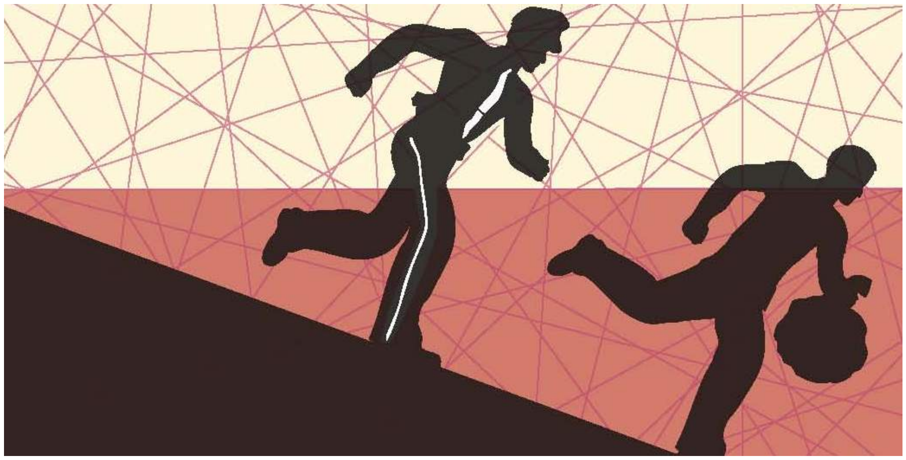
7th Graph Searching in Canada (GRASCan) Workshop



August 6–7, 2018

University of Regina

Regina, Canada

University of Regina

Pacific Institute for the Mathematical Sciences

Monday, August 6

8:45 - 9:00	Opening remarks
9:00 - 10:00	**Shannon Fitzpatrick**, University of Prince Edward Island *How to Survive a Zombie Attack*
10:00 - 10:30	COFFEE
10:30 - 11:00	**Kerry Ojakian**, Bronx Community College *Zombies can be much dumber than cops*
11:00 - 11:30	**Danielle Cox**, Mount Saint Vincent University *Saving vulnerable vertices*
11:30 - 12:00	**Sebastian Gonzalez Hermosillo de la Maza**, Simon Fraser University *The two-cops-move game on planar graphs*
12:00 - 12:30	**Amy Shaw**, University of Manitoba *Catching a fast robber on the grid*

Tuesday, August 7

9:00 - 10:00	**William B. Kinnersley**, University of Rhode Island *Slow Cops and Fast Robbers*
10:00 - 10:30	COFFEE
10:30 - 11:00	**Anthony Bonato**, Ryerson University *New bounds on the localization number*
11:00 - 11:30	**Karen Gunderson**, University of Manitoba *Finding small percolating sets*
11:30 - 12:00	**Katherine Perry**, University of Denver *Throttling for the Game of Cops and Robbers on Graphs*
12:00 - 12:30	**Stephen Finbow**, St. Francis Xavier University *Hyperopic Cops and Robbers*

Abstracts of Talks

Shannon Fitzpatrick, University of Prince Edward Island — Monday
How to Survive a Zombie Attack — 9:00 - 10:00

The game Zombies and Survivors is a variation of the classic game of Cops and Robbers. In the game, the zombies take over the role of the cops, while the survivors assume the role of the robbers. The rules of both games are the same with one exception: the zombies, being of limited intelligence, each move to a vertex that brings them closer to the nearest survivor. Because there may be multiple geodesics joining a zombie and its nearest survivor, the game can be considered from a probabilistic or deterministic approach. In the probabilistic model with a single survivor, the zombies "win" if the probability that a zombie eats the survivor is greater than 1/2. In the deterministic approach, 1/2 would be replaced with 0. In this talk, I will focus on the deterministic approach, discuss some known results, and answer some open questions.

While this model relies on the zombies being in a constantly active state, in *The Zombie Survival Guide*, by Max Brooks, the author argues that zombies are not particularly aggressive when "unexcited," and are only activated by sound. When unexcited, they tend to either stay put or mill about. In the final portion of the talk, I'll discuss how this observation could affect the rules of the game and its outcome.

Kerry Ojakian, Bronx Community College — Monday
Zombies can be much dumber than cops — 10:30 - 11:00

We answer some questions from the paper of Fitzpatrick, Howell, Messinger, and Pike 2016 about a deterministic version of the game of zombies and survivors. In particular, we show that there can be any gap between the zombie number and the cop number; and we observe that their conjecture is true: the zombie number of the hypercube is 2n/3. This is joint work with David Offner.

Danielle Cox, Mount Saint Vincent University — Monday
Saving vulnerable vertices — 11:00 - 11:30

Consider a model of cops and robbers where the vertices are vulnerable and we may not have enough cops to capture the robber. This now makes protecting as many vertices as possible the top priority. The minimum number of vertices that can not be protected by the cop is called the Damage Number of a graph and in this talk we explore the properties of this parameter. This is joint work with Asiyeh Sanaei of Kwantlen Polytechnic University.

Sebastian Gonzalez Hermosillo de la Maza, Simon Fraser University — Monday
The two-cops-move game on planar graphs — 11:30 - 12:00

One of the classic result in Cops and Robbers is that three cops can guarantee the robber's capture in a connected planar graph. Recently there has been interest in variations of the cops and robbers game were only a fraction of the cops can be moved each turn. The variant where one cop is allowed to move each turn has been called alternatively *Lazy Cops and Robbers*, *one-active-cop* game or *one-cop-moves* game. Gao and Yang showed that planar graphs exist in which the robber can evade three cops in the one-cop-moves game. It is still an open question whether a constant number of cops can win in any connected planar graph in the one-cop-moves game. In this talk, we show that if we allow two cops to move each turn, then three cops also suffice to guarantee the robber's capture in any connected planar graph, verifying a conjecture of Yang.

Amy Shaw, University of Manitoba — Monday 12:00 - 12:30
Catching a fast robber on the grid

We study the problem of Cops and Robbers on the grid, where the robber is allowed to move faster than the cops. It is well known that two cops are necessary and sufficient to catch the robber on any finite grid when the robber has unit speed. Here, we prove that when the speed of the robber is a sufficiently large constant, the number of cops needed to catch the robber on an $n \times n$ grid is $\exp(\Omega(\log n / \log \log n))$. Joint work with Paul Balister, Bela Bollobas, and Bhargav Narayanan.

William B. Kinnersley, University of Rhode Island — Tuesday 9:00 - 10:00
Slow Cops and Fast Robbers

In the classic formulation of Cops and Robbers, the cops and robber are equally mobile: everyone can traverse one edge on each turn. In some contexts, however, this might not be a reasonable model. What if the robber moves faster than the cops and can traverse many edges on a single turn? Or, perhaps the cops are slow; what if only one cop may move in each round, while the other cops must stay put? In this talk, we explore several Cops and Robbers variants of this sort, presenting a survey of known results and suggesting directions for future study.

Anthony Bonato, Ryerson University — Tuesday 10:30 - 11:00

New bounds on the localization number

Imperfect information is a realistic assumption in Cops and Robbers variants, where the robber is either invisible or partially visible during gameplay. In such games, the cops may have the assistance of traps, photo radar, or limited visibility. We consider the localization game played on graphs, where the cops attempt to determine the exact location of an invisible robber by exploiting distance probes. The corresponding optimization parameter for a graph G is called the localization number. We settle a conjecture by providing an upper bound on the localization number as a function of the chromatic number. We also prove that the localization number is at most 2 in outerplanar graphs, and we determine, up to an additive constant, the localization number of hypercubes.

Karen Gunderson, University of Manitoba — Tuesday 11:00 - 11:30

Finding small percolating sets

The r-neighbour bootstrap process is an update rule for the states of vertices in a graph where 'uninfected' vertices with at least r 'infected' neighbours become infected and a set of initially infected vertices is said to percolate if eventually all vertices are infected. While the focus is often on whether a randomly chosen set percolates, one can ask for the minimum size of a percolating set for a graph in such a process and which graph properties guarantee the existence of small percolating sets. I will present a new sharp result on minimum-degree conditions that allow one to find small percolating sets.

Katherine Perry, University of Denver — Tuesday 11:30 - 12:00

Throttling for the Game of Cops and Robbers on Graphs

The game of Cops and Robbers is a pursuit-evasion game played on a reflexive graph in which a cop or set of cops attempt to catch a single robber. The game is played over a countable sequence of time-steps in which the cops and robber take turns moving along the edges of the graph to neighboring vertices. In this talk, we consider the *cop-throttling* number of a graph G, $th_c(G)$, which is defined to be the minimum of $(k + capt_k(G))$, where k is the number of cops and $capt_k(G)$ is the minimum number of rounds needed for k cops to capture the robber on G over all possible games. We provide some tools for bounding the cop-throttling number, investigate the cop-throttling number for several classes of graphs, and consider how large $th_c(G)$ can be. This is joint work with Jane Breen, Anthony Bonato, Boris Brimkov, Josh Carlson, Jesse Geneson, Leslie Hogben, Carolyn Reinhart.

Stephen Finbow, St. Francis Xavier University
Hyperopic Cops and Robbers

Tuesday
12:00 - 12:30

A variation of the Cops and Robber game is introduced in which the robber has a short-range anti-predatory defense which can be used to confuse cops which are nearby (within distance 1), but those further away remain unaffected. We provide a comparison between the "hyperopic" cop number and the usual cop number. This is joint work with Anthony Bonato, Nancy Clarke, Danielle Cox, Fionn Mc Inerney, and Margaret-Ellen Messinger.

Participants

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