MCCNNY 2018, October 27, 2018

Presentation Title and Abstract

Keynote Presentation

Title: The Shape of Space
Presenter: **Jeff Weeks**
Time and Location: **9:00am—9:50am, Snell 212**
Abstract: When we look out on a clear night, the universe seems infinite. Yet this infinity might be an illusion. During the first half of the presentation, computer games will introduce the concept of a "multiconnected universe". Interactive 3D graphics will then take the viewer on a tour of several possible shapes for space. Finally, we'll see how satellite data provide tantalizing clues to the true shape of our universe. The only prerequisites for this talk are curiosity and imagination.

Title: **Graph structure and algorithm complexity**
Presenter: **Puck Rombach**, University of Vermont
Time and Location: **1:00pm – 1:50pm, Snell 212**
Abstract: Algorithmic complexity is the study of how fast algorithms run as the size of their input grows, and what the theoretical limits are on this speed. Often, we consider problems that can be solved in time that is a polynomial function of the size of the input as "easy" (called P) and others as "hard". However, a certain class of these hard problems (called NP) may in fact be easy; we don't know for sure. This question "P=NP?" is one of the famous Millennium Problems, and worth $1,000,000. In this talk, we'll go over the basic theory of algorithm complexity with various examples of problems on a graph (network), and discuss how structural properties of the graph affect the problem complexity.

Poster Presentations 10:00am – 11:00am Outside of Snell 212

Presenter: **Troupe, Jacob**, Department of Physics, Clarkson University, Senior, troupejb@clarkson.edu
Advisor: Michael Ramsdell, mramsdel@clarkson.edu
Title: **Modeling the Motion of a Falling Coffee Filter: Educational Implementation for a Non-Trivial Mechanics Problem**
Abstract: In introductory physics courses, real effects such as friction, drag, rotations, and physical dimensions of objects are often neglected to provide a solution that students can solve using simple algebra. Here we present an analysis of a simple falling coffee filter where we consider the effects of drag. We will present experimental data obtained through video analysis for the kinematics of the falling filter and drag force measurements on a 3D printed model filter in a wind tunnel. Analytical solutions for the falling filter along with numerical solutions that consider different approaches for modeling the drag force will be compared to the theoretically

predicted models. Suggestions for implementing this project in introductory physics laboratory setting will be presented.

Presenter: **Gilman, Guinevere,** Computer Science, St. Lawrence University, Senior, grgilm15@stlawu.edu
Advisor: Dr. Choong-Soo Lee, clee@stlawu.edu
Title: **High Bandwidth Mode in Overwatch**
Abstract: Interactive applications such as multiplayer online games require user interactions to be possible, because handled responsively, with the smallest amount of delay users must respond rapidly to the actions of other users in these types of games. A delay of even 50ms has been determined to make some multiplayer games to be frustrating and unplayable in previous investigations. However, there has not been sufficient research conducted to determine an acceptable threshold of delay for the playability of more modern games, as much of the data collected has been from games created in the 1990s and early 2000s.

This research focused on one of the most popular modern multiplayer team-based multiplayer games, known as Overwatch, which has made the claim that its relatively new high bandwidth mode will drastically increase the quality of experience bandwidth. It for players. It also claims to group is a first-person shooter, where two players with
teams of six similar players compete against each other to fulfill various objectives using player characters with different types of weapons including hit-scan and projectile-based ones.

Presenter**: Casey-Wagemaker, Emily**, ecase15@stlawu.edu, Mathematics and Spanish Double with Education Minor, St Lawrence University, Senior
Advisor: Daniel Look, dlook@stlawu.edu
Title: **Racism, classism, and education policy: A mixed methods analysis of disciplinary policies in the Greater Capital District of New York State**
Abstract: Current data show large disparities in disciplinary actions experienced by students of color as opposed to their White classmates. Discourse and policy language in school codes of conduct can reflect the endemic nature of racism in society, which, in turn, negatively impacts students of color. Utilizing statistical, sentiment, and critical discourse analysis, this mixed methods research provides a more complex view of the impact of policy on the disproportionality of discipline in schools. This research examines how racism and classism interact with discipline in schools and how this contributes to high dropout rates and the school-to-prison pipeline.

Presenter: **Gordon, Joshua,** jogordo@clarkson.edu, Department of Mathematics, Sophomore, Clarkson University
Presenter: **Massimiliano Cutugno**, cutugnma@clarkson.edu, Junior, Computer Science & Computer Engineering, Clarkson University
Advisor: Christino Tamon, ctamon@clarkson.edu
Title: **Simulation of Quantum Circuits**
Abstract: We created cross-platform tools for developing, writing, and running quantum programs. Contemporary languages and frameworks for quantum programming are largely missing out on features common among our classical tools, such as a graphical environment, a debugger, and disassemblers among other examples. Our work bridges the competing standards

for quantum assembly languages by implementing translation between QUIL, openQASM, Quipper ASCII, and our own graphical representation of a quantum circuit.

Presenter: **Kuhns, Brian**, kuhnsbt@clarkson.edu, Junior, Department of Mathematics, Clarkson University
Title: **Mixed Modeling Methods For Milfoil Managment**
Advisor: Jonathan Martin, Dianna White, jmarti@clarkson.edu, dtwhite@clarkson.edu
Abstract: Eurasian watermilfoil (EWM) is one of the most invasive aquatic plants in the US. As such, trying to understand its growth and determine control strategies is of utmost importance. Here, we extend on previously developed ODE models to study EWM growth over multiple seasons. Our model in analytically tractable and can used to explore different control strategies, like the bio-control, the milfoil weevil.

Presenter: **Viehl, Emily**, envieh15@stlawu.edu, Senior, Statistics, St. Lawrence University
Advisor: Ivan Ramler, iramler@stlawu.edu
Title: **Creating a Book Recommendation System for Project Gutenberg**
Abstract: Project Gutenberg is a digital library that was started in 1971 by Michael Hart that now contains over 57,000 books that anyone can download for free. The R software package gutenbergr was used to download a subset of books from Project Gutenberg. Sentiment analysis, stylometry, and hierarchical clustering methods were applied to the subset to create a recommendation system. Sentiment analysis is process of computationally analyzing subjective information to reveal the attitude or opinion of the writer or speaker (Liu, 2010). Each book was tidied before the sentiment was analyzed, meaning that stop words, punctuation, and spaces were removed and contractions were expanded. The bing and NRC lexicons were used to analyze sentiment. The bing lexicon identifies English words as either positive or negative in tone while the NRC lexicon matches words to 8 emotions: anger, sad, joy, disgust, anticipation, trust, surprise, or fear. The proportion of positivity/negativity as well as the proportion of each of the 8 emotions was computed for each book using these two lexicons. After collecting metrics on the sentiment of each book, measurements of the authors writing style were collected using measurements of the total number of unique words used by the author (words used only once), average number of words in a sentence, average word length, and average number of colons/semi colons. A complete linkage method was used for clustering. Once the cluster object was created a Shiny app (interactive web application) was also created as a user friendly way to access the cluster object. The Shiny app produces a table of recommendations based on the book initially entered by the user. In addition to the title and author of the book, a similarity score, and a hyperlink to the Project Gutenberg web page where the eBook can be downloaded are included in the table.

Presenter: **Indoung, Chayapuntika**, indounc@clarkson.edu, Junior, Department of Mathematics, Clarkson University,
Title: **Analysis of invariant sets in a double-gyre flow**
Advisor: Marko Budisic, marko@clarkson.edu
Abstract: Particles in fluid flows are modeled as trajectories in a velocity field. Since individual trajectories can be extremely complicated, we are going to describe them by their average properties. As an example, the Left-Right criterion is constructed as time-averaged function averaging a left-right indicator function along a trajectory. It identifies the proportion of time that

the particles travel across the middle line of the boundary. Level sets of the time-averaged function approximate an invariant partition. If the invariant partitions obtained from different functions are intersect, then the partition into ergodic sets will be created. Ergodic sets are significant because any trajectory starting in the ergodic set remains within the set. This poster will present analysis of invariant sets in a double-gyre flow and their dependence on choice of function, length of trajectory, and parameters of the flow. This forms a basis for future work where the technique will be applied to front propagation problem, introduced by Bargteil and Solomon in their recent paper. The technique can help us to understand positions of barriers to front propagation in order to predict how the front propagates in flows.

Oral Presentations 11:05am – 11:50am Snell 212, 213 and 214

Presenter: **Fuller, Daniel,** fullerdt@clarkson.edu, Graduate Student, Department of Mathematics, Clarkson University
Presenter: **Lufkin, Leon**, llufkin098@potsdam.k12.ny.us, High School Student
Tile and Location: **11:05am – 11:20am, Snell 212**
Advisor: Sumona Mondal, smondal@clarkson.edu
Title: **Consumption Effects of Adaptogens and Caffeine Source on Mood And Cognition**
Abstract: This study examined the effects of both synthetic and naturally-sourced caffeine on blood pressure, heart rate, fine motor task performance, state mental and physical energy, and mood. A post-screening sample of N=30 (female=17, male=13) partook in this placebo-controlled, double-blinded, within-subjects, randomized cross-over experiment, which examined the effects of a treatment, a positive control, and a placebo. A mental energy test battery was administered before and three times after beverage consumption. Hypotheses were tested using a series of both 2 Treatment x 4 Time points and 2 Treatment x 2 Tie points repeated measures ANCOVAs that controlled for prior night's sleep. Adjustments for sphericity, when needed, were made using the Huynh-Feldt epsilon. Significant interactions were decomposed using one-way ANOVAs and t-tests with familywise error controlled using LSD post-hoc tests. Effect size is presented as η2 or Cohen's d, with values of .20, .50, and .80 being considered small, medium and large respectively. Bivariate Pearson and Spearman correlations were used to explore linear associations between changes in salivary caffeine and changes in motivation, cognition, and mood. Analyses indicated both effects in accordance with existing literature and effects that contradict existing literature.

Presenter: **Amoah-Darko, Frederick Laud**, amoahdfl@clarkson.edu, Graduate Student, Department of Mathematics, Clarkson University
Tile and Location: **11:20am – 11:35am, Snell 212**
Advisor: Dr. Diana White, dtwhite@clarkson.edu
Title: **Continuous Model of the Dynamic Instability of Microtubules with Pausing**
Abstract: Microtubules are protein polymers found in eukaryotic cells and in some bacteria. These polymers provide structural support for the cell and help in the transportation of proteins and organelles. In performing these functions, they go through random periods of relatively slow polymerization (growth) and very fast depolymerization (shrinkage) known as the dynamic instability of Microtubules. Microtubule shortening events are called "catastrophes" and each of these events is followed by a "rescue", where normal growth of a microtubule resumes. Of course, rates of "catastrophe" and "rescue" can be modulated through polymerization conditions.

We present here, a novel mathematical model that accounts for growth, catastrophe, rescue, nucleation (the event that initiates formation of Microtubules) and a possible "pausing" stage Microtubules.
Keywords: Microtubules, Nucleation, Catastrophe, Rescue, Pausing, GTP (Guanosine triphosphate) is hydrolyzed into GDP (Guanosine diphosphate)

Presenter: **French, Zachary**, Frenchzj@clarkson.edu, Graduate Student, Department of Physics, Clarkson University
Tile and Location: **11:35am -- 11:50am, Snell 212**
Advisor: Michael Ramsdell, mramsdel@clarkson.edu
Title: **Using Data analysis and Modeling to Develop a Higher Understanding of Newtonian Physics**
Abstract: According to NSF between 2000 and 2016 there has been a 12 percent increase in student enrollment in a STEM field.1 While this is great news, the rate at which students exit STEM is alarming. The problem isn't getting students into the field its keeping them there. The goal is to increase the percentage of retained students. This is where COMPASS comes in. COMPASS(Coordinated Math and Physics Assessment for Student Success) is designed to achieve improved student performance in early STEM courses and increase retention through targeted assessment strategy. This is done by identifying the needs of the student by having them take 2 diagnostic tests in math and physics. After the tests, students are defined by 3 risk categories high, medium and low and are then lead to different pathways that highlight their strengths and play upon them. Details of their path will be described and their performance will be reported.

Presenter**:** **Xia, Congzhi**, xia@clarkson.edu, Graduate Student, Department of Mathematics, Clarkson University
Tile and Location: **11:05am – 11:20am, Snell 213**
Advisor: Professor Guohui Song, gsong@clarkson.edu
Title: **Reconstruction of piece-wise functions from non-uniform Fourier data**
Abstract: Non-uniform Fourier data are routinely collected in applications such as magnetic resonance imaging, synthetic aperture radar, and synthetic imaging in radio astronomy. However, reconstructing piece-wise smooth functions from Fourier measurements suffers from the Gibbs phenomenon. The popular filter/mollifier method could alleviate the Gibbs phenomenon and improve the accuracy away from the edges. We will introduce in this talk a hybrid filter-extrapolation method to further improve the accuracy around the jump discontinuities.

Presenter: **Madraki, Golshan**, gmadraki@clarkson.edu, Assistant Professor of Engineering and Management, Clarkson University
Tile and Location: **11:20am – 11:50am, Snell 213**
Title: **Finding the longest path in a structurally perturbed Directed Acyclic Graph**
Abstract: In a structurally perturbed Directed Acyclic Graph (DAG) multiple edges are added and deleted simultaneously. Finding the longest path in the perturbed DAGs after perturbation without doing the calculation from the scratch is a critical challenge. The solution for this problem can solve and improve different problems in manufacturing system, transportation, telecommunications and etc. All previous researched considered single edge addition/deletion at

a time. However, this research proposes an efficient algorithm called SPA to handle multiple edge deletions/additions with a single pass. This solution is more efficient in terms of time complexity than the previous approaches.

Presenter: **Chicoine, Noah,** chicoinc@clarkson.edu, Junior, Department of Mathematics, Clarkson University,
Tile and Location: **11:05am -- 11:20am, Snell 214**
Advisor: Dr. Sergei Fomin, sfomin@csuchico.edu, Mathematics and Statistics Department, California State University, Chio
Title: **Obtaining Thermophysical Properties of Solids in Contacting Solids Heating System**
Abstract: To discover the thermal diffusivity and thermal conductivity of materials, typical experimental apparatuses feature three components: a heat source, a solid with unknown properties (solid 2), and a solid with known properties (solid 3). By placing solid 2 between the other two components, the heat flow can be observed and compared to a temperature diffusivity model to calculate the value of the material's unknown thermal properties. This study solved a system of heat equations to formulate a model illustrating the theoretical heat transfer between the three components given a constant heat flux from the heat source. The heat transfer model was then fitted to synthetic temperature data by finding thermal conductivity and diffusivity values that minimize the residuals between the data and the model. Analysis on the computational efficiency and accuracy of two different minimization methods was done using Mathematica. Results showed that using an asymptotic approximation of the original model is more computationally efficient when finding experimental values of thermal conductivity and diffusivity, though it is less accurate than the values found using the original model.

Presenter: **Troupe, Jacob**, Department of Physics, Clarkson University, Senior, troupejb@clarkson.edu
Tile and Location: **11:20am -- 11:35am, Snell 214**
Advisor: Michael Ramsdell, mramsdel@clarkson.edu
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