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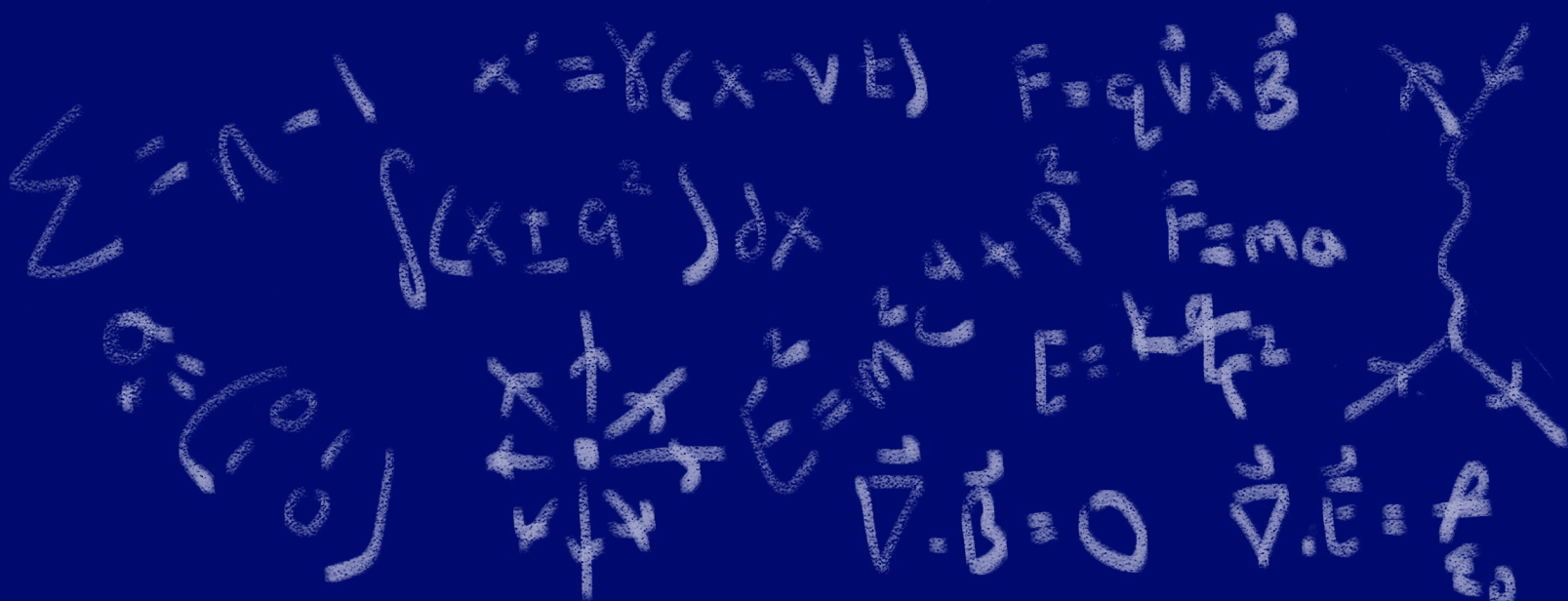
Presented by:

UWinnipeg Physics  
Student Association

UWinnipeg Math and  
Stats Student Association

# Student \_\_\_\_\_ \_\_\_\_\_ Seminars

Abstract Book



# Presentation — — Schedule

Thomas Czyzowicz 6:00 PM

Michael Grehan 6:15 PM

Mira Koop 6:30 PM

Kiera Pond Augusto 7:00 PM

Joshua Basman Monterrubio 7:15 PM

Marko Milsoevic 7:30 PM

# Presentation — — Abstracts

[1] More on the average order of dominating sets of trees

Thomas Czyzowicz

A dominating set of a graph  $G$  is a subset  $S$  of the vertex set of  $G$ , if the neighborhood of  $S$  is equal to the vertex set of  $G$ , then  $S$  is a dominating set of  $G$ . We call the smallest dominating set the minimum dominating set and its size is the domination number of the graph. Being able to determine the dominating sets of a graph has many real-world applications. For example, the planning and placement of radio towers to provide radio communications for small villages in remote parts of the world. Radio towers have a limited broadcasting range so many towers will need to be constructed to reach all the villages of a given region. Finding a placement of towers so that all villages receive coverage corresponds to finding a dominating set in a graph. This talk will primarily focus on the average order of the dominating sets of a tree. Concentrating on a tree structure makes finding patterns and developing an intuition on the average order of a dominating set much more tractable and will yield results that may help to understand the average order of a dominating set in other graph structures.



## [2] Calculating the Holographic Complexity of Numerical Black Hole Collapse in AdS

Michael Grehan

Hawking radiation gave rise to the information paradox which has led physicists to believe a better understanding of gravity is needed to create a theory of quantum gravity. Calculating information quantities, such as complexity, that correspond to a black hole may help provide this understanding. Previous work to calculate holographic complexity in AdS has been done in a simplified manner that allowed analytical solutions. Our work calculates the complexity using numerical methods, in a non-simplified manner, which will allow us to better understand the quantum state of a forming black hole. We performed holographic complexity calculations for both the action and the volume conjecture, in both 4 and 5 dimensional AdS.

## [3] Tier Ranking Math / Physics Books I Read This Year

Mira Koop

For my talk I am going to tier rank some math and physics related books I read recently and what I am excited to read this year. I will give a brief explanation of each book and what I liked and disliked and then put them into a tier (S, A, B, C, D, E, F). The books will be “E Squared” which was marketed as a physics book however ended up being about manifestation and was jam packed with quotes from famous physicists and used them to create an experiment for each method of manifestation. Next is “A Mind for Numbers” which is a relatively juvenile book about how to succeed in the sciences. Next is “Infinite Powers” which I am only halfway through but wanted to include as I can already tell it’s a great book, about the history of calculus. I’ll talk about “Winning Ways” which is about combinatorial game theory, “Humble PI” about when math goes wrong, “How to Think like Stephen Hawking” which was more a recount of his career and life, “Surely, you’re joking Mr. Feynman”, “Euler’s Pioneering Equation” about the most beautiful equation in Mathematics, and lastly “A Very Short Introduction to Number Theory” which was very good and I want to encourage reading the short introduction book collection by Oxford since niche topics are fun to briefly dive into. I will also very quickly share the books I read in elementary school which got me excited for math, and then some books I am excited to read this year. 3



# [4] Development of Ultra-Precise Cesium Magnetometers

Kiera Pond Augusto

The TUCAN (TRIUMF Ultracold Advanced Neutron) electric dipole moment (EDM) experiment seeks to measure the neutron EDM with great precision. To measure the neutron EDM new instruments using precision atomic physics techniques need to be developed. To develop new fibre-coupled laser-driven magnetometers, cesium cells needed to be characterized. The cesium cells lose vapour pressure over time, hence a ripening process is used to restore them. A key discovery made in these studies is that ripening the cells restores the lifetime and the relative absorption peak. However, ripening does not restore the relative absorption peak indefinitely.

# [5] A Marching Band's Dilemma

Joshua Basman Monterrubio

For a parade, the marching band was told they needed to line up in rows of 4. However after trying this arrangement, one band member was left out. So they tried lining up in rows of 5, but this time three band members were left out. In a final attempt, the marching band lined up in rows of 7 but alas, two band members were left out.

How many members are in the marching band?

This is an example of the Chinese Remainder Theorem in elementary number theory. Join me as we explore the use of modular arithmetic to solve systems of linear congruences and help those band members get in line, if there's any hope left for them at all.

# [6] To Bluff or Not to Bluff

Marko Milsoevic

Games of chance are often considered to be the birthplace of probability theory. One such game, 5-card poker, consists of a standard deck of playing cards from which each player receives 5 cards (5-card hand). These hands are then pitted against each other, with each player attempting to convince the others that theirs is the best hand. What determines the best hand? The answer involves probabilities. In this talk, we will discuss some relatively simple techniques to compute the probabilities of various poker hands in a 5-card game.