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Welcome Back

Welcome to The Goodsell Gazette; now that school has started, we hope everyone is as excited to spend time in the Mathematics and Statistics Department as we are! There's a lot to look forward to this year: a new professor, classes sure to inspire curiosity and challenge you throughout the term, and department events both large and small. Published every other week during the term, this newsletter will keep you informed of social and scholarly activities, visiting speakers, comings and goings in the department, your colleagues' comps talks, and job and research opportunities. To subscribe send an e-mail to sjandro.

Math Across the Cannon Speaker Series

Every year, the Carleton Department of Mathematics and Statistics and St. Olaf Department of Mathematics, Statistics, and Computer Science jointly host the Math Across the Cannon speaker series. This year, the speaker is Eugenia Cheng.

Eugenia Cheng is a mathematician and concert pianist. She is Scientist In Residence at the School of the Art Institute of Chicago and won tenure at the University of Sheffield, UK. She has previously taught at the universities of Cambridge, Chicago, and Nice, and holds a PhD in pure mathematics from the University of Cambridge. Alongside her research in Category Theory and passion for undergraduate teaching, her aim is to rid the world of "math phobia." Eugenia was an early pioneer of math on YouTube and her videos have been viewed over 15 million times to date. She has also assisted with mathematics in elementary, middle and high schools for 20 years. Her first popular math book *How to Bake Pi* was featured on the Late Show with Stephen Colbert, and *Beyond Infinity* was shortlisted for the Royal Society Science Book Prize in 2017. She also writes the Everyday Math column for the *Wall Street Journal*, and has completed mathematical art commissions for Hotel EMC2 and 6018 North in Chicago. She is the founder of the Liederstube, an intimate oasis for art song based in Chicago. Her most recent book, *The Art of Logic in an Illogical World* was published in 2018, and her next one *x + y : A Mathematician's Manifesto for rethinking gender* is due out in 2020.

Events:

Wednesday, October 2
Reception 7:00 pm

Performance 7:30-8:30 pm
Location: Applebaum Recital Hall in Weitz, Carleton College

The Sum of the Score: Math in Music
Math and music are often said to be related, but does this go any deeper than the fact that they both involve counting? In this lively hybrid of talk and concert, mathematician and pianist Eugenia Cheng uncovers mathematical structures in some of her favorite pieces of classical music. Joined by baritone Peter Wesoloski, she will perform works by Bach, Schubert, Schumann, Brahms, Wagner, Ravel, Debussy and Vaughan Williams. The music will be interspersed with discussion of a wide range of mathematical concepts in the music, including lowest common multiples, prime numbers, fractions, fractals, braids and more.

Thursday, October 3
Reception 3:00 pm
Talk 3:30-4:30 pm
Location: Tomson 280, St. Olaf College

Category Theory and Life:
Category theory can be thought of as being "very abstract algebra." It is thought of as "too abstract" by some people, and as "abstract nonsense" by some others. In this talk Cheng will show that while it is abstract, it is far from being nonsense. Cheng will argue that the abstraction has a purpose and that broad applicability is one of the powerful consequences. To demonstrate this, she will show how she applies concepts of category theory to important questions of life such as prejudice, privilege, blame and responsibility. She will introduce the category theory concepts from scratch so no prior knowledge is needed. These concepts will include objects and morphisms, isomorphisms and universal properties.

Thursday, October 3
Reception 6:30 pm
Talk 7:00-8:00 pm
Location: Weitz Cinema, Carleton College

The Art of Logic:
For thousands of years, mathematicians have used the timeless art of logic to see the world more clearly. Today, truth is buried under soundbites, spin, memes, divisive arguments and "fake news." Seeing clearly is more important than ever. In this talk, Cheng will show how anyone can think like a mathematician to understand what people are really telling us. Taking a careful scalpel to politics, privilege, sexism and dozens of other real-world situations, Cheng will show that math is not just about numbers and equations, but is about thinking better, and that it can help us find clarity without losing nuance in this complex world of ours.

Pizza + Statistics & Data Science!

When: <u>Tuesday, Oct. 1 from 12:00-1:00pm</u>
Where: CMC 209

Karl Broman, Professor of Biostatistics and Medical Informatics from the University of Wisconsin-Madison will be visiting the department for lunch on Tuesday, Oct. 1. He is here to talk about a bit about his work in statistical genetics and to describe the new UW-Madison PhD program in Biomedical Data Science. There will be pizza at this lunch-time event and he only plans to talk for about 20-30 minutes, so you will have plenty of time to ask Dr. Broman questions about his research and about graduate studies in statistics, data science, and related areas. For more information about Dr. Broman see https://kbroman.org. If you are interested in joining us next Tuesday, please fill out this <u>RSVP form by noon on Friday (9/27)</u>: https://forms.gle/tYEGt7LQmdttxApv8. (Note for majors: this lunch-time event will not count towards comps talk credit. Sorry!)

Talk details:
Opportunities in biomedical data science: The current explosion of biomedical data, including electronic medical records, biomedical imaging, and genomics/proteomics/metabolomics data, provide an awesome opportunity to improve understanding of the mechanisms and ultimately to improve human health care. Broman will briefly discuss his own work on data analysis in genetics, as well as that of some of his colleagues, and will describe the new PhD program in Biomedical Data Science at the University of Wisconsin-Madison. He will also point to the many other excellent data science graduate training opportunities around the US, in statistics, computer science,biostatistics, bioinformatics, computational biology, and related fields.

NUMS 2019

This year's Northfield Undergraduate Mathematics Symposium (NUMS for short, a joint event with St. Olaf) will be at St. Olaf on <u>October 29</u>, and we're looking for speakers. If you did some math or stats research this summer and are interested in giving a 20-minute talk at NUMS, then please fill out our (short) application form at https://forms.gle/Hvtfo6iWmbiSGhoP6. You can see examples of previous NUMS talks at https://www.carleton.edu/math/major/activities/nums/.

The deadline for submitting an application is <u>September 27 at 5pm</u>. Please contact Caroline Turnage-Butterbaugh (cturnageb@carleton.edu) or Mike Cohen (mcohen@carleton.edu) if you have any questions.

Winter Break Research Funding Opportunity

The Kolenkow-Reitz fellowship provides research support for Carleton students working with non-Carleton science and math faculty at another institution during the summer or over winter break. These research opportunities are intended to encourage Carleton student's development as scientists and their exploration of mathematics and the sciences as a possible career. Awards fund student stipends ($470/week for full-time work) for up to 3 weeks during winter break, and can include expenses up to

$150 for travel to the research site and/or supplies. Note that students must work full-time in order to qualify. Carleton students with a minimum GPA of 3.0 are eligible to apply for this funding.

Before applying, students should have already contacted and discussed the nature and timing of their project with the person they are planning to work with as well as a faculty member at Carleton who can vouch for the project. Because the intent of the fellowship is exploration in STEM fields, priority is given to students who have completed coursework related to the proposed research, but who have not yet had a significant funded research experience (7 or more weeks). Please note that students previously supported through the Kolenkow-Reitz Fund (winter break or summer) are less likely to receive funding, but are still eligible to apply.

Application Deadline: Friday, October 11, 2019, 5:00 PM. More details are available in the application form, which you can find here: https://apps.carleton.edu/mathscience/faculty/studentresearchaway/. Questions? Please contact Amy Csizmar Dalal (adalal@carleton.edu).

Student Research Symposium

The annual Student Research Symposium will take place on Friday Oct 18, from 3:30-5:30pm in the Weitz Commons. Students can register at go.carleton.edu/fe5. The registration deadline is Friday, Oct 4 at 5:00pm.

GRE Training and Practice

If you're thinking of taking the GRE Math subject test (often required for applications to math graduate schools), we have training and practice sessions for you! They're held on even-week Tuesdays at 3pm in CMC 209, and on odd-week Tuesdays at 11am in CMC 319. Each session covers a different set of topics and skills that appear on the GRE. For reminder emails and topic announcements, join the GRE Math mailing list by contacting Owen Biesel (obiesel@carleton.edu).

Problem Solving Group

If you have always really enjoyed the problem-solving aspect to your classes, then the problem-solving group is just for you. Come join us in CMC 328 from 4:30-5:30 on Wednesdays, where we will work on solving some fun and challenging math problems together, and learn some strategies for solving them. Students at all stages of their Carleton careers are welcome.

Rafe Jones will be hosting the session. You can contact him for more information at (rfjones@carleton.edu).

Upcoming Events

Week 3

Tuesday Oct 1, 12:00-1:00pm
Pizza + Statistics & Data Science - CMC 209

Wednesday Oct 2, 7:30-8:30pm
The Sum of the Score: Math in Music - Applebaum Hall, Weitz

Thursday Oct 3, 3:30-4:30pm
Category Theory and Life - Tomson 280, St. Olaf College

Thursday Oct 3, 7:00-8:00pm
The Art of Logic - Weitz Cinema

Job & Internship Opportunities

Consumer Financial Protection Bureau, Director's Financial Analyst:
The Consumer Financial Protection Bureau (CFPB) is recruiting this fall for the Director's Financial Analyst position. We are hiring for positions that begin in January 2020 and July 2020, and Class of 2020, 2019, and 2018 graduates are eligible to apply. This unique, two-year rotational fellowship sits at the intersection of the federal government and the financial services industry. Analysts will play an integral role in everything the Bureau does, from rigorous data-driven policy creation and market monitoring to on-site supervision of market participants. Interested students should send an email to CFPB_DFA_Program@cfpb.gov to be notified when the application window opens in late October 2019. If they have additional questions about the position or the application process, they can also reach out to Christine.Yan@cfpb.gov.

Puget Sound Regional Council, Assistant/Associate Data Analyst:
The Puget Sound Regional Council is seeking applicants for an assistant/associate data analyst position in the Data Science group. The Assistant/Associate Data Analyst will perform data analytics and data engineering tasks, including statistical evaluations, scripting, data analysis, visualization, and other data-related tasks using demographic, economic, land use, and transportation datasets. The position also involves written and oral communication of analytic needs, processes, and findings, and provides general assistance for data engineering work in support of modernizing the agency's technical capabilities. More information and application materials can be found at https://www.psrc.org/about/careers. The position is open until filled with applications reviewed beginning Tuesday, October 1, 2019.

Federal Reserve Bank of New York, Research Analyst:
Each fall the Federal Reserve Bank of New York recruits Research Analysts to work closely with the economists in our Research and Statistics Group, starting the following summer. We seek candidates who have records of superior scholarship and academic curiosity. Research Analysts usually have a strong background in economics, policy, mathematics, or computer science, though a major in one of these fields is not a necessity. Successful candidates often have previous research experience, and many are considering careers in economic research, public policy, or related fields. In addition, we seek candidates

from a wide range of backgrounds, particularly those that are typically underrepresented in economics. Thus we encourage many students with varying experiences and backgrounds to apply. Applications are being accepted now, on a rolling basis. Find more information and applications at https://www.newyorkfed.org/research/careers/research_analysts/index.html.
We recommend that candidates apply by October 15.

Mathematics Research Group at the National Security Agency, summer programs:
The Mathematics Research Group at the NSA offers exceptional summer programs for undergraduate and graduate mathematics students: The Director's Summer Program, Cryptoanalysis and Signals Analysis Summer Program, and Graduate Mathematics Program. These programs offer a unique opportunity to work directly with NSA mathematicians on advanced research and mission-critical problems that are vital to our nation's security. Due to the lengthy processing required, applications must be received by October 15th. To initiate your application, visit www.intelligencecareers.gov/nsa.

Carleton College Investment Office, Intern:
The Carleton College Investment Office, located in downtown Minneapolis, is responsible for the ongoing management of Carleton's endowment portfolio. They will be seeking spring, summer and fall interns (positions to be posted). There will be an information session Monday, October 7th, 12:30-1:30pm, Sayles 251; pizza provided, RSVP at the Tunnel. More details at https://apps.carleton.edu/career/events/?event_id=1861728&date=2019-10-07.

Problems of the Fortnight

Welcome, or welcome back, to a new academic year! Returning readers will be familiar with the routine: You can expect two problems in each issue of the *Gazette*; correct solutions are eligible for prizes from the B.B.O.P. (which stands not for a musical genre, but for the Big Box O' Prizes). Solutions can be submitted on paper (to my box in the CMC) or by e-mail (either in the body of an e-mail to me or as a pdf attachment; no other attachments, please). Solutions are due by noon on Tuesday of the next *Gazette* week - in this case, by noon on Tuesday, October 8. (Solutions that come in later but before my own solutions are posted will still be considered, but I probably won't be able to acknowledge them in that Friday's *Gazette*.) Although I tend to get behind on this, I'll try to return all solutions with (supportive) comments. People submitting incorrect solutions will not be identified in public, so don't hesitate to submit something even if you're not sure whether it's right. (On the other hand, to be eligible for a prize, a solution should show reasoning, not just an answer.) By the way, the problems are not necessarily in order of difficulty for you - for one thing, their difficulty may depend on what you happen to have seen!

Here are the first two problems of the term:

1. In this problem a, b, c are (not necessarily distinct) complex numbers; note that the real numbers are among the complex numbers.

   a) Given that each of the three numbers is the average of the *squares* of the two others (for example, $a = (b^2 + c^2)/2$), find all possibilities for a, b, c.

   b) If, instead, each of the numbers is the average of the *cubes* of the two others, how many possibilities are there for a, b, c, if we don't care about the order in which they are given?

2. Suppose we have a $2 \times n$ rectangle, divided into unit squares by lines parallel to the sides. (So there are $2n$ squares, in two rows of n each.) Let S be the set of all those unit squares. We say that a nonempty subset T of S is *connected* if for any two unit squares U, V in T, there is a sequence $U_1, \ldots, U_k$ of unit squares (within the rectangle) such that $U_1 = U$, $U_k = V$, and for each i with $1 \le i < k$, the squares U_i, U_{i+1} have a side in common. (This is exactly what your intuition says connected "should" mean, as long as you agree that two squares that have only a corner point in common are not directly connected.) Find the number of connected nonempty subsets of S, as a function of n. Note that your answer should evaluate to 3 for $n = 1$, to 13 for $n = 2$ (of the $2^4 - 1 = 15$ nonempty subsets of the four unit squares, only 2 are not connected) and to 40 for $n = 3$.

Solutions to both problems posed May 31 (which seems like a very long time ago, but there has been no *Gazette* since then) arrived from "Auplume".

- Mark Krusemeyer