13th Graph Searching in Canada (GRASCan) Workshop

May 24–25, 2025

Ottawa, Ontario

Saturday, May 24

9:45 - 10:00	Opening remarks
10:00 - 11:00	**Danielle Cox**, Mount Saint Vincent University *Searching for Answers*
11:00 - 11:30	BREAK
11:30 - 12:00	**Bojan Mohar**, Simon Fraser University and University of Ljubljana *Cops and robber on complete r-graphs*
12:00 - 12:30	**Rylo Ashmore**, Memorial University of Newfoundland *On a Lotta Novel Automata Models (for pursuit-evasion games)*
12:30 - 2:00	LUNCH
2:00 - 2:30	**Bill Kinnersley**, The University of Rhode Island *The burning game*
2:30 - 3:00	**William Kellough**, Memorial University of Newfoundland *Open Problems Regarding the Bodyguards and Presidents Game*
3:00 - 3:30	**Trent Marbach**, Toronto Metropolitan University *Meyniel Extremal Families of Graphs*
3:30 - 4:30	OPEN DISCUSSION

Sunday, May 25

10:00 - 11:00	**Danny Dyer**, Memorial University of Newfoundland *How do you solve a problem like deduction?*
11:00 - 11:30	BREAK
11:30 - 12:00	**Shannon Fitzpatrick**, University of Prince Edward Island *Deduction with k moves*
12:00 - 12:30	**Ryan Cushman**, University of Wisconsin, Eau-Claire *Burning pseudo-random graphs*
12:30 - 2:00	LUNCH
2:00 - 2:30	**Karen Collins**, Wesleyan University *Discrete-time immunization number*
2:30 - 3:00	**Logan Pipes**, Memorial University of Newfoundland *Limited Visibility Localization and the Radius of Location*
3:00 - 3:30	**John Marcoux**, Toronto Metropolitan University *Multi-Robber Localization: A New Metric Dimension Type Parameter For Localization*
3:30 - 4:30	OPEN DISCUSSION

Abstracts of Talks

Danielle Cox, Mount Saint Vincent University — Saturday
Searching for Answers — 10:00 - 11:00

From Cops & Robber to Eternal Domination, Graph Burning and beyond, we will look at recent results of a number of variations of discrete-time processes on graphs. Focusing on the collaborative spirit of GRASCan, we will highlight related open problems appropriate for undergraduate & graduate students, early & senior career researchers.

Bojan Mohar, Simon Fraser University and University of Ljubljana — Saturday
Cops and robber on complete r-graphs — 11:30 - 12:00

Let $K_n^{(r)}$ denote the complete r-graph, i.e. the hypergraph on n vertices in which each r-tuple forms a hyperedge. By replacing each hyperedge by a regular simplex, we obtain a simplicial complex whose points can be viewed as the points $(x_1, \ldots, x_n) \in R^n$ with at most r nonzero coordinates that satisfy $x_1 + \cdots + x_n = 1$. It is shown that bounded number of cops can win the game of Cops and Robber on this space.

This is joint work with Vesna Irsic and Alexandra Wesolek.

Rylo Ashmore, Memorial University of Newfoundland — Saturday
On a Lotta Novel Automata Models (for pursuit-evasion games) — 12:00 - 12:30

In the game of Cat Herding on a graph, one player (the herder) will omnipresently delete edges, while the other player (the cat) is on a vertex of the graph, and will move along any path to a new vertex. The cat's objective is to avoid capture, while the herder tries to hasten it. In an optimally played game on a finite graph, the number of cuts the herder made to isolate the cat is the *cat number* of the graph.

We discuss automata theory, formal logic, and how these ideas can be used to solve an infinite version of the cat herding game. In particular, we find an equivalence between certain logical sentences and cat-win structures. Using this equivalence with Rabin's Theorem, we obtain a finite time algorithm for identifying cat-win infinite trees and an explicit (transfinite) herder strategy for herder-win infinite trees. Time-permitting, we may also discuss applications of automatic techniques to the firefighting problem.

Bill Kinnersley, The University of Rhode Island — Saturday
The burning game — 2:00 - 2:30

We introduce the *burning game*, a two-player game motivated by the previously-studied burning and cooling processes. In the burning game on a graph G, the players *Burner* and *Staller* take turns selecting vertices of G to burn; additionally, in each round of the game, every burning vertex spreads fire to all unburned neighbors. Burner aims to burn all vertices of G as quickly as possible, while Staller aims to prolong the game as much as possible. When both players play optimally, the length of the game is the *game burning number* of G, denoted by $b_{\mathrm{g}}(G)$ if Burner plays the first move and by $b'_{\mathrm{g}}(G)$ if Staller plays first.

In this talk, we establish several fundamental properties of the burning game and explore similarities and differences between the burning game and the original burning process. We also pose an analogue to the well-studied burning number conjecture, and we show that determining the game burning number of a graph is NP-hard. Finally, we present several open questions and directions for future research.

This is joint work with Nina Chiarelli, Vesna Iršič Chenoweth, Marko Jakovac, and Mirjana Mikalački.

William Kellough, Memorial University of Newfoundland — Saturday
Open Problems Regarding the Bodyguards and Presidents Game — 2:30 - 3:00

Bodyguards and Presidents is a pursuit-evasion game where the pursuers, called bodyguards, win if and only if they surround the evader, called the president, by the end of all but finitely many bodyguard moves. The bodyguard number for a graph is the fewest number of bodyguards needed to win Bodyguards and Presidents on the graph. In this talk we will discuss the bodyguard number for several graph families and present bounds on the bodyguard number for various graph products. We will also share several open problems regarding the bodyguard number. This includes discussing graph families where the bodyguard number is unknown, a discussion on complexity, and introducing natural variations of the game. Joint work with Nancy Clarke and Danny Dyer.

Trent Marbach, Toronto Metropolitan University — Saturday
Meyniel Extremal Families of Graphs — 3:00 - 3:30

The well-known *Meyniel's conjecture* is that every connected graph with n vertices has cop number $O(\sqrt{n})$. A number of families of *Meyniel extremal* graphs that reach this proposed limit are known, and include incidence graphs of designs along with certain random graphs and Cayley graphs. Although this problem has received a lot of attention, the best upper bound has the form $\frac{n}{2^{(1-o(1))\sqrt{\log n}}}$; it is still unknown whether the cop number is $O(n^c)$ for any $c < 1$. Various properties of the graphs in these studied families are similar, and so it is natural to conjecture that there may be a link between these properties and the graphs having a large cop number.

We will present our recent work which shows, to the contrary, that there are

Meyniel extremal families of regular graphs with large chromatic number and large diameter, and we explore the connection between Meyniel extremal graphs and bipartite graphs. We also present results that show that there are an exponential number of new Meyniel extremal families with specified degrees. We give the best-known upper bound on the cop number of vertex-transitive graphs with a prescribed degree.

Using linear programming on hypergraphs, we explore the degrees in hypothetical families that have cop number $\omega(\sqrt{n})$, showing the surprising result that such families of graphs cannot be too close to being regular.

Danny Dyer, Memorial University of Newfoundland — Sunday 10:00-11:00
How do you solve a problem like deduction?

We will look at the deduction model for searching. This model has roots in classic pursuit evasion games with time restrictions and is equivalent to a restricted version of zero-forcing as well as to finding certain unusual matchings. We will examine its relation to classic graph parameters, explore its use in certain graph families, talk about some computational results, discuss work in progress, and mention several open problems.

Shannon Fitzpatrick, University of Prince Edward Island — Sunday 11:30 - 12:00
Deduction with k moves

The deduction game is a pursuit-evasion game played on a graph in which a set of searchers, or cops, must apprehend an invisible evader. Each cop knows every other cop's initial position on the graph and can only communicate with another cop if they occupy the same vertex. Otherwise, the cops do not know the others' positions during the game. In the original version of the game, each cop could make at most one move to an adjacent vertex. We consider a modified version of the game where each cop can make up to k moves for some fixed $k \geq 2$. In this talk, I will discuss deduction with k moves on various classes of graphs, and provide upper and lower bounds on the k-deduction number for Cartesian and strong products of paths. This is joint work with A. Burgess, N. Clarke, and M. Huggan.

Ryan Cushman, University of Wisconsin, Eau-Claire — Sunday 12:00 - 12:30
Burning pseudo-random graphs

Graph burning can model how contagion or misinformation spreads throughout a network. The burning number is the minimum number of discrete-time steps it takes for the entire graph to be engulfed. In this talk, we explore the burning number of pseudo-random graphs, which are deterministic graphs that try to mimic the core properties of binomial random graphs. We present general bounds on the burning number of pseudo-random graphs, as well as bounds on the burning number in relation to girth and diameter. We also present exact results for several classes of pseudo-random graphs, including types of strongly regular graphs: Moore graphs and incidence graphs of projective planes and generalized polygons. This is joint work with Seth Stevens.

Karen Collins, Wesleyan University — Sunday 2:00 - 2:30
Discrete-time immunization number

We introduce a discrete-time immunization version of the well-known Susceptible-Exposed-Infectious compartment model of a contagious disease. Our model has both an extended latency period and an extended protective period. Given a graph G, we assume that each vertex starts in the infected state, and that an immunization will clear a vertex for a fixed time period, and that the vertex will not become infected again unless it is adjacent to a contagious neighbor after the fixed time period has ended. We define the immunization number of G to be the smallest number of immunizers that are needed to clear all of the vertices of G, and provide several interesting bounds and examples.

Logan Pipes, Memorial University of Newfoundland — Sunday 2:30 - 3:00
Limited Visibility Localization and the Radius of Location

In the classic localization game, the cops use distance probes to determine the location of an invisible robber. By limiting the visibility of the probes to instead return the distance to the robber only when it is less than some threshold, we give an advantage to the robber. Typically, for some fixed threshold k, the question has been to find the minimum number of cops needed to locate the robber, called the k-visibility localization number, or the number needed to locate the robber in one turn, called the k-truncated metric dimension. We also examine the minimum value of k required when the number of cops is fixed instead. This is joint work with Danny Dyer and Melissa Huggan.

John Marcoux, Toronto Metropolitan University — Sunday 3:00 - 3:30
Multi-Robber Localization: A New Metric Dimension Type Parameter For Localization

One of the challenges of studying games like Localization and Cops and Robber is that these are typically studied as online processes, so showing strategies are optimal requires analyzing the choices made by both players. As such, many bounds on these parameters make use of offline processes like the domination number or the metric dimension.

In this talk we extend the well studied Localization game to allow for the inclusion of more than one robber. Our primary result is that if the number of robbers is large enough, we can narrow the number of cops required down to two values which depend on a variant of the metric dimension where only pairs of vertices at distance at most 2 need to be resolved. We show that this gives a new upper bound on the original localization number in terms of an offline process, we show that this bound can give an arbitrarily large improvement over the metric dimension bound, and we use this to reconstruct the current best known upper bound for the localization number of the hypercube.

We finish with some open problems about localization with one robber and with multiple robbers. This is joint work with Trent Marbach and Kerry Ojakian.

Participants

Ryle Ashmore (Memorial University of Newfoundland)

Beth Ann Austin (Memorial University of Newfoundland)

Iain Beaton (Acadia University)

Anthony Bonato (Toronto Metropolitan University)

Andrea Burgess (University of New Brunswick)

MacKenzie Carr (Simon Fraser University)

Nancy Clarke (Acadia University)

Alex Clow (Simon Fraser University)

Karen Collins (Wesleyan University)

Danielle Cox (Mount Saint Vincent University)

Ryan Cushman (University of Wisconsin, Eau-Claire)

Peter Danziger (Toronto Metropolitan University)

Alfie Davies (Memorial University of Newfoundland)

Danny Dyer (Memorial University of Newfoundland)

Jessica Enright (University of Glasgow)

Stephen Finbow (St. Francis Xavier University)

Shannon Fitzpatrick (University of Prince Edward Island)

Melanie Gauthier (Mount Saint Vincent University)

Melissa Huggan (Vancouver Island University)

Svenja Huntemann (Mount Saint Vincent University)

Caleb Jones (Toronto Metropolitan University)

William Kellough (Memorial University of Newfoundland)

Bill Kinnersley (University of Rhode Island)

Alice Lacaze-Masmonteil (University of Regina)

Gary MacGillivray (University of Victoria)

Tomasz Maciosowski (Concordia University of Edmonton)

Meagan Mann (Queen's University)

Trent Marbach (Toronto Metropolitan University)

John Marcoux (Toronto Metropolitan University)

Erin Meger (Queen's University)

Teddy Mishura (Toronto Metropolitan University)

Bojan Mohar (Simon Fraser University and University of Ljubljana)

Joy Morris (University of Lethbridge)

JD Nir (Oakland University)

Kerry Ojakian (CUNY Bronx)

Mohamed Omar (York University)

David Pike (Memorial University of Newfoundland)

Logan Pipes (Memorial University of Newfoundland)

Amanda Porter (University of Victoria)

Kyne Santos (Toronto Metropolitan University)

Ladislav Stacho (Simon Fraser University)

Mariam Walaa (Toronto Metropolitan University)

Zhiyuan Zhang (Toronto Metropolitan University)