

Duke University Math News

May 8, 2007

2007 Graduation

A record high of 81 students are graduating from Duke University this May with a major or a minor in mathematics. Many of these students will continue in graduate programs in mathematics, physics, economics, or computer science or will attend law, medical or business school. Others will enter a variety of careers such as in the financial sector, consulting, actuarial work and in secondary school teaching.

To those of you who are graduating this spring, we wish you the greatest success. Do let *Duke Math News* know of major events in your life and career.

To the parents: Thank you for entrusting your sons and daughters to us for these four years. We hope that the changes that you are seeing in them are mostly for the good.

Graduate Luncheon

At noon, immediately after Graduation Exercises on Sunday May 13, senior math majors and their families will meet in the LSRC dining room. In a short ceremony after lunch, those whose first major is mathematics will receive their diplomas.

Events

Mathematics Department Party

On April 18, 2007, the mathematics department hosted its annual party for math majors and faculty. At this event, students are encouraged to chat with their professors in an informal setting as they enjoy a light meal. Those students who have distinguished themselves in math competitions or research were honored with the new Duke Math 2007 shirt and, for some, a cash award. You may read about the accomplishments of these students in the articles in this newsletter.

Undergraduate News

DUMU

Duke University Math Union is an organization for undergraduates with a special interest in mathematics, mathematical competitions, and related activities on campus. DUMU organizes social events and guest lectures for the Duke mathematics community. Its main event is the Duke Math Meet, an annual ARML style mathematics contest for high school students. See below for details of last year's meet.

The chief officers for the coming year are president Kshipra Bhawalkar and vice presidents Aaron Pollack and Tirasan Khandawit. Many thanks and best wishes to graduating current president Brandon Levin and vice president Keigo Kawaji. To be added to the DUMU mailing list, send a note to secretary Aaron Wise at amw7@duke.edu.

Duke Math Meet

Each fall for the past decade, DUMU has hosted the ARML style Duke Math Meet for High school students from throughout the southeast. The meet has become quite popular, attracting over 180 students last November.

The team from East Chapel Hill High School finished first this year with the Georgia Math League team placing second, Vestavia Hills High School from Birmingham AL in third and Enloe High School from Cary in fourth. The overall winner, decided in a tie-breaking round, was Haito Mao of Thomas Jefferson High School in Virginia.

Putnam Competition

Ten Duke undergraduates ranked among the top 5% of the 3640 participants in the 67th annual William Lowell Putnam Mathematical Competition held last December: Kshipra Bhawalkar, Nikifor Bliznashki, Morgan Brown, Jason Ferguson, Calvin Hayes, Tirasan Khandhawit, Brandon Levin, Aaron

Pollack, Peng Shi, and Lingren Zhang. This is the largest number of students from Duke ever to rank among the top 200 in the decades of its participation in this six hour competition. In addition, Wutichai Chongchitmate, Matthew Rognlie and Charles Staats III ranked among the top 500 participants.

The Competition was especially grueling this year with nearly 2/3rds of the participants from over 500 colleges and universities throughout the United States and Canada receiving 0 out of 120 possible points. Only one out of five participants completely solved even one of the 12 problems.

Each participating school may choose a three person team to represent it. The Duke team of Bhawalkar, Bliznashki and Zhang ranked eighth in the team competition, the twelfth straight year in which the Duke team ranked among the top ten.

Menger Prize

The Menger prize of \$250 is awarded each year to the top three Duke participants in the annual W. L. Putnam Mathematical Competition. With his Honorable Mention rating, Freshman Peng Shi led all Duke contestants. Ranking among the top 100 of the 3640 contestants, Sophomore Jason Ferguson placed second. Tirasan Khandhawit and Lingren Zhang split the third place prize. See www.math.duke.edu/news/awards/menger/index.html for information about Karl Menger and a list of previous recipients.

Mathematics Contest in Modelling

For 96 hours, from February 8 to 12, seven teams of three Duke undergraduates each competed in the annual Mathematical Contest in Modeling (MCM) and the Interdisciplinary Contest in Modeling (ICM). Of the over 1200 teams from around the world that competed this year, 18 submitted papers that were deemed Outstanding. Of these 18 teams, four consisted of Duke students. No school has ever before had four Outstanding teams in a single year and only Duke in 2006 and Harvey Mudd in 1999 have had three.

Sponsored by the Consortium for Mathematics and its Applications (COMAP), these contests require teams of three students from colleges, universities, and high schools around the world to tackle a real-world problem by constructing and analyzing a mathematical model. Students are allowed to

use books, the internet and any other non-animate source during these four days. After developing their mathematical solution, they must write a paper explaining it. These papers tend to range from 30 to 60 pages. A panel of judges rates each paper as either Outstanding, Meritorious (top 13%), Honorable Mention (next 34%), or Successful Participant.

This year's ICM problem asked students to develop a fairer and more efficient way to arrange for kidney transplants. Four of the 224 entries in the ICM were awarded an Outstanding rating. The team of Duke freshmen Matthew Rognlie, Peng Shi and Amy Wen developed one of these winning models. They "have undertaken an extensive simulation-based review of various political and ethical questions underlying decisions about organ allocation" and proposed and analyzed various protocols to improve the pairing of kidney donors with those in need.

The two MCM problems this year addressed gerrymandering of congressional districts and efficient protocols for seating passengers on large airplanes. For the first problem, the teams were to develop an algorithm to produce "simple" shapes for districts that would be roughly equal in population and that would be considered fair by the general public. The team of senior Nikifor Bliznashki, sophomore Aaron Pollack and junior Russell Posner developed an algorithm to "divide the states into ...districts as elementary and compact as possible, where compactness is defined as the moment of inertia of a region with respect to its [population] density." They illustrated their procedure by drawing districts in Ohio and New York. This is the fourth contest and the second win for Bliznashki. Last year, Posner and his team received the Meritorious designation.

The Duke team of juniors Arnav Mehta, Qianwei Li, and Aaron Wise was named Outstanding for their model for more efficient boarding patterns on airplanes. Using stochastic agent-based simulations, genetic algorithms, and a Markov chain model, this team demonstrated that "a hybrid boarding process" that allows family units to board first and combines window to aisle and alternate row seating. This team won an Outstanding award last year in the ICM. Their paper, both this year and last, was also selected by the Institute for Operations Research and the Management Sciences (INFORMS)

for a special plaque and a \$300 cash prize for each team member.

The Duke team of juniors Michael Bauer, Kshipra Bhawalkar and Matt Edwards was also named Outstanding for their model of airplane boarding. Their computer simulations led them to the conclusion that congestion at the entrance to the plane and in the aisles caused by the stowing of bags were the primary cause of delays. With improvements to these, allowing passengers to seat themselves works best. Bauer and Edwards were part of a Meritorious team last year. This is the first competition for Bhawalkar.

The other three Duke teams each earned a Meritorious rating, placing them in the top 13% of teams worldwide. The teams were:

Tyler Huffman, Charles Staats III and Barry Wright III; Catherine Hartman, Keigo Kawaji, and Jesse Thorner; Yajing Gao, Michal Koszycki and Craig Reeson.

Team members come from a wide range of disciplines and majors, including mathematics, engineering, chemistry, biology, economics, and computer science.

For more information see www.math.duke.edu/news/awards/competitions/.html#modeling

Goldwater Scholar

Charles Staats III '08 became the mathematics department's most recent B.M. Goldwater Scholar. As a PRUV Fellow, Staats has been working with Dr. Eric Katz on problems in a new area of mathematics called Tropical Geometry. Last summer he read a paper on his research at a conference at Ohio State University. In 2006, Staats was on one of four teams in the world to be named Outstanding in the Interdisciplinary Contest in Modeling. Their paper *Managing the HIV/AIDS pandemic* was published in the UMAP journal last fall. After graduation in May 2008, Staats plans to pursue a Ph.D. in mathematics at a major university.

The Goldwater Scholarship program offers scholarships of \$7500 to over 300 engineering, science and mathematics undergraduates in the United States. Since this program began in 1986, 64 Duke students including 27 math majors have been so honored.

PRUV Fellows

Now in its eighth year, the PRUV program will provide stipends to five students, Jason Ferguson, Andy Ng, Aaron Pollack, Elliott Wolf, and Barry Wright III, for six weeks of intensive math related research under the mentorship of a Duke mathematics professor. The Fellows will write up their research results in an Independent Study course the following year to produce a senior thesis worthy of Graduation with Distinction. As of this May, 25 PRUV Fellows will have Graduated with Distinction. See www.math.duke.edu/vigre/pruv for details and information about applying.

MBS Certificate

This spring, the Arts and Science Council approved a certificate program in Modeling Biological Systems. MBS undergraduates will take a core course in their first or second year at Duke followed by classes in relevant areas of biology, mathematics and computer science. Students in this program will apply quantitative methods to areas such as gene regulatory mechanisms, physiological networks, and the description of protein structure. The program will be directed by professor John Harer.

Students chosen to participate in mentored research projects this summer under the direction of MBS affiliated faculty are Mehak Aziz, Catherine Hartman, Andy Ng, Jovana Pavisic, Russell Posner, Scott Spillias and Rory Wasiolek.

See David Kraines (dkraines@math.duke.edu) for more information about the MBS certificate program.

Graduation with Distinction

This May, three math majors, Morgan Brown, Stepan Paul and James Zou, will each Graduate with High Distinction and Brandon Levin will Graduate with Highest Distinction.

For his thesis under the direction of John Harer, Brown developed an algorithm for tracking persistence pairing of a discrete homotopy of Morse functions on S^2 . His algorithm may have applications to better understanding of questions in computational biology. Brown will be a graduate student in mathematics at the University of California at Berkeley.

For his senior thesis with Les Saper, *Class field theory and the problem of representing primes by binary quadratic forms*, Levin obtains new results in

Algebraic Number Theory. Levin will be a Churchill Scholar in mathematics at Cambridge University next year after which he plans to enter a graduate program in the US to complete his doctorate.

For his senior thesis under the direction of Joshua Davis, *Lines and conics relative to degenerating divisors in CP^2* , Paul developed degeneration techniques for computing relative Gromov-Witten invariants of the projective plane. Paul will be a graduate student in mathematics at the University of California, Santa Barbara.

In his senior thesis with John Harer, *3-D reconstruction and topological analysis of root architecture*, Zou developed a “Roots Imaging Toolbox” to get clear spatial images of root systems from a small number of X-ray images. Zou will be a Gates Scholar in mathematics at Cambridge University next year after which he plans to enter the graduate program at Harvard to complete his doctorate.

Julia Dale Prize

The Julia Dale Prize for Excellence in Mathematics will be shared this year by seniors Brandon Levin and James Zou. Each of them have won major fellowships to study mathematics in what is known as Part III of the Tripos at Cambridge University.

Levin is an A. B. Duke Scholar, a Goldwater Scholar, a PRUV Fellow and a member of an Outstanding team the Mathematics Contest in Modeling in 2006. He has served for two years as president of DUMU. He is a math major with a minor in Philosophy.

Zou is a mathematics and physics major with a minor in English. He has completed research projects in quantum computation, topological statistics, financial mathematics, bio-informatics and Riemann surfaces.

The Dale prize is the highest honor offered by the mathematics department. It is named in honor of Assistant Professor Julia Dale who died at an early age in 1936. See www.math.duke.edu/news/awards/dale/index/.html for more information and a list of previous recipients.

Graduate Program News

Graduating Ph.D Students

Ryan Haskett- His thesis, *Long-Time Asymptotic Solutions in Driven Microfluidic Processes*, was written under the supervision of Thomas Witslski.

William LeFew- His thesis, *A Mathematical Model for Precursor Behavior in Previously Unexplored Regimes*, was written under the supervision of Stephanos Venakides.

Jeffrey Streets- His thesis, *Ricci - Yang Mills Flow*, was written under the supervision of Mark Stern.

Faculty News

Robert Bryant

Robert Bryant, J.M. Kreps professor of mathematics, has been elected to the National Academy of Sciences, the foremost organization of American scientists and engineers dedicated to the furtherance of science and its use for the general welfare.

Bryant will be on leave from Duke as he assumes the Directorship of the Mathematical Sciences Research Institute. Founded in 1982 and located in the Berkeley hills, MSRI provides the resources to further mathematical research through broadly based programs in the mathematical sciences and closely related activities.

Maruo Maggioni

Assistant professor Mauro Maggioni has been awarded the Vasil Popov Prize for his outstanding research contributions to Harmonic Analysis on graphs and in particular for his work on diffusion geometry. The selection committee stated that “his work has already had a seminal impact in the fields of information organization, machine learning, spectral graph theory, image analysis, and medical diagnosis. The Popov Prize is awarded every third year to a young mathematician.

Margaret Hodel

After 34 years of teaching more than 3500 Duke students, Dr. Margaret J. Hodel is retiring from Duke. Long respected as one of the most demanding yet dedicated teachers here, Hodel has been a frequent nominee for the University Alumni Teaching Award.

After graduating from Vassar, she taught math in Athens and Rome for several years. She entered the math graduate program at Duke in 1968, earning her Ph.D. from Leonard Carlitz in 1972. Her favorite instructor in the graduate program was Dick Hodel whom she married in 1970. They have two children, Katie 24 and Richie 26.

Hodel looks forward to reading, traveling and volunteer work.

Other News

Presidential Award

Yunliang Yu has been honored with the Duke Presidential Award this April. As Senior Systems Programmer for the mathematics department, Dr. Yu has developed the Duke Faculty Database which is being used as a central repository for teaching, research and other activities of the faculty. His Web-based job application service, mathjobs.org, has saved the Duke math and other departments hundreds of hours in processing job applications. The American Mathematical Society encourages applicants for academic positions in mathematics to distribute their resumes to Duke and other math departments using Dr. Yu's program.

Last year he extended this service to other Duke departments by creating academicjobsonline.org, for use by the English, biology, economics and the physics departments.

Yu received his Ph.D. in mathematics at Duke in 1991 and has been Systems Programmer at Duke ever since. See more at www.dukenews.duke.edu/2007/04/you.html

Math Degree Candidates, Academic Year 2006-2007

First Majors

Ian Richard Appel
 Nikifor Bliznashki
 James Douglas Bragdon
 Morgan Veljko Brown
 Daniel Antonio Daly
 Alexandra Miragaia De Oliveira
 Dean Thomas Demakis
 Katherine Ahern Dunn
 Amanda Gail Frese
 Patricia Anne Frost
 Bich Thuan Vong Hoai
 Allyson Lynn Johnson
 Vyacheslav Kungurtsev
 Brandon William Levin
 Amelia R Lombard
 Adrian Gutierrez Lucero
 Ibraheem Maqsood Mohammed
 Ryan Chase Morton-Wurst
 Mallory O'Connell
 Kyle Raymond O'Donnell
 Stepan Sebouh Paul
 Jenna Marie Pellecchia
 Robert Maxwell Sanders
 Aaron Elihu Silver
 Luke Jesse Hartley Stewart
 Andrew Anthony Tignanelli
 Lauren Teresa Tippets
 Elizabeth Mae Vanderslice
 Janice May Wilson
 Jingyuan Wu
 Mingzhe Yi
 Cheng Zhang
 James Yang Zou

Second Majors

Aaron Thomas Baxter
 Alejandro Jose Caceres
 Daniel Edward Carlin
 James John Dias
 Luyuan Fan

Kostia Serguei Fastovets
 Aakanksha Gulati
 Nathan Robert Herr
 Tristan Abbott Hopkins
 Kevin Ji
 Keigo Kawaji
 Stephen Michael LaFata
 Andrew Michael Lang
 William Sang Lee
 Christopher Paul Lin
 Wenwen Mao
 Patrick Paczkowski
 Mark Kendal Redmond
 Mili Seoni
 Secil Topak
 John Yue Zhuo

Minors

Bryon Alvarez
 Joyce Elizabeth Coppock
 Randa Selin Dilmener
 Paul Otto Drews
 Andrew Scott Grochall
 Ying Chiat Ho
 Caroline Anne Holland
 Jeremy Huang
 Kyung-Wha Kim
 Amrith KrushnaKumaar
 Hannah Wei Liu
 Ryan Matthew Mattison
 William Edward Monaco
 Leon Haim Ojalvo
 Constantine A Paras
 Tyler Homann Patla
 Stephen Richard Reading
 Sritha Nukalapati Reddy
 Eric Stephen Rogstad
 Emily Suzanne Schmidt
 Drew Stokesbary
 Daniel Edward Summerhays
 Daniel Lincoln Tao
 Richard Arthur Wall
 Everett Dineen Wetchler
 Yanjia Yao
 David Kyoungso You

Master of Arts

Oliver Gjoneski
 Jeffrey Loren Jauregui
 Lauren Margaret Shareshian
 Rachel Lee Thomas
 Philip Adam Vetter
 Andrea Chereese Watkins

Ph.D

Mr. Ryan Patrick Haskett
 Mr. William Rosser LeFew
 Mr. Timothy Allen Lucas
 Mr. Jeffrey Daniel Streets

Duke Math News

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

To read about other news, honors and events concerning mathematics at Duke, visit www.math.duke.edu/news/. The on-line calendar at 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 www.math.duke.edu/computing/broadcast.html for more information.

—David Kraines, DMN Faculty Sponsor

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