

*Duke University
Math News
October 9, 2014*



• ◆ • *FALL 2014 EDITION* • ◆ •

Duke University Math News

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Welcome

As Director of Undergraduate Studies in the math department it is my pleasure to welcome you back for the fall semester! I hope that you had an enjoyable summer and that the fall semester is off to a good start.

We welcome our new Associate Director of Undergraduate Studies, Professor Sarah Schott. Many of you already know her as math department representative at the majors' fair and organizer of the mentoring program for undergraduate women interested in mathematics.

As the term advances questions and problems are bound to come up. Your major advisor is there to help. For those who have recently declared a first major in math, but don't yet have an advisor, new advisors will be assigned in mid-October prior to registration for spring term in November. For further questions, contact me at schoen@math.duke.edu.

The beginning of fall semester is the high point for visits to campus by employers offering career and intern positions. To keep informed of the many opportunities available, contact the Duke Career Center <http://studentaffairs.duke.edu/career/online-tools-resources/erecruiting> or send an e-mail to Katie Smith katie.smith@duke.edu.

Deadlines for graduate school fellowships are coming up soon. Some information is available at <http://www.math.duke.edu/undergraduate/gradschooldeadlines2014.html> Applications for admission to graduate schools are for the most part not due before December.

Many Duke students study abroad. In these programs, one tends to focus on courses that take advantage of the particular location. Math courses seldom fall in this category, although the Budapest Semesters in Mathematics is an exception. See <http://www.budapestsemesters.com/>. For

information about taking math courses abroad see <http://www.math.duke.edu/undergraduate/studyabroad.html>

I hope that your semester is enjoyable and productive!

—Chad Schoen, *Director of Undergraduate Studies, Mathematics*

Duke Alumnus named MacArthur Fellow

Craig Gentry '95, Duke's second Putnam Fellow and member of our 1993 First Place Putnam team (along with Andrew Dittmer and Jeff Vanderkam) has been named a MacArthur Fellow for his work on encryption algorithms. <http://www.macfound.org/fellows/914/>

Craig gave a talk at Duke in our Undergraduate Alumni Series on this work. Here is the abstract of his talk from February 2010.

Computing on Encrypted Data

Abstract: What if you want to query a search engine, but don't want to tell the search engine what you are looking for? Is there a way that you can encrypt your query, such that the search engine can process your query without your decryption key, and send back an (encrypted) response that is well-formed and concise (up to some upper bound on length that you specify)? The answer is yes, if you use a "fully homomorphic" encryption scheme. As another application, you can store your encrypted data in the cloud, and later ask the server to retrieve only those files that contain a particular (boolean) combination of keywords, without the server being able to "see" either these keywords or your files.

We will present a recent fully homomorphic encryption scheme. In particular, we will highlight the main ideas of the construction, discuss issues concerning the scheme's performance, and mention other applications.

Duke Undergraduate Lecture

Professor Ken Ono of Emory University gave a lecture in the Duke undergraduate series on the Legacy of Ramanujan. The talk was attended by over 60 students and faculty. His abstract is below.

Srinivasa Ramanujan is one of the most enigmatic figures in the history of mathematics. He was a self-trained amateur mathematician whose ideas befuddled the accumulated wisdom of western European mathematicians in the early 20th century. His legacy has played a central role in the development of many of the deepest subjects in arithmetic geometry and number theory. Ramanujan tragically died at the early age of 32. Ramanujan's story will be retold as a major Hollywood movie in 2015 with Dev Patel (of *Slumdog Millionaire* fame) playing Ramanujan and Jeremy Irons playing G. H. Hardy, Ramanujan's mentor. The speaker spent much of this past summer working on the film in a variety of roles in pre-production and on-location filming. The speaker will discuss the legacy of Ramanujan and also tell stories about the filming of *The Man Who Knew Infinity*.

After the lecture, six students enjoyed a long dinner and conversation with Professor Ono. Among their impressions:

Dr. Ono is such an exuberant speaker.

It was an incredible opportunity to hear him speak with such passion about the work of Ramanujan and how it relates to number theory and the upcoming film during his lecture.

He had some great insights about research opportunities and graduate schools.

For more about the speaker, see Ken Ono <http://www.mathcs.emory.edu/ono/>

Advising Award

Clark Bray, Associate Professor of the Practice and Supervisor of First Year Instruction, was presented with the 2014 Partnership in Advising Award by the Academic Advising Center.

The award was presented to the Mathematics Department in appreciation for the extraordinary collaboration with the Academic Advising Center in furtherance of undergraduate education.



Undergraduate News

DUMU

The Duke University Mathematics Union is an organization for undergraduate students interested in mathematics and its applications. DUMU sponsors math contests, guest speakers, informational panels, games nights, and many other events.

Current DUMU activities include the half-credit Problem Solving Seminar class, which meets weekly to help students prepare for undergraduate mathematics competitions, as well as the Freshman Social to allow first-year students to learn more about DUMU and its members.

To join the DUMU mailing list, please contact the DUMU president, Brett Schnobrich, at brett.schnobrich@duke.edu. You will receive notices of many events, including recruiting sessions, research opportunities, and mathematics talks.

Please feel free to send any ideas for other math-related activities and events as well.

—Brett Schnobrich, President
brett.schnobrich@duke.edu

Competitions

We encourage all interested undergraduates to participate in various mathematical contests throughout the year. The Virginia Tech Math Contest will be held on Saturday, October 25, 2014 from 9:00 am to 11:30 am in Bio-Sci 144. The more challenging W. L. Putnam Contest will be held on Saturday, December 6, 2014 from 10 am to 6 pm.

Both these contests are proof-based and require creative insight and careful rigor rather than knowledge of much advanced mathematics. The Problem Solving Seminar, Math 281S, helps to prepare interested students for these contests. The seminar meets weekly on Thursday evenings in Physics 119 from 6:30 to 8:00 and all are welcome to attend. Please contact Alex Milu (aam47) or David Kraines (dkrain@math.duke.edu) for more information.

In the Mathematical Contest in Modeling, to be held from February 5 to 9, 2015, students work in teams of three for 96 hours to develop a model for an open-ended real-world problem. Nearly 8000 teams competed worldwide last year. Duke students have had much success in the past.

For more information about these contests, contact contest coordinator David Kraines (dkrain@math.duke.edu) and see <http://www.comap.com/undergraduate/contests/mcm/www.math.duke.edu/news/awards/competitions.html>.

Summer Research Opportunities

Several opportunities are available for qualified students to pursue original research in mathematics and its applications. Seven undergraduates gave short lectures on their research projects this September and 18 others discussed their work during the summer.

The PRUV Fellow program provides summer stipends for qualified advanced sophomores and juniors to engage in mathematical research projects leading to a senior thesis and Graduation with Distinction honors. Each summer since 2000, up to nine undergraduates have been paired with faculty mentors for six weeks of intensive research.

For more information and an application, see www.math.duke.edu/vigre/pruv/ or contact David Kraines dkrain@math.duke.edu.

The Mathematical Biology program at Duke provides summer stipends to qualified students to work on problems related to mathematical models in biology. <http://www.math.duke.edu/mathbio/undergrad.html>

The following students were selected for summer 2014: Lindsey Brown, Neda Jamshidi-Azad, Ray

Lee, Rod Shayesteh, Muhammed Tayyab Wassim, Andrew You, Michael Zhang, David Zhou

The program arranged for these students to present posters at the Mathematical Biosciences Institute at Ohio State, last August. Neda Jamshidi-Azad was invited to lecture on her work. For more information about this REU program, contact professor Michael Reed at reed@math.duke.edu



Caption: Wassim, Brown, You, Jamshidi-Azad, Zhang, Lee, Zhou, Shayesteh

Last summer, eight Duke undergraduates (Marshall Ratliff, Derrick Nowak, Carmen Cox, Julia Ni, Alex Pieloch, Roger Zou, Joy Patel, and Aaron Park) were joined by Courtney Smith (Wyoming), Matt Farrell (Cornell), and David Moon (Williams), for the 9-week *Data and Brains* summer research program, with funding provided by the National Science Foundation and workspace provided by the Information Initiative at Duke (iiD).

The students worked on several projects, including the use of topology to build a music genre classifier and image-analysis techniques for mitochondria detecton. The results were spectacular, leading to two submitted papers, as well as excellent code that has been incorporated into research software.

Next summer the program will transform into *Data+*, hosted and partially funded by iiD. Up to 20 Duke students will be invited to work on data-driven interdisciplinary projects in an exciting and collaborative atmosphere. For more details on this program, please contact Paul Bendich (bendich@math.duke.edu). Watch for upcoming announcements.

In addition to these programs, internships and research opportunities are available throughout the country for math and math related activities. Over the past decades, many Duke students have attended NSF sponsored Research Experiences for Undergraduates programs in math. A list of such programs for summer of 2015 should be available by the end of this year at http://www.nsf.gov/crssprgm/reu/list_result.jsp?unitid=5044

Graduate Student News

Andrew Goetz and Phillip Andreae were selected as winners of the L. P. and Barbara Smith Award for Excellence in Teaching. They will receive a substantial award from a fund provided by the Smiths.

Andreae was cited for his outstanding level of seriousness and empathy toward his students. He went to extraordinary lengths to help them learn in class. Goetz was praised for his contributions to the curriculum, and for development of pedagogical methods, and for his encouragement and help to fellow instructors. He has been successful in giving his students a stronger understanding of the material.

Captain L.P. Smith joined the Duke Math faculty in 1967 after a long career in the US Navy. He served as Supervisor of Freshmen Instruction and as an Assistant Dean of Duke's Trinity College.

Babara Smith received the BA and MA degrees in psychology from American University (in Washington, DC), where she subsequently served as an instructor in the Department of Psychology.

After his retirement in 1982, L.P. and his wife, Barbara established a fund to encourage excellence in teaching by graduate students. Those of us who knew them remember them fondly.

We welcome 10 new Graduate Students this fall:

- Gavin Ball, Cambridge University
- Yan Chu, Bard College
- Gabriel Earle, University of Texas at Austin
- Ran Huo, Nanjing University

- Jeffrey LaComb, Rensselaer Polytechnic University
- Weifan Liu, Worcester Polytechnic University
- Ruibo Ma, Peking University
- Sarah Ritchey, Youngstown State University
- Shan Shan, Agnes Scott College
- Kyle Thicke, Missouri University of Science and Technology

Faculty News

New Faculty

Visiting Assistant Professors:

Henry Adams will be working with John Harer and is also a postdoc fellow at the IMA. PhD Stanford University

Austin Baird will be working with Anita Layton. PhD UNC-CH

Anirban Basak works in probability theory. PhD Stanford University

Justin Curry will be working with Harer. PhD University of Pennsylvania

Anastasia Deckard will be working with John Harer. PhD Duke

Francis Motta will be working with John Harer. PhD Colorado State University at Fort Collins

Assistant Research Professors:

Gonçalo Oliveira works in geometry, especially gauge theory and special holonomy. He received his PhD from Imperial College London.

Zhennan Zhou works on computational methods in quantum dynamics. He received his PhD from University of Wisconsin.

Assistant Professor

We welcome Lillian Pierce to the department. She received her PhD in 2009 from Princeton University under the direction of Eli Stein, and subsequently did a postdoctoral year at the Institute for Advanced Study, funded by the NSF and the Simonyi Fund.

She then spent three years at the University Oxford as a Marie Curie Incoming International Fellow and Fellow of Wolfson College, with additional funding from the NSF. Although hired at Duke in 2013, she deferred her appointment in order to spend a year at the University of Bonn as a Bonn Junior Fellow of the Hausdorff Center for Mathematics.

Pierce's research interests span from classical analytic number theory to harmonic analysis. A particular interest is achieving strong bounds for character sums and oscillatory integrals. These have applications to a wide array of problems such as counting integral solutions to Diophantine equations (via the circle method or sieves), bounding operators arising in harmonic analysis that involve integration over hypersurfaces with curvature, and discrete operators combining the flavors of both analysis and number theory.

Awards

Robert Calderbank, the Charles S. Sydnor Professor of Computer Science, has been named recipient of the prestigious Claude Shannon prize. This prize is given annually by the IEEE Information Theory Society for consistent and profound contributions to the field of information theory. Professor Calderbank was honored at a reception by President Brodhead on August 21.

<http://today.duke.edu/2014/07/calderbankshannon>

<http://www.itsoc.org/honors/claude-e-shannon-award>

http://en.wikipedia.org/wiki/Claude_E._Shannon_Award

Calderbank is currently director of the Information Initiative at Duke (iiD)
<http://bigdata.duke.edu/>

Duke Math News

The *Duke Math News* is published several times a year and is distributed to those in the Duke mathematics community. For previous editions and other news, see <http://www.math.duke.edu/news/>. We welcome items of interest for our next issue. Send them to dept@math.duke.edu or dkrain@duke.edu

To read about other news, honors and events concerning mathematics at Duke, visit <http://www.math.duke.edu/news/>. The on-line calendar at <http://www.math.duke.edu/mcal> lists both regular and special seminars and colloquia for the upcoming weeks. The department maintains video

archives of talks, lecture series and special conferences at Duke, many of which are available, on-line. See <http://www.math.duke.edu/computing/broadcast.html> for more information.

—David Kraines, DMN Faculty Sponsor

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