STUDC Research Session
Session de recherche du Comité des étudiants

PETER BRADSHAW, Simon Fraser University
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
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
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
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

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.