ is said to shatter a set $A \subseteq \mathcal{X}$ if $\forall\ a \subseteq A, \exists\ c \in \mathcal{C}$ such that $a = A \cap c$. The VC-dimension of $\mathcal{C}$, denoted as $VCD(\mathcal{C})$, is defined as the cardinality of the largest subset of $\mathcal{X}$ that $\mathcal{C}$ shatters. A concept class $\mathcal{C}$ over a domain $\mathcal{X}$ with $VCD(\mathcal{C}) = d$ is called a maximum concept class if it attains equality in the well-known upper bound $|\mathcal{C}| \leq \sum_{i=0}^{d} \binom{|\mathcal{X}|}{i}$ due to Sauer, Shelah, and Perles. The subset teaching dimension of a concept class $\mathcal{C}$ measures the difficulty to encode the concepts of $\mathcal{C}$ in terms of their elements in a certain way. In this talk, we prove that every maximum concept class $\mathcal{C}$ with $VCD(\mathcal{C}) = 2$ has subset teaching dimension equal to 2. This result is extended to higher VC-dimension for a particular kind of maximum concept class known as Simple Linear Arrangement. This is joint work with Sandra Zilles.

KERRY TARRANT, University of Iowa
[Sunday June 9 / dimanche 9 juin, 17:30 – ED 106.2, Education building]
The Good, The Bad, and The Ugly: Minimally Cop Win and Maximally Robber Win Graphs

Cops and robbers is a two-player pursuit and evade game played on discrete graphs. This presentation will investigate the addition and removal of any one edge to change the outcome of the game. In one instance, the removal of any edge will change a cop win game into a robber win game (called minimally cop win). In another instance, the addition of any edge will turn a robber win game into a cop win game (called maximally robber win). Characterizing the former is quite simple. However, characterizing maximally robber win graphs presents many challenges. Our efforts were greatly aided by studying such graphs in the complement, with unexpected results.

HARMONY ZHAN, Centre de Recherches Mathématiques, Universite de Montreal
[Sunday June 9 / dimanche 9 juin, 17:00 – ED 106.2, Education building]
Quantum state transfer in the algebra of the Johnson scheme

A real matrix A in the adjacency algebra of a distance regular graph represents a spin network with non-nearest neighbour couplings. We are interested in a quantum phenomenon called perfect state transfer, that is, $|\exp(itA)_{u,v}| = 1$ for some vertices u, v and time t. It is known that the only generalized Johnson graphs that admit perfect state transfer are disjoint unions of edges. In this talk, we characterize all real matrices in the algebra of the Johnson scheme that admit perfect state transfer. This is joint work with Luc Vinet.

XIAOHONG ZHANG, University of Manitoba
[Sunday June 9 / dimanche 9 juin, 10:00 – ED 106.2, Education building]
Perfect state transfer on weighted paths

Let X be a weighted graph, and denote its Laplacian matrix by $L(X)$. Let $U(t) = e^{itL(X)}$. Then $U(t)$ is a complex symmetric unitary matrix. We say that X admits Laplacian perfect state transfer (Laplacian PST) between vertices j and k at time $t = t_0$ if $|(U(t_0))_{j,k}|^2$, the fidelity of state transfer between vertices j and k at time t_0, is 1. It is known that the unweighted path on n vertices admits Laplacian PST only for $n = 2$. In this talk I will show that no weighted path on $n \geq 3$ vertices admits Laplacian PST between its end vertices.

Probabilistic Methods in Geometric Functional Analysis and Convexity
Méthodes probabilistes en analyse et en convexité fonctionnelle géométrique

Org: Grigoris Paouris (Texas A&M), **Alina Stancu** (Concordia), **Beatrice-Helen Vritsiou** (Alberta) and/et **Vlad Yaskin** (Edmonton)

Schedule/Horaire **Room/Salle: ED 193, Education Building**

Saturday June 8 — samedi 8 juin

8:00 - 8:30	Elisabeth Werner (Case Western Reserve University), *Entropy inequalities for log concave functions* (p. 98)
8:30 - 9:00	Galyna Livshyts (Georgia Institute of Technology), *Smallest singular value of inhomogeneous random square matrices via double counting and random rounding* (p. 96)
9:00 - 9:30	Konstantin Tikhomirov (Georgia Institute of Technology), *Small ball probability for the condition number of random matrices* (p. 98)
9:30 - 10:00	Arnaud Marsiglietti (University of Florida), *Hyperplane conjecture and central limit theorem* (p. 97)
10:00 - 10:30	Piotr Nayar (University of Warsaw), *The log-concave moment problem* (p. 97)
16:00 - 16:30	Mokshay Madiman (University of Delaware), *Sharp moment-entropy inequalities for log-concave distributions* (p. 96)
16:30 - 17:00	Yair Shenfeld (Princeton University), *Extremals in Minkowski's quadratic inequality* (p. 97)
17:00 - 17:30	Kateryna Tatarko (University of Alberta), *On the solution to the reverse isoperimetric problem* (p. 98)
17:30 - 18:00	Susanna Dann (Universidad de los Andes), *Affine isoperimetric inequalities on flag manifolds.* (p. 95)

Sunday June 9 — dimanche 9 juin

8:00 - 8:30	Jie Xiao (Memorial University of Newfoundland), *Gaussian BV Capacity* (p. 98)
8:30 - 9:00	Deping Ye (Memorial University of Newfoundland), *The polar Orlicz-Minkowski problem* (p. 99)
9:00 - 9:30	Qingzhong Huang (Memorial University of Newfoundland), *The L_p John ellipsoid for Sobolev functions* (p. 96)
9:30 - 10:00	Sudan Xing (Memorial University of Newfoundland), *The general dual-polar Orlicz-Minkowski problem* (p. 98)
10:00 - 10:30	Victor Glasgo (Case Western Reserve University), *Gravitational illumination bodies (Preliminary report)* (p. 95)
16:00 - 16:30	Alexander Litvak (University of Alberta), *On the volume ratio between convex bodies* (p. 96)
16:30 - 17:00	Paata Ivanisvili (University of California, Irvine), *Weissler's conjecture on the Hamming cube* (p. 96)
17:00 - 17:30	Sergii Myroshnychenko (University of Alberta) (p. 97)
17:30 - 18:00	Boaz Slomka (Weizmann Institute of Science), *On Hadwiger's covering problem* (p. 97)

Abstracts/Résumés

SUSANNA DANN, Universidad de los Andes

[Saturday June 8 / samedi 8 juin, 17:30 – ED 193, Education Building]

Affine isoperimetric inequalities on flag manifolds.

We introduce r-flag affine quermassintegrals and their dual versions. These quantities generalize the affine and dual affine quermassintegrals as averages on flag manifolds (where the Grassmannian can be considered as a special case). We establish affine and linear invariance properties and sharp inequalities extending all known results to this new setting. We also discuss inequalities for functional forms of these new quantities. This is joint work with Grigoris Paouris and Peter Pivovarov.

VICTOR GLASGO, Case Western Reserve University
[Sunday June 9 / dimanche 9 juin, 10:00 – ED 193, Education Building]
Gravitational illumination bodies (Preliminary report)

We introduce a new class of convex bodies, the gravitational illumination bodies. We show some of their properties and explore their relation to affine surface area of convex bodies.

Based on joint work with Andreas Kreuml and Elisabeth M. Werner.

QINGZHONG HUANG, Department of Mathematics and Statistics, Memorial University of Newfoundland
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 193, Education Building]
The L_p John ellipsoid for Sobolev functions

The L_p John ellipsoid for convex bodies was introduced by Lutwak, Yang and Zhang, which contains the John ellipsoid ($p = \infty$), the LYZ ellipsoid ($p = 2$), and the Petty ellipsoid ($p = 1$) as special cases. In this talk, we will discuss the L_p John ellipsoids for Sobolev functions and for log-concave functions. Moreover, a functional Blaschke-Santal*ó* inequality for L_2 John ellipsoid will be presented. This talk is based on the joint work with Ai-jun Li and Deping Ye.

PAATA IVANISVILI, University of California, Irvine
[Sunday June 9 / dimanche 9 juin, 16:30 – ED 193, Education Building]
Weissler's conjecture on the Hamming cube

Let $1 \leq p \leq q < \infty$, and $z \in \mathbb{C}$. We show that the Hermite operator $\exp(z\Delta)$ is bounded from $L_p(\{-1,1\}^n)$ to $L_q(\{-1,1\}^n)$ with norm independent of n if and only if $|p - 2 - e^{2z}(q-2)| \leq p - |e^{2z}|q$. This solves an old open problem in complex hypercontractivity theory on the Hamming. Certain cases of the triples (p, q, z) were characterized by Bonami (1970) ; Beckner (1975) ; and Weissler (1979). Several applications will be presented. Work in progress with Fedja Nazarov.

ALEXANDER LITVAK, University of Alberta
[Sunday June 9 / dimanche 9 juin, 16:00 – ED 193, Education Building]
On the volume ratio between convex bodies

In this talk I'll survey known results on volume ratio between convex bodies. Cubical and simplex ratios will be discussed as well as the general case and Banach-Mazur type distances.

GALYNA LIVSHYTS, Georgia Institute of Technology
[Saturday June 8 / samedi 8 juin, 8:30 – ED 193, Education Building]
Smallest singular value of inhomogeneous random square matrices via double counting and random rounding

We show that the small ball behavior of random square matrices is optimal under minimal assumptions. An important step in the proof is showing that the "random normal" — random vector orthogonal to a collection of (n-1) random vectors — has very good behavior, and its projection onto another random vector is not concentrated on any short interval. Previously, such result was known only under additional i.i.d. assumption, and the key technique leading to it was developed by Rudelson and Vershynin. Their approach, however, does not work without the i.i.d. requirement.

In order to show that the random normal is "good" we prove that the set of "bad" vectors is small: we construct a net on it of small cardinality. This net is a subset of a net on the sphere with simple lattice structure, and its construction relies on the method of random rounding. To show that the cardinality of this subset is small, we show that most of the vectors on a lattice are "good", and therefore cannot be close to "bad" vectors. This key step is done via harmonic-analytic techniques from discrepancy theory. This is a joint work with K. Tikhomirov and R. Vershynin.

MOKSHAY MADIMAN, University of Delaware
[Saturday June 8 / samedi 8 juin, 16:00 – ED 193, Education Building]
Sharp moment-entropy inequalities for log-concave distributions

We show that the uniform distribution minimises entropy among all symmetric log-concave distributions with fixed variance, and also discuss some related ideas. (Based on joint work with Piotr Nayar and Tomasz Tkocz.)

ARNAUD MARSIGLIETTI, University of Florida
[Saturday June 8 / samedi 8 juin, 9:30 – ED 193, Education Building]
Hyperplane conjecture and central limit theorem

The hyperplane conjecture, raised by Bourgain in 1986, is a major unsolved problem in high-dimensional geometry. We discuss a probabilistic approach toward solving the hyperplane conjecture, which consists of rewriting the problem as a (strong form of the) central limit theorem.

SERGII MYROSHNYCHENKO, University of Alberta
[Sunday June 9 / dimanche 9 juin, 17:00 – ED 193, Education Building]

PIOTR NAYAR, University of Warsaw
[Saturday June 8 / samedi 8 juin, 10:00 – ED 193, Education Building]
The log-concave moment problem

Let us fix real numbers $p_1, \ldots, p_n > -1$. We say that a finite sequence of real numbers $m_1, \ldots, m_n$ is admissible, if there exists a symmetric log-concave function $f : \mathbb{R} \to \mathbb{R}$ such that $m_i = \int |t|^{p_i} f(t) \mathrm{d}t$ for all $i = 1, \ldots, n$. During the talk I will provide a description of all admissible sequences. Based on a joint work with A. Eskenazis and T. Tkocz.

YAIR SHENFELD, Princeton
[Saturday June 8 / samedi 8 juin, 16:30 – ED 193, Education Building]
Extremals in Minkowski's quadratic inequality

The ball uniquely minimizes the surface area among all convex bodies with fixed volume. On the other hand, if one wishes to control also the mean-width of the bodies, for example, then there are many minimizers whose shapes are quite strange. The characterization of such bodies follows from understanding the equality cases in Minkowski's quadratic inequality. This problem was open for more than hundred years. In this talk I will discuss the problem and its solution. (Joint work with Ramon van Handel.)

BOAZ SLOMKA, Weizmann Institute of Science
[Sunday June 9 / dimanche 9 juin, 17:30 – ED 193, Education Building]
On Hadwiger's covering problem

A long-standing open problem, known as Hadwiger's covering problem, asks what is the smallest natural number $N(n)$ such that every convex body in $\mathbb{R}^n$ can be covered by a union of the interiors of at most $N(n)$ of its translates.

In this talk, I will present a recent work in which we prove a new upper bound for $N(n)$. This bound improves Rogers' previous best bound, which is of the order of $\binom{2n}{n} n \ln n$, by a sub-exponential factor. Our approach combines ideas from previous work with tools from asymptotic geometric analysis. As a key step, we use thin-shell estimates for isotropic log-concave measures

to prove a new lower bound for the maximum volume of the intersection of a convex body K with a translate of $-K$. We further show that the same bound holds for the volume of $K \cap (-K)$ if the center of mass of K is at the origin.

If time permits we shall discuss some other methods and results concerning this problem and its relatives.

Joint work with H. Huang, B. Vritsiou, and T. Tkocz

KATERYNA TATARKO, University of Alberta
[Saturday June 8 / samedi 8 juin, 17:00 – ED 193, Education Building]
On the solution to the reverse isoperimetric problem

The classical isoperimetric problem asks which domain, among all domains with a

fixed surface area, has maximal volume. The question has a long and beautiful history and has been generalized to a variety of different settings. On the other hand, one can formulate the reverse isoperimetric problem: under which conditions can one minimize the volume among all domains of a given constraint.

In this talk we consider a class of λ-concave bodies in $\mathbb{R}^{n+1}$; that is, convex bodies with the property that each of their boundary points supports a tangent ball of radius $1/\lambda$ that lies locally (around the boundary point) inside the body. In this class, we solve a reverse isoperimetric problem: we show that the convex hull of two balls of radius $1/\lambda$ (a sausage body) is a unique volume minimizer among all λ-concave bodies of given surface area. This is joint work with Roman Chernov and Kostiantyn Drach.

KONSTANTIN TIKHOMIROV, Georgia Institute of Technology
[Saturday June 8 / samedi 8 juin, 9:00 – ED 193, Education Building]
Small ball probability for the condition number of random matrices

Let A be an n by n random matrix with i.i.d. entries of zero mean, unit variance and a bounded subgaussian moment. We show that the smallest singular value of A, rescaled by the square root of n, is a subgaussian random variable. Although the statement can be obtained as a combination of known results and techniques, it was not noticed in the literature before. As a key step of the proof, we apply estimates for the intermediate singular values of A obtained (under some additional assumptions) by Hoi Nguyen. The talk is based on a joint work with Alexander Litvak and Nicole Tomczak-Jaegermann.

ELISABETH WERNER
[Saturday June 8 / samedi 8 juin, 8:00 – ED 193, Education Building]
Entropy inequalities for log concave functions

We discuss new reverse log Sobolev type inequalities for log concave functions that strengthen existing ones. Equality characterizations in these inequalities lead to a Monge Ampere differential equation. We investigate the solutions of this Monge Ampere equation.

Based on joint work with U. Caglar and A. V. Kolesnikov.

JIE XIAO
[Sunday June 9 / dimanche 9 juin, 8:00 – ED 193, Education Building]
Gaussian BV Capacity

Since the Gaussian perimeter exists as an (n-1)-dimensional area with the standard Gaussian density, the Gaussian space merits a geometrical capacitary analysis on the bounded variation functions which are differentiable in the weakest measure theoretic sense. This talk will address a Gaussian analogy of the bounded variation capacity of a subset of Euclidean space, which is treated as a foundation of L.Liu-J.Xiao-D.Yang-W.Yuan's monograph: Gaussian Capacity Analysis, Lecture Notes in Mathematics 2225, Springer.

SUDAN XING, Memorial University of Newfoundland
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 193, Education Building]
The general dual-polar Orlicz-Minkowski problem

In this talk, I will discuss the general dual-polar Orlicz-Minkowski problem, which is "polar" to the recently initiated general dual Orlicz-Minkowski problem and "dual" to the newly proposed polar Orlicz-Minkowski problem. The problem states as follows:

Under what conditions on a nonzero finite Borel measure μ defined on the unit sphere, continuous functions $\varphi : (0,\infty) \to (0,\infty)$ and $G : (0,\infty)\times S^{n-1} \to (0,\infty)$ can we find a convex body K (with the origin in its interior) solving the following optimization problems

$$\inf / \sup \left\{ \int_{S^{n-1}} \varphi(h_Q(u)) d\mu(u) : Q \in \widetilde{\mathcal{B}} \right\},$$

where $\widetilde{\mathcal{B}} = \left\{ Q \in \mathcal{K}^n_{(o)} : \ \widetilde{V}_G(Q^\circ) = \widetilde{V}_G(B^n) \right\}$ with B^n the unit ball and $\widetilde{V}_G$ the general dual volume. In particular, we will present the existence, continuity and uniqueness of the solutions for the general dual-polar Orlicz-Minkowski problem. This talk is based on a joint work with Deping Ye and Baocheng Zhu.

DEPING YE, Memorial University of Newfoundland
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 193, Education Building]
The polar Orlicz-Minkowski problem

In this talk, I will talk about the polar Orlicz-Minkowski problem, which is closely related to but quite different from the problem of finding the Orlicz-Petty bodies. In particular, I will explain how the polar Orlicz-Minkowski problem was developed. Moreover, the existence, uniqueness, and continuity of solutions to this problem will be discussed.

This talk is based on a joint paper with Luo and Zhu.

Randomness and Limited Information in Graph Searching Problems
Problèmes liés au caractère aléatoire et à l'information limitée dans la recherche en graphe

Org: Danny Dyer (Memorial) and/et **Ryan Tifenbach** (Mount Allison)

Schedule/Horaire **Room/Salle: CK 187, Centre for Kinesiology**

Saturday June 8 **samedi 8 juin**

8:00 - 8:30	Anthony Bonato (Ryerson), *Limited information Cops and Robbers games* (p. 100)
8:30 - 9:00	Andrea Burgess (University of New Brunswick St. John), *Cops that surround a robber* (p. 100)
9:00 - 9:30	Ryan Hayward (University of Alberta), *Searching for Winning Strategies in Hex* (p. 100)
9:30 - 10:00	Shahin Kamali (University of Manitoba), *On the complexity of burning and broadcasting problems* (p. 101)
10:00 - 10:30	David Pike (Memorial University of Newfoundland), *The Firebreak Problem* (p. 101)

Abstracts/Résumés

ANTHONY BONATO, Ryerson University
[Saturday June 8 / samedi 8 juin, 8:00 – CK 187, Centre for Kinesiology]
Limited information Cops and Robbers games

In limited information variants of Cops and Robbers games, the robber is either invisible or partially visible during gameplay. Although they were studied for decades, there is now a renewed interest in limited information games among graph theorists and theoretical computer scientists. We present results on two recent variants, the localization game and Hyperopic Cops and Robbers. In the localization game, we settle a recent conjecture of Bosek et al. by providing an upper bound on the localization number as a function of the chromatic number.

ANDREA BURGESS, University of New Brunswick Saint John
[Saturday June 8 / samedi 8 juin, 8:30 – CK 187, Centre for Kinesiology]
Cops that surround a robber

In this talk, we introduce a variant of the game of cops and robber in which the winning condition for the cops is to "surround" the robber by occupying all of his adjacent vertices. The *surrounding cop number* $s(G)$ is the minimum number of cops required to guarantee that the cops have a winning strategy. Trivially, $s(G)$ is bounded below by $\delta(G)$, the minimum degree of G. It is easy to see that the cop number $c(G)$ is also a lower bound for $s(G)$, since once the cops surround the robber they can occupy his position in the next round; thus $s(G)$ cops win the traditional cops and robber game. While $s(G)$ is close to $\max\{c(G), \delta(G)\}$ for some graph classes, the difference between $s(G)$ and both $c(G)$ and $\delta(G)$ can be arbitrarily large.

We present some results and observations on the surrounding cops and robber game. This includes an exploration of the game for various classes of graphs, such as generalized Petersen graphs, incidence and intersection graphs of designs, and certain product graphs.

This is joint work with Rosalind Cameron, Nancy Clarke, Peter Danziger and David Pike.

RYAN HAYWARD, University of Alberta
[Saturday June 8 / samedi 8 juin, 9:00 – CK 187, Centre for Kinesiology]
Searching for Winning Strategies in Hex

Hex is the classic 2-player alternate-turn connection game played on a hexagonal n-by-by grid. John Nash famously used strategy-stealing to prove that there exists a winning strategy for the first player, but finding explicit strategies for arbitrary Hex positions is P-space-complete. To date, such strategies are known only up to 10-by-10.

Go expert Jing Yang was first to find such strategies for 7-by-7 through 9-by-9. 10-by-10 was first solved by computer. I will show one way to find strategies both for arbitrary positions. I will also discuss a recent attempt to find new empty-board 10-by-10 and 11-by-11 strategies.

This is joint work with Chao Gao, Wai Yi Low, Justin Francis, Jarrett Knauer and Scott Dupasquier. For more on Hex, see Hex, the Full Story (Hayward and Toft, CRC Press, 2019).

SHAHIN KAMALI, University of Manitoba

[Saturday June 8 / samedi 8 juin, 9:30 – CK 187, Centre for Kinesiology]

On the complexity of burning and broadcasting problems

Given an unweighted, undirected graph, there are many broadcasting and burning protocols for the dissemination of information in (or burning of) the graph. We review some of these protocols from an algorithmic point of view. The focus of the talk will be on telephone broadcasting, the firefighter problem, and the graph burning problem. Finding optimal dissemination schemes is NP-hard in all of these problems. Despite similarities like this, these problems have different behaviour with respect to approximation algorithms. We review a recently-introduced algorithm for the graph burning problem which has a constant approximation factor. Meanwhile, the existing hardness result indicates that the firefighter problem is APX-hard. For telephone broadcasting, the presence of an approximation algorithm with constant factor is an open problem. We review the existing approximation algorithms for telephone broadcasting and pose a few open problems relating the burning and broadcasting problems.

DAVID PIKE, Memorial University of Newfoundland

[Saturday June 8 / samedi 8 juin, 10:00 – CK 187, Centre for Kinesiology]

The Firebreak Problem

Suppose we have a network that is represented by a graph G. Potentially a fire (or other type of contagion) might erupt at some vertex of G. We are able to respond to this outbreak by establishing a firebreak at k other vertices of G, so that the fire cannot pass through these fortified vertices. The question that now arises is which k vertices will result in the greatest number of vertices being saved from the fire, assuming that the fire will spread to every vertex that is not fully behind the k vertices of the firebreak. This is the essence of the Firebreak decision problem, which we establish is intractable on the class of split graphs as well as on the class of bipartite graphs, but can be solved in linear time when restricted to graphs having constant-bounded treewidth, or in polynomial time when restricted to intersection graphs.

This is joint work with Kathleen Barnetson, Andrea Burgess, Jessica Enright, Jared Howell, and Brady Ryan.

Org: Michael Kozdron (University of Regina) and/et **Gregory Lawler** (University of Chicago)

Schedule/Horaire **Room/Salle: ED 623, Education Building**

Saturday June 8 **samedi 8 juin**

9:00 - 9:30	Christian Benes (Brooklyn College), *Rates of Convergence for the Simple Random Walk Green's Function* (p. 102)
9:30 - 10:00	Larissa Richards (University of Toronto), *The polynomial rate of convergence of critical interfaces.* (p. 102)
10:00 - 10:30	Arno Berger (University of Alberta), *Best Kantorovich and Levy approximations on the real line* (p. 102)
16:00 - 16:30	Yinon Spinka (University of British Columbia), *A short proof of the discontinuity of phase transition in the planar random-cluster model with $q > 4$* (p. 103)
16:30 - 17:00	Kasun Fernando Akurugodage (University of Toronto) (p. 102)
17:00 - 17:30	Sarai Hernandez Torres (University of British Columbia), *Scaling limits of uniform spanning trees in three dimensions* (p. 103)

Abstracts/Résumés

KASUN FERNANDO AKURUGODAGE, University of Toronto
[Saturday June 8 / samedi 8 juin, 16:30 – ED 623, Education Building]

CHRISTIAN BENES, City University of New York, Brooklyn College
[Saturday June 8 / samedi 8 juin, 9:00 – ED 623, Education Building]
Rates of Convergence for the Simple Random Walk Green's Function

For a given domain $D \subsetneq \mathbb{C}$, one would expect the simple random walk Green's function on $D \cap \frac{1}{n}\mathbb{Z}^2$ to converge at a rate that depends on the regularity of the domain. In the particular case $D_\alpha = \mathbb{D} \setminus \{re^{i\theta} \in \mathbb{C} : r \geq 0, |\theta| \leq \alpha/2\}$, where $\mathbb{D}$ is the unit disk centered at the origin, we find upper bounds for the rate of convergence that suggest that this is indeed the case.

ARNO BERGER, University of Alberta
[Saturday June 8 / samedi 8 juin, 10:00 – ED 623, Education Building]
Best Kantorovich and Levy approximations on the real line

Finding best purely atomic approximations of a given probability measure on the real line is an important basic problem that has been studied widely. In this talk, new necessary and sufficient conditions are presented that characterize best approximations relative to the classical Kantorovich (or Wasserstein) and Levy probability metrics, given any number of atoms, and allowing for additional constraints regarding the locations or weights of atoms. Wherever possible, the precise asymptotics (as the number of atoms goes to infinity) of the approximation error is identified for the important special cases of best uniform (i.e., all atoms having equal weight) and best (i.e., unconstrained) approximations, respectively. When compared to similar results known for other probability metrics, the results for Levy approximations, in particular, are more complete and require fewer assumptions.

LARISSA RICHARDS, University of Toronto
[Saturday June 8 / samedi 8 juin, 9:30 – ED 623, Education Building]
The polynomial rate of convergence of critical interfaces.

We will analyze a general framework for establishing a rate of convergence of the critical interfaces of various critical lattice models to SLE. Following the work of S. Smirnov and A. Kemppainen and the work of F. Viklund, assuming a polynomial rate of convergence of the driving functions we can obtain a polynomial rate of convergence provided the random curve satisfies some mild conditions. We will check the required condition and discuss the implementation for certain models.

YINON SPINKA, University of British Columbia
[Saturday June 8 / samedi 8 juin, 16:00 – ED 623, Education Building]
A short proof of the discontinuity of phase transition in the planar random-cluster model with $q > 4$

We give a short proof of the discontinuity of phase transition for the random-cluster model on the square lattice with parameter $q > 4$. This result was recently shown by Duminil-Copin et al via the so-called Bethe ansatz for the six-vertex model. Our proof also exploits the connection to the six-vertex model, but does not rely on the Bethe ansatz. Our argument is soft and only uses very basic properties of the random-cluster model.

Joint work with Gourab Ray.

SARAI HERNANDEZ TORRES, University of British Columbia
[Saturday June 8 / samedi 8 juin, 17:00 – ED 623, Education Building]
Scaling limits of uniform spanning trees in three dimensions

Wilson's algorithm allows efficient sampling of the uniform spanning tree (UST) by using loop-erased random walks. This connection gives a tractable method to study the UST. The strategy has been fruitful for scaling limits of the UST in the planar case and in high dimensions. However, three-dimensional scaling limits are far from understood. In this talk, I will discuss recent advances on this problem. I will show that rescaled subtrees of the UST in three dimensions converge to a limiting object.

This work is part of ongoing joint work with Omer Angel, David Croydon, and Daisuke Shiraishi.

Representation Theory of Groups Defined Over Local Fields
Théorie des représentations de groupes définis sur des champs locaux

Org: Monica Nevins (Ottawa) and/et **Jerrod Smith** (Calgary)

Schedule/Horaire **Room/Salle: ED 312, Education Building**

Saturday June 8 **samedi 8 juin**

8:00 - 8:30	Paul Mezo (Carleton University), *Equivalent definitions of Arthur-packets for real classical groups* (p. 106)
8:30 - 9:00	Nicolas Arancibia (Carleton University), *A(rthur)-Packets of Cohomological Representations* (p. 104)
9:00 - 9:30	Ed Belk (University of British Columbia), *The Local Trace Formula as a Motivic Identity* (p. 104)
9:30 - 10:00	Daniel Le (University of Toronto), *mod p representations of p-adic GL_2* (p. 106)
10:00 - 10:30	Boaz Elazar (University of British Columbia), *Schwartz Functions And Tempered Distributions On Singular Quasi-Nash Varieties* (p. 105)
16:00 - 16:30	Adele Bourgeois (University of Ottawa), *On the Multiplicities in the Restriction of a Supercuspidal Representation* (p. 105)
16:30 - 17:00	David Roe (Massachusetts Institute of Technology), *A database of p-adic tori* (p. 106)
17:00 - 17:30	Nicole Kitt (University of Calgary), *An ABV-packet for a General Linear Group with Two Representations* (p. 105)
17:30 - 18:00	Loren Spice (Texas Christian University), *New developments in the construction of tame, supercuspidal representations* (p. 107)

Sunday June 9 **dimanche 9 juin**

8:30 - 9:00	Qing Zhang (University of Calgary), *local converse theorems for unitary groups* (p. 107)
9:00 - 9:30	Joshua Lansky (American University), *Explicit liftings of conjugacy classes in finite reductive groups* (p. 105)
9:30 - 10:00	Wan-Yu Tsai (University of Ottawa), *The orbit philosophy for Spin groups* (p. 107)
10:00 - 10:30	Hadi Salmasian (University of Ottawa), *The minimal faithful dimension of finite p-groups: an application of the orbit method to the essential dimension* (p. 106)

Abstracts/Résumés

NICOLAS ARANCIBIA, Carleton University
[Saturday June 8 / samedi 8 juin, 8:30 – ED 312, Education Building]
A(rthur)-Packets of Cohomological Representations

For classical real groups we can list three important constructions of A(rthur)-packets. We can begin by mentioning the definition due to Arthur that appears in his work on the classification of the discrete automorphic spectrum of classical groups, and that relies on techniques from harmonic analysis. A second and radically different definition is due to Adams, Barbasch and Vogan. Their approach to A-packets is by means of sophisticated geometrical methods, using the theory of perverse sheaf, $\mathcal{D}$-modules and some others tools from microlocal geometry. A third construction in the context of unitary representations with cohomology, is due to Adams and Johnson. The aim of this talk is to explain why in this latter context the three constructions coincide.

ED BELK, University of British Columbia
[Saturday June 8 / samedi 8 juin, 9:00 – ED 312, Education Building]
The Local Trace Formula as a Motivic Identity

In 1991, James Arthur published a local trace formula, which is an equality of distributions on the Lie algebra of a connected, reductive algebraic group G over a field F of characteristic zero. His approach was later used by Jean-Loup Waldspurger to give a slight reformulation, identifying the value of a particular distribution on a test function with that of its Fourier transform. We aim to show that this identity may be formulated as an identity of motivic distributions on definable manifolds. By so doing, we would make available the use of the transfer principle to establish the trace formula for groups defined over fields of positive characteristic.

ADELE BOURGEOIS, University of Ottawa
[Saturday June 8 / samedi 8 juin, 16:00 – ED 312, Education Building]
On the Multiplicities in the Restriction of a Supercuspidal Representation

The representation theory of reductive groups over p-adic fields can be split into two areas, namely the study of parabolically induced representations and the study of supercuspidal representations. Given a reductive group G defined over a p-adic field F, one can construct supercuspidal representations of any positive depth via the Adler-Yu construction. This construction uses what Yu called a G-datum. It was later proved by Kim-Fintzen that these constructions exhaust all positive depth supercuspidal representations for large enough p.

In this talk, we will be interested in the restriction of a positive depth supercuspidal of $G(F)$ to the subgroup $G_{der}(F)$, where G_{der} denotes the derived subgroup of G. The goal is to further explore a conjecture regarding multiplicity one established by Adler and Prasad. To understand such a restriction, we first define how to restrict a G-datum to G_{der}-data. We can then study how the supercuspidals arising from the various G_{der}-data produced appear in the restriction to $G_{der}(F)$ of the supercuspidal arising from the initial G-datum. The question of multiplicity one in this restriction then reduces to the study of certain depth zero supercuspidal representations.

BOAZ ELAZAR, UBC
[Saturday June 8 / samedi 8 juin, 10:00 – ED 312, Education Building]
Schwartz Functions And Tempered Distributions On Singular Quasi-Nash Varieties

Schwartz functions and tempered distributions are important tools in representation theory and are used, for example, in studying closures of orbits of group actions. Those closures might be singular semi-algebraic varieties. For the study of Schwartz functions on such varieties, I shall introduce the space of quasi-Nash varieties. I will show how Schwartz functions and tempered distributions can be defined on quasi-Nash varieties, and will discuss several important properties of those functions. If time permits, I will talk about integrating Schwartz functions over singular algebraic curves.

NICOLE KITT, University of Calgary
[Saturday June 8 / samedi 8 juin, 17:00 – ED 312, Education Building]
An ABV-packet for a General Linear Group with Two Representations

It is known that not all ABV-packets are Arthur packets, and in particular, that Arthur packets for general linear groups are singletons. My research project concerns, what is believed to be, the smallest known example of an ABV-packet for a general linear group that is not a singleton, and hence is not of Arthur type. Specifically, I will be completing a calculation with C.Cunningham which shows that there is an irreducible admissible representation π of p-adic GL(16) with the property that its ABV-packet contains exactly one other irreducible representation, π'.

The main tool we are using to calculate the ABV-packet for p-adic GL(16) is the functor Ev which is built from Deligne's vanishing cycles functor. In this talk, I will illustrate the methods used to compute this functor. In particular, we will discuss geometric techniques used to calculate perverse sheaves and their microlocal vanishing cycles on quiver representation varieties of type A.

JOSHUA LANSKY, American University
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 312, Education Building]
Explicit liftings of conjugacy classes in finite reductive groups

Let k be a field, $\tilde{G}$ a connected reductive k-group, and Γ a finite group. Previous work with Adler defined what it means for a connected reductive k-group G to be *parascopic* for $(\tilde{G}, \Gamma)$. (Roughly, this is a generalization of the situation where Γ acts on $\tilde{G}$, and G is the connected part of the group of Γ-fixed points in $\tilde{G}$.) In this setting, there is a canonical map $\mathcal{N}^{st}$ of stable semisimple conjugacy classes from the dual $G^\wedge(k)$ to $\tilde{G}^\wedge(k)$. When k is finite, this implies a lifting from packets of representations of $G(k)$ to those of $\tilde{G}(k)$. After reviewing this theory, we describe a method for decomposing a given instance of parascopy into simple atomic components for which $\mathcal{N}^{st}$ arises from an explicit k-morphism $G^\wedge \longrightarrow \tilde{G}^\wedge$. As a consequence, our lifting of representations is seen to be compatible with Shintani lifting in some important cases. In other cases, our lifting factors through the set of representations of an intermediate group.

DANIEL LE, University of Toronto
[Saturday June 8 / samedi 8 juin, 9:30 – ED 312, Education Building]
mod p representations of p-adic GL_2

Congruences between automorphic forms and Galois representations have proven to be powerful tools in the Langlands program. The search for a representation-theoretic framework for these congruences naturally leads us to study mod p representations of p-adic groups. Rather little is presently known about the characteristic p case, which seems to be substantially different from other characteristics. We will highlight some recent results and questions in the area, mainly focusing on the case of GL_2.

PAUL MEZO, Carleton University
[Saturday June 8 / samedi 8 juin, 8:00 – ED 312, Education Building]
Equivalent definitions of Arthur-packets for real classical groups

In his most recent book, Arthur defines A(rthur)-packets for classical groups using techniques from harmonic analysis. For real groups an alternative approach to the definition of A-packets has been known since the early 90s. This approach, due to Adams-Barbasch-Vogan, relies on sheaf-theoretic techniques instead of harmonic anaysis. We will report on work in progress, joint with N. Arancibia, in proving that these two different definitions for A-packets are equivalent for real classical groups.

DAVID ROE, Massachusetts Institute of Technology
[Saturday June 8 / samedi 8 juin, 16:30 – ED 312, Education Building]
A database of p-adic tori

Maximal tori in reductive groups form the foundation for many constructions in p-adic representation theory. Many of these constructions place constraints on the tori involved, requiring that they split over unramified or tamely ramified extensions of the ground field. When the residue characteristic is small, wild tori occur even for groups of small rank. Such tori complicate standard tools used to construct representations, such as Bruhat-Tits buildings, Néron models and the Moy-Prasad filtration. In an effort to aid in the study of representations in small characteristic, I will present an online database of p-adic tori.

As the database is still at an early stage, I will be soliciting feedback on what kinds of data, presentation or search features would be most useful to researchers in the audience.

HADI SALMASIAN, University of Ottawa
[Sunday June 9 / dimanche 9 juin, 10:00 – ED 312, Education Building]
The minimal faithful dimension of finite p-groups: an application of the orbit method to the essential dimension

For a finite group G and a field K, the faithful dimension of G over K is defined as the smallest possible dimension of a faithful K-representation of G. By a result of Karpenko and Merkurjev, if G is a p-group and K contains a primitive p-th root of unity, then the faithful dimension of G is equal to the essential dimension of G over K, a notion introduced by Buhler and Reichstein. We use the orbit method to obtain qualitative and quantitative results on the faithful dimension of G for a wide range of examples. This is joint work with M. Bardestani and K. M. Karai.

LOREN SPICE, Texas Christian University
[Saturday June 8 / samedi 8 juin, 17:30 – ED 312, Education Building]
New developments in the construction of tame, supercuspidal representations

In 2012, Yu gave a talk at American University suggesting the possibility of a new perspective on his construction of tame, supercuspidal representations that would make it more compatible with the local Langlands correspondence. Surprisingly, this compatibility hinges on a small detail, which is the nature of the lifting to a genuine representation of the projective representation of a finite symplectic group called the Weil representation. In joint work with DeBacker, I described an appropriate modification for so called toral supercuspidal representations. Kaletha's work on regular supercuspidal representations suggests a vast generalisation of the work with DeBacker. In this talk, I will report on joint work in progress with Fintzen and Kaletha involving how to perform the necessary modifications to the Weil representation in the setting of regular, and hopefully all tame, supercuspidal representations.

WAN-YU TSAI, University of Ottawa
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 312, Education Building]
The orbit philosophy for Spin groups

Let G be a semisimple Lie group with Lie algebra $\mathfrak{g}$ and maximal compact subgroup K. The philosophy of coadjoint orbits suggests a way to study unitary representations of G by their close relations to the coadjoint G-orbits on $\mathfrak{g}^*$. In this talk, we study a special part of the orbit philosophy. We provide a comparison between the K-structure of unipotent representations and regular functions of bundles on nilpotent orbits for complex and real groups of type D. More precisely, we provide a list of genuine unipotent representations for a Spin group ; separately we compute the K-spectra of the regular functions on certain small nilpotent orbits, and then match them with the K-types of the genuine unipotent representations.This is joint work with Dan Barbasch.

QING ZHANG, University of Calgary,
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 312, Education Building]
local converse theorems for unitary groups

Let F be a p-adic field and E/F be a fixed quadratic extension. Let $\mathrm{U}_n(F)$ be the quasi-split unitary group of size n with $n \geq 2$ associated with E/F. The local converse theorem asserts that, an irreducible (supercuspidal) generic representation π of U_n is uniquely determined by various local gamma factors $\gamma(s, \pi \times \tau, \psi)$ of π twisted by irreducible generic representations τ of $\mathrm{GL}_k(E), 1 \leq k \leq [\frac{n}{2}]$, where ψ is a fixed nontrivial additive character of F. In this talk, I will give a sketch of a recent proof of this theorem when n is odd.

STUDC Research Session
Session de recherche du Comité des étudiants

Schedule/Horaire **Room/Salle: CK 185, Centre for Kinesiology**

Sunday June 9 **dimanche 9 juin**

8:00 - 8:30	Curran McConnell (Dalhousie University), *Combinatorics of spaces of trees: an application of topology to phylogenetics* (p. 109)
8:30 - 9:00	Asmita Sodhi (Dalhousie University), *Integer-valued polynomials and a game called p-ordering* (p. 109)
9:00 - 9:30	Nicole Kitt (University of Calgary), *How to calculate perverse sheaves on quiver representation varieties of type A* (p. 108)
9:30 - 10:00	Anne Dranowski (Univeristy of Toronto), *MV cycles from generalized orbital varieties* (p. 108)
10:00 - 10:30	Peter Bradshaw (Simon Fraser University), *Cops and robbers on Cayley graphs* (p. 108)

Abstracts/Résumés

PETER BRADSHAW, Simon Fraser University
[Sunday June 9 / dimanche 9 juin, 10:00 – CK 185, Centre for Kinesiology]
Cops and robbers on Cayley graphs

We discuss the pursuit-evasion game "Cops and Robbers" with regard to Cayley graphs. We show that Meyniel's Conjecture holds for several classes of Cayley graphs, including abelian Cayley graphs and dihedral Cayley graphs. We also extend several known Cops and Robbers results for Cayley graphs to other pursuit-evasion variants.

ANNE DRANOWSKI, Univeristy of Toronto
[Sunday June 9 / dimanche 9 juin, 9:30 – CK 185, Centre for Kinesiology]
MV cycles from generalized orbital varieties

Representations constructed from the geometry of homogeneous spaces involve many choices, so we would like to parametrize coarse invariants, like dimensions of weight spaces of irreducible representations, by combinatorial objects. A classical example is the Grothendieck–Springer resolution of the variety of nilpotent elements $\mathcal{N}$ in a semi-simple Lie algebra: the top Borel-Moore homology of a fibre of this resolution is an irreducible representation of the associated Weyl group. In type A, a canonical basis is parametrized by Young tableaux. This talk will review a more modern example: the torus-equivariant cohomology of upper-triangular Slodowy slices. We explain the representation theory and combinatorics of this example: using the geometric Satake correspondence and a Spaltenstein decomposition, we show that orbital varieties in Slodowy slices define bases in representations. Under the magnifying glass of a finer geometric invariant — the Duistermaat-Heckmann measure — we show that not all bases are created equal.

NICOLE KITT, University of Calgary
[Sunday June 9 / dimanche 9 juin, 9:00 – CK 185, Centre for Kinesiology]
How to calculate perverse sheaves on quiver representation varieties of type A

In their 1997 paper, Geometric construction of crystal bases, Masaki Kashiwara and Yoshihisa Kashiwa Saito described a singularity in a quiver representation variety of type A_5 with the property that the characteristic cycles of the singularity is reducible, thus providing a counterexample to a conjecture of Kazhdan and Lusztig. This singularity is now commonly known as the Kashiwara-Saito singularity. While the 1997 paper showed that the characteristic cycles of the Kashiwara-Saito singularity decomposes into at least two irreducible cycles, they promised, but did not prove, that it decomposes into exactly two irreducible cycles.

The goal of this project is to complete this calculation using geometric techniques developed in the example part of the Voganish paper. The first step in this calculation is to compute perverse sheaves on the quiver representation variety of type A_5. In this talk, I will illustrate the methods used to make such a calculation by calculating perverse sheaves for a specific quiver representation variety of type A. In doing so, I will show how to construct a proper smooth cover for any quiver variety of type A.

CURRAN MCCONNELL, Dalhousie University
[Sunday June 9 / dimanche 9 juin, 8:00 – CK 185, Centre for Kinesiology]
Combinatorics of spaces of trees: an application of topology to phylogenetics

Various metrics are used in phylogenetics to study sets of evolutionary trees generated from gene sequences. We want to use some of these metrics to consider what persistent homology might be able to contribute to the study of these trees. Our "data points" are points in the space of all trees with n leaves, where n is the number of species considered. We will consider the family of edge complexes, indexed by a sequence of real numbers ϵ_i, obtained by adding an edge between two data points if their distance is less than or equal to ϵ_i. This gives us a filtration of the $((2n-3)!!-1)$-simplex with interesting homological properties, in particular for the quartet distance. Any given data set will give rise to a subsimplex of this $((2n-3)!!-1)$-simplex and a subfiltration. Understanding the properties of the surrounding simplicial complex and its filtration will be important in understanding which features are truly features of the data set we are considering. In this talk I will discuss the features of these simplicial complexes for low values of n and I will present some conjectures for what this means for higher values of n.

ASMITA SODHI, Dalhousie University
[Sunday June 9 / dimanche 9 juin, 8:30 – CK 185, Centre for Kinesiology]
Integer-valued polynomials and a game called p-ordering

In this talk we will visit the world of integer-valued polynomials, and also introduce the ring of polynomials that are integer-valued over a subset of $\mathbb{Z}$. We will explore Bhargava's "game called p-ordering", and see how p-orderings and p-sequences allow us to find a $\mathbb{Z}$-module basis for the ring of integer-valued polynomials for a subset of the integers. Finally, we will briefly see how Bhargava's tools may be extended to the noncommutative case of integer-valued polynomials over the ring $M_n(\mathbb{Z})$ of $n \times n$ integer matrices.

The Mathematics behind Quantum Information Science
Les mathématiques derrière la science de l'information quantique

Org: Nathaniel Johnston (Mount Allison) and/et **Sarah Plosker** (Brandon)

Schedule/Horaire **Room/Salle: ED 230, Education Building**

Saturday June 8	**samedi 8 juin**
8:00 - 8:30	Vern Paulsen (University of Waterloo), *Constant Gap for Self-embezzlement* (p. 113)
8:30 - 9:00	Mizanur Rahaman (University of Waterloo), *A new bound on quantum Wielandt inequality* (p. 113)
9:00 - 9:30	Nathaniel Johnston (Mount Allison University), *Pairwise Completely Positive Matrices and Quantum Entanglement* (p. 111)
9:30 - 10:00	Sarah Plosker (Brandon University), *The robustness of k-coherence* (p. 113)
10:00 - 10:30	Eric Chitambar (University of Illinois Urbana-Champaign), *Playing Mermin's Game with Nonlocal Resources* (p. 110)
16:00 - 16:30	Rupert Levene (University College Dublin), *Schur multipliers and mixed unitary maps* (p. 112)
16:30 - 17:00	Jeremy Levick (University of Cape Town), *Factorizable Quantum Channels and Linear Matrix Inequalities* (p. 112)
17:00 - 17:30	Rajesh Pereira (University of Guelph), *Quasiorthogonal algebras* (p. 113)
17:30 - 18:00	Sabine Burgdorf (University of Konstanz), *Quantum correlations and optimization* (p. 110)

Sunday June 9	**dimanche 9 juin**
8:30 - 9:00	Gilad Gour (University of Calgary), *Theories of Dynamical Quantum Resources* (p. 111)
9:00 - 9:30	Carlo Maria Scandolo (University of Calgary), *Necessary and Sufficient Conditions on Measurements of Quantum Channels* (p. 114)
9:30 - 10:00	Jason Crann (Carleton University), *State convertibility in the von Neumann algebra framework.* (p. 111)
10:00 - 10:30	Comfort Mintah (University of Guelph), *Operator algebras and quantum one-way LOCC state distinguishability* (p. 112)
16:00 - 16:30	Neil J. Ross (Dalhousie University), *A Characterization of Integral, Real, and Gaussian Clifford+T Operators* (p. 114)
16:30 - 17:00	Sam Harris (University of Waterloo), *Separating the matrix-valued bipartite correlation sets* (p. 111)
17:00 - 17:30	Jamie Sikora (Perimeter Institute), *Shadow Probabilities* (p. 114)
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Abstracts/Résumés

SABINE BURGDORF, University of Konstanz
[Saturday June 8 / samedi 8 juin, 17:30 – ED 230, Education Building]
Quantum correlations and optimization

Entanglement is one of the key features of quantum mechanics, e.g., creating (bipartite) correlations which cannot be obtained classically. There are basically two mathematical models to describe bipartite quantum correlations: via commuting operators and via tensor products of operators. We will present conic descriptions of these sets, which allows a broader use of (real) algebraic methods for a better understanding of quantum correlations. We will discuss some of these aproaches mostly related to approximation methods from conic or polynomial optimization.

ERIC CHITAMBAR, University of Illinois at Urbana-Champaign
[Saturday June 8 / samedi 8 juin, 10:00 – ED 230, Education Building]
Playing Mermin's Game with Nonlocal Resources

In a popular science article [Am. J. of Phys. 49, 940 (1981)], N.D. Mermin presented a conceptually simple demonstration of quantum nonlocality. The phenomenon is described using a pair of three-input/two-output boxes that are constrained to have identical outputs whenever the same inputs are chosen. The game then consists in trying to maximize the probability of differing outputs whenever different inputs are chosen. In this talk I will describe a variant of Mermin's game in which the constraint of identical outputs is relaxed. When the constraint is completely removed the CHSH is recovered, while in general the largest quantum advantage is shown to scale linearly in the relaxation parameter ϵ. We then consider playing Mermin's game with nonlocal boxes, or PR-boxes. We show that the optimal score in Mermin's game with one PR-box is $1/6$ while with two PR-boxes the game can be won perfectly.

JASON CRANN, Carleton University
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 230, Education Building]
State convertibility in the von Neumann algebra framework.

Nielsen characterized the convertibility of two finite-dimensional bipartite pure states via local operations and classical communication (LOCC) using majorization. This important result, which has seen many applications in quantum information, describes the LOCC-transfer of entanglement between bipartite pure states. In this talk, we present a version of Nielsen's theorem in the commuting operator framework using a generalized class of LOCC operations and the theory of majorization in von Neumann algebras. As a corollary, we obtain an operational interpretation of maximal entanglement relative to von Neumann factors of type II_1. This is joint work with David Kribs, Rupert Levene and Ivan Todorov.

GILAD GOUR, University of Calgary
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 230, Education Building]
Theories of Dynamical Quantum Resources

A common theme in Chemistry, Thermodynamics, and Information Theory is how one type of resource – be it chemicals, heat baths, or communication channels – can be used to produce another. These processes of conversion and their applications are studied under the general heading of "resource theories". While resource theories use a wide range of sophisticated and apparently unrelated mathematical techniques, there is also an emerging general mathematical framework which seems to underpin all of them. In this talk, I will introduce some of these common mathematical structures that appear in resource theories, particularly those appearing in resource theories of quantum processes.

SAM HARRIS, University of Waterloo
[Sunday June 9 / dimanche 9 juin, 16:30 – ED 230, Education Building]
Separating the matrix-valued bipartite correlation sets

In recent years, there has been much study devoted to various sets of quantum bipartite correlations in a finite-input, finite-output system. These sets are often denoted by $C_t(m,k)$, where m is the number of inputs, k is the number of outputs, and t represents the model that is being used. Some of the most notable models are the finite-dimensional (tensor product) model ($t = q$) and the tensor product model ($t = qs$). Thanks to recent work of W. Slofstra, it is known that $C_{qs}(m,k)$ is not a closed set if m and k are large enough. Recent work of A. Coladangelo and J. Stark shows that $C_q(5,3) \neq C_{qs}(5,3)$. In this talk, we consider a matrix-valued generalization of these sets, denoted $C_t^{(n)}(m,k)$, where Alice and Bob have access to n (orthonormal) states instead of just 1. We show that there is some $n \leq 13$ such that, whenever $m,k \geq 2$ and $(m,k) \neq (2,2)$, we have that $C_q^{(n)}(m,k) \neq C_{qs}^{(n)}(m,k)$ and that $C_{qs}^{(n)}(m,k)$ is not a closed set. This is based on joint work with Li Gao and Marius Junge.

NATHANIEL JOHNSTON, Mount Allison University
[Saturday June 8 / samedi 8 juin, 9:00 – ED 230, Education Building]
Pairwise Completely Positive Matrices and Quantum Entanglement

We introduce a generalization of the set of completely positive matrices that we call "pairwise completely positive" (PCP) matrices. These are pairs of matrices that share a joint decomposition so that one of them is necessarily positive semidefinite while the other one is necessarily entrywise non-negative. We explore basic properties of these matrix pairs and develop several testable necessary and sufficient conditions that help determine whether or not a pair is PCP. We then establish a connection with quantum entanglement by showing that determining whether or not a pair of matrices is pairwise completely positive is equivalent to determining whether or not a certain type of quantum state, called a conjugate local diagonal unitary invariant state, is separable. Many of the most important quantum states in entanglement theory are of this type, including isotropic states, mixed Dicke states (up to partial transposition), maximally correlated states, as well as the central states of interest in the absolute separability problem.

RUPERT LEVENE, University College Dublin
[Saturday June 8 / samedi 8 juin, 16:00 – ED 230, Education Building]
Schur multipliers and mixed unitary maps

We consider the tensor product of the completely depolarising channel on $d \times d$ matrices with the map of Schur multiplication by a $k \times k$ correlation matrix and characterise, via matrix theory methods, when such a map is a mixed (random) unitary channel. When $d = 1$, this recovers a result of O'Meara and Pereira, and for larger d is equivalent to a result of Haagerup and Musat that was originally obtained via the theory of factorisation through von Neumann algebras. We obtain a bound on the distance between a given correlation matrix for which this tensor product is nearly mixed unitary and a correlation matrix for which such a map is exactly mixed unitary. This bound allows us to give an elementary proof of another result of Haagerup and Musat about the closure of such correlation matrices without appealing to the theory of von Neumann algebras.

This is joint work with Sam Harris, Vern Paulsen, Sarah Plosker and Mizanur Rahaman.

JEREMY LEVICK
[Saturday June 8 / samedi 8 juin, 16:30 – ED 230, Education Building]
Factorizable Quantum Channels and Linear Matrix Inequalities

We find a connection between the existence of a factorization of a quantum channel through the algebra $M_N(\mathbb{C})$ and the existence of low-rank solutions to certain linear matrix inequalities. Using this, we show that if a quantum channel is factorized by a direct integral of factors, it must lie in the convex hull of quantum channels which are factorized respectively by the factors in the direct integral. We use this to characterize some non-trivial extreme points in the set of factorizable quantum channels and give a class of examples.

COMFORT MINTAH
[Sunday June 9 / dimanche 9 juin, 10:00 – ED 230, Education Building]
Operator algebras and quantum one-way LOCC state distinguishability

We study the physical description of Quantum Local Operations and Classical Communications (LOCC) and its schematics. We restrict ourselves to one-way LOCC (one of the schemes of LOCC) and discuss detailed analysis in quantum information of recently derived operator relations. We indicate how operator structures such as operator systems and operator algebras naturally arise from these settings and make use of these structures to derive new result and new derivations of some established results in one-way LOCC. We compare perfect distinguishability of one-way LOCC versus arbitrary quantum operations and see how for several families of operators that appear jointly in matrix and operator theory and quantum information theory, the relations are equivalent.

SATISH PANDEY, Technion
[Sunday June 9 / dimanche 9 juin, 17:30 – ED 230, Education Building]

VERN PAULSEN, Univerity of Waterloo
[Saturday June 8 / samedi 8 juin, 8:00 – ED 230, Education Building]
Constant Gap for Self-embezzlement

W. van Dam and P. Hayden proved that in the standard tensor model for representing bipartite quantum systems, it is impossible to catalytically produce an entangled state. But that as one allowed the dimensions of the state spaces to increase one could carry out this process to arbitrary precision. They referred to this process as "embezzlement" since if one knew the accuracy to which a third party could make observations, then one could "appear" to carry out an impossible task. Later in joint work with Cleve and Liu, we proved that one could not carry out this catalytic production of entangled states in the tensor model even if one allowed infinite dimensional state spaces, but one could carry it out exactly in the commuting model for bipartite systems. In this work we consider the task of not just producing any entangled state but producing the entangled state that is itself the catalyst. We prove that in finite dimensions, there is a constant gap, independent of the dimension, on how "nearly" one can carry out this task. We then prove that this task can be carried out exactly in infinite dimensions in the commuting model.

In this way we obtain a "task" that can be done in infinite dimensions but can not be done approximately in finite dimensions. This talk is based on joint work with B. Collins, R. Cleve and L. Liu.

RAJESH PEREIRA, University of Guelph
[Saturday June 8 / samedi 8 juin, 17:00 – ED 230, Education Building]
Quasiorthogonal algebras

Two unital subalgebras of a matrix algebra are said to be quasiorthogonal if their trace zero-subspaces are orthogonal in the trace inner product norm. We will explore some existence results for quasiorthogonal algebras and some of their mathematical properties. We will also discuss the application of quasiorthogonality to topics in quantum information (such as quantum error correction, quantum privacy and entanglement).

SARAH PLOSKER, Brandon University
[Saturday June 8 / samedi 8 juin, 9:30 – ED 230, Education Building]
The robustness of k-coherence

The degree to which a quantum state is in superposition with respect to a given orthonormal basis is called the coherence of the state. Numerous measures of coherence have been identified and studied recently. Here, we are interested in two separate generalizations of the robustness of coherence. We show that the two measures agree with each other when restricted to pure-state inputs by deriving an explicit closed expression.

MIZANUR RAHAMAN, University of Waterloo
[Saturday June 8 / samedi 8 juin, 8:30 – ED 230, Education Building]
A new bound on quantum Wielandt inequality

The Wielandt number for a primitive matrix with non-negative entries, is the minimum number of self-compositions needed so that all its entries become non-zero. In 2010, this concept has been generalized for trace preserving and completely positive maps (quantum channels). In this talk, I will establish a bound on quantum Wielnadt inequality for positive maps as opposed to quantum channels. This bound depends only on the dimension of the system the map is acting on and not on the map itself.

The techniques used to get this new bound provides a way to obtain improved bounds for this inequality for some specific classes of quantum channels. The motivation of this work is to provide an answer to a question raised by Sanz-Garcia-Wolf and Cirac who introduced the Wielandt inequality for quantum channels.

NEIL J. ROSS, Dalhousie University
[Sunday June 9 / dimanche 9 juin, 16:00 – ED 230, Education Building]
A Characterization of Integral, Real, and Gaussian Clifford+T Operators

In 2012, Giles and Selinger showed that Clifford+T operators correspond to matrices of the form $U = (1/\sqrt{2})^k M$ where k is a nonnegative integer and M is a matrix over the ring $\mathbb{Z}[\omega]$. Here, we consider the operators that arise when one restricts M to be a matrix over a subring of $\mathbb{Z}[\omega]$. We focus on the subrings $\mathbb{Z}$, $\mathbb{Z}[\sqrt{2}]$, and $\mathbb{Z}[i]$, which define the integral, real, and Gaussian Clifford+T operators, respectively. We prove that these restricted Clifford+T operators correspond to circuits over well-known universal sets of quantum gates. Explicitly, we show that the integral Clifford+T operators are generated by the gate set $\{X, CX, CCX, H\}$, from which the real and Gaussian operators are obtained by adding the CH and S gate, respectively.

CARLO MARIA SCANDOLO, University of Calgary
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 230, Education Building]
Necessary and Sufficient Conditions on Measurements of Quantum Channels

Quantum supermaps are a higher-order generalization of quantum maps, taking quantum maps to quantum maps. It is known that any completely positive, trace non-increasing (CPTNI) map can be performed as part of a quantum measurement. By providing an explicit counterexample we show that, instead, not every quantum supermap sending a quantum channel to a CPTNI map can be realized in a measurement on quantum channels. We find that the supermaps that can be implemented in this way are exactly those transforming quantum channels into CPTNI maps even when tensored with the identity supermap.

JAMIE SIKORA, Perimeter Institute
[Sunday June 9 / dimanche 9 juin, 17:00 – ED 230, Education Building]
Shadow Probabilities

Semidefinite optimization has proven to be a powerful tool in the study of quantum theory, with a wide array of applications. In this talk, I'll present a concept known as shadow prices which are quantities studied in mathematical economics, usually presented in the context of linear optimization. I'll discuss shadow prices in the context of semidefinite optimization and demonstrate how they appear in different areas of quantum theory, giving rise to shadow probabilities.

Org: Martin Frankland, **Donald Stanley** and/et **Paul Arnaud Songhafouo Tsopméné** (Regina)

Schedule/Horaire **Room/Salle: ED 318, Education Building**

Saturday June 8 — samedi 8 juin

8:30 - 9:00	Robin Koytcheff (University of Louisiana at Lafayette), *Operadic decompositions of spaces of string links* (p. 116)
9:00 - 9:30	Laura Scull (Fort Lewis College), *Transitive Groupoids with Interesting Topological Properties* (p. 118)
9:30 - 10:00	Jeffrey Carlson (University of Toronto), *Local integration in equivariant cobordism theory* (p. 115)
10:00 - 10:30	Rachel Hardeman (University of Calgary), *An Introduction to A-Homotopy Theory: A Discrete Homotopy Theory for Graphs* (p. 116)
16:00 - 16:30	Ben Williams (University of British Columbia), *$\mathbb{A}^1$-homotopy and a conjecture of Suslin* (p. 118)
16:30 - 17:00	Steven Rayan (University of Saskatchewan), *The quiver at the bottom of the twisted nilpotent cone on $\mathbb{P}^1$* (p. 117)
17:00 - 17:30	Cihan Okay (University of British Columbia), *Mod-ℓ homotopy type of the classifying space for commutativity* (p. 117)
17:30 - 18:00	Anthony Bahri (Rider University), *Polyhedral products and their applications* (p. 115)

Sunday June 9 — dimanche 9 juin

8:30 - 9:00	Tyrone Ghaswala (University of Manitoba), *Promoting circle actions to actions on the real line* (p. 116)
9:00 - 9:30	Patrick Naylor (University of Waterloo), *Trisections and twists of 4-manifolds* (p. 116)
9:30 - 10:00	Kate Poirier (New York City College of Technology), *Directed planar trees, V-infinity algebras, and string topology* (p. 117)
10:00 - 10:30	Krishanu Sankar (University of British Columbia), *Mod 2 cohomology and the braid group* (p. 117)

Abstracts/Résumés

ANTHONY BAHRI, Rider University
[Saturday June 8 / samedi 8 juin, 17:30 – ED 318, Education Building]
Polyhedral products and their applications

A polyhedral product is a natural subspace of a Cartesian product specified by a simplicial complex. Though they arose from the topological approach to toric geometry, their utility has expanded rapidly in recent years into areas which include: representation theory, combinatorics, geometric group theory, the topology of toric spaces, free groups and monodromy, complements of subspace arrangements, number theory, graph products, quadratic algebras, arachnid mechanisms and homotopy theory. In this talk I shall describe a new approach to their cohomology and discuss a few applications.

JEFFREY CARLSON, University of Toronto
[Saturday June 8 / samedi 8 juin, 9:30 – ED 318, Education Building]
Local integration in equivariant cobordism theory

It has long been known that the equivariant complex T-cobordism class $[M]$ of an stably complex manifold M equipped with the action of a torus T is uniquely determined by the equivariant normal bundle $\nu(M^T)$ to its fixed point set, and tom Dieck and Lü–Wang respectively showed $[M]$ is also determined by its equivariant-K-theoretic and Borel-cohomological Chern numbers.

Each of these results constructs an injection of the bordism ring $\Omega_*^{U,T}$ into local data, but none identifies the image. Not all local data is possible, by the Atiyah–Bott/Berline–Vergne ("ABBV") localization theorem, which expresses equivariant characteristic numbers in terms of tangent and normal data on M^T, thus imposing identities involving mixed Chern numbers and tangent and normal representation data. It is natural to wonder whether these ABBV identities cut out the image of $\Omega_*^{U,T}$ or there are further constraints.

For isolated fixed points, normal data essentially comprises a list of T-representations. In the case of GKM torus actions and semifree circle actions, we show, in some cases via concrete construction, that there are no other constraints: every list of representation data consistent with the ABBV identities in fact occurs.

This work builds on that of Alastair Darby in the GKM case and is joint with Adina Elisheva Gamse and Yael Karshon.

TYRONE GHASWALA, University of Manitoba
[Sunday June 9 / dimanche 9 juin, 8:30 – ED 318, Education Building]
Promoting circle actions to actions on the real line

Circularly-orderable and left-orderable groups play an important, and sometimes surprising, role in low-dimensional topology and geometry. For example, these combinatorial conditions completely characterize when a countable group acts on a 1-manifold. Through the so-called L-space conjecture, left-orderability of the fundamental group of rational homology 3-sphere is connected to analytic and topological properties of the manifold. I will present new necessary and sufficient conditions for a circularly-orderable group to be left-orderable, and introduce the obstruction spectrum of a circularly-orderable group. This raises a plethora of intriguing questions.

This is joint work with Jason Bell and Adam Clay.

RACHEL HARDEMAN, University of Calgary
[Saturday June 8 / samedi 8 juin, 10:00 – ED 318, Education Building]
An Introduction to A-Homotopy Theory: A Discrete Homotopy Theory for Graphs

A-homotopy theory was invented by R. Aktin in the 1970s and further developed by H. Barcelo and others in the early 2000s as a combinatorial version of homotopy theory. This theory respects the structure of a graph, distinguishing between vertices and edges. While in classical homotopy theory all cycles are equivalent to the circle, in Ahomotopy theory the 3-cycle and 4-cycle are contractible and all larger cycles are equivalent to the circle.

In this talk, we will examine the fundamental group in A-homotopy from the perspective of covering spaces. We will also establish explicit lifting criteria and examine the role of the 3-cycles and 4-cycles in these criteria.

ROBIN KOYTCHEFF, University of Louisiana at Lafayette
[Saturday June 8 / samedi 8 juin, 8:30 – ED 318, Education Building]
Operadic decompositions of spaces of string links

Budney showed that the space of long knots in 3-space is the free 2-cubes object on the space of prime knots, generalizing prime decomposition of knots from isotopy classes to the space of knots. He also showed that the space of long knots is freely generated over a splicing operad by the subspace of torus and hyperbolic knots, generalizing satellite decomposition of knots from isotopy classes to the space level. In joint work with Burke, we constructed a colored operad for string link infection, generalizing Budney's splicing operad from knots to links. We then decomposed a a subspace of 2-component string links over a certain suboperad of the infection operad. We conjecture that the full space of 2-string links admits a decomposition involving a suboperad related to the Swiss cheese operad. This conjecture is the subject of planned work with Songhafouo Tsopméné.

PATRICK NAYLOR, University of Waterloo
[Sunday June 9 / dimanche 9 juin, 9:00 – ED 318, Education Building]
Trisections and twists of 4-manifolds

Trisections were introduced by Gay and Kirby in 2013 as a way to study 4-manifolds. They are very similar in spirit to Heegaard splittings of 3-manifolds, and have the advantage of changing problems about manifolds into problems about diagrams. In this talk, I will give a brief introduction to trisections, and explain how they can be used to reprove a theorem of Katanaga, Saeki, Teragaito, and Yamada that relates Gluck and Price twists of 4-manifolds. This answers a recent question of Seungwon Kim and Maggie Miller.

CIHAN OKAY, University of British Columbia
[Saturday June 8 / samedi 8 juin, 17:00 – ED 318, Education Building]
Mod-ℓ homotopy type of the classifying space for commutativity

The classifying space for commutativity, denoted by $B_{\mathsf{com}}G$, of a Lie group G is assembled from commuting tuples in G as a subspace of the usual classifying space BG. The resulting space classifies principal G-bundles whose transition functions generate an abelian subgroup of G whenever they are simultaneously defined. The relationship between the homotopy type of G and the space $B_{\mathsf{com}}G$ is much more interesting, and non-trivial compared to the case of BG. In this talk, I will present a work, joint with Ben Williams, where we study the mod-ℓ homotopy type of $B_{\mathsf{com}}G$ at a prime ℓ. The techniques involve a homotopy colimit decomposition over a topological category generalizing the construction of Adem-Gomez and application of results on mapping spaces between classifying spaces of compact Lie groups due to Dwyer-Wilkerson. We show that for a connected compact Lie group the mod-ℓ homotopy type of $B_{\mathsf{com}}G$ depends on the mod-ℓ homotopy type of BG.

KATE POIRIER, City University of New York - New York City College of Technology
[Sunday June 9 / dimanche 9 juin, 9:30 – ED 318, Education Building]
Directed planar trees, V-infinity algebras, and string topology

Stasheff's associahedra are polyhedra that provide a model for algebras whose products are associative up to homotopy. In this talk, we introduce "assocoipahedra," which model $\mathcal{V}_\infty$ algebras—algebras with a product and a co-inner product and relations that hold up to homotopy. Where associahedra are described combinatorially in terms of rooted planar trees, assocoipahedra are generalizations described in terms of directed planar trees. We use the structure of assocoipahedra to describe Tradler–Zeinalian's algebraic string operations on the Hochschild complex of a $\mathcal{V}_\infty$ algebra and Drummond-Cole–Poirier–Rounds's corresponding string topology operations on the singular chains of the free loop space of a manifold. We also use this structure to show that the operad governing $\mathcal{V}_\infty$ algebras is Koszul. This is joint work with Thomas Tradler.

STEVEN RAYAN, University of Saskatchewan
[Saturday June 8 / samedi 8 juin, 16:30 – ED 318, Education Building]
The quiver at the bottom of the twisted nilpotent cone on $\mathbb{P}^1$

For the moduli space of Higgs bundles on a Riemann surface of positive genus, critical points of the natural Morse-Bott function lie along the nilpotent cone of the Hitchin fibration and are representations of A-type quivers in a twisted category of holomorphic bundles. The fixed points that globally minimize the function are representations of A_1. For twisted Higgs bundles on the projective line, the quiver describing the bottom of the cone is more complicated. We determine it and show that the moduli space is topologically connected whenever the rank and degree are coprime.

KRISHANU SANKAR, University of British Columbia
[Sunday June 9 / dimanche 9 juin, 10:00 – ED 318, Education Building]
Mod 2 cohomology and the braid group

A classical theorem of Mahowald states that the Eilenberg-Maclane spectrum of $Z/2$ is the Thom spectrum of the stable Hopf bundle on the double loopspace of the 3-sphere. Thus, $HZ/2$ is filtered by Thom spectra on the classifying spaces of the braid groups. There is a closely related filtration built from symmetric powers, and these two filtrations capture the intricate behavior of mod 2 power operations.

I'll discuss recent work which generalizes this story to the equivariant setting, including two actions of the cyclic group of order two on the braid group and a geometric interpretation of equivariant mod 2 homology in terms of bundles.

LAURA SCULL, Fort Lewis College
[Saturday June 8 / samedi 8 juin, 9:00 – ED 318, Education Building]
Transitive Groupoids with Interesting Topological Properties

I will discuss some examples of interesting transitive topological groupoids from the literature. This talk is an offshoot of a project with J. Watts and C. Farsi, where we studied the actions of transitive groupoids. Under normal topological conditions, we can reduce the action of a transitive groupoid to the action of a single isotropy group on a fibre. However, we ran across examples of some more unusual topological groupoids where this is not possible. I will discuss examples from Muhly-Renault-Williams and Buneci.

BEN WILLIAMS, University of British Columbia
[Saturday June 8 / samedi 8 juin, 16:00 – ED 318, Education Building]
$\mathbb{A}^1$-homotopy and a conjecture of Suslin

This is joint work with Aravind Asok and Jean Fasel.

Fix an infinite perfect field k.

The $\mathbb{A}^1$-homotopy theory of SL_n is intimately related with algebraic K-theory. Specifically, for $i \in \{1, \dots, n-2\}$, one has $\pi_i^{\mathbb{A}^1}(SL_n)(k) = K_i(k)$. The boundary case of $i = n-1$ has something to do with the interface between rank-n vector bundles and K-theory, which has been extensively studied. We give a partial calculation of $\pi_2^{\mathbb{A}^1}(SL_3)$ and a complete calculation of $\pi_3^{\mathbb{A}^1}(SL_4)$, and we show how this (partly in the case of $n = 3$) answer a question of Suslin's from 1984 regarding the homology of the group $SL_n(k)$.

Org: Yuliya Nesterova (Queen's University) and/et **Asmita Sodhi** (Dalhousie University)

Abstracts/Résumés

LIU ANKAI, Queens University

A Generalization of the Compression Cone Method for Integral Equations with Changing Sign Green's Functions

A new class of cone is proposed as a generalization to the compression cone techniques in studying existence of solutions for integral equations using fixed-point index. As a result, the method is shown to be more adaptable particularly in dealing with integral equations with changing sign Green's functions. We prove new results for semi-linear integral equations. Applications are illustrated by examples. Limitations of such new method are also discussed.

MEHWISH ANWAR, University of Regina

A Connection Between Graphs and the Quantum Group $U_q(\mathfrak{sl}_2(\mathbb{C}))$

We will explore a connection between certain graphs and the quantum group $U_q(\mathfrak{sl}_2(\mathbb{C}))$, as well as applications of this to representation theory. Given a distance-regular, bipartite, and dual bipartite graph, we construct its Terwilliger algebra. We will see how to map $U_q(\mathfrak{sl}_2(\mathbb{C}))$ onto the Terwilliger algebra, which lets us understand the algebraic structure of the latter. A simple example of this involves the cube graph, which we shall consider in detail.

JACK DING, University of Toronto

The Atiyah-Bott Fixed Point Theorem for the Based Loop Group

The Atiyah-Bott fixed point theorem for elliptic complexes is a powerful tool to compute the Lefschetz number of an elliptic operator in terms of data around the fixed points of a compact Lie group action. It has various applications in geometry and representation theory, including a new way to prove the Weyl character formula for semisimple Lie algebras. In that case, the rational functions one multiplies at each fixed point is given by the Weyl denominator.

The based loop group of a compact group K has a natural action by its maximal torus T and a rotation action by the circle S^1, these two actions commute. We extend the Atiyah-Bott formula to the based loop group of $\Omega SU(2)$ and provide a formula for the rational functions one must multiply at each fixed point of the $T \times S^1$ action. This is done by applying the Atiyah-Bott theorem on a filtration of $\Omega SU(2)$ comprised of finite-dimensional spaces and taking a limit.

FARID GASSOUMOV, York University

Osmotic Pressure of Confined Square Lattice Self-Avoiding Walks

Flory-Huggins theory is a mean field theory for modelling the free energy of dense polymer solutions and polymer melts. In this poster presentation, we use the Flory-Huggins theory as a model of a dense two-dimensional self-avoiding walk confined to a square in the square lattice. The theory described the free energy of the walk well, and we estimate the Flory interaction parameter of the walk Chi $= 0.32$

FARRAH HUNTINGHAWK, Brandon University

Exploring positive operator-valued measures

Positive operator-valued measures (POVMs) arise naturally in quantum mechanics. Here, we study them from a mathematical point of view, employing techniques from operator theory and measure theory.

ROGHAYEH MALEKI, University of Regina

Maschke's Theorem for Table Algebras

We give a generalization of the averaging argument for Maschke's theorem in the setting of table algebras (aka. fusion rings). Table algebras are algebras with involution over $\mathbb{C}$ with finite basis B that contains 1, is $*-$closed, has non-negative real structure constants $\{\lambda_{bcd} : b, c, d \in B\}$ given by $bc = \sum_d \lambda_{bcd} d$, and satisfies the $\underline{pseudo-inverse\ condition}$: $\lambda_{bc1} > 0 \Longleftrightarrow c = b^*$, and $\lambda_{b*b1} = \lambda_{bb*1}$. When F is a field with (possibly trivial) involution $^-$ containing the structure constants $\{\lambda_{bcd} : b, c, d \in B\}$, then FB becomes an F-algebra with involution defined by

$$\left(\sum_{b\in B} \alpha_b b\right)^* = \sum_{b\in B} \bar{\alpha_b} b^*.$$

This version of Maschke's theorem gives sufficient conditions on the characteristic of the field F for FB to be a semisimple algebra, in terms of arithmetic properties of the table algebra basis B.

COMFORT MINTAH, University of Guelph

Operator structures and conditions for quantum one-way LOCC

We study the physical description of Quantum Local Operations and Classical Communications (LOCC) and its schematics. We restrict ourselves to one-way LOCC (one of the schemes of LOCC) and discuss detailed analysis in quantum information of recently derived operator relations. We indicate how operator structures such as operator systems and operator algebras naturally arise from these settings and make use of these structures to derive new result and new derivations of some established results in one-way LOCC. We compare perfect distinguishability of one-way LOCC versus arbitrary quantum operations and show the equivalence relation for several families of operators that appear jointly in matrix and operator theory and quantum information theory.

MARIIA SOBCHUK, University of Waterloo

Quantum chromatic number

Chromatic number of the graph is the minimum integer t such that each vertex is assigned one of the t colours, but adjacent vertices receive different colours. Recently, there has been interest in its quantum analogue. Published between 2007 and 2016, papers of Cameron, Mancinska, Roberson and Scarpa provide most of what is known to date about quantum chromatic number, which turns out to be defined in terms of quantum measurements, or a specific set of projections. Interestingly, we will see examples when quantum chromatic number is strictly less than chromatic number of the graph and outline directions of further research.

SUDAN XING, Memorial University of Newfoundland

The general dual-polar Orlicz-Minkowski problem

In this poster, I will present the general dual-polar Orlicz-Minkowski problem, which is "polar" to the recently initiated general dual Orlicz-Minkowski problem and "dual" to the newly proposed polar Orlicz-Minkowski problem. The problem states as follows:

Under what conditions on a nonzero finite Borel measure μ defined on the unit sphere, continuous functions $\varphi : (0, \infty) \to (0, \infty)$ and $G : (0, \infty) \times S^{n-1} \to (0, \infty)$ can we find a convex body K (with the origin in its interior) solving the following optimization problems

$$\inf / \sup \left\{ \int_{S^{n-1}} \varphi(h_Q(u)) d\mu(u) : Q \in \widetilde{\mathcal{B}} \right\},$$

where $\widetilde{\mathcal{B}} = \left\{Q \in \mathcal{K}^n_{(o)} : \widetilde{V}_G(Q^\circ) = \widetilde{V}_G(B^n)\right\}$ with B^n the unit ball and $\widetilde{V}_G$ the general dual volume. In particular, we will present the existence, continuity and uniqueness of the solutions for the general dual-polar Orlicz-Minkowski problem. This poster is based on a joint work with Deping Ye and Baocheng Zhu.

2019 CMS
Winter Meeting

December 6-9, 2019

The Chelsea Hotel, Toronto, Ontario

CALL FOR SESSIONS

The Canadian Mathematical Society (CMS) welcomes and invites session proposals for the 2019 CMS winter meeting in Toronto from December 6-9.

Proposals should include (1) names, affiliations, and contact information for all session co-organizers, (2) title and brief description of the focus and purpose of the session, (3) a preliminary list of potential speakers, with their affiliations and if they have agreed to participate, along with a total number of expected speakers.

Sessions will take place December 7, 8, and 9. The meeting schedule will accommodate 9 speakers per full day, and 4 or 5 per half day. Sessions will be advertised in the CMS Notes, on the web site and in the AMS Notices. Speakers will be requested to submit abstracts, which will be published on the web site and in the meeting program. Those wishing to organize a session should send a proposal to the Scientific Directors. Those submitting proposals are encouraged to pay attention to the diversity of both the session invitees and the proposed session organizers.

Scientific Directors:

Patrick Ingram (York University) pingram@yorku.ca
Jane Heffernan (York University) jmheffer@yorku.ca

Réunion d'hiver
de la SMC 2019

6-9 décembre 2019

The Chelsea Hotel, Toronto, Ontario

APPEL DE PROPOSITIONS DE SESSIONS

La Société mathématique du Canada (SMC) invite la communauté mathématique à proposer des sessions pour sa Réunion d'hiver 2019, qui se tiendra à Toronto du 6 au 9 décembre.

Ces propositions doivent comprendre : 1) le nom, l'affiliation et les personnes à contacter pour tous les coorganisateurs de session; 2) le titre et une brève description de l'orientation et des objectifs de la session; 3) une liste préliminaire de conférenciers potentiels avec leur affiliation et leur intention de participer, ainsi que le nombre de conférenciers prévus.

Les sessions se dérouleront les 7, 8, et 9 décembre. Le format de la Réunion peut accommoder 9 conférenciers par journée pleine, et 4 ou 5 par demi-journée. Toutes les sessions seront annoncées dans les Notes de la SMC, sur le site Web et dans les notices de l'AMS. Les conférenciers devront présenter un résumé, qui sera publié sur le site Web et dans le programme de la Réunion. Toute personne qui souhaiterait organiser une session est priée de faire parvenir une proposition aux directeurs scientifiquespatrick. Nous vous invitons, dans votre proposition, à porter attention à la diversité des personnes invitées et des organisateurs de la session proposée.

Directeurs scientifiques :

Patrick Ingram (York University) pingram@yorku.ca
Jane Heffernan (York University) jmheffer@yorku.ca

Canadian Mathematical Society
Société mathématique du Canada

CMS 75th Anniversary Meeting

The Canadian Mathematical Society (CMS) welcomes and invites proposals for scientific sessions for the 2020 CMS Summer meeting in Ottawa from June 5-8, 2020.

Proposals should include (1) names, affiliations, and contact information for two (or more) session co-organizers, (2) a title and brief description of the focus and purpose of the session, (3) a preliminary list of potential speakers with their affiliations, along with a total number of expected speakers. Potential organizers are encouraged to consider diversity in their selection of session invitees.

Sessions will take place June 5-8. They will be advertised in the CMS Notes, on the CMS website and in the AMS Notices. Speakers will be requested to submit abstracts, which will be published on the website and in the meeting program.

Those wishing to organize a session should send a proposal to the Scientific Directors:

Ailana Fraser (University of British Columbia) **afraser@math.ubc.ca**
Monica Nevins (University of Ottawa) **mnevins@uottawa.ca**
Mateja Šajna (University of Ottawa) **msajna@uottawa.ca**

Proposals should be submitted by **September 30, 2019**.

Réunion du 75e anniversaire de la SMC

La Société mathématique du Canada (SMC) sollicite des propositions de sessions scientifiques pour sa Réunion d'été 2020, qui se tiendra à Ottawa du 5 au 8 juin 2020.

Les propositions doivent inclure (1) les noms, affiliations et coordonnées d'au moins deux coorganisateurs, (2) un titre et une brève description du sujet et du but de la session, (3) une liste préliminaire des conférenciers potentiels avec leurs affiliations, ainsi que le nombre de conférenciers attendus. Les organisateurs potentiels sont invités à prendre en compte la diversité dans leur sélection d'invités.

Les sessions auront lieu du 5 au 8 juin. Toutes les sessions seront annoncées dans les Notes de la SMC, sur le site web de la SMC et dans les AMS Notices. Les conférenciers devront présenter un résumé, qui sera publié sur le site web et dans le programme de la Réunion.

Toute personne qui souhaiterait organiser une session est priée de faire parvenir une proposition aux directeurs scientifiques :

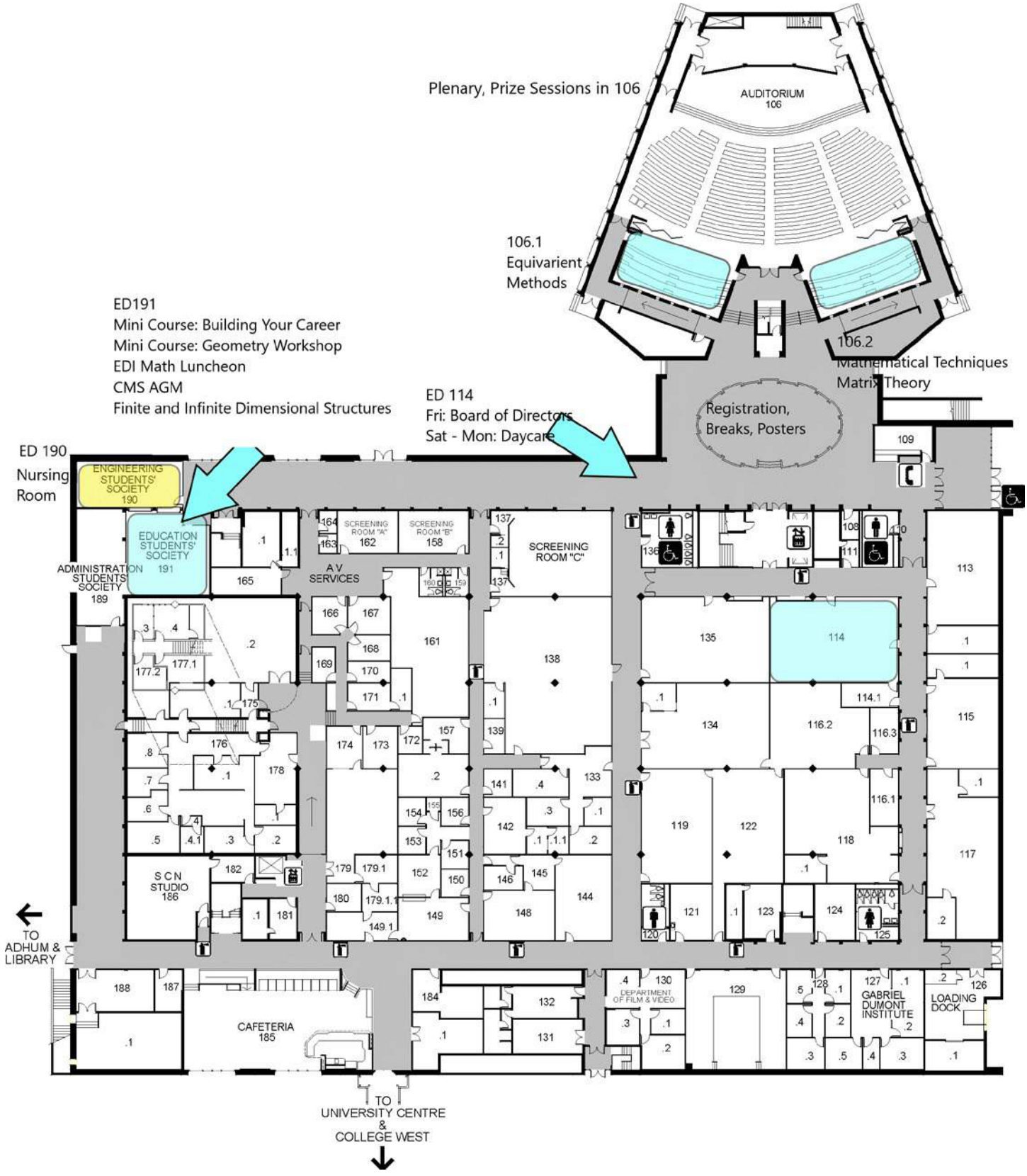
Ailana Fraser (Université de la Colombie-Britannique) **afraser@math.ubc.ca**
Monica Nevins (Université d'Ottawa) **mnevins@uottawa.ca**
Mateja Šajna (Université d'Ottawa) **msajna@uottawa.ca**

La date limite pour présenter une proposition est le **30 septembre 2019**.

Floorplans / Cartes

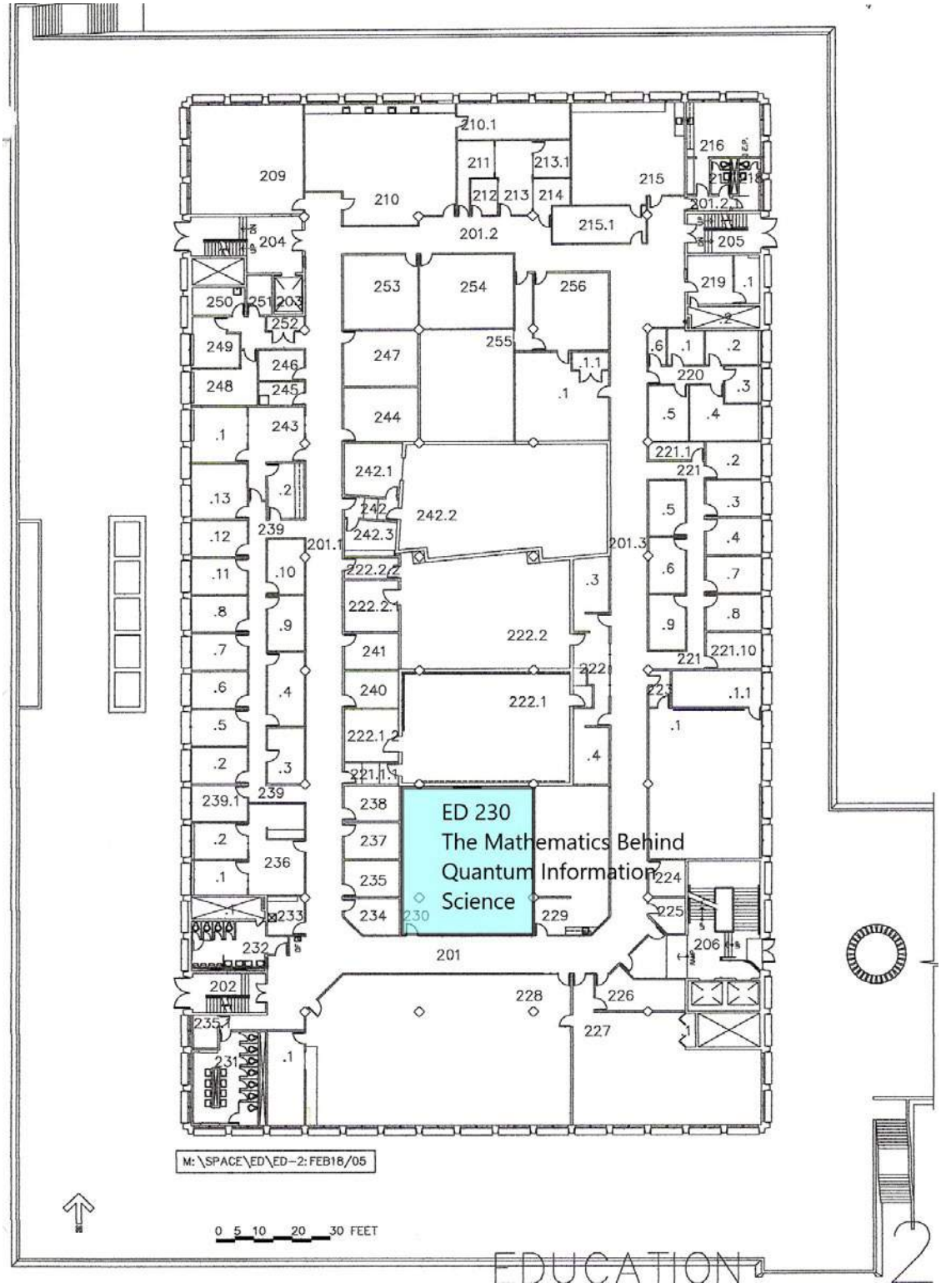
Education Building

1st Floor / 1er étage



Education Building

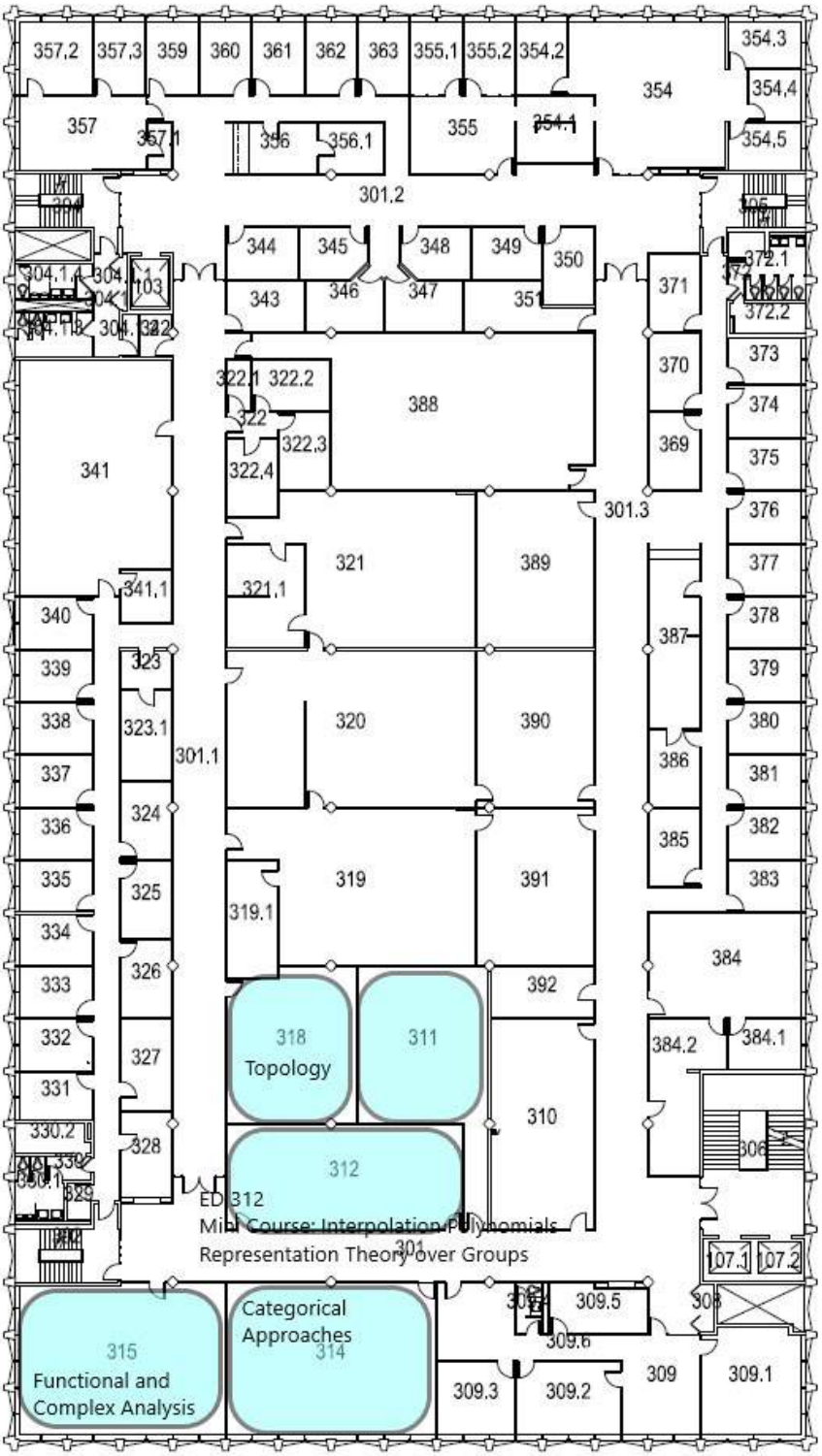
2nd Floor / 2e étage



Floorplans / Cartes

Education Building

3rd Floor / 3e étage



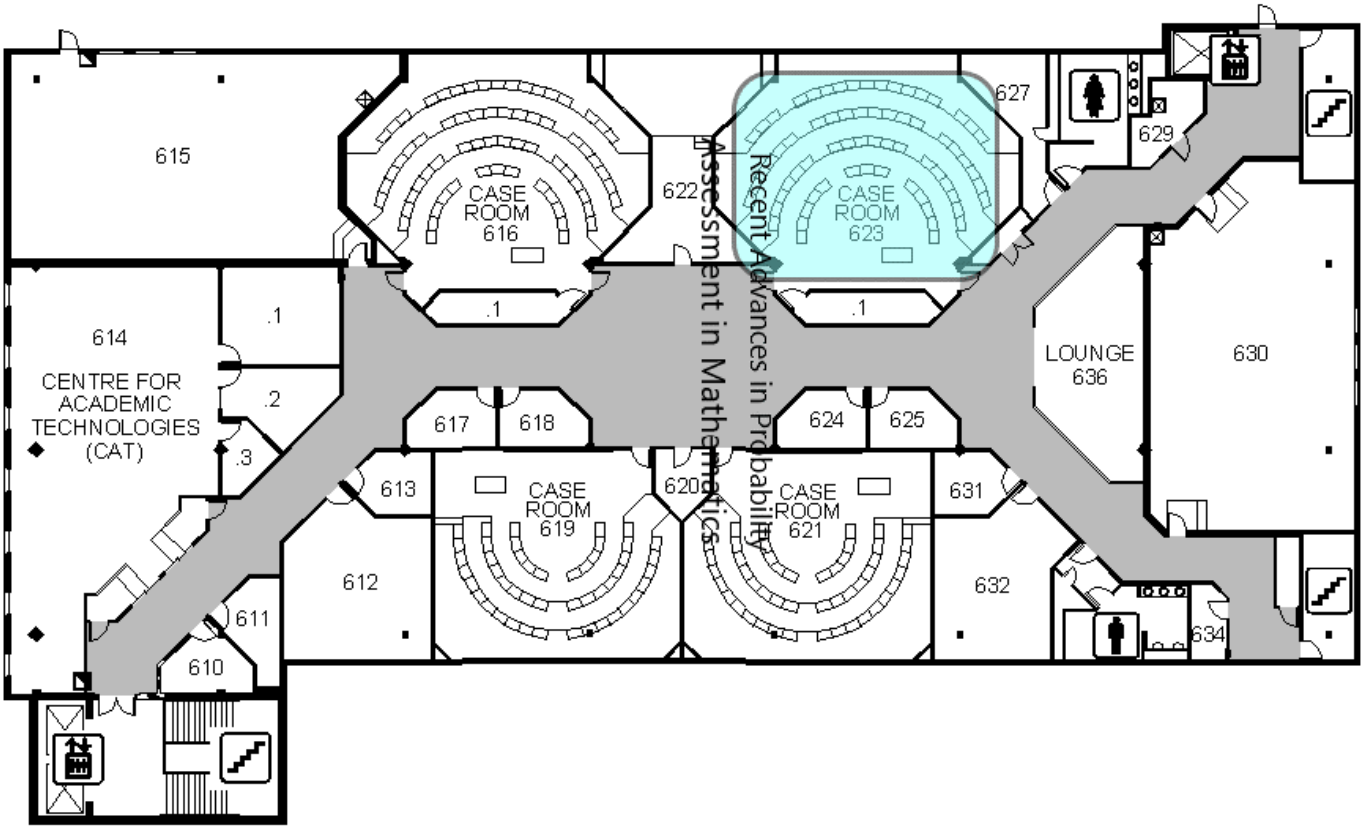
Education Building

5th Floor / 5e étage

Floorplans / Cartes

Education Building

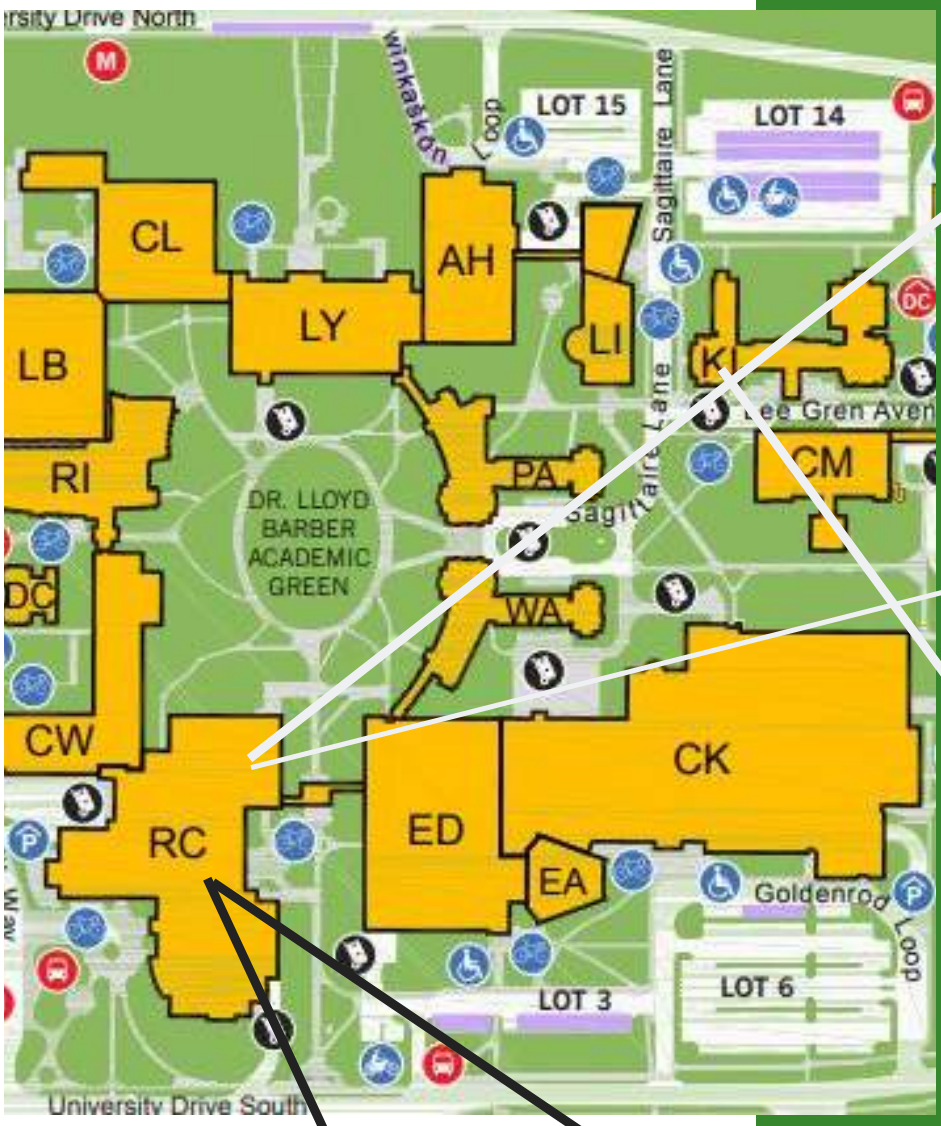
6th Floor / 6e étage



University of Regina Dining Locations

Campus Map / Carte du campus

WHATS OPEN



Common Ground

Double Treat Bakery

On the Go

Riddell Centre Common Ground Coffee Shop open
June 8th and 9th: 7am-5pm
June 7th and 10th: 7am-2pm

Tim Hortons

Riddell Centre Tim Hortons
June 7th and 10th 7am-4pm

Kīšik C-Store

Tim Hortons

Kisik Towers Store with Tim Hortons. Open June 8th and 9th from 9am - 1pm

June 7th & 10th: 11am-3pm

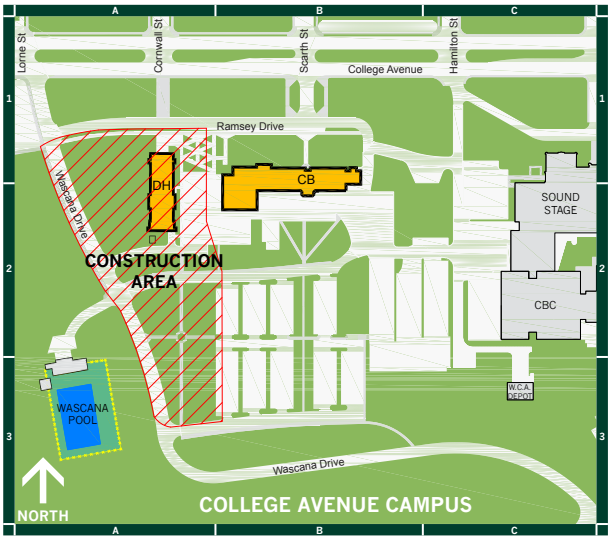
Riddell Centre
June 7th and 10th
Global Village
Lunch 11am-3pm
Dinner 4pm - 7pm

The Owl Pub
Friday, 11am-12am
Saturday 11am-5pm
Sunday 11am - Close

Floorplans / Cartes

University of Regina

Campus Map / Carte du campus



Building Code	Building and Address	Map Grid
	MAIN CAMPUS	
AH	**Administration-Humanities**, 3719 wînkaskôn Loop	C4
CM	**Campion College**, 3825 Lee Gren Avenue	C5
CK	**Centre for Kinesiology, Health and Sport**, 3925 Goldenrod Loop	C5
CL	**Classroom**, 3707 Sureau Loop	B4
CW	**College West**, 3903 wîbazuką Road	B5
DC	**Day Care**, 3809 wîbazuką Road	B5
EA	**Education Auditorium**, 3919 University Drive South	C6
ED	**Education**, 3919 University Drive South	C5
FN	**First Nations University of Canada**, 1 First Nations Way	E4
GG	**Greenhouse Gas Technology Centre** (GGTC), 4029 cistêmâw Court	C7
HP	**Heating Plant**, 4005 Innovation Loop	C6
KI	**Kîšik Towers**, 3747 Lee Gren Avenue	C5
LB	**Laboratory**, 3711 Sureau Loop	B5
LC	**Luther College**, 3829 Lee Gren Avenue	D5
LI	**Language Institute**, 3727 Sagittaire Lane	C5
LY	**Dr. John Archer Library**, 3715 University Drive North	B5
PA	**Paskwâw Tower**, 3817 Sagittaire Lane	C5
RC	**Dr. William Riddell Centre**, 3907 Buffaloberry Way	B6
RI	**Research and Innovation Centre**, 3805 wîbazuką Road	B5
TD	**Technology Development Facility**, 3303 Grant Road	
WA	**Wakpá Tower**, 3821 Sagittaire Lane	C5
	COLLEGE AVENUE CAMPUS	
CB	**College Building**, 2155 College Avenue	B1
DH	**Darke Hall**, 2255 College Avenue	A1
	INNOVATION PLACE	
2R	**2 Research Drive**, 2 Research Drive	B6
5R	**Saskatchewan Disease Control Laboratory**, 5 Research Drive	B7
6R	**Petroleum Technology Research Centre** (PTRC), 6 Research Drive	B7
10R	**The Terrace**, 10 Research Drive	B7
ISM	**ISM**, 1 Research Drive	B6

Mini-Courses | Mini-cours

Friday June 7 | Vendredi 7 juin

9AM – 12PM | 9 H – 12 H

Minicourse on Building Your Career in Mathematics | Mini-cours sur la préparation à une carrière en mathématiques

Facilitators | Formateurs:
Allen Heman and Karen Meagher (Regina)

1PM – 4PM | 13 H – 16 H

Convex-Geometric Methods in Random Matrix Theory | Méthodes de la géométrie des convexes en théorie des matrices aléatoires

Presenter:
Konstantin Tikhomirov (Georgia Tech)

Basics of Quantum Information Theory | Fondements de la théorie de l'information quantique

Facilitators | Formateurs :
Sarah Plosker (CRC Chair, Brandon) and Nathaniel Johnston (Mount Allison)

Geometry Workshop | Atelier de géométrie

Facilitators:
Chris Fisher (University of Regina), Brett Stevens (Carleton University) and Tim Alderson (University of New Brunswick)

Using the Sage Mathematics Software System in Algebra and Discrete Math | Utilisation du logiciel de mathématiques Sage en algèbre et en mathématiques discrètes

Facilitator | Formateur :
Krystal Guo

Introduction to Graph Searching | Introduction à la recherche de graphes

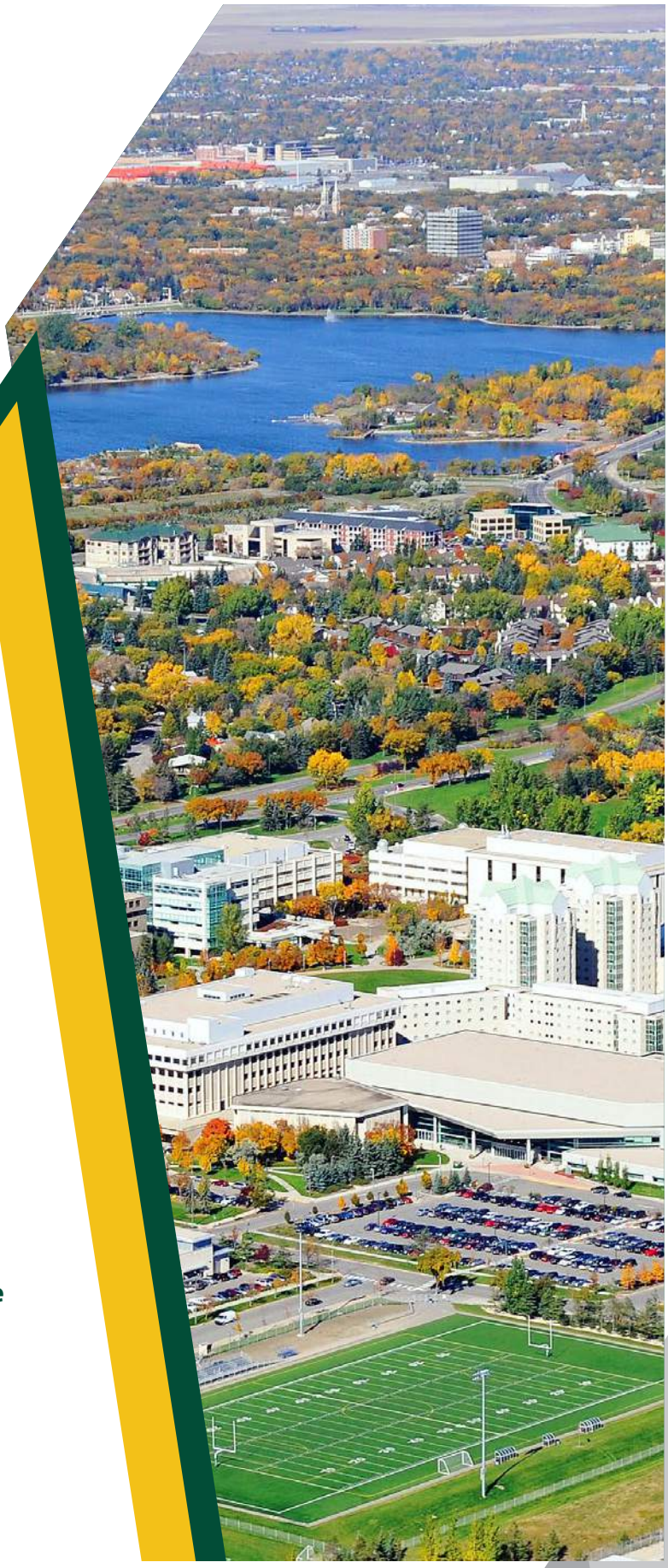
Facilitators | Formateurs :
Ryan Tifenbach (Mount Allison University) and Danny Dyer (Memorial University)

Interpolation polynomials and representation theory: transcending the classical Capelli identity | Polynômes d'interpolation et théorie des représentations : transcender l'identité classique de Capelli

Facilitator | Formateur :
Hadi Salmasian (University of Ottawa)

Category Theory in Topological Data Analysis

Instructor | Formateur :
Jonathan Scott (Cleveland State University)




CMS
SMC


FIELDS
PIMS
AARMS
CRM


University
of Regina