Calls for Participation at Fall Meeting

Call for Student Papers

Students (and recent graduates) from the Northeastern Section are invited to present talks at the Spring meeting on topics in mathematics, statistics, or computer science. The presentations should be 10-15 minutes in length, on expository work, research projects, employment experiences, or problems from mathematical periodicals. The registration fee and cost of meals will be waived for one student presenter per paper. Interested students should contact Michael Cullinane, mcullina@keene.edu, or Raimundo Kovac , RKovac@ric.edu . The deadline for submission is Nov. 5.

Call for Contributed Papers

Participants at the Fall Meeting of the section are invited to submit contributed papers. We are particularly interested in papers that will appeal to a variety of participants. If you are planning to speak about results of your research, keep in mind that the audience most likely will not be familiar with your specialty, so you will want to give some motivation and context for your work. Your presentations should be approximately 15 minutes in length. Please send an abstract and your mailing address together with a list of any special equipment you may need to Tommy Ratliff at tratliff@wheatoncollege.edu. Email submissions are preferred, but you may also send a typed submission to Tommy Ratliff; Department of Mathematics; Wheaton College; Norton, MA 02766 The deadline for submission of abstracts is Nov. 1.

Northeastern Section of the MAA
Northeastern Fall Sectional Meeting

Confernce Committee:

Program Committee Chair, Suzanne L. Weekes, WPI
Local Arrangements Chair, Brigitte Servatius, WPI
Bogdan Vernescu, WPI
Peter Christopher, WPI

Friday, November 19, 2004

2:00 - 6:00 **Registration (3rd Floor WPI Campus Center)**
2:00 - 3:00 **Executive Committee Meeting, Mid Century Room, Campus Center**
3:00 - 4:00 **Workshop/Panel: Careers in Industry, Olin Hall 126**
3:00 - 4:00 ***Quantum mechanics and combinatorial designs* , Olin Hall 107**
P. K. Aravind , Worcester Polytechnic Institute
4:00 - 5:00 **Student Paper Sessions, Olin Hall 214 and**

5:00 - 6:00 DISTINGUISHED TEACHER LECTURE, Olin Hall 107
***On Teaching Differential Equations... ,* Joseph McKenna, University of Connecticut**
6:00 - 6:30 Reception, Higgins House
6:30 - 8:00 Banquet, Higgins House
8:00 - 9:00 CHRISTIE LECTURE, Olin Hall 107
Elliptic Curves, The Silver Bullets of Modern Mathematics
Ezra 'Bud' Brown, Virginia Polytechnic Institute

Saturday, November 20, 2004

8:00 - noon Registration (3rd floor WPI Campus Center)
8:00 - 9:00 New Colleagues Presentations, Olin Hall 214 and 218
9:00 - 10:00 Graduate Student Presentations, Olin Hall 214 and 218
10:00 - 10:30 Graduate Reception, Mid Century Room
10:00 – 10:30 Break
10:30 - 11:30 POLYA LECTURER, Olin 107
Alternating Sign Matrices,
David Bressoud, Macalester College
11:30 - 12:00 BUSINESS MEETING AND ELECTION OF OFFICERS, Olin 107
12:00 - 1:00 Lunch, Campus Center
1:00 - 2:00 *Counting on Determinants,* Olin Hall 217
Arthur Benjamin, Harvey Mudd College
2:00 - 3:00 *Folding Robot Arms, Proteins, Origami: ...,* Olin Hall 223
Ileana Streinu, Smith College
2:00 -3:00 Workshop:: CUPM Curriculum Guide 2004, Olin Hall 218
David Bressoud
3:00 - 4:00 Workshop: Industrial Math for Undergrads, Olin Hall 126
A. Heinricher & S. L. Weekes,
3:00 -4:00 *Spherical Codes, Fullerenes, ... ,* Olin Hall 107
Jack Graver - Olin Hall 107
4:30 - 5:30 Contributed Presentations, Olin Hall 214 and 218

Abstracts / Speakers

Quantum mechanics and combinatorial
P. K. Aravind , Worcester Polytechnic Institute
Abstract
Recent proofs of Bell's theorem in the foundations of quantum mechanics have led into some unexpected areas of discrete mathematics such as regular polytopes, projective configurations and combinatorial designs. In particular, this work has led to the emergence of the concept of a

"quantum block design" that is a generalization of the balanced incomplete block design known to experts in combinatorics and statistical design. The purpose of this talk is to expose this connection between quantum mechanics and combinatorial mathematics for the benefit of mathematicians who know next to nothing about quantum mechanics. This will be done by focusing on a particular example that illustrates this connection in detail rather than by dwelling on abstract generalizations. Having done this, I will discuss some open questions connected with quantum block designs that mathematicians may feel inclined to address. The possible physical applications of quantum block designs will also be touched upon.

Biography

P.K.Aravind received his B.Sc and M.Sc degrees from Delhi University in Delhi, India. He received his Ph.D degree in theoretical physics from Northwestern University and then held research positions at the University of California at Santa Barbara and the University of Wisconsin-Madison. He joined WPI in 1984 and is currently a professor in the Department of Physics. His research over the years has spanned the areas of condensed matter physics, surface physics, quantum optics, Bell's theorem and the foundations of quantum mechanics, and quantum information theory. He has taught for many years in WPI's FRONTIERS program, a summer program designed to draw more high school students into science, mathematics and engineering.

Counting on Determinants

Arthur Benjamin, Harvey Mudd College

Abstract

We demonstrate how determinants solve many interesting combinatorial problems. Determinants count nonintersecting lattice paths, spanning trees, and permutations with specified descent points. Elegant proofs of these results are based on the definition of the determinant and occasionally the principle of inclusion-exclusion. Applications to Pascal's Triangle, Fibonacci numbers and Catalan numbers will also be given. This talk is based on joint work with Naomi Cameron of Occidental College. Folding Robot Arms, Proteins, Origami: a Combinatorial Approach

Biography

Arthur Benjamin earned his B.S. in Applied Mathematics from Carnegie Mellon and his PhD in Mathematical Sciences from Johns Hopkins. Since 1989, he has taught at Harvey Mudd College, where he is Professor of Mathematics and past Chair. In 2000, he received the Haimo Award for Distinguished Teaching by the Mathematical Association of America. His research interests include game theory and combinatorics, with a special fondness for Fibonacci numbers. He recently co-authored (with Jennifer Quinn) "Proofs That Really Count: The Art of Combinatorial Proof", published by MAA. Professors Benjamin and Quinn are the co-editors of Math Horizons magazine, published by MAA, read by more than 20,000 math students in the nation. Art is also a magician who performs his mixture of math and magic to audiences all over the world, including the Magic Castle in Hollywood. He is currently on sabbatical at Brandeis

University.

Alternating Sign Matrices,
David Bressoud, Macalester
Abstract
This will be an overview of what is known and what is conjectured about Alternating Sign Matrices, a combinatorial structure with ties to partition theory, representation theory, and statistical mechanics. The talk will include an overview of the story of the Alternating Sign Matrix Conjecture, a tale that begins with a Lewis Carroll algorithm for evaluating determinants and ends with Kuperberg's realization that the 6-vertex model of Izergin and Korepin held the key to the solution.
Workshop:: CUPM Curriculum Guide 2004, Olin Hall 218
The MAA Committee on the Undergraduate Program in Mathematics (CUPM) updates its recommendation for the undergraduate curriculum in mathematics roughly every ten years. The most recent and the most extensive set of recommendations ever produced by the CUPM was published in February: CUPM Curriculum Guide 2004. This is the first CUPM curriculum guide to look at all mathematics courses and the needs of all students taking mathematics rather than dealing solely with the preparation of majors in the mathematical sciences. This workshop will explain what can be found in this guide and how it can be used
Biography
David Bressoud is DeWitt Wallace Professor of Mathematics at Macalester College in St. Paul, Minnesota. He was a Peace Corps Volunteer in Antigua, West Indies (1971-73), received his Ph.D. (1977) from Temple University where he studied with Emil Grosswald. He taught at Penn State from 1977 to 1994, becoming a full professor in 1986. He has held visiting positions at the Institute for Advanced Study (1979-80), University of Wisconsin (1980-81 & 1982), University of Minnesota (1983 & 1998), and the University of Strasbourg (1984-85). He has received the MAA Distinguished Teaching Award and the MAA's Beckenbach Book Award for *Proofs and Confirmations: The Story of the Alternating Sign Matrix Conjecture*. He has published over fifty research articles in number theory, combinatorics, and special functions, and his other books include *Factorization and Primality Testing* (1989), *Second Year Calculus from Celestial Mechanics to Special Relativity* (1991), *A Radical Approach to Real Analysis* (1994), and, with Stan Wagon, *A Course in Computational Number Theory* (2000). He currently serves as Chair of the College Board's AP Calculus Development Committee, Chair of the MAA's Committee on the Undergraduate Program in Mathematics, and as Director of Macalester's FIPSE and NSF-sponsored program "Quantitative Methods for Public Policy."

Elliptic Curves, The Silver Bullets of Modern Mathematics
Ezra 'Bud' Brown, Virginia Polytechnic Institute

Abstract

Elliptic curves made their first appearance seventeen centuries ago and are among the most beautiful objects in mathematics --- and the most useful. This talk will be about elliptic curves and their connections to such things as:
Doughnuts and 49/20 ; A page from Diophantus; Magic squares, finite geometries and inflection points ; Congruent numbers and other diophantine problems ; Fermat's Last Theorem; Factoring Large Primes; Chocolate-Key Cryptography. A talk on all of these would run for days, so the audience will choose the topics to be presented.

Biography

Ezra (Bud) Brown grew up in New Orleans, has degrees from Rice and LSU, and professes mathematics at Virginia Tech, where he has been since 1969. The elliptic curve bug first bit him while he was in graduate school and has never really gone away. Although most of his research has been in number theory and combinatorics, he once wrote a paper with a sociologist. He has received the MAA's Allendoerfer Award, the Polya Award (twice), and the MD-DC-VA Section's teaching award. He enjoys singing in operas, playing jazz piano, gardening, and talking about his granddaughter Phoebe Rose. He occasionally bakes biscuits for his students.

Spherical Codes, Fullerenes

Jack Graver

Abstract

Spherical Codes (maximum families of non overlapping identical spherical caps on a sphere), Fullerenes (large carbon molecules) and the structures of solutions to the problems of Thomson (minimize the potential of n unit charged particles on the sphere) and Tammes (distribute n points on the sphere to maximize the minimum distance between them) all give rise to large planar graphs. This talk is about the structures of these graphs and the relationships between the graphs that arise from different problems.

Biography

Jack Graver grew up in Cincinnati, Ohio. He earned his bachelors degree from Miami of Ohio; his masters and doctorate from Indiana University. After two years at Dartmouth College as a John Wesley Research Instructor, he came to Syracuse where he has been for 35 years. He has published research papers in design theory, integer and linear programming and in several different areas in graph theory. He has authored or coauthored four books: two graduate level texts and two elementary level books one on rigidity theory and one on group theory and graph theory for students of architecture. In 1957 he joined the MAA and, during the 38 years he has been in the Seaway Section, he has held many offices including section chair and section governor. In 1993 he was awarded a Certificate of Meritorious Service by the MAA. He is also a long time member of the AMS, SIAM, NCTM and AMTNYS (Assoc. of Math. Teachers of New York State). Starting in the early 60s, he has taught a variety of

summer workshops for high school teachers; in Indiana, New York, the Virgin Islands and England. It is an activity that he continues to find particularly satisfying.

On Teaching Differential Equations... ,
Joseph McKenna, University of Connecticut
Abstract
I taught my first course in differential equations thirty years ago. It was a basic cookbook course and I just followed the textbook slavishly, often barely grasping what I was teaching. Here, I will describe some of the things I've learned since I started.
Biography
Joe McKenna got his B.Sc. from U.C.D. in Dublin and his Ph.D. from the University of Michigan with Lamberto Cesari in 1976. Since then, he has been professor of mathematics at the universities of Wyoming, Florida and (currently) Connecticut. He was also Professor of Applied Mathematics at U.C.C. in Cork from 1999-2000. His mathematical interests are all manner of nonlinear differential equations, ordinary and partial, especially existence and multiplicity properties, their numerical solution, and applications to vibrations in bridges and ships. Other distinctions include the University of Connecticut Chancellor's Award for Excellence in Research. He is indentified at www.isihighlycited.com as one of the highly cited researchers in the mathematical sciences. Nonmathematical interests include theater and opera, cooking, history, and detective novels.

Folding Robot Arms, Proteins, Origami: ...,
Ileana Streinu, Smith College
Abstract
Robot arms can be modeled as simple polygonal chains with rigid bars and rotating joints. Planning non-colliding motions between two configurations of a robot arm is a notoriously hard problem, for which the currently known best algorithms run in exponential time. An efficient solution in dimension 3 could have an impact in understanding apparently unrelated questions, such as how proteins fold. In this talk I will present a surprisingly simple combinatorial solution to the 2-dimensional version. The Carpenter's Rule Problem, "Can every planar polygonal chain be convexified with non-colliding planar motions?" was open since the '70. It was answered in the affirmative in the early 2000, and my contribution - the subject of this talk - was to give an efficient algorithmic solution. I will present it with a lot of graphical props: animations, games, even some 3d-graphics. Along the way, we'll use tools ranging from a 19th century theorem of J. Clerk Maxwell to graph embeddings, oriented matroids, combinatorial rigidity theory and visibility computations in Computational Geometry. I will conclude with some algorithmic insights into origami folding induced by this approach.

Biography

Ileana Streinu earned her B.S., M.S., and Doctorate degrees in Mathematics and Computer Science from the University of Bucharest. She received her Ph.D. in Computer Science from Rutgers University. She has taught at Smith College since 1994 and is now a full professor of Computer Science. Her research interests are in combinatorial and computational geometry and applications in computational molecular biology, computer graphics, robotics, graph drawing, computation statistics and data visualization.