



# Goodsell Gazette

Carleton College

May 3, 2019

Northfield, MN 55057

The newsletter for the Carleton mathematics and statistics community

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## COMPS Announcement Meeting

**Date/Time:** Tuesday, May 7, 4:00 - 5:00 p.m.

**Location:** CMC 206

Attention all Junior math/stats majors, we will be having a meeting next week during which we will describe your comps options for next year. The comps descriptions will be available on our website starting at noon on Monday, May 6. Please review the comps options prior to the meeting on Tuesday.

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## Our New SDAs!

SDAs are students who serve two very important roles in the department. First, they help students navigate the math and stats majors and the math minor. Second, SDAs organize a variety of social events and get-togethers around the department. We are thrilled to announce our new SDAs for next year are Elisa Loy, Liraly Smith, and Fares Soufan. Please join us in welcoming our new SDAs for 2019-20!

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## Independent Comps Talks

The students who chose to present their independent comps during Spring Term are about to put the finishing touches on their presentations. They'll present in CMC 206 on Thursday, May 9th. Stop by for a talk or two (or all of them!) and you'll be sure to learn something about the fields of mathematics and statistics you've never encountered!

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## Thursday, May 9

**Title:** Outlier Detection and Ranking Methods

**Speaker:** James Yang

**Time:** 3:30 p.m.

**Abstract:** What do we talk about when we talk about outliers? Noises in the data? Pesky dots that are more than 1.5 IQR away? Or the very existence that threatens the *normal* lives of statisticians? Fear no

more. In my comps, I will present various existing approaches that look for these annoyances by ranking their probabilities of being outliers. Moreover, I will talk about how we can use outliers to isolate interesting (or suspicious) patterns in the data. Whether it is your basic EDA with a boxplot, or studying their underlying parametric distributions, or even trying out cool algorithmic approaches such as clustering and Naive Bayes (or even neural networks, who knows) - I will introduce and compare these methods using several evaluation metrics on a super cool dataset. I will also talk about the many caveats of these algorithms, as well as their appropriateness given the dataset. Last but not least, I will briefly discuss some of the more recent research and what the future holds for this particular field of data mining.

**Title:** Continued Fractions

**Speaker:** Fabio da Silva Soares

**Time:** 4:00 p.m.

**Abstract:** We all know rational numbers can be represented as fractions, but what if I told you that irrational numbers can also be represented as an infinite sequence of nested fractions? In this presentation, we will introduce you to the amazing world of continued fractions and some of its applications. We will show how every real number has a continued fraction representation (albeit possibly infinite), describe some properties of convergents, and explain how they can be used to solve Pell equations.

**Title:** Coefficients of Cyclotomic Polynomials

**Speaker:** Johnny Reichman

**Time:** 4:30 p.m.

**Abstract:** One of the most commonly factored expressions is  $x^n - 1$  where  $n$  is a natural number. When factored, it actually leads to some pretty interesting polynomials. These are called cyclotomic, or "circle cutting," polynomials. In my talk, I will introduce these polynomials, share some of their interesting properties, and describe how recent algorithms have allowed breakthroughs in this long-stagnant field of mathematics. This talk will highlight how number theory can be used in tandem with savvy computation to lead to new discoveries.

**Title:** Dynamic Linear Models

**Speaker:** Matt Kaye

**Time:** 5:00 p.m.

**Abstract:** Often, time series are observed with noise. Maybe we can't use a very precise sensor to measure the position of a particle, or we use a survey to calculate an economic statistic like unemployment that's supposed to approximate a true population parameter. When we consider the observations in these types of time series, it is often interesting to "filter" out the noise in order to get at the signal: the true position of the particle or the true unemployment rate at any given time. Dynamic Linear Models--a special case of state-space models--utilize an elegant probabilistic framework supported by the famed Kalman filter to help us get a better idea of the signal in our time series than either our predictions or observations would alone. This talk will cover the basics and some interesting applications of Dynamic Linear Models, as well as R implementation.

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## Upcoming Events

**Week 6**, Tuesday, May 7, 4:00 - 5:00 p.m.  
Comps Announcement Meeting - CMC 206

**Week 6**, Thursday, May 9, 3:30 - 5:30 p.m.  
Comps Talks - CMC 206

**Week 7**, Tuesday, May 14, 3:30 - 6:30 p.m.  
Comps Talks - Olin 141

**Week 7**, Thursday, May 16, 3:30 - 6:30 p.m.  
Comps Talks - Olin 141

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## ENTS GIS Lab Presentations

Please join us Tuesday, May 7 and Tuesday, May 14 during common times for ENTS GIS Lab Show-And-Tell. Jared Kannel (ENTS, Math, 2020) and Wei-Hsin Fu are going to share what they learned about performing space-time data visualization and pattern mining with ArcGIS Pro. The presentations will discuss the results from the past 10 presidential elections in Minnesota counties.

**Date/Time:** Tuesday, May 7, 12:00 - 1:00 p.m.

**Location:** CMC 109

**Title:** Space-time Data Visualization with ArcGIS Pro

This presentation introduces the work flow for visualizing space-time cubes in ArcGIS Pro.

**Date/Time:** Tuesday, May 14, 12:00 - 1:00 p.m.

**Location:** CMC 109

**Title:** Space-time Data Pattern Mining with ArcGIS Pro

This second presentation introduces two space-time data pattern mining tools in ArcGIS Pro, Emerging Hot Spot Analysis based on Getis-Ord  $G_i^*$  statistic, and Local Outlier Analysis based on Anselin Local Moran's  $I$  statistic. Gentle conceptual introduction to the statistics will be given.

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## Job & Internship Opportunities

### National Security Agency (NSA), Summer 2020 Opportunities

Applications for summer 2020 are now open for the Directors Summer Program, Cryptanalysis and Signals Analysis Summer Program, and Graduate Mathematics Program. These 12 week paid internships provide students with the opportunity to work directly with NSA Mathematicians on mission-critical problems and experience the excitement of the NSA mathematics community. While next summer is a ways away, they encourage early applications as every participant must obtain a security clearance. Completed applications must be submitted by Oct. 15, 2019. Please note that U.S. citizenship is required.

For more information and to apply, visit:

<https://www.intelligencecareers.gov/icjobsearchapply.html>

**Oxeon Partners, Associate**

Oxeon's Invested Search practice recruits the senior leadership teams for high-growth healthcare technology and services businesses that are disrupting the US healthcare system. Their mission is to make people healthier through their network and unique perspective on the transformative power of human capital. They are looking to hire entry-level Associates in their Seattle office. As an associate, you will take a consultative approach to developing a comprehensive understanding of their healthcare clients, their markets, products/services, competition, and differentiation. For more information and to apply, visit: The Tunnel.

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# Problems of the Fortnight

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To be acknowledged in the next *Gazette*, solutions to these problems should reach me by noon on Tuesday, May 14.

1. In how many ways can you spell the word "PROBLEMS" in the design above? Obviously, the word must start with the P in the middle; you are allowed to move up, down, left, or right to move from one letter to the next, but you must use each letter that you encounter.
2. Let  $m, n \geq 3$  be integers such that  $n$  is odd. Consider the region in the plane bounded by a regular  $m$ -gon. Is it always possible to divide this region into congruent regions that are bounded by  $n$ -gons? ("Congruent" means that the regions have the same size and shape; in particular, the  $n$ -gons bounding them will be congruent. They do *not* have to be regular.) If so, explain how; if not, for which values of  $m$  and  $n$  is it possible?

It's a pleasure to report, if not a flood, at least a sprinkling of submitted solutions for the problems posed April 19. Specifically, the first problem was solved by Aaron Li and by John Snyder; there were also at least two would-be solvers who apparently overlooked the condition that different letters should represent different digits (which led them to the incorrect "answer" 4099). The second problem was solved by Josh Gerstein, Oscar Smith, John Snyder, and "Auplume". As for the B.B.O.P., Aaron and Josh should each collect an item from it (to do so, see Sue Jandro in CMC 217). Good work, all; enjoy midterm break, and the new problems!

- Mark Krusemeyer



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