

# Duke University Math News

April 24, 2001

## Events

Duke University has done itself real proud this year. Your fellow students have captured Duke's third national championship - in the Putnam mathematical competition as well as NCAA basketball tournament. Another Duke team was named Outstanding for the fourth straight year in the international Mathematical Contest in Modeling. See details of these and other awards and events below.

### Math Department Gala

The Duke mathematics community celebrated the end of the school year with a big party on April 19. Students and faculty ate and socialized in the informal atmosphere of department lounge. The department chair Richard Hain, the DUS Stephanos Venakides and DUMU advisor David Kraines welcomed the many students and listed some of their interesting and varied plans of the graduating math majors. Four students will work for doctorates in mathematics at top graduate schools while others have accepted computer related positions, will join investment or insurance corporations, or will attend medical or law school. President Nan Keohane, Provost Peter Lange, and Deans William Chafe, Robert Thompson, Berndt Mueller and Kay Singer joined the party to help present the many awards that these students have received this year. The new Duke math shirts were distributed to many and a good time was had by all.

### Graduation Luncheon

Graduating students with a major in mathematics are cordially invited to a luncheon at the Levine Science and Research Center on Sunday, May 13. In a brief ceremony at the end of the lunch, diplomas will be presented to those whose first major is mathematics.

## Undergraduate News

### Putnam Champs

A team of three Duke students won the 61st annual W. L. Putnam mathematical competition that was held on Saturday, December 2, 2000. Duke beat out MIT, Harvard and 431 other teams from colleges and universities throughout the US and Canada to capture the \$25,000 prize. This is the third win for Duke since 1993.

In this challenging six hour competition, 2818 participants struggled to solve six problems in the morning and another six in the afternoon. Only about one quarter of the participants managed to solve as much as one of the twelve problems while twelve of the seventeen Duke students did at least that well.

John Clyde '01, Nathan Curtis '02, Kevin Lacker '02, and Carl Miller '01 each ranked among the top 15 of the 2818 participants and each will receive a check for \$1000. As members of the winning team, Clyde, Curtis, and Lacker will each receive an additional \$1000. Freshman David Arthur and senior Michael Colsher received Honorable Mention for being among the top 2%. Senior John Thacker and sophomores Matthew Atwood and Daniel Wong ranked among the top 15%. This has been the best overall performance by Duke ever in the prestigious Putnam competition, according to associate professor and contest advisor, David Kraines. For more information, see <http://math.scu.edu/putnam/> and <http://www.math.duke.edu/news/awards/competitions.html#putnam>

At their meeting on May 11, the Board of Trustees will pay tribute to the senior members on the championship math teams, John Clyde, Michael Colsher, Carl Miller, Daniel Neill and John Thacker and their coach David Kraines, along with this year's Rhodes Scholar and senior members of the men's basketball team and their coach Mike Krzyzewski.

### Modelers fourth straight Outstanding

For the fourth straight year, a team from Duke has been designated as Outstanding in the Mathematics Contest in Modeling (MCM). Working from 12:01 am Friday, February 9, until 11:59 pm Monday, February 12, the team of junior, Sam Malone, and seniors, Carl Miller and Daniel Neill, produced a 47 page paper describing and evaluating strategies to evacuate a half million people from coastal communities when a hurricane threatens. Nine of the 496 papers submitted from around the globe were declared Outstanding. These papers will be published in the journal *Undergraduate Mathematics and its Applications*. This is Malone's third straight Outstanding performance on the MCM and Neill's second. For more information, see <http://www.comap.com/undergraduate/contests/mcm/index.html> and <http://www.math.duke.edu/news/awards/competitions.html#modeling>

Last year, the MCM team received the Outstanding designation for their paper on air traffic control problems. The team members, Sam Malone '02, Daniel Neill '01 and Jeff Mermin '00 have been invited to talk about their results at the Federal Aviation Administration in Washington in May.

### Duke students dominate Virginia Tech Math Contest

Carl Miller '01, Nathan Curtis '02, Kevin Lacker '02, David Arthur '04 and David Mermin '04 finished first, second, third, fourth and sixth respectively in the 22nd annual Virginia Tech Math Contest held on October 28. Michael Colsher '01, Adam Siegel '04, Jonathan Godshall '03, Daniel Wong '03 and Fred Zahrn '02 also finished among the top 10% of the 299 participants from 37 schools in the southeast region on this two and a half hour test of mathematical ingenuity and problem solving ability. Last year, Lacker won this contest. The top contestants will receive cash awards. For more information about the contest, see <http://www.math.vt.edu/events/>

### ACM Programming Contest

The Duke team of David Arthur '04, Kevin Lacker '02, and Melanie Wood '03 tied for 14th among the 64 teams competing at the World Finals of The 25th Annual ACM International Collegiate Programming Contest held on March 10, 2001, in Vancouver, Canada. These teams were selected from regional competitions involving 2,700 teams representing 1,079 universities in 70 countries on six continents. See <http://acm.baylor.edu/acmicpc/> for more details.

### Duke Math Meet

Over 100 high school students from Georgia to Virginia participated in the annual Duke Math Meet on Saturday, March 24. Members of the Duke University Math Union sent out invitations, wrote and graded the problems and presented the awards to the winners of this ARML style team/individual competition. The top two teams came from Thomas Jefferson High School of Science and Technology with NC School of Science and Math, the Charlotte Math Club and Chapel Hill HS also placing high among the 18 teams of six. Winning the tie breaker for best individual performance was Greg Price from TJHSST for the second year in a row with Anders Kaseorg from Charlotte placing a close second. Rounding out the field of five winners were Ricky Biggs, Yan Zhang and Josh Dezube from TJHSST. Congratulations to DUMU president Carl Miller, Nathan Curtis, David Arthur and the other DUMU members for a job well done!

### Karl Menger award

The Menger award is given in recognition of superior performance on the William Lowell Putnam Mathematical Competition. The winners of the \$250 prize are John Clyde '01, Nathan Curtis '02, Kevin Lacker '02 and Carl Miller '01. These students each ranked among the top 15 among the 2818 participants. This is third Menger award for Clyde, Curtis and Lacker. Karl Menger influenced several mathematical movements of the 20th century. The Karl Menger award was established by Menger's daughter, Eva Menger-Hammond in 1990.

### Julia Dale prize

Many candidates were nominated this year for the Julia Dale prize for excellence in mathematics, the highest honor awarded by the mathematics department. The winners, seniors Michael Colsher, Carl Miller, and John Thacker, have received a wide array of honors at Duke.

First prize went to Miller for his research projects, his leadership of DUMU and his completion of 16 graduate level mathematics courses at Duke. Miller's senior thesis has qualified him for Graduation with Highest Distinction. Miller has been awarded an NSF graduate fellowship and an NDSEG fellowship and will study Algebraic Topology and Algebraic Geometry at the University of California in Berkeley.

Second prize winners are Colsher who will study Applied Mathematics at the Courant Institute in New York City with his NSF graduate fellowship, and Thacker who will study Probability at Cornell University with his NDSEG Fellowship.

Julia Dale received her doctorate in mathematics from Cornell University in 1924 and joined the faculty of Duke University in 1930. Soon after she died in 1936, friends and relatives established the Julia Dale Memorial Fund. See <http://www.math.duke.edu/news/awards/dale/index.html> for more information.

### PRUV Fellows

The research program for undergraduates in the mathematics department (PRUV) is off to a great start. This program, sponsored by the National Science Foundation, encourages undergraduates to participate in research in mathematics and its applications under the supervision of a Duke professor. The current PRUV Fellows, Michael Colsher, Sam Malone, Carl Miller and Daniel Neill, worked with their mentors for six weeks last summer, continuing this past year with independent study courses. Neill's project, *Optimality under noise: higher memory strategies for the Alternating Prisoner's Dilemma*, has been accepted for publication by the *Journal of Theoretical Biology*. Miller's paper, *Exponential*

*Iterated Integrals and the Solvable Completion of Fundamental Groups* will soon be submitted for publication.

Five students, Matt Atwood '03, Thomas Finley '02, Carl Pearson '03, Tristan Tager '03, and Melanie Wood '02, have been named PRUV Fellows for 2001-03. They will work on problems ranging from physics and computer science to pure mathematics. Each PRUV Fellow will receive a stipend of \$3000 for the six weeks of mentored research.

### Goldwater Scholars

Mathematics majors, Sam Malone '02 and Melanie Wood '03, have been named Barry M. Goldwater Scholars. This prestigious honor and its \$7500 scholarship is given to over 300 students annually for outstanding achievement in mathematics, science and engineering. The total number of Goldwater Scholars from Duke since 1989 is now 45 of whom 19 have been mathematics majors. Nationally, about 10% of the Goldwater Scholars are mathematics majors. See <http://www.act.org/goldwater/2001pressr.html> for more information.

*I contend, that each natural science is real science only in so far as it is mathematical. . . . It may be that a pure philosophy of nature in general (that is, a philosophy which concerns itself only with the general concepts of nature) is possible without mathematics, but a pure science of nature dealing with definite objects (physics or psychology), is possible only by means of mathematics, and since each natural science contains only as much real science as it contains a priori knowledge, each natural science becomes real science only to the extent that it permits the application of mathematics.*

—Immanuel Kant

## Gergen lectures

### Nowak

In September 2000, Martin A. Nowak, the head of the Theoretical Biology Program at the Institute for Advanced Study, gave three talks as part of the Gergen Lecture Series in honor of the late Duke professor and former department chairman John J. Gergen.

**Evolution of Language:** What sets us apart from other animals is the ability to talk about everything. Professor Nowak presented mathematical models to help formulate an evolutionary theory of human language and discussed how populations evolve and maintain a coherent lexicon and universal grammar.

**Fairness and Cooperation:** Darwin's theory of evolution is based on competition and does not easily account for fairness or cooperation. Yet many animals, most notably humans, engage in cooperative and altruistic interactions. In the ultimatum game, humans prefer fairness over rationality. Professor Nowak presented mathematical models and games illuminating the evolution of cooperation and fairness.

**Virus dynamics:** Mathematical models have been developed to describe the dynamics of virus infections. This has led to detailed insights into how viruses reproduce and evolve within infected patients. The models provide a quantitative understanding for the success and failure of HIV combination therapy and help to design efficient treatment regimens.

### Penrose

Sir Roger Penrose, the Rouse Ball professor of mathematics at Oxford University, delivered three lectures from October 23-25 as part of the Mathematics Department's Gergen Lecture Series.

Penrose's three talks ranged over ground as varied as theoretical physics, mathematics and philosophy. His first talk, entitled *Science and the Mind*, drew the three fields together as he used mathematical as well as philosophical ar-

guments to support a philosophical claim, and suggested a possible explanation based on theoretical physics.

Specifically, Penrose applied Gödel's Incompleteness Theorem to his assertion that no Turing machine could completely simulate a human mind in an argument detailed more fully by his book *Shadows of the Mind*.

"The claim is that no knowable computational procedures can encapsulate human understanding and insight," he said. "Gödel tells us that no knowable computational procedures can characterize the properties of the natural numbers... yet a child can grasp the idea of the actual natural numbers after being given only very simple descriptions."

Ultimately, Penrose explained that a possible reason for the mind's incomputability could lie in the gray area that separates classical Newtonian physics from quantum physics, a subject he discussed in more detail in his second talk, entitled *Schrödinger's Cat: A Gravitational Resolution?*

Penrose suggested that a new theory of *objective reduction* might be necessary to explain the interaction between quantum and classical physics.

Penrose's third talk, entitled *Twistor Theory, Old Ideas and New*, presented some new aspects of twistor theory, which Penrose conceived more than 30 years ago to try to explain Einstein's general theory of relativity in terms of quantum mechanics.

In addition to *Shadows of the Mind*, Penrose is the author of *The Emperor's New Mind* and, most recently, *The Large, the Small, and the Human Mind*. He was knighted in 1994 for his contributions to science, and shared the 1988 Wolf Prize for Physics with Stephen Hawking. Penrose is famous for his work in geometry, including his study of ways to tile the plane without repetition, as well as his research in theoretical quantum physics such as twistor theory and theories of consciousness and understanding.

—Matt Atwood

## Graduate Student News

### Receiving Ph.D.

Aaron Ashih received his doctorate this spring under the direction of David Schaeffer. His thesis is entitled *Spatial and stochastic models of population growth with sexual and asexual reproduction*. Ashih expects to attend medical school next year.

Sung Ho Wang received his doctorate this spring under the direction of Robert Bryant. His thesis is entitled *Legendrian Submanifold Path Geometry*. Wang will be a postdoctoral fellow at Centre de Reserches Mathematiques at University de Montreal next year

## Conferences at Duke

### The Second DMJ-IMRN Conference

The Second Duke Mathematical Journal and International Mathematics Research Notices Conference will be held Friday, April 27 through Sunday, April 29, 2001. The speakers will be: Jinho Baik (Princeton), *Longest increasing subsequences and random matrices*; Hubert Bray (MIT), *Black Holes, Minimal Surfaces, and Differential Geometry*; Brian Conrad (Michigan), *Modular Curves and rigid analytic spaces*; Dennis Gaitsgory (Harvard), *On the Geometric Langlands conjecture*; Allen Knutson (Berkeley), *Some recent collisions of combinatorics with algebraic geometry*; Dirk Kreimer (Mainz), *Feynman graphs: from operads to renormalization group to number theory*; Paul Seidel (Palaiseau), *Real and complex Morse theory in two variables*; Wendelin Werner (Orsay), *Random planar curves and conformal invariance*. For more details, see <http://www.math.duke.edu/conferences/dmj-imrn/>.

*The moving power of mathematical invention is not reasoning but imagination.*

—A. DeMorgan

## CAARMS7

The 7th Annual Conference for African-American Researchers in the Mathematical Sciences (CAARMS7) will take place from June 19 to 22, 2001. The keynote speaker will be Dr. Freeman Hrabowski, President, University of Maryland, Baltimore County. For more information, see <http://cm.bell-labs.com/who/will/caarms7.html>.

### Chautauqua workshop

The NSF sponsored Chautauqua workshop, "Teaching Mathematics with Online Materials," will be held in the Duke Interactive Computer Classroom from June 26 to 28. Associate professors Lang Moore and David Smith are the organizers. For more details, see <http://www.engrng.pitt.edu/~chautauq/>.

## New Courses

### Math 239 Mathematical Finance: Portfolio Theory and Option Pricing

Introduction to basic concepts in mathematical finance, along with tools from optimization theory and stochastic calculus. Topics include mean-variance analysis of portfolios, efficient frontiers, utility functions, Capital Asset Pricing Model, beta, options, arbitrage, geometric Brownian motion, stochastic integration, stochastic differential equations, Black-Scholes pricing formula and its applications, numerical methods for pricing options. Prerequisites: Math 103,104, and 135. The course will be taught this fall by Dr. Petters.

## Faculty News

### David Smith

Associate professor David Smith will be the keynote speaker at The Kansas City Regional Mathematics Technology EXPO, October 5-6, 2001. Details are at <http://www.kcmetro.cc.mo.us/~mathtechexpo/expo.html>.

## Misc

### New Journal

The *Journal of Online Mathematics and its Applications* has published its first issue this January. According to Editor in Chief, associate professor David A. Smith, this web-based journal will feature research articles on student learning via online materials and other technology-rich environments, innovative class-tested web-based learning materials, articles on design and use of online materials, surveys of existing online materials, high-quality "mathlets" (self-contained, dynamic, single-purpose learning tools), and other articles on related subjects.

All articles and other materials published by JOMA will be peer-reviewed. As each new issue is published, the content of the preceding issue will be archived in the mathematical sciences digital library (MATHDL). For more information, see <http://www.joma.org>

### Duke Math Shirt

The 2000-01 Duke Math shirt are on sale for \$8.50 for L and XL in Math Physics 121. Those who competed in the Putnam receive a complementary shirt. The design is based on the Putnam problem: The vertices of an octagon inscribed in a circle are alternately the vertices of an inscribed square of area 5 and an inscribed rectangle of area 4. Find, with rigorous proof, the maximum possible area of the octagon.

Answer =  $3\sqrt{5}$ .

### Other News

To read about other news, honors and events concerning mathematics at Duke, visit [www.math.duke.edu/news/](http://www.math.duke.edu/news/). The on-line calendar at [www.math.duke.edu/cgi-bin/mcal](http://www.math.duke.edu/cgi-bin/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](http://www.math.duke.edu/computing/broadcast.html) for more information.

## Obituary

### Shoenfield

Joseph R. Shoenfield, professor emeritus of mathematics at Duke University died on Wednesday, November 15, 2000 at Duke Medical Center.

He was born in Highland Park, Michigan on May 1, 1927, the son of Dr. Adolph and Frances Shoenfield. After serving in the U S Army for a short time at the end of World War II, he completed his undergraduate and graduate work at the University of Michigan.

Shoenfield joined the Duke Mathematics Department in 1952. He was an NSF Postdoctoral Fellow at the Institute for Advanced Study in 1956-1957, was editor of the *Duke Mathematical Journal* from 1961 to 1970, was chairman of the Duke Mathematics Department from 1970 to 1973 and was president of the Association for Symbolic Logic from 1972 to 1976. He retired in 1992.

Shoenfield made many important and highly original contributions to mathematical logic, most notably in the areas of set theory and recursion theory. The method of forcing, invented by P. Cohen to prove consistency results in set theory, owes much to Shoenfield. The very first issue of the *Bulletin of Symbolic Logic* (1965) featured a long article by Shoenfield on the work of S. Kleene in recursion theory. His book *Mathematical Logic* published in 1967, has been the pre-eminent book in that field.

In addition to his professional interests he was an accomplished bridge player, an avid poker player, a lover of all sports and games (many of whose histories he was familiar with), a lover and producer of good food and a lover (but not a producer) of good music.

His life was full of devotion to old friends, a concern for justice and a willingness to take on unpopular causes.

—Richard Hodel and Richard Scoville

## Math Degree Candidates, Academic Year 2000-2001

### First Majors

John Joseph Clyde  
 Michael James Colsher  
 Benjamin Michael Erdeljac  
 Julisa Espinoza  
 Rodrigo Garcia Etcheto  
 Thomas Tyson Gilpin  
 Aaron Paul Greenblatt  
 Jeffrey Weston Janis  
 Alexandra Manee Ledbetter  
 Gil Libling  
 Adrian Gutierrez Lucero  
 Carl Alexander Miller  
 Alison Michelle Perry  
 Shiv Sudhakar  
 John Alexander Thacker  
 Alison Corinne Welch  
 Joshua Thomas Wills  
 Jake Angus Woods

### Second Majors

Michael James Ewell  
 Sara Harris  
 Mark William Jenkins  
 Albert Sidney Kyle, V  
 Matthew Patrick O'Brien, II  
 Christopher Kerry Reedy  
 Sophia Teresa Santillan  
 Joshua Samuel Schiffrin  
 Sha Mayn Teh  
 Anil Someswar Vedula  
 Brian Edward Weiner

### Minors

Janel Levon Baskerville  
 Christopher Bruce Battjer  
 Mark Chapple Baumann  
 Keith Girolamo Cascio  
 Gabriel Aaron Cohen  
 Donald Ellis Flood  
 David Chang Sung Kim  
 Elizabeth Ann Kralik  
 John Nicholas Massari  
 Eric Daniel McGimpsey  
 Daniel Bertrand Neill  
 Gianmarco Francesco Pinton  
 Brian Gary Skotko  
 Ankur Ashok Vyas  
 Daniel Yoav Wolfson

### Master of Arts

Kevin Jay Kessler  
 Jose Antonio Trujillo Ferreras  
 John Boone Greer  
 Colleen Catharine Mitchell

### Ph.D.

Aaron Christopher Wesley Ashih  
 Sung Ho Wang

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