Department of Mathematics

March 4, 2019

UNDERGRADUATE MATH SEMINAR

Professor Ehssan Khanmohammadi

This week's seminar will be the last one of the winter term. We hope you have enjoyed the series of talks!

DATE: **Thursday, March 7**

Time & **12:30pm –** Refreshments in **Bailey 204**

Location: **1:00 –** Seminar in **Bailey 207**

In this seminar, **Professor Ehssan Khanmohammadi** from the Department of Mathematics at **Union College** will present the following talk:

Title: The Spectacular Spectral Theory

Abstract: Do you know the reason for the collapse of the Tacoma Narrows Bridge in 1940? Have you ever wondered about the mathematical idea behind Google's page ranking and Netflix's movie recommendation? Do you know why scientists believe that distant stars are largely composed of hydrogen?

This talk is an invitation to the spectacular spectral theory which is the key to answering all of these questions.

Union's Putnam Team Does Well!

Do you enjoy working on tough math problems? For six hours? On a Saturday?

This past December, a trio of brave Union students, **Noah Lehman Borer, Khoa Ngo The,** and **Cameron Yang**, did just that when they participated in the 2018 William Lowell Putnam Competition.

The Putnam Exam is widely regarded as the world's most difficult collegiate math contest. It consists of two three-hour sessions, one in the morning and one in the afternoon. In each session, contestants work, independently, on six (proof-writing) problems. Each problem is scored from 0 to 10 so the maximum possible score in the contest is 120.

In this year's competition, there were 4623 participants from 568 institutions. Two students earned 114 points, the highest score in this year's competition. To put that into perspective, the median score on this year's exam was 2. Of the top 15 students, 11 are from MIT, 3 from Harvard, and 1 is from Princeton. Khoa was Union's top scoring student, placing in *the top 15% of all participants*, and Noah placed just outside the top 30%. Congratulations, Khoa and Noah!

Institutional teams consist of three team members. Harvard won the team competition, with MIT placing second.

Union's team of three, coached by **Professor George Todd**, did very well, placing 148th, just outside the top 25% - a wonderful showing!

If you might be interested in participating in the Putnam competition next December, contact Professor Todd, and start practicing … perhaps by working on our Problems of the Newsletter!

Upcoming Events

- The next meeting of the **Math Club** is **Thursday, March 7 at 2:00** in **Bailey 204**, the Math Common Room. This is right after this week's math seminar, so why not make it a wonderful mathematical Thursday? Help the club as it plans upcoming events, including its annual Pi Day fundraising pie sale, the proceeds of which will go to The Schenectady Foundation STEM Alliance which connects under-resourced students with opportunities in STEM fields.
- **HRUMC – Saturday, March 23, 2019 at Smith College: Sign-up Now!**
  - If you would like to give a 15-minute talk at this year's Hudson River Undergraduate Mathematics Conference (HRUMC) - similar to a Steinmetz talk – contact your math project advisor, and then submit an abstract to the HRUMC website by the **Friday, March 8** abstract submission deadline.
  - If you would like to attend the HRUMC (even if you are not giving a talk!) please email **Professor Paul Friedman** (friedmap@union.edu). Transportation to/from the conference might be limited, but we will do our best to accommodate all interested students. (There is **no charge** for attending the conference, and breakfast and lunch will be provided at the conference.)

Prime Producing Formula: A Prime-Representing Constant

Wouldn't it be wonderful if there were a simple formula that produced all of the prime numbers? Well, unfortunately, it is known that there is no formula that takes in n and produces the n^{th} prime.

Euler did find a really neat polynomial, n^2+n+41, that produces prime numbers for all integers n from 0 to 39. In fact, a slight variant of the polynomial, n^2-n+41, gives the same 40 primes for n from 1 to 40. By transforming Euler's polynomial to $(n-40)^2+(n-40)+41=n^2-79n+1601$, primes are obtained for 80 consecutive integers. (For more on this, see http://mathworld.wolfram.com/Prime-GeneratingPolynomial.html, from which this description is taken.)

In the January 2019 issue of *The American Mathematical Monthly*, there is a wonderful note by Dylan Fridman, Juli Garbulsky, Bruno Glecer, James Grime, and Massi Tron Florentin entitled "A Prime-Representing Constant," whose main theorem is the following:

> **Theorem:** Let $f_1 = 2.920050977316\ldots$ and define, $f_n=[f_{n-1}](f_{n-1} - [f_{n-1}]+1)$, where $[x]$ is the greatest integer less than or equal to x. Then $[f_n]$ is the n^{th} prime!

This short, very readable article, gives more detail on the definition of f_1 and f_n in the course of proving this theorem. Unfortunately, their definitions rely on the sequence of primes already. The authors also prove that f_1 is irrational. The Acknowledgement in the paper is also quite interesting:

"**ACKNOWLEDGMENT:** Dylan, Juli, Bruno and Massi are a group of 18/19 year-old friends from Buenos Aires, Argentina. The original idea came to Juli while having a shower. Bruno calculated the prime-generating constant, first by brute force and then by finding its formula. As the investigations continued, Juli and Bruno were joined by Massi and Dylan. Later, the team contacted mathematician James Grime who helped by tidying up some of the proofs and writing this note…."

Problem(s) of the Newsletter – March 4, 2019

Last week's problem: Unfortunately, no correct solutions to last week's problem were submitted. However, a solution to the problem has been posted at the newsletter sites in Bailey Hall.

This week's problem (from a past Putnam competition): Let A be the n x n matrix whose entry in the i-th row and the j-th column is $\frac{1}{\min(i,j)}$. Compute det(A).

Professor Friedman (friedmap@union.edu) will accept solutions until midnight Friday, March 8.