Student Research Session
Session de présentations de recherche par les étudiants
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DYLAN CANT, Université de Montréal
Mathematician's Toolkit

Mathematics has always depended on its tools, from chalk and paper to the software we use today to write, collaborate, and share our work. This workshop is a practical, informal tour of the technologies that shape how mathematicians work now, with a few stories about where these tools came from and why they exist. We will look at how to work more efficiently, how to collaborate and keep a trustworthy record of your work, and how to make your work visible. We will also discuss how to use emerging AI tools thoughtfully and responsibly in research and teaching.
No prior experience is needed; bring your questions and your workflow frustrations!

ABDOULAYE DIALLO,
Lamé monodromy and modular Schwarzian equations

We introduce two second-order ordinary differential equations in Schrödinger form: the Lamé equation in the elliptic variable (z), with potential $(n(n+1)\wp(z;\tau)+B)$, and a modular differential equation in the modulus (τ), with a weight-four modular potential. We link the two equations through the period monodromy of the Lamé equation. At spectral values where the period monodromy is not completely reducible, we identify its projective Jordan datum with a projective period class $\mathcal{C}$ and show that $\mathcal{C}$ is equivariant under the modular group.

We then study the permutation monodromy obtained by varying the elliptic modulus. Over the Legendre parameter line, each nonlinear irreducible Type I or marked Type II spectral cover of degree N is simply branched at $N(N-1)$ points and has full symmetric monodromy S_N. We explain how intersections of the marked branch loci govern the Galois groups, including the exceptional quadratic cases.

We will close with the explicit example $n=3$, $B=0$, where the Schwarzian derivative of the projective period class satisfies

$$\{\mathcal{C},\tau\} = 2\pi^2 E_4(\tau).$$

NOHA ELGAREM, University of Toronto
Image Cones and Conjugacy Invariants of Matrix Lie Subalgebras

The classification of Lie subalgebras up to conjugacy is a fundamental problem in Lie theory. An important aspect of this problem is finding invariants that distinguish non-conjugate subalgebras.

In this talk, I present results concerning the *image cone* of a matrix Lie subalgebra $\mathfrak{g}$, defined by

$$\mathrm{im}(\mathfrak{g}) = \{Xv : X \in \mathfrak{g},\ v \in \mathbb{C}^n\}.$$

Although the image cone is closed under scalar multiplication, it need not be a vector subspace. I investigate conditions under which it is a subspace, proving that, among all conjugacy classes of subalgebras of $\mathfrak{sl}_3(\mathbb{C})$, exactly one has an image cone that is not a vector subspace. I also establish that the image cone is a vector subspace for every subalgebra of $\mathfrak{so}_n(\mathbb{C})$ when $n \leq 4$, while this property does not necessarily hold in higher dimensions.

In addition, I introduce and study conjugacy invariants, including the total column rank and total row rank. Together with other structural invariants, these provide a complete set of invariants distinguishing the conjugacy classes of subalgebras of $\mathfrak{sl}_3(\mathbb{C})$.

JOEY FINGOLD, University of Guelph
A moment generating function inference framework for thinned Poisson autoregressions

Count time series models are popular for modelling surveillance data of infectious diseases, such as COVID-19 and influenza, due to their flexibility and interpretability. However, observed data on daily infections is subject to underreporting, as not every infected individual seeks medical care. One such model with an underreporting mechanism is the binomially-thinned Poisson autoregression. This model is challenging to fit since it involves high-dimensional and serially correlated integer-valued unknowns. We propose a novel inference framework that uses moment generating functions (MGFs) to encode an entire binomially-thinned Poisson autoregression into a single object. We recursively define this MGF using induction and subsequently condition it on the observed data using their Fourier series representation. We further propose an implementation through Monte Carlo integration with a novel approach to parameter estimation.

MUSBAHU IDRIS, Institut Élie Cartan de Lorraine & University of Lorraine

TAMIS PANAGIOTAKIS, University of Toronto
Kähler Manifolds and Chow's Theorem

The Whitney embedding theorem states that any smooth manifold has a smooth embedding into some Euclidean space. However, the holomorphic analogue fails; compact connected complex manifolds of positive dimension have no holomorphic embedding into $\mathbb{C}^n$. Instead, $\mathbb{CP}^n$ can replace $\mathbb{C}^n$ as an ambient space to embed such manifolds, but not all compact complex manifolds embed into $\mathbb{CP}^n$. We explain that the existence of such an embedding is constrained by vanishing cohomology in even degrees with real coefficients. By Chow's theorem, which we deduce from classical results of Serre, we present a correspondence between closed complex submanifolds and smooth projective algebraic subvarieties of $\mathbb{CP}^n$, further establishing that projective space is a natural ambient space to study such manifolds.

JOHNNA PARENTEAU, University of Regina
Distinct Spectra and Interlacing in Hollow Graphs

Historically, the characteristic polynomial has primarily been the object used to derive spectral information about a graph; however, the *weighted matching polynomial*, denoted by $m_w(G, x)$ has recently been a topic of interest. It is well known that the roots of the weighted matching polynomial enjoy an interlacing property with respect to a vertex-deleted subgraph. A natural question is "for which graphs G does strict interlacing hold among the roots of roots of $m_w(G, x)$ and $m_w(G\backslash\{v\}, x)$?" A classical example of such a graph is one that contains a Hamilton path. In this talk, we generalize this notion to establish a new class of graphs called SRSI_w graphs and characterize them by providing a construction using a simple graph expansion operation.

YUXUAN SUN, University of Toronto
Some Results in Coxeter Schubert Calculus

In this talk, I will give an overview of Coxeter Schubert calculus following the recent preprint by Bergeron, Gagnon, Spink and Tewari. Coxeter Schubert calculus is the study of intersections of Coxeter Schubert cycles, which may be viewed as torus-invariant subvarieties of Schubert cycles defined via a fixed Coxeter word. I will first give a brief summary of Schubert cycles on complete flag varieties, followed by the construction of Coxeter Schubert cycles and their relations to (ordinary) Schubert cycles. Then, I will present some positivity results in Coxeter Schubert calculus, with a focus on how these results connect to positivity in ordinary Schubert calculus. In particular, all of the results presented are valid in a torus-equivariant setting. No prior knowledge of Schubert calculus will be assumed from the audience.

TALK/PANEL/Q&A,
Studc Town Hall

Student groups, events, and communities thrive when students shape them. The CMS Student Committee (StudC) works to support math students across Canada, from local student groups to national initiatives. Join us for a 10-minute overview of what we do and how you can get involved.

Afterwards, let's talk! What would make StudC more useful or interesting to you? What's missing? Share your questions, ideas, and honest feedback, because what we hear will directly shape what we do next.

Open to all undergraduate and graduate students.

IZ TECUM, Columbia University
Generic C^2 Spline Dimensions via Defect Modules and Deformation

We study planar C^2 spline dimensions through graded defect modules and deformations of vertex coordinates. For an explicit infinite family of triangulations obtained from split bipyramids, we aim to prove that every quartic spline on a generic realization is a global polynomial. We also derive a conditional first-order criterion for eliminating degree-six cofactor generators, illustrated by an exact rational calculation. These results address specific families and deformation mechanisms within the higher-smoothness generalization of Strang's spline dimension problem.