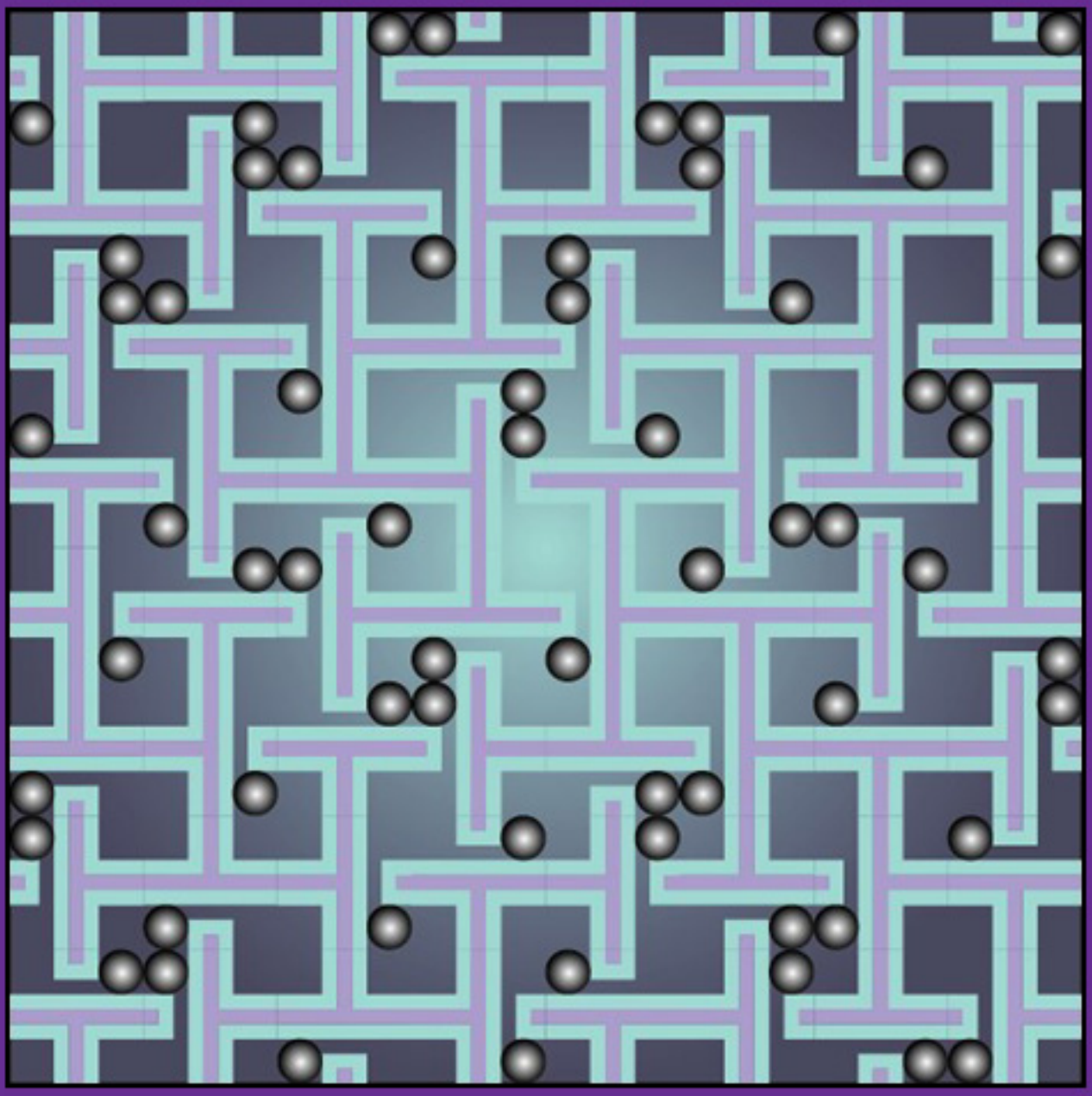
Department of Mathematics
Cornell University

Annual Report 2001–2002



The cover design is a representation of the multiplication table of the dihedral group of a square. Each cell of the 8 x 8 grid is obtained by acting on the fundamental domain by the group element in that spot of the multiplication table. Thanks to my wife, Amy Szczepanski, for the idea.

— James Conant, VIGRE Assistant Professor

Department of Mathematics

Annual Report 2001–2002

Year in Review:
Mathematics Instruction
and Research

Cornell University
first among private institutions
in undergraduates who later earn Ph.D.s.

Ithaca, New York, the home of Cornell University, is located in the heart of the Finger Lakes Region. It offers the cultural activities of a large university and the diversions of a rural environment.

Mathematics study at Cornell is a unique experience. The university has managed to foster excellence in research without forsaking the ideals of a liberal education. In many ways, the cohesiveness and rigor of the Mathematics Department is a reflection of the Cornell tradition.

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The Year in Review 2001–2002

My three-year term as chair is over, and this is the last *Year in Review* that I will write. Being department chair has been a very interesting experience. There have been changes: a new building; the VIGRE grant with new postdocs, new graduate students and new activities; two new staff members; a reduced teaching load for H. C. Wangs; and a new department teaching award. On the other hand, many things have stayed the same: a helpful and knowledgable staff; a dedicated faculty; enthusiastic graduate students; dedicated math majors; and a dean who supports our efforts.

Searches conducted this year resulted in the hiring of a number of new faculty. We hired two H. C. Wang assistant professors: Indira Chatterji (ETH Zürich) and Dan Zaffran (Ruhr-Universität Bochum). We were also fortunate to hire three VIGRE postdocs: Tara Brendle (Columbia University), Alexander Meadows (Stanford University) and Brian Smith (Cornell University). We are very happy to have them join us. (See p. 14 to learn more about our new faculty.)

Béla Bajnok and Carolyn DeSilva, both on leave from Gettysburg College in Gettysburg, Pennsylvania, participated in this year's visiting program. We appreciate their efforts, and once again our teaching program havs benefited from visiting program participation. (For more information about their experiences at Cornell, see page 79.) Recruitment efforts have produced four participants for the 2002–2003 academic year.

Rick Durrett was recently elected a fellow of the American Academy of Arts and Sciences. He is the only Cornell professor elected to the prestigious academy's class of 2002. He joins two department faculty who are previously-elected academy members: Eugene Dynkin and Harry Kesten. Founded in 1780, the academy honors distinguished scientists, scholars and leaders in public affairs, business, administration and the arts. The induction ceremony will be held at the academy headquarters in Cambridge, Massachusetts on October 5, 2002.

Ravi Ramakrishna was awarded the Russell Distinguished Teaching Award from the College of Arts and Sciences and an AMS Centennial Fellowship. Ravi will spend his fellowship year at McGill University (Canada) in the fall and at Berkeley in the spring. John Guckenheimer was elected as Fellow of the American Association for the Advancement of Science at the February 2002 annual meeting in Boston.

In December 2001, at our annual holiday party, we awarded the first annual departmental teaching awards. Al Schatz won the senior faculty award, Ravi Ramakrishna won the junior faculty award and Lee Gibson won the graduate student award. Several graduate student awards were also presented. Fernando Marques received the Battig Award. Christopher Francisco received the York Award. In addition, Dan Ciubotaru, Jean Cortissoz, Yuval Gabay and Sam Hsaio received Hutchinson Fellowships for the spring semester.

Daniel Ramras received the annual Kieval Prize from the department at the department's graduation ceremony in May. I am also pleased to report that Peter Clark, a sophomore majoring in mathematics and biology, and a college scholar, was one of four Cornell recipients of a Barry M. Goldwater Scholarship in science and mathematics.

Birgit Speh completed her first year as director of undergraduate studies (DUS). Birgit did an exemplary job in this faculty administrative position, and we are very grateful to her for all her hard work.

Special thanks to Lou Billera, who finished his term as director of graduate studies (DGS) at the end of June 2002. Lou was an effective and energetic DGS who served in that capacity since January 2001. We appreciate his dedication to the position and his special talents. Michael Stillman has agreed to accept the position beginning July 1, 2002.

This past year the department conducted a review of the graduate program curriculum, the first in over 25 years. The effort was headed up by committee chair Dan Barbasch. Committee members Lou Billera, Ken Brown, Rick Durrett, Leonard Gross and Shankar Sen contributed to this review, along with numerous department faculty members. (See page 9 for more information about this review and the changes generated for the graduate curriculum.)

Once again, Rick Durrett served with distinction as VIGRE coordinator. Special notice should be taken of the first VIGRE Faculty Development Workshop, held May 7, 2002, at the Rose Inn. This was an especially successful and exciting mentoring effort. Topics covered making the transition from being a graduate student to being an independent researcher, writing NSF proposals and delivering good teaching lectures.

Two long-term faculty, Harry Kesten and Richard Platek, have retired, effective June 30, 2002. We are happy to report that Harry Kesten and his wife will remain in Ithaca, and he will continue his research and involvement with the department. Richard Platek will be moving to Sarasota, Florida.

The dean of the College of Arts and Sciences and the dean of the Engineering College have both approved a two-year extension to the current Engineering Restructuring agreement. This agreement was originally negotiated in 1996 by then chairman Robert Connelly. The goal of the effort continues to be to provide outstanding calculus instruction in cooperation with Theoretical and Applied Mechanics by offering small class sizes. The new agreement gives our department some additional flexibility with respect to VIGRE postdocs, which should lead to continued high quality teaching.

In closing, I would like to thank the staff for their hard work, and I would like to thank chair's assistants Cathy and Linda and my family for putting up with my idiosyncracies during my three-year term. I would like to thank everyone who said "yes" when I asked them to do something for the department. In particular, let me thank Ken Brown for agreeing to be my successor.

VIGRE

The 2001–2002 academic year was the second year of the Mathematics Department's five-year NSF VIGRE grant. The acronym VIGRE is pronounced "vigor" and stands for Vertically InteGrated Research and Education. At a recent meeting held by the NSF to judge the successes and chart the future direction of its new program, Benedict Gross (Harvard) quipped, "Like the pill whose name it resembles, the purpose of the VIGRE grant is varied. It is intended to increase the population, revitalize old relationships and allow participants to have more fun." Said less flippantly, the purpose of the VIGRE program is (1) to provide more support for postdocs and prepare them to take on and balance a broad spectrum of faculty duties in research, teaching and service, (2) to provide support for graduate students to allow them to prepare for the wide range of opportunities available to individuals with training in the mathematical sciences, and (3) to engage undergraduates in research that will enhance their training and increase the chances that they will consider a career in mathematics.

VIGRE Postdocs: The fall semester brought two new VIGRE postdocs: Matthew Fickus from the University of Maryland and Anita Mareno from Cornell's Department of Theoretical and Applied Mechanics (where she worked with Tim Healey). Two new NSF postdocs also arrived: Jason Schweinsberg and Alexander Vladimirsky, both from the University of California at Berkeley, Statistics and Mathematics, respectively.

The recruitment process for fall 2002 took place in February. We reached our target of three new postdocs in hiring Tara Brendle from Columbia University, Alexander Meadows from Stanford University, and Brian Smith from the University of Alabama at Birmingham.

On May 7, 2002, we held our first ever VIGRE professional development workshop. This event was held at the Rose Inn, a bed and breakfast about ten miles north of Ithaca; it involved our eight VIGRE/NSF postdocs and eight department faculty members. Participants discussed the road from Ph.D. to tenure, planning research and writing proposals, and issues involved in planning courses and delivering good lectures.

VIGRE Graduate Fellows: Our second group of three VIGRE graduate fellows arrived in the fall: Jason Bode (Calvin College), Edoardo Carta (University of Puerto Rico) and William Gryc (Amherst College). These students were free from teaching responsibilities their entire first year, making it easier to get through their demanding first-year courses. They will also have one semester free in each of the second and third years to allow them to broaden their education and explore possible thesis areas. Our recruitment target for fall 2002 was four fellows; however, a very successful recruiting season yielded six: David Biddle (SUNY at Binghamton), Andrew Cameron (University of Virginia), Benjamin Chan (University of Rochester), Heather Heston (Millersville University), Michael O'Connor (University of Massachusetts) and Jay Schweig (George Mason University).

Graduate Student VIGRE Semesters: Continuing graduate students can benefit from the VIGRE grant through VIGRE semesters. In fall 2001, Sarah Spence worked to develop course materials for MATH 336 on the applications of algebra to developing codes. Carla Martin (CAM) was supported in spring 2002 to help develop course materials for a new course on the applications of mathematics to biology (MATH 362/BIOEE 362), which was taught jointly by John Guckenheimer and Steve Ellner (Ecology and Evolutionary Biology). Finally, Christopher Hardin, a student in logic working with Richard Shore, used his VIGRE semester in spring 2002 to take two computer science courses working toward a masters in computer science. This year VIGRE also supported graduate students from other institutions

who attended the conference *Analysis and Probability on Fractals* organized by Robert Strichartz, which took place at Cornell June 16–20, 2002.

Summer Support for Undergraduates: At the undergraduate level, the VIGRE grant helped to support the Cornell Research Experiences for Undergraduates program in three ways: (1) VIGRE money allowed the program to be expanded to include two more Cornell undergraduates. (2) It provided additional financial support for the faculty members who devoted eight weeks of their summer to supervising undergraduate projects. (3) It enhanced the program by supporting visitors who work with the various projects.

Three undergraduates also received small grants to work directly with Cornell faculty in summer 2001. Debbie Grier worked with Louis Billera, Brian Renne with Anil Nerode and S. Alex Smith with Robert Strichartz. In most cases, these efforts were preliminary work for a senior thesis, completed during the academic year.

Math Explorers Club: The Math Explorers Club continued this year under the leadership of Robert Strichartz with support from VIGRE. The club endeavors to stimulate an interest in mathematics in local high school students by exposing them to material not usually encountered in the high school curriculum. (See p. 15.)

VIGRE Interdisciplinary Colloquium: The final activity of the VIGRE grant is the VIGRE Interdisciplinary Colloquium. In the fall lectures were given by Robert Jarrow (Johnson School of Management), Ron Elber (Computer Science), Carlos Castillo-Chavez (a member of both the new Biological Statistics and Computational Biology department and T&AM), Richard Rand (T&AM) and Viet Elser (Physics). There were no talks in the spring, as the VIGRE coordinator was doing a lot of travelling. The colloquium will return in the fall.

The VIGRE grant partially supported the visit of Richard Guy, who gave the Kieval Lecture. (See p. 18.) On the following Monday, he gave a talk for graduate students and faculty on unsolved problems in combinatorial games.

NSF/NIGMS Grant

This year Richard Durrett received approval for a grant under a joint initiative of the National Science Foundation and the National Institue of General Medical Sciences to support research in the mathematical sciences. His proposal was a joint effort with Chip Aquadro from the Department of Molecular Biology and Genetics and Rasmus Nielsen from the newly-formed Department of Computational Biology and Biological Statistics. Their research concerns problems in probability and statistics that arise from two topics. The first looks for footprints of the fixation of advantageous mutations in DNA seqeunce data generated in the Aquadro lab. The second is the study of how whole genomes are rearranged by large-scale processes that move or invert large segments of chromosomes. Awards in the new NSF/NIGMS program are quite generous compared to typical mathematics grants. In each of its five years, the grant will support a postdoc, a computer programmer, three graduates students, and one month of summer support for each of the three investigators.

Graduate Program

The Cornell Mathematics Department is rated among the top in the country by the American Mathematical Society. The *U.S. News and World Report* placed Cornell ninth in the nation in its 1999 national ranking of graduate mathematics programs.

The graduate program included 69 graduate students during the 2001–2002 academic year. Ph.D. degrees were awarded to three students, while nine earned special masters degrees in mathematics, and two received double masters in mathematics and computer science. The total number of full-time students in the coming year will be 72. Due to an especially effective recuiting season, the entering class this fall will consist of sixteen new Ph.D. students. Ten of the current students will complete their Ph.D. degrees by August. In addition, three students have dropped out of the program as of June 2002. Five one-year nondegree students will be in residence in 2002–2003: one student from University of Paris VII (France) who will be supported under an exchange agreement with the Cornell Abroad EDUCO Center in Paris, two advanced students from Duke working with Gregory Lawler, one student from Marseilles who is working with John Hubbard, and an additional student from University of Paris VI who is visiting Richard Durrett.

Entering students Andrei Maxim, Mauricio Velasco and Jessica Zuniga received one-year fellowships from the Cornell Graduate School; these fellowships will cover full tuition and stipend. David Biddle, Andrew Cameron, Benjamin Chan, Heather Heston, Michael O'Connor and Jay Schweig received VIGRE fellowships, awarded under our NSF VIGRE grant. After her first year, Zuniga will also be a VIGRE fellow for three years. Sarah Koch, our

top recruit from last year, is transferring from Berkeley and will enter Cornell with a National Physical Science Consortium Fellowship. The remaining six entering students — Drew Armstrong, Nikolai Dimitrov, Bradley Forrest, Timothy Goldberg, Radu Murgescu and James Worthington — will be supported as teaching assistants.

Graduate students play an essential role in all aspects of the department: teaching, research, mentoring of undergraduates and community outreach programs. Kristin Camenga and Lee Gibson taught mini-courses in local schools as part of the Graduate Student School Outreach Program. For the first time, three of our students — Lee Gibson, Todd Kemp and Melanie Pivarski — organized a recruitment weekend for prospective students. Of the seven students who attended, five decided to attend Cornell. Many students are also active in the Preparing Future Professors program (p. 18), Expanding Your Horizons (p. 16) and the Math Explorers Club (p. 15).

Class representatives were G. Christopher Hruska (sixth and seventh year), Matthew Horak (fifth year), Nelia Charalambous (fourth year), James Belk (third year), Kristin Camenga (second year) and Henri Johnston (first year). The graduate and professional student representatives were Gil Rosenberg and Franco Saliola.

Awards were given to students for outstanding achievement in coursework, research and teaching:

- Dan Ciubotaru, Jean Cortissoz, Yuval Gabay and Sam Hsiao received Hutchinson Fellowships.
- Fernando Marques received the Battig Award.
- Christopher Francisco received the York Award.

(See Department Prizes and Awards, p. 7.)

The Olivetti Club is devoted to expository talks on current research areas and is organized entirely by graduate students. This year the organizers were Noam Greenberg and Evgueni Klebanov in the fall and Todd Kemp and Roland Roeder in the spring. Most of the speakers were graduate students. (See Department Colloquia, p. 32, for a list of talks.)

Forty-one graduate students gave 88 talks in department seminars. The graduate students were also active in giving off-campus research presentations at meetings and specialized conferences. A sampling of these follows.

- Christian Benes — Seminar on Finite Markov Chains at Oberwolfach;
- Ryan Budney — Brown University, AMS meeting, University of Georgia and Ohio State University;
- Christopher Francisco — Route 81 Conference on Cummutative Algebra and AMS meeting Special Session on Commutative Algebra in Algebraic Geometry;
- Lee Gibson — Seminar on Finite Markov Chains at Oberwolfach and attended the Stochastic Processes Seminar at Princeton University;
- Noam Greenberg — Hebrew University and the Association for Symbolic Logic;
- Spencer Hamblen — attended the Canadian Number Theory Association VII meeting;
- Matthew Horak — Preparing Future Faculty at Ithaca College;
- Suzanne Hruska — Corning Community College Math Career Day;
- Sam Hsiao — invited lecture at the 2002 Central Section Meeting of the AMS in Ann Arbor, attended two Eastern Section Meetings of the AMS;
- Henri Johnston — attended the Canadian Number Theory Association VII meeting;
- Todd Kemp — a short course, "Representation Theory of Compact Lie Groups, Binghamton University, spring 2002;
- Melanie Pivarski — Seminar on Finite Markov Chains at Oberwolfach;
- Franco Saliola — Eastern Section Meeting of the AMS;
- Reba Schuller — Cornell Cognitive Studies;
- Sarah Spence — invited speaker at the Joint Mathematics Meeting and AWM Poster Session in San Diego;
- José Trujillo Ferreras — Seminar on Finite Markov Chains at Oberwolfach.

Reba Schuller published a paper with K. Etessami and T. Wilke, *Fair simulation relations, parity games and state space reduction for Buchi Automatia.*

Between August 2001 and May 2002, three Ph.D. degrees were conferred:

- David Brown, assistant professor at Ithaca College;
- Kathryn Nyman, a postdoc at Texas A&M University;
- Sarah Spence, assistant professor at Franklin W. Olin College of Engineering.

(See Degrees Granted, p. 25.)

Nine others are preparing to complete their degrees in August 2002. Of the ten students receiving Ph.D. degrees in May and August 2002, two (Christopher Hruska

and David Revelle) were awarded prestigious NSF Mathematical Science Postdoctoral Fellowships (at Chicago and Berkeley, respectively), two took assistant professor positions (one for one year at Cornell) and four secured postdocs (mostly VIGRE-supported) at various institutions around the country (Indiana, Rochester, SUNY Stony Brook, Texas A&M). The remaining two are arranging positions in Europe and India. We expect the job market for our graduates to continue to be strong for at least the next several years.

Undergraduate Program

The Cornell undergraduate program in mathematics in 2001–2002 included 140 majors (including three conditional acceptances). One of our new majors, Peter Clark, won a Goldwater Scholarship. (See Special Honors and Awards, p. 7.) Several of our graduating seniors wrote senior theses: Scott Bailey, Ari Blinder, Debbie Grier, S. Alex Smith and Benjamin Szekely. At least four of our majors applied to study abroad for all or part of next year:

- Michelle Fullwood (Budapest, fall 2002);
- Sebastian Mekas (Cambridge, Robinson College);
- Oded Yacobi (Budapest, fall 2002);
- Paul Young (Moscow, fall 2002).

The majors committee organized a fall reception for potential majors, a fairly big event where major and career options were discussed. Robert Strichartz discussed REU programs. Study abroad options, particularly the Moscow and Budapest programs, were presented to the students, and someone from Career Services spoke as well. The reception was announced in classes and in the school paper; about 15–20 students and over a dozen faculty attended.

In the spring, the majors committee organized an advising reception for students interested in upper-level mathematics classes. This event highlighted new upper-level courses, and many of the instructors of these (and other) courses attended. Posters were displayed that included the instructors' photographs to make it easier for students to find them. This event was advertised like the fall reception with about the same turnout.

Bachelors degrees were awarded to 44 students, including one in August 2001 and six in January 2002. One student graduated summa cum laude, five graduated magna cum laude, and seven graduated cum laude. Several of our graduates are going on to graduate school in mathematics (Columbia, Northwestern, Ohio State, Stanford and UCLA). Daniel Ramras, this year's Kieval Prize winner, won an NSF graduate fellowship as well as a DOD fellowship. A few other students attending graduate school next year will be getting VIGRE support.

Research and Professional Activities

Department-sponsored research expenditures for the fiscal year 2001–2002 totaled $1,736,048. This included 42 grants and contracts from federal, state and private agencies awarded to 39 faculty. Faculty submitted 18 new grant proposals, six of which have been funded to date. Editorships included:

- Dan Barbasch, editor of *Proceedings of the AMS*;
- Yuri Berest, editor of the *Journal of Nonlinear Mathematical Physics*;
- Louis Billera, member of the editorial boards of the *Journal of Algebraic Combinatorics* and *Discrete and Computational Geometry*;
- Robert Connelly, editor of *Beiträge für Algebra und Geometrie*;
- R. Keith Dennis, coeditor of the Jahrbuch Project;
- Richard Durrett, associate editor of *Notices of the AMS* and the *Journal of Theoretical Probability*;
- Clifford Earle, coeditor of *Proceedings of the Second Iberoamerican Congress on Geometry*;
- José F. Escobar, member of the editorial boards of the *Electronic Journal of Differential Equations*, *Revista Colombiana de Matemàticas* and *Innovación y Ciencia*;
- Leonard Gross, member of the editorial boards of the *Journal of Functional Analysis*, *Reviews of Mathematical Physics*, *Potential Analysis*, the *Soochow Journal of Mathematics* and *Revista Colombiana de Matemàticas* and of the advisory board of *Methods of Functional Analysis and Topology*;
- John Guckenheimer, editor of the *Journal of Experimental Mathematics*, the *SIAM Journal of Applied Dynamical Systems* and the *Moscow Mathematical Journal*;
- Yulij Ilyashenko, editor-in-chief of the *Moscow Mathematical Journal*, member of the editorial boards of *Functional Analysis and its Applications*, *Dynamical and Control Systems*, *Ergodic Theory and Dynamical Systems*, *Proceedings of the Moscow Mathematical Society* and *Mathematical Enlightenment*;

- Harry Kesten, member of the editorial boards of the *Indiana University Journal of Mathematics*, the *New York Journal of Mathematics* and *Journal d'Analyse Mathématique*;
- Gregory Lawler, associate editor of *Combinatorics, Probability and Computing*;
- Anil Nerode, member of the editorial boards of *Annals of Pure and Applied Logic*, *Mathematical and Computer Modelling*, the *Journal of Pure and Applied Algebra*, the *International Journal of Hybrid Systems* and *Annals of Math & AI*;
- Michael Nussbaum, member of the editorial boards of *Annales de l'Institut Henri Poincaré* and *Probabilités et Statistiques*;
- James Renegar, associate editor of the *SIAM Journal on Optimization*;
- Laurent Saloff-Coste, editor of *Mathematische Zeitschrift*, associate editor of *Stochastic Processes and their Applications*, the *European Series of Industrial and Applied Mathematics* (Probability and Statistics) and *Annales de la Faculté des Sciences de Toulouse*;
- Shankar Sen, member of the editorial board of the *Journal of the Ramanujan Mathematical Society*;
- Richard Shore, editor of *Studies in Logic* and the *Foundations of Mathematics*;
- Birgit Speh, editor of the *New York Journal of Mathematics* and the *Journal of Representation Theory*;
- Michael Stillman, algebraic geometry editor for *Proceedings of the AMS*;
- Robert Strichartz, executive editor of the *Journal of Fourier Analysis and Applications*;
- Lars Wahlbin, editor of *Mathematics of Computation*;
- James West, associate editor of *Fundamenta Mathematicae*.

Support Staff

Last summer two new staff members were hired, and many of the staff positions underwent a reorganization with new job responsibilities. For those affected, the past year has been spent learning new tasks and adjusting to new responsibilities. This has been a successful change, and the staff have settled in nicely to their new routines.

The staff task review project continued throughout the 2001–2002 academic year. Eighteen task meetings were held, wherein key administrative tasks were documented, reviewed, analyzed and in some cases changed. This brings the total documented and completed tasks to 34, for inclusion in the departmental job task manual. Upon completion, this task manual will help with staff cross-training and supervision.

Faculty Changes

Harry Kesten decided to retire at the end of this academic year. The tenured faculty voted unanimously to confer emeritus professor status on him effective July 1, 2002. Richard Platek also retired effective July 1, 2002; he is moving to Sarasota, Florida.

John Smillie completed his term of three years as department chairperson on June 30, 2002. The faculty selected Kenneth Brown as the next chairperson to serve a three-year term beginning July 1, 2002.

The faculty also voted to give Robert Terrell a half-time appointment as senior lecturer to begin July 1, 2002. (Other department personnel changes are noted in the Department Directory, pp. 12–13.)

On leave for 2001–2002:
Stephen Chase, sabbatical leave, spring 2002
Peter Kahn, sabbatical leave, fall 2001
Harry Kesten, leave, academic year
Gregory Lawler, leave, fall 2001
Michael Morley, sabbatical leave, spring 2002
Irena Peeva, leave, academic year
Oscar Rothaus, leave, spring 2002
Richard Shore, sabbatical leave, spring 2002
Reyer Sjamaar, sabbatical leave, spring 2002
Robert Strichartz, sabbatical leave, spring 2002

On leave for 2002–2003:
Eugene Dynkin, sabbatical leave, spring 2003
Clifford Earle, sabbatical leave, academic year
Leonard Gross, sabbatical leave, fall 2002
John Guckenheimer, sabbatical leave, fall 2002
J. T. Gene Hwang, sabbatical leave, spring 2003
Michael Morley, sabbatical leave, fall 2002
Ravi Ramakrishna, leave, academic year
Laurent Saloff-Coste, sabbatical leave, spring 2003
Shankar Sen, sabbatical leave, fall 2002
John Smillie, sabbatical leave, academic year

Gifts

As always, we appreciate the kindness and generosity of alumni and other friends of mathematics. During the 2001–2002 academic year, designated donor gifts in-

creased the principal of various department endowments. In addition, the department received some unrestricted gift donations, which are used to supplement departmental activities for the mathematics community at Cornell. In many cases, contributions were received in response to the department newsletter, *Math Matters*. By distributing this newsletter, we hope to keep our many friends current on department activities. If you would like to be added to the newsletter mailing list, please contact Catherine Stevens at cls15@cornell.edu.

Department Prizes and Awards

Recipients of three new **Department Teaching Awards** were announced at the department's annual holiday party on Friday, December 7. The *Teaching Recognition Award* was given to Al Schatz, the *Junior Faculty Teaching Award* to Ravi Ramakrishna and the *Graduate Student Teaching Award* to Lee Gibson.

The **Robert John Battig Graduate Prize** was awarded to Fernando Marques. Recipients of the Battig Prize are graduate students in mathematics at Cornell who have passed their A exam (typically in their second year of study). Any such graduate student is eligible regardless of social and financial background. A department committee composed of the chair, the director of graduate studies and three members of the graduate admissions committee select a recipient each year based on excellence and promise in mathematics.

The department sponsored the third annual **Freshman Math Prize Exam** this year. This is a challenging prize exam with cash awards open to all freshmen at Cornell. The winner this year was Yong-Jae Kwon. Second prize went to Shawn Drenning and Guanhan Chew. Other winners were Tomohiko Tanabe, Scott Schiffman, Jerry Chiang, Katya Isichenko, Hemanth Srinivas, Jonathan Blender, Wei Yoong Teo and Harikrishna Palaiyanur.

The **Hutchinson Fellowship** was awarded to Dan Ciubotaru, Jean Cortissoz, Yuval Gabay and Sam Hsiao. Awarded to mathematics graduate students who have been outstanding in their work as teaching assistants or as students in the graduate program, the Hutchinson Fellowship provides one semester of relief from teaching to allow the students to work on their thesis problems. Accordingly, it is given to students who have completed three years of study and are not in their final year.

Kenneth Brown presented the **Ithaca High School Senior Prize** this year to Zach Cater-Cyker, a senior who has demonstrated substantial interest and significant native ability in mathematics. This prize is funded substantially by contributions solicited from various faculty. Each year, the high school selects a small group of students; one or two of our faculty interview them and then select a winner.

Daniel Alexander Ramras, who graduated summa cum laude in mathematics in May, won the **Harry S. Kieval Prize in Mathematics**. The Kieval Prize, established in 1994 by Harry S. Kieval '36, provides an annual award to an outstanding graduating senior mathematics major. The student is selected by the Mathematics Department's honors committee on the basis of academic performance, the quality and variety of mathematics courses taken, and faculty recommendations.

The **Eleanor Norton York Award** for 2001–2002 was awarded to Karen Masters and Britt Scharringhausen in Astronomy and Christopher Francisco in Mathematics. The York Award was established by friends of Eleanor York, who died of cancer in 1993. Each year a student in the Mathematics Department and a student in the Astronomy Department, in which Eleanor was employed, are selected to receive this award. The recipients are chosen from those in the middle of their graduate education on the basis of their achievements to date to encourage them to have even more success in the future.

Special Honors and Awards

Harry Kesten, **Gregory Lawler** and **John Smillie** have been invited to address the International Congress of Mathematicians, to be held in August 2002 in Beijing, China. The ICM is held once every four years and is attended by thousands of mathematicians from around the world.

John Guckenheimer was elected a fellow of the American Association for the Advancement of Science this year. He was recognized for his contributions to the sciences at the February 16th Fellows Forum during the AAAS Annual Meeting in Boston, Massachusetts.

John was also appointed to the group of Founders — a kind of board of trustees — of Cornell's Computing and Information Sciences (CIS). CIS is a new college, run by Dean Robert Constable and the Founders, with responsibility for computer science and for interacting with other departments on related issues.

Ravi Ramakrishna was honored this year for his commitments to both research *and* teaching. He was awarded a Centennial Research Fellowship by the American Math-

ematical Society, an award which is made annually to outstanding mathematicians to help further their careers in research. Ravi was also presented with a Stephen and Margery Russell Teaching Award by the College of Arts and Sciences for his devotion to teaching.

Richard Durrett was named a Fellow of the American Academy of Arts & Sciences, the nation's preeminent learned society. Among the academy's fellows are scholars in mathematics, the physical and biological sciences, medicine, the social sciences and humanities, business, government, public affairs, and the arts, including more than 160 Nobel Prize laureates and 50 Pulitzer Prize winners.

Stephanie van Willigenburg, a visiting assistant professor, was awarded a University Faculty Award by the Natural Sciences and Engineering Research Council (NSERC) of Canada. NSERC awards 20 of these awards annually to talented Canadian female scientists. Recipients enjoy a reduced teaching load for 3–5 years thanks to salary contributions from this award.

Graeme Bailey, adjunct professor in mathematics and director of the computer science MEng program, was awarded one of the first Kendall S. Carpenter Memorial Advising Awards. The $5,000 award was established by Stephen Ashley, a member of the Cornell Board of Trustees, to honor his former advisor; it recognizes "sustained and distinguished contributions of professorial faculty and senior lecturers to undergraduate advising."

SIAM awarded the first (biennial) Moore Prize for Applications of Interval Analysis to **Warwick Tucker**, an H. C. Wang assistant professor, for his paper *A rigorous ODE solver and Smale's 14th problem*, Foundations of Computational Mathematics **2** no. 1 (2002), 53–117. The prize was awarded at a ceremony at the SIAM Workshop on Validated Computing 2002 in Toronto.

Peter Clark, a sophomore majoring in mathematics and biology, and a college scholar, was one of four Cornell recipients of a **Barry M. Goldwater Scholarship** in science and mathematics. The Goldwater Scholarship, established by Congress in 1986 to honor Senator Barry M. Goldwater, was designed to encourage outstanding students to pursue careers in the fields of mathematics, the natural sciences and engineering. It is a premier undergraduate award of its type in these fields. The one- and two-year scholarships cover college expenses up to $7,500 per year, including tuition, fees, books and room and board. This is the seventh year in a row that Cornell has had three or more Goldwater winners and the third year in a row that one of the Cornell recipients was a mathematics major.

Instructional Activities

The faculty taught 121 courses in 204 lectures and 168 recitations during the 2001–2002 academic year, generating 22,258 credit hours. They taught 5,690 students aided by 89 teaching assistants and associates. The enrollment figures are reflected on pp. 10–11. The Dept. of Theoretical and Applied Mechanics shares the teaching of engineering calculus and is accredited with 50% of the credit hours for MATH 190 and 191 in the fall and MATH 293 and 294 in the fall and spring; the remaining 18,536 credit hours are accredited to Mathematics.

Curriculum Changes

Two new courses were introduced into the department's curriculum during the 2001–2002 academic year.

MATH 311, *Introduction to Analysis*, provides a transition from calculus to theoretical analysis and emphasizes the understanding and construction of proofs in that area of mathematics. It is designed to provide for mathematics majors who do not take the honors analysis sequence MATH 413–414.

MATH 321 was offered with the new title *Manifolds and Differential Forms* and with a completely revised syllabus. Developed and taught by Reyer Sjamaar, it treats vector calculus on manifolds and its applications to partial differential equations, fluid mechanics and electromagnetism.

Stimulated by a mandate of its five-year NSF VIGRE grant, the Mathematics Department began a comprehensive review of its entire curriculum in late 1999 and continued it the entire 2001–2002 academic year. After reviewing how the department serves students outside the Mathematics Department we decided to introduce next year MATH 323, *Introduction to Differential Equations*. It is basically designed for students who wish to learn about basic properties of and methods for both ordinary and partial differential equations in one semester (rather than taking one course on each of ordinary and partial differential equations, as is presently offered at the 400 level). Considering that the preenrollment is at 29, such a course appears to fill a need.

Graduate Curriculum Review: A committee chaired by Dan Barbasch reviewed the curriculum for new graduate students. Our graduate program has been generally suc-

cessful, but it has not been reviewed in over twenty years. In the last two years, discussions among Louis Billera, director of graduate studies, and the mathematics graduate students have uncovered problems with the delivery of the four required courses in the Ph.D. program. While not questioning the specific requirements, many graduate students expressed that the amount of written work required in these courses had far outstripped the time available to do it, making "doing the problems" rather than "learning the material" the primary focus of many students. In this atmosphere, variation in the course syllabi (as has been the case in 631 and 612) has been a source of particular irritation.

After an extremely intense first-year experience, many students find the second and third year to be a time without much focus, and they drift without much guidance until they are forced (by policies of the Graduate School) to form a committee and take the A exam. Students indicated that they would like more structure and guidance in the program.

In general, the graduate committee agreed that the workload for basic courses should be such that a student with full teaching assistant duties should be able to take three courses per semester. Special care should be taken that this is possible for first-year students. The faculty voted in favor of

- creating a canon of six courses with a certain degree of regularity, with TA support and emphasizing that these are important courses for the students,
- creating two semesters of algebra where there is currently one semester,
- adding the course on differentiable manifolds (MATH 652) to the list of required courses.

The committee will continue to work on the curriculum next year.

Interdisciplinary Instructional Activity

Engineering Restructuring: The Department of Mathematics, in collaboration with the Department of Theoretical and Applied Mechanics in the College of Engineering, completed the fifth year of an experimental program for the restructuring of the teaching of engineering calculus. The object of this program is the delivery of instruction in small classes for the second-semester engineering calculus course, MATH 192, during the fall semesters. The program thus continues a process, begun in the early 1990s, of replacing large lectures by small classes in all of the first-year engineering calculus courses. Thirty classes in these three courses — MATH 190, 191 and 192 — were offered in fall 2001, with an average class size of 25 students.

According to the restructuring agreement, part of the instructional resources needed to staff the small classes is supplied by faculty recruited from scientific departments throughout the university. These faculty, who are highly qualified to teach the mathematics relevant to engineering calculus, complement faculty and instructional teaching assistants provided by the two core departments, Mathematics and T&AM. In fall 2001 we were pleased and fortunate to have recruited the following faculty:

- Joel Ariaratnam (Mathematics),
- Bingham Cady (T&AM),
- T. Michael Duncan (Chemical Engineering),
- Chung-Yuen Hui (T&AM),
- Richard Lovelace (Applied & Engineering Physics),
- Anita Mareno (Mathematics),
- Jane Wang (T&AM),
- Abdul-Aziz Yakubu (Biometrics and T&AM).

This was Prof. Cady's third year in the program, Prof. Duncan's fourth, Prof. Hui's third, Prof. Lovelace's second and Prof. Wang's third. Professor Cady will continue with the program next fall.

Mathematics Course Enrollment Statistics

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
103	Mathematical Explorations	Lecture	Morley, Taimina, A. Solomon	66	198	Fall 2001
103	Mathematical Explorations	Lecture	B. West, J. West	57	171	Spring 2002
105	Finite Math For the Life and Social Sciences	Lec/Sec	Durrett	113	339	Fall 2001
106	Calculus For The Life and Social Sciences	Lec/Sec	Saloff-Coste	160	480	Spring 2002
111	Calculus	Lecture	Bajnok, Coleman, DeSilva, Rybnikov, M. Terrell (Czar)	358	1,432	Fall 2001
111	Calculus	Lecture	Cohen (Czar)	112	448	Spring 2002
112	Calculus	Lecture	Earle (Czar)	178	712	Fall 2001
112	Calculus	Lecture	Bajnok, DeSilva, Sen (Czar)	200	800	Spring 2002
121	Honors Calculus	Lec/Sec	Henderson	14	56	Fall 2001
122	Honors Calculus	Lec/Sec	Mitrea, Strichartz	47	188	Fall 2001
122	Honors Calculus	Lec/Sec	Salur	20	80	Spring 2002
171	Statistical Theory and Applications	Lec/Sec	Bendikov, Hwang, Nussbaum	93	372	Fall 2001
171	Statistical Theory and Applications	Lec/Sec	Bendikov, Hwang, Schweinsberg, Tsai	93	372	Spring 2002
189	FWS: Experiencing Math Through Writing	Seminar	Cynthia Francisco	16	48	Spring 2002
190	Calculus For Engineers	Lec/Sec	Hui (T&AM)*	24	96	Fall 2001
191	Calculus For Engineers	Lec/Sec	Guckenheimer (Czar), Schatz, Z. Wang (T&AM)*, Yakubu (T&AM)*	259	1,036	Fall 2001
191	Calculus For Engineers	Lec/Sec	Schatz	6	24	Spring 2002
192	Calculus For Engineers	Lec/Sec	Bux, Cady (T&AM)*, Connelly (Czar), Duncan (ChemE), Lovelace (A&EP), Mareno, Ramírez, Smith, Yakimov	460	1,840	Fall 2001
192	Calculus For Engineers	Lec/Sec	Ramakrishna	283	1,132	Spring 2002
213	Calculus	Lec/Sec	van Willigenburg	16	64	Fall 2001
213	Calculus	Lec/Sec	Bendikov	15	60	Spring 2002
221	Linear Algebra and Calculus	Lec/Sec	Dindos, Limic, Nerode, Sjamaar	100	400	Fall 2001
221	Linear Algebra and Calculus	Lec/Sec	Lawler, Ramírez, Vogtmann	75	300	Spring 2002
222	Calculus	Lec/Sec	Back, Qian	47	188	Fall 2001
222	Calculus	Lec/Sec	Back, Qian, Speh	65	260	Spring 2002
223	Honors Linear Algebra and Calculus	Lec/Sec	Hubbard, Tucker	43	172	Fall 2001
224	Honors Linear Algebra and Calculus	Lec/Sec	Tucker	34	136	Spring 2002
231	Linear Algebra	Lecture	R. Terrell	16	48	Spring 2002
281	Deductive Logic	Lecture	Hodes (Philosophy)	1	4	Fall 2001
293	Engineering Mathematics	Lec/Sec	Jenkins (T&AM)*, Stillman	370	1,480	Fall 2001
293	Engineering Mathematics	Lec/Sec	Burns (T&AM)*, Stillman	450	1,800	Spring 2002
294	Engineering Mathematics	Lec/Sec	K. Brown, R. Terrell	386	1,544	Fall 2001
294	Engineering Mathematics	Lec/Sec	Jenkins (T&AM)*, Phoenix (T&AM)*	366	1,464	Spring 2002
311	Introduction to Analysis	Lecture	Mitrea	26	104	Spring 2002
321	Manifolds and Differential Forms	Lec/Sec	Sjamaar	19	76	Fall 2001
332	Algebra and Number Theory	Lecture	Smithline	39	156	Fall 2001
336	Applicable Algebra	Lecture	Berest, K. Brown, Rybnikov, van Willigenburg	89	356	Spring 2002
356	Groups and Geometry	Lecture	Hatcher	22	88	Spring 2002
362	Dynamic Models in Biology	Lecture	Ellner (E&EB) / Guckenheimer	9	27	Spring 2002
384	Foundations of Mathematics	Lecture	Hodes (Philosophy)	10	40	Fall 2001
401	Honors Seminar: Topics In Modern Math.	Lecture	Barbasch	5	20	Spring 2002
402	Smorgasbord Seminar	Seminar	Strichartz	4	4	Fall 2001
403	History of Mathematics	Lecture	Taimina	17	68	Spring 2002
413	Honors Introduction to Analysis	Lecture	Bendikov, Saloff-Coste	57	228	Fall 2001
414	Honors Introduction to Analysis	Lecture	Wahlbin	32	128	Spring 2002
418	Function Theory of One Complex Var.	Lecture	Dynkin	11	44	Spring 2002
420	Differential Equations & Dynamical Systems	Lec/Sec	Tucker	21	84	Fall 2001
420	Differential Equations & Dynamical Systems	Lec/Sec	Vladimirsky	17	68	Spring 2002
422	Applied Complex Analysis	Lec/Sec	Wahlbin	29	116	Spring 2002
424	Wavelets and Fourier Series	Lecture	Fickus	36	144	Spring 2002
427	Intro. to Ordinary Differential Equations	Lecture	Dindos	5	20	Spring 2002
428	Intro. To Partial Differential Equations	Lecture	Ilyashenko	17	68	Fall 2001
431	Introduction To Algebra	Lecture	Chase	35	140	Fall 2001
432	Introduction To Algebra	Lecture	Rybnikov	13	52	Spring 2002
433	Honors Introduction To Algebra	Lecture	Dennis, Tsai	40	160	Fall 2001
434	Honors Introduction To Algebra	Lecture	Dennis	24	96	Spring 2002
441	Introduction To Combinatorics	Lecture	Swartz	24	96	Fall 2001
451	Euclidean and Spherical Geometry	Lecture	Henderson	19	76	Fall 2001
452	Classical Geometries	Lecture	Connelly	17	68	Spring 2002
453	Introduction To Topology	Lecture	J. West	10	40	Fall 2001
454	Introduction To Differential Geometry	Lecture	Smith	8	32	Spring 2002
455	Applicable Geometry	Lecture	Billera	6	24	Fall 2001

Course and Title		Format	Instructor	Enroll	Cr Hrs	Semester
471	Basic Probability	Lecture	Schweinsberg	20	80	Fall 2001
472	Statistics	Lecture	Nussbaum	11	44	Spring 2002
483	Intensional Logic	Lecture	Graff (Philosophy)	1	4	Spring 2002
486	Applied Logic	Lecture	R. Miller	7	28	Spring 2002
490	Supervised Reading and Research	Ind Stud	Faculty	9	34	Fall 2001
490	Supervised Reading and Research	Ind Stud	Faculty	12	43	Spring 2002
500	College Teaching	Lecture	M. Terrell	15	15	Fall 2001
505	Educ. Issues In Undergraduate Mathematics	Lecture	Henderson	5	20	Spring 2002
507	Teaching Secondary Mathematics	Lecture	A. Solomon	10	40	Spring 2002
508	Math. For Secondary School Teachers	Lecture	A. Solomon	3	3	Fall 2001
508	Math. For Secondary School Teachers	Lecture	A. Solomon	5	8	Spring 2002
611	Real Analysis	Lecture	L. Gross	23	92	Fall 2001
612	Complex Analysis	Lecture	Hubbard	15	60	Spring 2002
613	Topics In Analysis	Lecture	Hubbard	5	20	Fall 2001
615	Mathematical Methods In Physics	Lecture	L. Gross	10	40	Fall 2001
617	Dynamical Systems	Lecture	Ilyashenko	9	36	Fall 2001
619	Partial Differential Equations	Lecture	Wahlbin	10	40	Fall 2001
620	Partial Differential Equations	Lecture	Mitrea	4	16	Spring 2002
621	Measure Theory and Lebesgue Integration	Lecture	Fickus	8	32	Fall 2001
631	Algebra	Lecture	Ramakrishna	21	84	Fall 2001
634	Algebra	Lecture	Stillman	7	28	Spring 2002
650	Lie Groups	Lecture	Dynkin	8	32	Spring 2002
651	Introductory Algebraic Topology	Lecture	Hatcher	15	60	Spring 2002
652	Differentiable Manifolds	Lecture	Barbasch	2	8	Fall 2001
661	Geometric Topology	Lecture	Conant	11	44	Fall 2001
662	Riemannian Geometry	Lecture	Smith	5	20	Spring 2002
671	Probability Theory	Lecture	Dynkin	17	68	Fall 2001
672	Probability Theory	Lecture	Lawler	12	48	Spring 2002
674	Introduction To Mathematical Statistics	Lecture	Nussbaum	4	16	Spring 2002
681	Logic	Lecture	Nerode	4	16	Spring 2002
711	Seminar In Analysis	Lecture	Saloff-Coste	14	56	Fall 2001
713	Functional Analysis	Lecture	L. Gross	12	48	Spring 2002
715	Fourier Analysis	Lecture	Dindos	5	20	Fall 2001
717	Applied Dynamical Systems	Lecture	Guckenheimer	5	20	Spring 2002
731	Seminar In Algebra	Seminar	Billera	10	40	Fall 2001
732	Seminar In Algebra	Seminar	Dennis	3	12	Spring 2002
735	Topics In Algebra	Lecture	Barbasch	3	12	Fall 2001
735	Topics In Algebra	Lecture	Yakimov	4	16	Spring 2002
737	Algebraic Number Theory	Lecture	Sen	4	16	Fall 2001
739	Topics In Algebra	Lecture	Bux	11	44	Spring 2002
751	Seminar In Topology	Seminar	Swartz	4	16	Fall 2001
752	Seminar In Topology	Seminar	K. Brown	8	32	Spring 2002
753	Algebraic Topology	Lecture	Hatcher	8	32	Fall 2001
757	Topics In Topology	Lecture	Cohen	3	12	Fall 2001
758	Topics In Topology	Lecture	Conant	4	16	Spring 2002
761	Seminar In Geometry	Seminar	Escobar	5	20	Fall 2001
762	Seminar In Geometry	Seminar	Escobar	5	20	Spring 2002
767	Algebraic Geometry	Lecture	Berest	9	36	Spring 2002
771	Seminar In Probability and Statistics	Seminar	Seminar	0	0	Fall 2001
772	Seminar In Probability and Statistics	Seminar	Seminar	0	0	Spring 2002
777	Stochastic Processes	Lecture	Ramírez	7	28	Fall 2001
778	Stochastic Processes	Lecture	Limic	6	24	Spring 2002
781	Seminar In Logic	Seminar	Shore	5	20	Fall 2001
782	Seminar In Logic	Seminar	Nerode	5	20	Spring 2002
783	Model Theory	Lecture	R. Miller	4	16	Spring 2002
784	Recursion Theory	Lecture	Shore	8	32	Fall 2001
788	Topics In Applied Logic	Lecture	Platek	12	48	Fall 2001
790	Supervised Reading and Research	Ind Stud	Faculty	18	96	Fall 2001
790	Supervised Reading and Research	Ind Stud	Faculty	16	60	Spring 2002

NOTE: Enrollments in graduate courses may not reflect total attendance. Faculty and graduate students are not required to register.

TOTALS	Courses	Lectures	Enroll	Dept* Cr Hrs	Total Cr Hrs
Fall Semester	59	115	3,145	10,267	12,357
Spring Semester	62	89	2,545	8,269	9,901
Academic Year	121	204	5,690	18,536	22,258

* The Department of Theoretical and Applied Mechanics shares in the teaching of engineering calculus and is accredited with 50% of the credit hours for Math 190 and 191 in the fall and Math 293 and 294 in the fall and spring; the remainder are accredited to Mathematics.

Mathematics Department Directory 2001–2002

Professors:
Dan Barbasch
Louis Billera
Kenneth Brown
Stephen Chase
Marshall Cohen
Robert Connelly
R. Keith Dennis
Richard Durrett
Eugene Dynkin
Clifford Earle
José Escobar
Leonard Gross
John Guckenheimer
Allen Hatcher
David Henderson
John Hubbard
J. T. Gene Hwang
Yulij Ilyashenko
Peter Kahn
Harry Kesten
Gregory Lawler
Michael Morley
Anil Nerode
Michael Nussbaum
Oscar Rothaus
Laurent Saloff-Coste
Alfred Schatz
Shankar Sen
Richard Shore
John Smillie, chair
Birgit Speh
Michael Stillman
Robert Strichartz
Karen Vogtmann
Lars Wahlbin
James West

Professors Emeritus:
James Bramble
Roger Farrell
G. Roger Livesay
Lawrence Payne
Alex Rosenberg
Moss Sweedler

Associate Professors:
Richard Platek
Reyer Sjamaar

Assistant Professors:
Yuri Berest
Irena Peeva
Ravi Ramakrishna

Acting Professor:
Allen Back

Adjunct Professor:
Graeme Bailey

Adjunct Associate Professor:
Robert Terrell

Postdoctoral Associate:
Ricardo Oliva

H.C. Wang Assistant Professors:
Kai-Uwe Bux
Martin Dindoš
Vlada Limic
Irina Mitrea
José Ramírez
Konstantin Rybnikov
Jason Schweinsberg
Harrison Tsai
Warwick Tucker
Alexander Vladimirsky
Milen Yakimov

VIGRE Assistant Professors:
James Conant
Matthew Fickus
Anita Mareno
Russell Miller
Lawren Smithline
Edward Swartz

Senior Lecturers:
Avery Solomon
Maria Terrell
Beverly West

Field Members from Other Departments:
Timothy Healey (T&AM)
Dexter Kozen (Computer Science)
Philip Protter (OR&IE)
Richard Rand (T&AM)
James Renegar (OR&IE)

Visiting Faculty:
Joel Ariaratnam
Alexander Bendikov
Michael Coleman
Zhongmin Qian
Sema Salur
Brian Smith
Daina Taimina
Stephanie van Willigenburg

Visiting Program Participants:
Bela Bajnok
Carolyn DeSilva

Visiting Scholars:
Oleg Chalykh
Yasunari Fukai
Ryuichi Fukuoka
Alexey Glutsyuk
Martin Grothaus
Thomas Rishel
Sue Whitesides

Teaching Associate:
Richard Furnas

Graduate Students:
Bryant Adams
Christian Avart (nondegree)
James Belk
David Benbennick
Janet Best
Jason Bode
Sylvain Bonnot (nondegree)
Ryan Budney
Kristin Camenga
Edoardo Carta
Nelia Charalambous
Dan Ciubotaru
Jean Cortissoz
Alan Robert Demlow
Amelie DiFabio (nondegree)
Farkhod Eshmatov
Christopher Francisco
Yuval Gabay
Ferenc Gerlits
Lee Gibson
Leah Gold
Noam Greenberg
William Gryc

Pavel Gyrya
Radu Haiduc
Spencer Hamblen
Christopher Hardin
Matthew Horak
Geoffrey Christopher Hruska
Jennifer Suzanne Lynch Hruska
Samuel Hsiao
Henri Johnston
Todd Kemp
Evgueni Klebanov
Sebastien Krief (nondegree)
JaEun Ku
Dmitriy Leykekhman
Hway Kiong Lim
Yi Lin
Swapneel Mahajan
Fernando Marques
Jason Martin
Jeffrey Mermin
Joseph Stephen Miller
Vadims Moldavskis
Antonio Montalban
Steven Morris
Melanie Pivarski
Rajmohan Rajagopalan
David Robert Revelle
Roland Roeder
Gil Rosenberg
Franco Saliola
Everilis Santana-Vega (on leave)
Hasanjan Sayit
Rebecca Schuller
Fernando Schwartz
Achilleas Sinefakopoulos
Steven Sinnott
Serguei Slavnov
Maria Sloughter
Aaron Solo
Sarah Agnes Spence
John Thacker
José Antonio Trujillo Ferreras
Jonathan Turnes
Brigitta Vermesi
Shawn Walker
Treven Wall
Russell Woodroofe
Yan Zeng
Yan Zhang
Huibin Zhou

Administrative Support Staff:
Linda Clasby
Arletta Havlik
Joy Jones
Michelle Klinger
Gayle Lippincott
Brenda Smith
Donna Smith
Catherine Stevens
Colette Walls, manager

Computer Consultants:
Douglas Alfors
Robert Terrell

Instructional Computer Lab:
Allen Back, director

Mathematics Support Center:
Douglas Alfors, director
Richard Furnas

Mathematics Library Staff:
Steven Rockey, librarian
Natalie Sheridan

Changes for 2002–2003

New H.C. Wang Asst. Professors:
Indira Chatterji
Rodrigo Perez
Dan Zaffran

New VIGRE Asst. Professors:
Tara Brendle
Alexander Meadows
Brian Smith

New Adjunct Asst. Professors:
Vlada Limic
Warwick Tucker

New Graduate Students:
Drew Armstrong
David Biddle
Andrew Cameron
Benjamin Chan
Nikolai Dimitrov
Bradley Forrest
Timothy Goldberg
Heather Heston
Sarah Koch
Andrei Maxim
Radu Murgescu
Michael O'Connor
Jay Schweig
Mauricio Velasco
James Worthington
Jessica Zuniga

Faculty Departures:
Konstantin Rybnikov

Faculty Retirements:
Harry Kesten
Richard Platek

Faculty Leaves:
Eugene Dynkin, spring 2003
Clifford Earle, academic year
Leonard Gross, fall 2002
John Guckenheimer, fall 2002
J. T. Gene Hwang, spring 2003
Michael Morley, fall 2002
Ravi Ramakrishna, academic year
Laurent Saloff-Coste, spring 2003
Shankar Sen, fall 2002
John Smillie, academic year

New Faculty Members for 2002–2003

Tara Brendle
VIGRE Assistant Professor

Tara Brendle received a Ph.D. in mathematics in May 2002 from Columbia University under the direction of Joan Birman. Professor Brendle's research interests are in geometric topology, 3-manifolds, Heegaard splittings, Torelli groups, and representations of mapping class groups of surfaces. Professor Brendle is especially interested in the algebraic structure of the Torelli group.

Indira Chatterji
H. C. Wang Assistant Professor

Indira Chatterji received a Ph.D. in mathematics in September 2001 from ETH Zürich in Switzerland under the direction of Marc Burger and Alain Valette. Professor Chatterji's research area is centered around the Baum-Connes conjecture, focusing on the aspects related to geometric group theory and topology. Professor Chatterji's current research interests are in property (RD) and relative property (RD) and the consequences of the Baum-Connes/Bost related conjectures in many different fields.

Alexander Meadows
VIGRE Assistant Professor

Alexander Meadows received a Ph.D. in mathematics in May 2002 from Stanford University under the direction of Leon Simon. Professor Meadows' research interests include nonlinear elliptic partial differential equations, geometric measure theory and calculus of variations. His current research focuses on the geometry of singular sets and the regularity of solutions to elliptic PDEs arising in differential geometry.

Brian Smith
VIGRE Assistant Professor

Brian Smith received a Ph.D. in mathematics in August 2001 from the University of Alabama at Birmingham under the direction of Gilbert Weinstein. Professor Smith's research interests include differential geometry, nonlinear partial differential equations and general relativity. His current research interests involve the study of asymptotically flat Riemannian 3-manifolds of nonnegative scalar curvature.

Rodrigo Perez
H. C. Wang Assistant Professor

Rodrigo Perez received a Ph.D. in mathematics in May 2002 from SUNY at Stony Brook under the direction of John Milnor. Professor Perez's research interests are in complex dynamics in both one and several variables. In particular, Professor Perez's work focuses on the combinatorial structure of orbits and its implications on the geometry of Julia sets.

Dan Zaffran
H. C. Wang Assistant Professor

Dan Zaffran received a Ph.D. in mathematics in December 2000 from the Université de Provence in Marseille, France, under the direction of Karl Oeljeklaus. Professor Zaffran's research interests are in the area of complex holomorphic geometry and complex analysis: classification of compact complex surfaces; Inoue-Hirzebruch surfaces; Serre problem (holomorphic fiber bundles and Stein spaces); holomorphic foliations; singularities of complex surfaces; dynamics of Hénon automorphisms. From 1995 through 2001 he taught at the Université de Provence. In 2001–2002 Professor Zaffran was in Bochum, Germany, working with A. T. Huckleberry.

Special Programs and Activities

The Math Explorers Club

The Math Explorers Club, a program for high school students funded by the department's VIGRE grant, began its second full year of operation this fall. The Saturday meetings are open to all interested students at no charge. The goal of the club is two-fold: to stimulate an interest in mathematics by exposing students to material not usually encountered in the high school curriculum and to provide a peer group of students who share an interest in mathematics.

Participants choose among modules that provide instruction in interesting areas of mathematics, computer lab activities and problem-solving sessions. Two intense hour-long sessions are separated by a break, during which participants of all modules can gather to relax and talk things over.

Three modules were offered this fall: *Knot Theory* by Graeme Bailey, *The Fibonacci Sequence and the Golden Ratio* by Robert Strichartz and *Geometry and Topology of Surfaces* by Edward Swartz. Two modules were offered in the spring: *Probability and Statistics* by Ravi Ramakrishna and *From the Finite to the More Than Infinite* by James Conant.

The program is run by four graduate students — Sharad Goel (CAM), Todd Kemp, Maria Sloughter and Tiberiu Tomita (CAM) — and has modules taught by faculty members. It is a great opportunity for graduate students to interact with faculty in an informal setting and to gain valuable experience in education and outreach that will help them in future job searches. Participants enjoy the challenge of communicating the excitement of mathematics to young and eager minds and spreading the word that mathematics is a cool subject. We expect the program to evolve and grow in response to the needs and interests of the participants.

Mathematics Awareness Month

April is Mathematics Awareness Month, and once again the department organized several activities as our contribution to this national event. The general public was invited to come to Malott Hall for the third annual public lecture, aimed at presenting interesting new developments in mathematics to a wider audience.

Public Lecture

This year's lecture, *Using a Computer to Do Rigorous Mathematics*, was given by Warwick Tucker. The audience — composed of high school students, secondary math teachers, staff and students from both Cornell and Ithaca College, and members of the general public — was quite appreciative.

It is widely understood that mathematics had an important role in the development of computers, and computers have had an enormous influence on all areas of life and learning. But the role of computers in mathematics itself is a much more subtle and controversial issue.

The general feelings about using computers in science can be divided into two main categories: One group of researchers considers all problems to be solvable, given a sufficiently large and fast computer. The other group claims that computers are inherently inexact, and that virtually no results produced by machines are to be trusted.

In this talk, Tucker showed that there is a narrow (but non-empty!) region that fits in between these two schools of thought. The main underlying idea is to NOT try to model the real numbers using a computer's floating point numbers, but rather to enclose entire sets of real numbers in small intervals with well-defined endpoints. As it turns out, computers handle this situation rather well, allowing theorems to be proven with mathematical rigor.

Mathematics Awareness Week at Area Schools

The American Mathematical Society encourages universities to support the idea of a math awareness week in April at area schools. We have participated in this practice since its inception. We sponsor a T-shirt design contest, won this year by Joshua Berggren, a sophomore at Ithaca High School. The Departments of Mathematics at Cornell University and Ithaca High School underwrote the cost of producing 90 shirts that were distributed to staff and students at Cornell and several area schools. At Ithaca High, students won the shirts as prizes for solving a math problem of the day, or a more extensive week-long challenge.

Expanding Your Horizons

Created in 1976, *Expanding Your Horizons in Science and Mathematics* is a national program aimed at encouraging middle-school girls' interest in math and science and motivating them to continue taking math and science courses throughout high school. Organized and run by women in mathematics and science, it is held in over 100 locations nationwide. The Math/Science Network — a non-profit membership organization of educators, scientists, mathematicians, parents, community leaders, and government and corporate representatives — licenses and coordinates this network of EYH conferences (www.expandingyourhorizons.org). M/SN's mission is to promote the continuing advancement in mathematics and science education of all people, with a particular emphasis on the needs of women and girls. It initiates local EYH sites and provides them with technical assistance and conference and planning materials, as well as support services such as coordinated publicity and public relations posters and buttons. The Network also provides a "networking" link between sites.

On April 27, 2002, the graduate students of the Cornell Mathematics Department once again participated in a day of hands-on workshops in mathematics for 7th and 8th grade girls. The Mathematics Department sponsored a workshop on game theory, run by several students in the department. In the workshop *The Secret of Nim*, Cynthia Bowers Francisco, Leah Gold, Melanie Pivarski, Rajmohan Rajagopalan and Maria Sloughter worked with a group of girls using M&Ms and pretzels to study the game of Nim. They started by having the girls pair up to play the 20 game: Starting at the number 20, each player takes turns subtracting an integer between 1 and 4 until zero remains; the player who ends at zero wins. After playing the game for a bit, the girls found the pattern and generalized it to similar games. Then the entire group challenged an 'Expert' (one of the graduate students) to a game, and by correctly deciding whether or not to go first the girls defeated the Expert! From there the group moved on to two-pile Nim, where players take turns removing however many items they want from exactly one of two piles. The player who takes the last item wins. Soon the girls solved this and moved on to the three-pile case. After experimenting with different strategies for a while, the entire group challenged and defeated the Expert.

The Center for Applied Mathematics (CAM) also sponsored a session, *Symmetry and Tesselations*, in which Nelia Charalambous and Jean Cortissoz participated. During the first part of the presentation, Mercedes Franco (CAM) showed the girls some examples of tilings from art around the world and proceeded to describe the symmetries found in tesselations of the plane. With these ideas in mind, the girls were given a square with a fixed design inside it, and they were asked to fill a page with the square and symmetric images of it. The purpose of the exercise was to create a pattern in the plane that could have a number of symmetries. (For example, it could be reflected over a line rotated about a point.) To make things even more interesting, the coordinators asked them to color their tiling and see how coloring could preserve or completely remove the symmetry of a pattern. The possibilities were too many to be explored in half an hour, but the girls took some more pictures home with them to practice on. During the second part of the session, Nelia demonstrated how one could go about finding the symmetries in the work of M. C. Escher. The girls were given a few of Escher's drawings and asked to look for the fundamental region that the artist used for tiling the plane. Knowing the basic tile helped in finding many of the symmetries, and all of a sudden a complicated work of art was broken down into a few simpler patterns.

Spring Concert Series

On the evening of Sunday, May 5, 2002, a group of talented faculty, visitors, graduate students, undergraduates, family and friends of the Mathematics Department performed before an appreciative audience in the department's twelfth annual Spring Concert, held at the A. D. White House. As the program below shows, performers entertained the audience with a variety of selections, ranging from classical to modern.

Prelude in C Major (Book 1 of the Well-Tempered Clavier), Johann Sebastian Bach: Lawren Smithline — piano.

Duo Für Zwei Gitarren, op. 34, Fernando Sor: John Hubbard and Warwick Tucker — guitar.

Valse Brilliante in A Minor, Frédéric Chopin: Diana Dorothy Hubbard — piano.

Moj Dilbere, trad. Bosnian: Vlada Limić — guitar, vocal; Gregory Lawler — guitar, prim, vocal.

Ne Dirajte mi Ravnicu, Miroslav Škoro: Vlada Limić — guitar, vocal; Gregory Lawler — guitar, prim, vocal.

Ariel's Song, Robert Strichartz (words from Shakespeare's *The Tempest*): Kristin Camenga, Todd Kemp — vocal; Robert Strichartz — piano.

Never Rain, Brian Lukoff: Brian Lukoff — piano.

Au pays où se fait la guerre, Henri Duparc (Poème de Théophile Gautier): Eleanor Hubbard — vocal; Graeme Bailey — piano.

Rain-Wheels, Clive James (lyrics) and Pete Atkin (music): Noam Greenberg — piano; Christopher Hardin — electric guitar (bass); Steve Morris — electric guitar; Treven Wall — vocal.

Payday Evening, Clive James (lyrics) and Pete Atkin (music): Noam Greenberg — piano; Christopher Hardin — electric guitar (bass); Steve Morris — electric guitar; Treven Wall — vocal.

Cumbia, traditional Colombian music and dance: Mercedes Franco, Ariel Cintron-Arias — dancers.

Piano Quartet, 1st movement (Allegro), Robert Palmer: Carla Martin — violin; Robert Strichartz — piano; Nancy Sundell — viola; Graeme Bailey — cello.

Waltz in C# Minor, Frédéric Chopin: Greg Padowski — piano.

Concerto in D Minor for Two Violins and Piano, Johann Sebastian Bach: Carla Martin, Sebastian Mekas — violin; Kristin Camenga — piano.

Nocturne, Opus 9, #2 (in E-flat major), Frédéric Chopin: Noam Greenberg — piano.

Piano Quartet, Opus 47 (3rd movement), Robert Schumann: Carla Martin — violin; Graeme Bailey — cello; Nancy Sundell — viola; Robert Strichartz — piano.

The Merry Maiden and the Tar (from H.M.S. Pinafore), Gilbert and Sullivan: John Hubbard, Todd Kemp — vocal; Graeme Bailey — piano.

A British Tar (from H.M.S. Pinafore), Gilbert and Sullivan: John Hubbard, Todd Kemp — vocal; Graeme Bailey — piano.

I Am the Very Model of a Modern Major General (from Pirates of Penzance), Gilbert and Sullivan: Todd Kemp — vocal; Graeme Bailey — piano.

I Will Survive, D. Fekaris and F. Perren, Stephanie van Willigenburg (lyrics): Kristin Camenga, Stephanie van Willigenburg — vocal; Todd Kemp — piano.

Cornell Conference on Analysis and Probability on Fractals

Analysis and probability on fractals is an exciting new area of mathematical research that studies basic analytic operators and stochastic processes when the underlying space is fractal. The books *Diffusions on Fractals* by M. Barlow (Lecture Notes 1690, Springer, 1998) and *Analysis on Fractals* by Jun Kigami (Cambridge University Press, 2001) and the expository article *Analysis on fractals* by R. Strichartz (Notices AMS **46** (1999), 1199–1208) give an indication of the accomplishments in this area in the recent past. Research in this area is closely related to work in analysis and probability when the underlying space is manifold or a graph.

The purpose of the Cornell Conference on Analysis and Probability on Fractals (June 16–20, 2002) was to bring together mathematicians who are already working in this area, and also graduate students and researchers from related areas who wanted to learn more about it. Toward this end, the conference included a mini-course intended to bring neophytes up to speed on the subject, starting with basic definitions and examples, and reaching to the frontiers of research.

Martin Barlow, Jun Kigami, Robert Strichartz and Alexander Teplyaev were the members the organizing committee. Invited speakers were: Martin Barlow, University of British Columbia; Richard Bass, University of Connecticut; Rostislav Grigorchuk, Steklov Institute of Mathematics; Ben Hambly, Oxford University; Alf Jonsson, University of Umea; Jun Kigami, Kyoto University; Takashi Kumagai, Kyoto University; Michel Lapidus, University of California at Riverside; Volker Metz, Bielefeld University; Hirofumi Osada, Nagoya University; Christophe Sabot, University of Paris; Robert Strichartz, Cornell University; Alexander Teplyaev, University of California at Riverside. There were about 50 outside attendees.

Cornell Topology Festival

The topology/geometry group of the Mathematics Department hosted the fortieth annual Cornell Topology Festival on May 3–5 this year. Now an internationally-known tradition, the Festival was founded in part by Paul Olum in 1963 as a small regional conference that celebrated the return of spring and reviewed the outstanding results in topology during the preceding year.

The current festival attracts fifty to eighty topologists and geometers annually and is funded by the National Science Foundation. In the current era of highly specialized conferences, the Cornell Topology Festival is noteworthy in that — representing the interests of the current faculty — it presents a broad spectrum of current mathematics, usually featuring topics in geometric and algebraic topology, geometric group theory and geometry.

The festival consists of seven or eight one-hour lectures interspersed with thirty-minute breaks for discussion of

results, conjectures and new theorems. Other activities include an opening reception, a dinner, an open house and a picnic. This format encourages a lively and open exchange of ideas and promotes mathematical collaboration. This year's featured speakers and their topics were:

Mladen Bestvina, University of Utah: *Measured Laminations and Group Theory*

Daniel Biss, Massachusetts Institute of Technology: *The Combinatorics of Smooth Manifolds: Oriented Matroids in Topology*

Steve Gersten, University of Utah: *Isoperimetric Inequalities for Nilpotent Groups*

Dusa McDuff, SUNY at Stony Brook: *The Topology of Groups of Symplectomorphisms*

Yair Minsky, SUNY at Stony Brook: *On Thurston's Ending Lamination Conjecture*

Peter Ozsvath, Princeton University: *Holomorphic Disks and Low-Dimensional Topology*

Guoliang Yu, Vanderbilt University: *The Novikov Conjecture and Geometry of Groups*

The forty-first Cornell Topology Festival will be held May 2–4, 2003. (Next year's schedule will be posted at www.math.cornell.edu/~festival/)

Preparing Future Professors

The department's Preparing Future Professors program continues to prepare graduate students for the professorate while it attracts attention from outside administrative agencies. The program was funded this year by the Office of the Dean of the College of Arts and Sciences, under the direction of Dr. Maria Terrell.

Cornell graduate students gave talks to mixed audiences of faculty and students at nearby colleges and universities. This experience afforded participants the opportunity to talk about their work in ways that anticipate both professional meetings and job searches. Speakers included Matt Horak, *Mobius bands, Klein bottles and knots: an intuitive introduction to topology*, at Ithaca College; Kristin Camenga, *A tale of two proofs*, at Rochester Institute of Technology; Joseph Miller, *The game of Hex: provably pointless or positively playable?*, at SUNY Cortland; Noam Greenberg, *Paradoxes and the foundations of mathematics: how to escape the serpent's tongue*, at Wells College; and Todd Kemp, *You can't comb a coconut, unless it's odd (dimension)*, at SUNY Binghamton. Graduate students Sarah Spence, Lee Gibson and Roland Roeder coordinated the talks.

Special Guest Lectures

Kieval Lecture

Richard Guy, Emeritus and Faculty Professor of the University of Calgary delivered the 2001 Kieval lecture, *Fun from Mathematics and Mathematics from Fun*, in November. The lecture was an autobiographical history of combinatorial games. Combinatorics is the branch of mathematics that includes the enumeration of complicated configurations and patterns.

Professor Guy has taught mathematics at all levels from kindergarten to post-graduate in Britain, Singapore, India and Canada. He has published over 250 papers and a dozen books, including *Winning Ways* with Elwyn Berlekamp and John Conway.

The Kieval lecture, designed for undergraduate students and members of the public who have a basic scientific and mathematical knowledge, is funded through a bequest of the late Dr. Harry S. Kieval '36. Kieval, a longtime professor of mathematics at Humboldt State University in Arcata, CA, died in 1994.

Math Club Guest Lecture

Professor Jordan Ellenberg gave a special guest lecture in April titled *The mathematics of Set -or- Everything I know about Fourier analysis I learned from playing cards*, sponsored by the Student Activities Finance Commission.

Set is a fairly popular card game. (To learn about Set, visit www.cabinfevergames.com/cf_set.html.) Prof. Ellenberg spoke about how "sets" in the game correspond to "lines" in various geometries and gave an exposition of how many cards guarantee that a set will occur.

Prof. Ellenberg received his A.B. and Ph.D. degrees in mathematics from Harvard University. He is currently on the faculty of the Princeton University Mathematics Department and is a frequent contributor to the online magazine slate.com, writing on issues from baseball to politics and how mathematics applies to understanding them.

Research Experiences for Undergraduates Program

The Cornell Research Experiences for Undergraduates (REU) program, funded through a grant from the National Science Foundation and supplemented by the department's VIGRE grant, is one of the nation's leading summer programs for undergraduate research. During the summer of 2001, the eighth summer for this program, fourteen undergraduates from across the country, including such well-known institutions as Harvard, Chicago and Cornell and some lesser-known institutions as University of Missouri at Rolla and North Central College, came here to work on research projects in three areas: analysis on fractals, directed by Robert Strichartz, geometry of numbers, directed by Konstantin Rybnikov, and discrete geometry, directed by Károly Bezdek, a visiting professor from Eötvös University, Budapest, Hungary. Graduate students Todd Kemp, Melanie Pivarski and Franco Saliola assisted with the program.

During the past eight years, this program has served 87 students (20 female) and produced over two dozen research papers, published in such journals as *Transactions of the AMS*, *Indiana University Mathematics Journal*, *Geometria Dedicata* and *Experimental Mathematics*. In a typical year, the department receives over one hundred applications. The students in the program receive a generous stipend, although some students have come with funding from outside sources. One student from the program received the Morgan Prize for Undergraduate Research, a prestigious national award, and another has been nominated for this award based on work done during the program.

Students work individually or in small groups on problems that have been carefully chosen to be accessible to undergraduate, but are still of interest to the general mathematical community. Often these problems involve computer experimentation. At the end of the program, the students give public lectures on their results at an Undergraduate Research Forum, and many go on to give talks at various conferences. The students get to hone their lecturing skills at a weekly jam session in which they discuss their work with other participants. They attend the Smorgasbord Seminar, a lecture series in which members of the department dish out small tastes of what research is like in many different areas of mathematics.

Analysis on Fractals

Students working with Prof. Strichartz in the program since 1996 have already made important contributions to this developing area, the goal of which is to create the analogs of calculus and differential equations for functions defined on fractals. This theory goes far beyond what is generally thought of as fractal geometry and makes contact with many classical areas such as partial differential equations, harmonic analysis, analysis on manifolds and numerical analysis. The students carry out computer experiments to explore new problems.

This summer, the students explored the sampling problem: recover a function from just a finite set of its values, under appropriate spectral hypotheses. The experimental results suggest that this problem is actually much better behaved than the classical Shannon sampling theorem. They began work on defining a nonlinear differential operator, the p-Laplacian, on the Sierpinski gasket fractal, and on defining a standard Laplacian on the octagasket fractal, which has a more complicated structure than the fractals previously studied. They also continued work begun in summer 2000 in developing a finite element method numerical analysis scheme on the pentagasket fractal and using it to help understand the spectrum of the Laplacian in this case.

Geometry of Numbers

Students working with Prof. Konstantin Rybnikov studied the geometry of quadratic forms over the integers, or equivalently lattices in high-dimensional Euclidean spaces, and certain geometric objects associated with them: the Delaunay polytopes and the Voronoi polyhedron in $\mathrm{Sym}(n, R)$. In particular, they studied an infinite series of integer polytopes, introduced by Erdahl and Rybnikov, called supertopes. They gathered a great deal of combinatorial information about the supertopes and made progress toward proving their conjectured Delaunay property. In addition, one of the students, Kirsten Wickelgren, was successful in proving a conjecture of Shtogrin and Ryshkov, dating to 1974, concerning the group of the Voronoi polyhedron.

Discrete Geometry

Students worked with Prof. Károly Bezdek on a number of problems concerning sets of points in finite-dimensional vector spaces, not just with respect to the usual Euclidean distance but more general distances defined by arbitrary norms. One of the students was able to find the largest surface density of faces of Voronoi cells in unit sphere packings in Euclidean 3-space. Another student found estimates for the largest number of equidistant points that can be placed in a given normed space and related questions. Other problems studied included estimating the minimum diameter of a set of seven points in a plane (with arbitrary norm) when the points are at least a distance of one from each other.

Summer Program

In summer session 2001, the Mathematics Department offered 12 courses in the three-week, eight-week and six-week sessions, among them *Statistical Theory and Application in the Real World*, *Applicable Algebra*, *Calculus* and *Engineering Mathematics*. Students can choose from a variety of courses and take whatever they need to fulfill their graduation requirements or just get ahead.

Mathematical Explorations (MATH 103) is a very popular offering, both in summers and during the academic year, and is taught in the three-week and six-week sessions. The instructor chooses the topic. In the three-week session, Prof. Zoran Sunik's topic was *Mathematics and Politics*; Prof. Thomas Barr taught *Cryptology* in the six-week session.

Even for traditional calculus courses, the special characteristics of summer study allow for a much greater interaction between students and faculty, creating a more exciting educational experience for both. The Mathematics Department enrolled a total of 227 students in summer 2001, including students from Cornell, other colleges and high schools. High school students who come to Cornell in the summer are able to experience the vitality of mathematical life here. Many of these students apply for undergraduate study at Cornell the following year. In addition to our own faculty, visiting faculty from other colleges and universities join us to teach summer classes. Mathematics graduate students appointed as teaching assistants provide support to our instructors.

Special Instructional Support

Computer Lab

Classes that made significant use of the lab this year were *Statistical Theory* (MATH 171), *Mathematical Explorations* (MATH 103), *Teaching Secondary Mathematics* (MATH 507) and *Multivariable Calculus* (MATH 222). *Classical Geometry* (MATH 452), *Applied Dynamical Systems* (MATH 717), *Differential Equations/Dynamical Systems* (MATH 420) and several sections of elementary *Calculus* (MATH 112) also made limited use of the lab.

The Math Explorers Club for high school students continued to be a heavy user of the lab many Saturday mornings. Students working on senior theses and Research Experiences for Undergraduates program participants were also significant users of the lab.

The frontline resources of the lab currently center on the thirteen 1.4 gigahertz Pentium 4 computers dual-booting Windows 2000 and Redhat Linux. The linux sides of these machines were improved this year to support widespread REU and potential classwide dynamical systems use. These Pentium 4 machines are supported by the two one-year-old fast Pentium 3 SCSI servers. We continued to use three older 266 megahertz NT machines, to meet our course capacity of 30 students working in partners at 15 machines.

A new system of networking charges at Cornell raised the share of our budget for this purpose from around 2% to 22%, with a further rise to 32% scheduled in the next fiscal year. We had to restrict opening hours during the spring by more than 20 hours per week and will apparently need continuing cuts during the summer and off-semester times.

Mathematics Support Center

An academic support wing of the Mathematics Department, the Mathematics Support Center provides free one-on-one and small-group tutoring, workshops and review sessions on topics of common concern in mathematics, approximately fifty brief printed capsules on various mathematical topics, and advice, encouragement or referrals for students. Although the Center focuses on the support of introductory courses, it employs both undergraduates and postgraduates (about eight each year) of diverse backgrounds and provides some limited tutoring even in upper-level courses. Douglas S. Alfors directs the operations of the MSC and coordinates its efforts with the instructors of the introductory calculus sequence.

The MSC is located on a main thoroughfare of Malott Hall and is consequently quite visible and accessible to students. We have several tutoring areas that are sufficiently separated from one another to address privacy and noise issues, yet are not so widely separated that we lose contact with someone who is working on something. Our 'reception area' can adequately accommodate students who are waiting for their turn to be tutored, and we have a couple of sites that work nicely for small groups. The small library of texts that we maintain can be accessed easily by tutors and tutees, and mathematics computer programs provide additional support when needed. We anticipate having a more visible web presence soon and plan to replace some antiquated computer equipment.

Management of the facility, strictly speaking, remains as before. We continue weekday hours of service (10 AM–5 PM), as well as Sunday hours (1:30 PM–5:30 PM).

Learning Strategies Center

The Learning Strategies Center (LSC) provides academic support in a variety of subjects across campus, including biology, chemistry, physics, economics, writing, study skills, mathematics and statistics. The mission of the LSC is to provide academic assistance to students during their transition from high school students to accomplished Cornell students. Studies have shown that students who successfully complete their freshman year generally go on to graduate from Cornell. Therefore, most of the LSC's efforts are directed to supporting large, primarily freshmen, courses.

In the 2001–2002 academic year, the LSC provided academic support for MATH 105, MATH 106, MATH 111 and MATH 112. Support included respective supplemental courses MATH 005, MATH 006, MATH 011 and MATH 012. These courses consisted of a ninety-minute weekly lecture held on either Sunday, Monday or Wednesday evening, which reviewed material covered in the parent course, with an emphasis on problem solving and prelim preparation. In addition, extensive tutoring hours were provided by the supplemental course instructors and their assistants.

Support for MATH 171, as well as other undergraduate statistics courses, was also provided by the LSC in the Center for Learning and Teaching Support Instructional Lab. The tutor-staffed lab was open three evenings and two afternoons per week, equipped with statistical software and respective problem sets for the courses supported.

During the 2002–2003 academic year, support will continue to be provided as described above for MATH 105, MATH 106, MATH 111, MATH 112 and MATH 171.

Center for Applied Mathematics

Cornell's Center for Applied Mathematics (CAM) was established to promote research and advanced study in applied mathematics and to bring together students and professors with interests in various branches of the subject. Terrence L. Fine was appointed director of CAM effective July 1, 1999.

The environment for applied mathematics at Cornell today is rich and varied. Viewed nationally, Cornell is a major center of activity in applied mathematics and scientific computations, and its students are among the best at Cornell. The 80 center faculty are drawn from the Department of Mathematics and 14 other departments in engineering and the sciences.

The following Mathematics Department faculty are members of CAM: L. Billera, R. Connelly, R. Durrett, E. B. Dynkin, J. F. Escobar, L. Gross, J. Guckenheimer, J. H. Hubbard, H. Kesten, A. Nerode, L. Saloff-Coste, A. H. Schatz, J. Smillie, M. Stillman and L. B. Wahlbin.

Mathematics Library

The Mathematics Library continues to have a high level of use that often finds most of the library computers and many seats full. Paintings and items of interest are on display in the library. Most notable is a collection of oil paintings of early faculty of the department, including a large portrait of James Edward Oliver, who started the department colloquium series in 1891. This year, wireless networking service was added inside the library via Cornell's RedRover.

The Mathematics Library collection at Cornell is one of the finest in the nation and supports research and instruction in mathematics and statistics for the Cornell community. The research collection consists of works on mathematics, statistics, applied mathematics, mathematics education and the history of mathematics. For undergraduates with an interest in mathematics, the library is a wonderful resource for materials to support instructional and career needs as well as expository and recreational reading. The library collection has great historic depth and breadth, and includes materials from around the world in many languages.

An increasing portion of the journals in the library collection is now available either on paper in the library or online to all Cornell users. A small number of titles are now available only online; the University Library has negotiated some site license contracts that make the online-only option financially favorable and provide archival reliability. New online resources are important, but they are not less expensive than the printed resources they will eventually replace. A crisis is looming because one publisher, Elsevier, is poised to significantly increase their prices. Elsevier represents only 6% of our current journal subscriptions but consumes 30% of our budget. It is likely that we will have to significantly retrench our collection of their titles, canceling subscriptions and paying for online use on an article by article basis.

Gifts to the library endowment and improved endowment payout have made endowment income a very significant source of funding for the purchase of library materials. The university-appropriated budget for the library continues to grow but not as fast as the cost of library materials. Thanks to the continued support of

our donors, endowment income has grown from 1.5% of our budget in 1990 to 21.5% for the coming fiscal year. Gifts are the difference between an excellent library and a mediocre one.

The Mathematics Library encourages and welcomes all patrons in the Cornell community to use its resources. Reciprocal interlibrary loan agreements with other institutions make Cornell's resources available throughout the world and open the world to Cornell researchers. The need for quantification, analysis and more mathematical sophistication in the social, biological and engineering sciences attracts a spectrum of patrons from across the campus and generates frequent use of the collection. A full range of reference, circulation, printing and photocopy services are available in person and via phone, e-mail or the world wide web.

The library staff consists of Steven Rockey, the director of the library, Natalie Sheridan, branch manager, and approximately a dozen part-time undergraduate student employees. The veteran professional staff and the competent student employees are always ready to serve the public, and they welcome feedback. A primary goal is to make the library experience for the staff and patrons interesting, productive and enriching in a small and personal environment.

The Mathematics Library's world wide web home page (www.math.cornell.edu/~library/) has information about the library's services and hours of operation with pointers to relevant databases such as MathSciNet, links to mathematical science resources, and an extensive bibliography of "collected works" of mathematicians. Library personnel are always adding new and relevant links. Visit our library, our home page, or contact us electronically or by telephone to find out how the Mathematics Library can serve you.

Project Euclid

Project Euclid (projecteuclid.org) is Cornell University Library's electronic publishing initiative in mathematics. With support from the Mellon Foundation and SPARC (Scholarly Publishing and Academic Resources Coalition), Euclid provides a shared web platform for society and independent publishers of mathematics journals, easing their transition to the electronic environment and allowing them to compete with large commercial publishers. At present, Euclid provides current journal content, but some publishers have expressed interest in retrodigitizing. Euclid is now in production. It is currently partnering with 14 journals in theoretical and applied mathematics and statistics, and further partnerships are being negotiated.

Euclid is in a period of transition, still doing system development work, on one hand, but aiming for cost recovery beginning next year. Marketing the journal package to libraries is a priority in this regard. Euclid's governance structure for the cost-recovery phase is under discussion.

Project Euclid is managed by Zsuzsa Koltay, CUL's coordinator of electronic publishing. More information about Project Euclid is available on the web at euclid.library.cornell.edu/project/; Zsuzsa Koltay can answer questions at (607) 255-7964 or zk10@cornell.edu.

Cornell University Mathematics Collection

The Cornell University Mathematics Collection (library5.library.cornell.edu/math.html) is a collection of 577 digitized books that were scanned from originals held by the Mathematics Library as part of an early CUL-Xerox collaboration on digital preservation techniques. The titles can be viewed electronically, and the Mathematics Library also does a brisk (cost-recovery) business selling bound paper facsimiles to libraries and individuals. Over the decade during which the reprints have been offered, sales have averaged roughly 100 books per year; the program has been so successful, in fact, that the printers used for producing the reprints are burning out.

The Math Books collection consists mostly of pre-1914 titles, originally selected according to these criteria: the books were out-of-print; there were no copyright restraints on digitizing; they were not otherwise available in reprint or microform; and they represented important research in mathematics. The electronic version of the first reviewing journal in mathematics, Die Jahrbuch über die Fortschritte der Mathematik (1868–1942) (www.emis.de/projects/JFM) has links to most of these books, as well as other retrodigitized mathematical publications. The digital Math Books collection is slated to migrate to Project Euclid in the near future. The roles of the two projects may already be merging.

Distributed Digital Library of Mathematical Monographs (NSF/DFG)

This collaboration among Cornell University Library, the University of Michigan Library, and the State and University Library Goettingen (Germany) is funded by the NSF and the DFG (Deutsche Forschungsgemeinschaft). Interoperability is the goal of the NSF/DFG project: to find a viable common protocol that will allow access to three bodies of material. When finished, the system should deliver easy, searchable, electronic access to several thousand mathematics books from the three universities. The new protocol is derived from the Dienst protocol and draws on the Open Archives Initiative. To date, cross-collection searching between the CUL and UM collections has been set up.

Digital Mathematics Library (DML)

The NSF has tentatively funded a two-year planning process for the initiative in which CUL will serve as the coordinator of a working group of mathematicians, publishers, and librarians. The DML proposal responds to a white paper prepared by John Ewing, the executive director of the American Mathematics Society, *Twenty centuries of mathematics: digitizing and disseminating the past mathematical literature* (www.ams.org/ewing/Twenty_centuries.pdf). Prof. Keith Dennis convened an unofficial session during the Joint Mathematics Meetings in San Diego in February to discuss the proposal. It was attended by scholars, publishers and librarians from Europe and North America involved in mathematics digitization efforts, as well as by representatives from the NSF. The first official meeting of the DML advisory committee will take place July 29 and 30 in Washington, DC. Questions involving the scope and content of the collection, as well as issues of standards and interoperability, are on the agenda. Keith Dennis will deliver a report from the DC meeting to the August meeting of the International Mathematics Union in Beijing. A second planning meeting will follow in 2003.

Electronic Mathematics Archives Initiative (EMANI)

EMANI is a collaborative effort between the German scientific publisher Springer and the libraries at Cornell, Goettingen, Tsinghua (Beijing), and Orsay (Paris) that focuses on the archiving of digital mathematics literature and also addresses repository and dissemination issues. Springer wishes to establish its reputation as a leader in digital archiving in a public-spirited fashion and hopes to benefit from the good will this can generate. Springer also hopes that a systematic and collaborative approach to digital archiving will speed their transition to electronic-only publishing. EMANI will not be a "dark archive." Springer has declared its intention to make its archived materials accessible in a relatively short time after publication. EMANI is expected to be an important component in the broader Digital Mathematics Library initiative if Springer can in fact offer a model for other publishers of an open and collaborative approach to issues of archiving and access provision.

The normalization of TEX (the default standard markup language for mathematical notation) is seen as key to the success of EMANI, and Goettingen is taking the lead on this. Springer has promised to normalize TEX for all its publications according to library specifications. There is also an interest in the development of MathML as an alternative.

Zentralblatt MATH and EMIS Mirror Sites

Cornell University Library provides one of nine international mirrors for the online Zentralblatt MATH database (euclid.library.cornell.edu). Zentralblatt publishes abstracts and reviews of the international mathematics literature drawn from more than 2,300 serials and journals, going back as far as 1931. The Ithaca site is not electronically synchronized with the main site; instead, Zentralblatt's policy is to send updates in the form of CDs, which are loaded manually at CUL. Consequently, coverage at the mirrors is frequently one issue behind the main site.

CUL also mirrors the European Mathematical Society's EMIS (European Mathematical Information Service) site. The EMIS mirror (emis.library.cornell.edu) provides outside links to several mathematics databases and stores the content of 62 mathematics journals. Annual user hits to the EMIS mirror number in the thousands. Unlike Zentralblatt, the EMIS mirror is updated "live."

Mathematics Education

Cornell/Schools Mathematics Resource Program

The Cornell/Schools Mathematics Resource Program was initiated in 1985 by Cornell's Committee on Education and the Community. Developed and facilitated by David Henderson and Avery Solomon, it has received continued funding and support from Cornell.

The CSMRP is aimed at improving the state of mathematics teaching and learning by providing in-service mathematics courses and workshops for teachers, researching and developing materials for the classroom that follow a broader approach to mathematics, and initiating and supporting cooperative efforts between Cornell University and local schools.

The focus of the Saturday workshops during 2001–2002 has been to present teachers with new areas of research that show how the mathematics we teach in schools is being explored and applied. Among those making presentations were John Hubbard, Lawren Smithline, David Henderson and Daina Taimina of Cornell.

The CSMRP also initiated an NSF proposal to form a five-year partnership with local schools to help them to solve several problems in curriculum, new testing requirements, and at-risk students.

Cornell Teacher Education

Sponsored jointly by the departments of Mathematics and Education, this five-year program seeks to recruit and prepare students to become secondary mathematics teachers, allowing participants to attain a Master of

Arts in Teaching and New York State certification. This year we sought to improve student and faculty awareness of the program, through discussions with several other university departments, preparation and dissemination of informational materials, and open forums for interested students. With the creation of a new position in Mathematics Education in the Education department and active interest among several members of the Mathematics Department, we hope Cornell will soon be able to assume a leadership role in addressing the critical national need for mathematics teachers.

Mathematics Department Endowments

The department is thankful to alumni, friends and family who support the department endowments. Without their generosity, we would be unable to provide many of the offerings that make our department unique.

The **Cornell University Department of Mathematics Award** is presented to an Ithaca High School student who has excelled in mathematics and who has demonstrated originality and innovative power in mathematics. The recipient of this award is selected by interviews with members of the Department of Mathematics.

We have recently instituted new departmental teaching awards for graduate students and faculty. We would like to endow the **Teaching Award for Graduate Students** so that a generous prize can accompany it.

The **Colloquium Endowment Fund** was instituted to invite distinguished scientists to speak at Cornell. Earnings from this endowment are used to pay for honoraria and travel expenses for guest lecturers who speak at the Oliver Club seminars during the academic year. The Oliver Club was founded (as the Mathematical Club of Cornell University) in January 1891 by James E. Oliver, who was then chair of the department.

The **Eleanor Norton York Endowment** was established in honor of Eleanor Norton York, with the intent of recognizing outstanding graduate students in both Astronomy and Mathematics. The income from this endowment is used to provide annual prizes to a continuing graduate student at Cornell.

The **Faculty Book Endowment** is dedicated to providing the Cornell community with immediate access to one of the world's finest collections of mathematics books and publications.

The **Israel Berstein Memorial Fund** was established in honor of Israel Berstein, who was a professor in this department from 1962 through 1991. The memorial fund has as its central purpose helping young mathematicians in the field of topology. An award has been established for an outstanding graduate student in topology or neighboring areas.

The **Logic Endowment** was established as the direct result of a very generous gift from a former Cornell undergraduate. This endowment seeks to actively support promising logic students in the areas of institutional memberships and travel expenses to the Association for Symbolic Logic meetings and events, as well as other activities in the field of logic.

The **Robert John Battig Endowment** was established by his parents in December 1997, after the untimely death of Robert Battig, a graduate student in mathematics. The current purpose of this fund is to provide an annual prize to an outstanding continuing graduate student in Mathematics at Cornell.

Degrees Granted 2001–2002

Doctoral Degrees

August 2001

David Anthony Brown

Using Spider Theory to Explore Parameter Spaces

MS Special, Cornell University, 1999
BS, Ithaca College, 1995
Committee: Hubbard, Earle, Smillie
First Position: assistant professor, Ithaca College

Abstract: For a fixed integer $d \geq 2$, consider the family of polynomials $P_{d,\lambda}(z) = \lambda(1 + z/d)^d$, where λ is a complex parameter. In this work, we study the location of parameters λ for which $P_{d,\lambda}$ has an attracting cycle of a given length, multiplier, and combinatorial type.

Two main tools are used in determining an algorithm for finding these parameters: the well-established theories of external rays in the dynamical and parameter planes and Teichmüller theory. External rays are used to specify hyperbolic components in parameter space of the polynomials and study the combinatorics of the attracting cycle. A properly normalized space of univalent mappings is then employed to determine a linearizing neighborhood of the attracting cycle.

Since the image of a univalent mapping completely determines the mapping, we visualize these maps concretely on the Riemann sphere; with discs for feet and curves as legs connected at infinity, these maps conjure a picture of fat-footed spiders. Isotopy classes of these spiders form a Teichmüller space, and the tools found in Teichmüller theory prove useful in understanding the *Spider Space*. By defining a contracting holomorphic mapping on this spider space, we can iterate this mapping to a fixed point in Teichmüller space which in turn determines the parameter we seek.

Finally, we extend the results about these polynomial families to the exponential family $E_\lambda(z) = \lambda e^z$. Here, we are able to constructively prove the existence and location of hyperbolic components in the parameter space of E_λ.

Kathryn Louise Nyman

Enumeration in Geometric Lattices and the Symmetric Group

MS Special, Cornell University, 1998
BS, Carthage College, 1995
Committee: Billera, Stillman, Renegar
First Position: postdoctoral position, Texas A&M University

Abstract: This work primarily deals with questions relating to the enumeration of chains in geometric lattices. The study of geometric lattices arose in the process of characterizing the lattices of subspaces formed by a finite set of points in projective or affine space, and ordered by inclusion. More generally geometric lattices encode the structure of matroids (or combinatorial geometries), which take an axiomatic approach to the concept of dependence.

The flag Whitney numbers of a geometric lattice count the number of chains of the lattice with elements having specified ranks. We are interested in the linear inequalities satisfied by the flag Whitney numbers.

We present a lower bond on the flag Whitney numbers of a lattice in terms of its rank and number of atoms. We also show that all flag Whitney numbers are simultaneously minimized by the lattice corresponding to the near pencil arrangement of points in $\mathbb{R}^n$. Next we focus on rank 3 geometric lattices and give a collection of inequalities which imply all the linear inequalities satisfied by the flag Whitney numbers of rank 3 geometric lattices. We further describe the smallest closed convex set containing the flag Whitney numbers of rank 3 lattices corresponding to oriented matroids.

The *ab*-index is a polynomial associated to a lattice which contains all of the information regarding the flag Whitney numbers. We give a recurrence relation for the *ab*-index of families of lattices satisfying a particular set of conditions. We also give a collection of inequalities for the *ab*-index of geometric lattices.

Finally, we turn our attention to the group algebra of the symmetric group. The peak set of a permutation σ is the set $\{i : \sigma(i-1) < \sigma(i) > \sigma(i+1)\}$. We prove the existence of a subalgebra of Solomon's descent algebra in which elements are sums of permutations that share a common peak set.

May 2002

Sarah Agnes Spence

Subspace Subcodes and Generalized Coset Codes

MS Special, Cornell University, 2000
BS, University of Richmond, 1997
Committee: Kozen, Wicker, Billera
First Position: assistant professor, Franklin W. Olin College of Engineering

Abstract: This dissertation considers codes that are formed using certain subsets of algebraic error-control codes and signal space codes. We first consider subspace subcodes of Reed-Solomon (SSRS) codes. We prove a conjecture of Hattori concerning how to identify subspaces that give an SSRS code whose dimension exceeds a certain lower bound.

We next consider generalized coset codes, which are built using partitions of signal space codes. We extend the concepts of generalized coset codes in Euclidean space by defining generalized coset codes in Lee space. We prove that all linear codes over $\mathbb{Z}_m$ are realizable as these new Lee-generalized coset codes. This implies that linear codes over $\mathbb{Z}_m$ have desirable symmetry properties. We also discuss some relationships among integer lattices, linear codes over $\mathbb{Z}_4$, and generalized coset codes.

Master of Science Special

(No Thesis Required)

August 2001

Samuel Hsiao, Mathematics
BS, Haverford College, 1995
Committee: Billera, Stillman, K. Brown

January 2002

Christopher A. Francisco, Mathematics
BS, University of Illinois at Urbana-Champaign, 1999
Committee: Stillman, Billera, K. Brown

Dmitriy A. Leykekhman, Mathematics
BA, New York University, 1998
Committee: Wahlbin, Schatz, Vavasis

Rajmohan Rajagopalan, Computer Science
BA, Oberlin College, 1998
Committee: Shore, Kleinberg, Nerode, Kozen

Russell S. Woodroofe, Mathematics
BS, University of Michigan, 1998
Committee: K. Brown, Dennis, Billera

May 2002

James M. Belk, Mathematics
BS, Binghamton University, 1998
Committee: K. Brown, Cohen, Saloff-Coste

Lee R. Gibson, Mathematics
BS, University of Louisville, 1999
Committee: Saloff-Coste, Durrett, K. Brown, Lawler

Todd A. Kemp, Mathematics
BS, University of Calgary (Canada), 2000
Committee: L. Gross, Saloff-Coste, Sjamaar

Rajmohan Rajagopalan, Mathematics
BA, Oberlin College, 1998
Committee: Shore, Kleinberg, Nerode, Kozen

Gil Rosenberg, Mathematics
BA, Swarthmore College, 2000
Committee: J. West, Sen, Speh

Timothy A. Roughgarden, Mathematics
BS, Stanford University, 1997
Committee: Tardos, Kleinberg, Shmoys, Billera

Rebecca Schuller, Mathematics and Computer Science
BA, Grinnell College, 1998
Committee: Nerode, Hartmanis, Caruana

Maria T. Sloughter, Mathematics
BA, Carleton College, 1999
Committee: Connelly, Billera, Stillman

Bachelor of Arts

August 2001
Christopher Michael Snyder

January 2002
Anna Allegra Angus †
Ziv Feldman †
Scott Matthew Kramer †
Christopher Ré
Michael Anthony Savalli
Jennifer Marie Zimmer

May 2002
Ryan Shay Babcock †
Scott Michael Bailey †
Magna Cum Laude in Mathematics
Jordan Michael Barry †
Cum Laude in Mathematics
Magna Cum Laude in Economics
Ari Zev Blinder †
Cum Laude in Mathematics
James Chen
Tingting Chen
P. Devin Corr
Melissa Chatanay DiBella
Jason Flannick †
Cum Laude in Mathematics
Summa Cum Laude in Physics
Han Pin Goh †
Cum Laude in Mathematics
Summa Cum Laude in Physics
Debbie Sara Grier †
Cum Laude in Mathematics
Paul Ezra Katz
Justin Block Kinney
Magna Cum Laude in Mathematics
Summa Cum Laude in Physics
Supap Kirtsaeng †
Cum Laude in Mathematics
Vince Lee
Justin Ryan Matis
William John Meakem
Douglas Christopher Mitarotonda †
Cum Laude in Asian Studies
Lauren A. Moskowitz †
Akshay Murthy †
Summa Cum Laude in Economics
Hui Khoon Ng †
Magna Cum Laude in Mathematics
Summa Cum Laude in Physics
Timofei Piatenko
Daniel Alexander Ramras †
Kieval Prize in Mathematics
Summa Cum Laude in Mathematics
Scott Michael Selikoff
Daniel Simone †
Scott Alexander Smith †
Magna Cum Laude in Mathematics
Jay Alexander Sorenson
Julie Ann Staub
Michael Andrew Suppe
Benjamin Haber Szekely †
Cum Laude in Mathematics
Joon Leng Tan
Linda Tieu
Raciel Valle †
Magna Cum Laude in Mathematics
Samuel Joseph Wald
Brian Zhong-Hua Wong
Janet Suzie Yoon †
Homa Shaghaghi Zarghamee †

† **Distinction in all subjects**

Department Colloquia

Analysis Seminar

September 2001

Matthew Fickus, Cornell University: *Finite normalized tight frames*

Martin Dindoš, Cornell University: *Hardy spaces and potential theory on C^1 domains*

Irina Mitrea, Cornell University: *The Dirichlet problem for the Laplacian on rough domains*

Laurent Saloff-Coste, Cornell University: *Hypoellipticity in infinite dimension*

October 2001

Brian Smith, Cornell University: *On the connectedness of the space of initial data for the Einstein equations*

Robert Strichartz, Cornell University: *Analysis on fractals (some new results)*

Zhongmin Qian, CNRS (France) and Cornell University: *Curvature-dimension inequality and the heat equation*

José F. Escobar, Cornell University: *New results on conformal deformation of metrics*

November 2001

Yulij Ilyashenko and Vadims Moldavskis, Cornell University: *Rotation numbers and moduli of elliptic curves: good and bad news about an Arnold's conjecture*

Marius Mitrea, University of Missouri at Columbia: *Smoothness spaces and elliptic PDEs in nonsmooth domains*

Robert Strichartz, Cornell University: *p-energy and p-harmonic functions on the Sierpinski gasket*

December 2001

Alexander Kiselev, University of Chicago: *Enhancement and quenching of combustion by fluid flow*

Martin Grothaus, Cornell University: *Reverse hypercontractivity for subharmonic functions*

January 2002

Natasa Pavlovic, University of Illinois at Chicago: *A cheap Caffarelli-Kohn-Nirenberg inequality for the Navier-Stokes equations with hyper-dissipation*

Craig Sutton, Dartmouth College: *Constructing simply-connected isospectral Riemannian manifolds via Sunada's method*

February 2002

Alexander Bendikov, Cornell University: *Ultracontractivity of semigroups obtained by subordination*

Zhongmin Qian, CNRS (France) and Cornell University: *Extremal metric, unitary group and holomorphic Dirichlet form*

John Hubbard, Cornell University: *The Farey basis of Sobolev H^1*

Clifford Earle, Cornell University: *The world's greatest Schwarz-Pick metric*

March 2002

Florin Catrina, Rochester University: *Weighted elliptic equations with critical Sobolev exponents*

Irina Mitrea, Cornell University: *Boundedness criteria for singular integral operators of Calderon-Zygmund type*

April 2002

Martin Dindoš, Cornell University: *Stationary Navier-Stokes equation on Lipschitz domains*

Guozhen Lu, Wayne State University: *Convex functions on the Heisenberg and stratified groups*

Allan Greenleaf, Rochester University: *Uniqueness in the Calderón problem for conormal potentials and conductivities*

Tadeusz Iwaniec, Syracuse University: *Smooth approximation and the degree formula for mappings between manifolds*

Combinatorial and Algebraic Geometry Seminar

September 2001

Stephanie van Willigenburg, Cornell University: *Pieri operators and Eulerian enumeration*

John Hubbard, Cornell University: *Resolving the singularities of Hilbert modular surfaces: a dynamical point of view*

Sara Billey, MIT: *A root system description of pattern avoidance with applications to G/B*

October 2001

Ezra Miller, MIT: *Determinantal ideals and the combinatorics of Schubert polynomials*

Eva-Maria Feichtner, ETH Zürich (Switzerland): *Incidence combinatorics of resolutions*

Louis Billera, Cornell University: *Quasisymmetric functions, Hopf duality and Eulerian enumeration*

Frank Sottile, University of Massachusetts at Amherst: *Common transversals and tangents in P^3*

November 2001

Geanina Tudose, York University (Canada): *On the combinatorics of the Verlinde algebra*

Oleg Chalykh, Moscow State University (Russia) and Cornell University: *Macdonald polynomials and a new proof of the Macdonald conjectures*

Marcelo Aguiar, Texas A&M University: *Loday's types of algebras and Rota's types of operators*

December 2001

Swapneel Mahajan, Cornell University: *On the Hopf algebra of permutations of Malvenuto and Reutenauer*

January 2002

Christopher Francisco, Cornell University: *Some conjectures on lex-plus-powers ideals*

February 2002

Harrison Tsai, Cornell University: *Baum-Sell algorithm for maximizing polynomials*

Edward Swartz, Cornell University: *101 uses for a broken circuit* (in two parts)

March 2002

Weiqiang Wang, University of Virginia and MSRI: *Hilbert schemes and wreath products: a comparison*

Lawren Smithline, Cornell University: *Compact operators with rational generating functions*

April 2002

Steve Sinnott, Cornell University: *Factoring ordinary differential operators with Laurent polynomial coefficients*

Swapneel Mahajan, Cornell University: *Operads + Hopf algebras + Coxeter groups ?*

Discrete Geometry and Graph Theory Seminar

September 2001

Andrei Raigorodskii, University of Moscow (Russia): *Measuring the difference between bases of Z^n*

Konstantin Rybnikov, Cornell University: *Delaunay tilings and Dirichlet-Voronoi polytopes of lattices*

Franco Saliola, Cornell University: *Forbidden minors*

Franco Saliola, Cornell University: *The Colin de Verdière graph invariant*

October 2001

Maria Sloughter, Cornell University: *Polytopes and the Colin de Verdière number*

Sue Whitesides, McGill University (Canada) and Cornell University: *Fixed parameter tractability results for crossing minimization problems in layered graphs* (in two parts)

November 2001

Robert Connelly, Cornell University: *The Kneser-Pousen conjecture: an update*

David Benbennick, Cornell University: *Unfolding convex polytopes* (in two parts)

John Hubbard, Cornell University: *Andreev's theorem: is it true?*

February 2002

Konstantin Rybnikov, Cornell University: *Abelian gain graphs and their application in discrete geometry*

April 2002

Walter Whiteley, York University (Canada): *Inductive techniques for plane frameworks*

Daniel Dix, University of South Carolina: *Discrete structures for biomolecular geometry*

Tom Zaslavsky, SUNY at Binghamton: *Semi-unique representation of a cute kind of matroid*

Ileana Streinu, Smith College: *On the number of embeddings of minimally rigid graphs*

May 2002

Jason Cantarella, University of Georgia: *Rope length critical curves -or- on a kind of continuous tensegrity theory*

Dynamics and Geometry Seminar

September 2001

John Hubbard, Cornell University: *Escalle-Voronin invariants in 1 and 2 dimensions* (in two parts)

October 2001

Michael Coleman, Cornell University: *A stable walking toy that cannot stand still*

Vadim Kaloshin, MIT: *Dynamics of the oil spill*

Roland Roeder, Cornell University: *Hamiltonian mechanics of a tokamak's magnetic field*

Ricardo Oliva, Cornell University: *Overview of some aspects of complex dynamics*

November 2001

Yulij Ilyashenko, Cornell University: *Restricted versions of Hilbert's 16th problem*

December 2001
Alexander B. Vladimirsky, Cornell University: *Anisotropy in front propagation and control theory*

January 2002
Sebastian Wieczorek, Vrije Universiteit (Netherlands): *Nonlinear dynamics and bifurcations of an optically injected semiconductor laser* (in two parts)

February 2002
Nikola Petrov, University of Texas at Austin: *Regularity of conjugacies between critical circle maps: numerical results*

March 2002
John Hubbard, Cornell University: *How to find all roots of complex polynomials by Newton's method*

April 2002
Sylvain Bonnot, Cornell University and Université de Marseille (France): *A proof of Jakobson's theorem* (in two parts)

Group Theory Seminar

September 2001
R. Keith Dennis, Cornell University: *Commutators, characters and the Casimir element* (in three parts)

October 2001
Laurent Saloff-Coste, Cornell University: *Random walks on finite groups*

November 2001
Gerhard Michler, University of Essen (Germany): *The Brauer-Fowler theorem and the existence and uniqueness of the sporadic simple groups*
Kenneth Brown, Cornell University: *The coset poset*
Russ Woodroofe, Cornell University: *Shellings and the coset poset*

Lie Groups Seminar

September 2001
Milen Yakimov, Cornell University: *Symplectic leaves in complex reductive Poisson-Lie groups*
Tom Graber, Harvard University: *Rational points of curves over function fields*

October 2001
Eckhart Meinrenken, University of Toronto (Canada): *The Duflo homomorphism for subalgebras*
Paula Cohen, Lille University (France): *On special points and some hyperbolic distribution problems*
Yuri Berest, Cornell University: *Cherednik algebras and differential operators on quasi-invariants*
Oleg Chalykh, Moscow State University (Russia) and Cornell University: *Schroedinger operators with trivial local monodromy and deformed root systems*

November 2001
Catherine O'Neil, MIT: *Moduli of 'n-prepared' genus one curves (with no points)*
Ludmil Katzarkov, University of California at Irvine: *Symplectic geometry and quivers*
Birgit Speh, Cornell University: *On the Arthur Selberg trace formula*

December 2001
Michael Thaddeus, Columbia University: *Mirror symmetry and Higgs bundles*

January 2002
Tara Holm, MIT: *A hint at differential topology on graphs*

February 2002
Laurent Saloff-Coste, Cornell University: *Analysis on high dimensional compact Lie groups*
Farkhod Eshmatov, Cornell University: *Projective modules over Dixmier algebras and quiver varieties*
Milen Yakimov, Cornell University: *Poisson Lie groups via symplectic (Marsden-Weinstein) reduction*

March 2002
Alex Feingold, SUNY at Binghamton: *Perspectives on vertex operator algebra*
Jacques Hurtubise, McGill University (Canada): *Elliptic Sklyanin integrable systems*
Stephen Bullock, University of Michigan: *Bueler's conjecture and inadmissible weights*

April 2002
Swapneel Mahajan, Cornell University: *Deformation quantization for operads*
Charles Dunkl, University of Virginia: *Nonsymmetric Jack polynomials, commuting self-adjoint operators and norm evaluations*
Dan Barbasch, Cornell University: *Hecke algebras and the Plancherel theorem*

Logic Seminar

September 2001

Michael Morley, Cornell University: *Infinitary formulas*

Noam Greenberg, Cornell University: *Precipitous and saturated ideals*

Joseph Miller, Cornell University: *Computable infinitary formulas*

Yuval Gabay, Cornell University: *Barwise compactness*

Noam Greenberg, Cornell University: *Sharps and projective ordinals* (in two parts)

Joseph Miller, Cornell University: *Hyperarithmetic sets of formulas*

October 2001

Russell Miller, Cornell University: *Some automorphisms of the lattice of c.e. sets*

Yuval Gabay, Cornell University: *Applications of barwise compactness*

Julia Knight, Notre Dame University: *Complicated relations in computable structures*

Julia Knight, Notre Dame University: *n-diagrams*

Christopher Hardin, Cornell University: *Computable linear orderings* (in two parts)

Richard Shore, Cornell University: *Invariants, reverse mathematics and Boolean algebras* (in two parts)

Christopher Hardin, Cornell University: *Computable Boolean algebras*

November 2001

Antonio Montalban, Cornell University: *Completeness and forcing* (in three parts)

Noam Greenberg, Cornell University: *A measurable and saturation imply Not CH, effectively* (in three parts)

Shai Ben-David, Technion (Israel): *On the inability to resolve the P versus NP question*

Vivian Morley, Cornell University: *The Ash-Nerode theorem* (in two parts)

December 2001

Andre Nies, University of Aukland (New Zealand): *Randomness and lowness properties of sets*

February 2002

Russell Miller, Cornell University: *Introduction to O-minimal theory* (in four parts)

Noam Greenberg, Cornell University: *Stationary towers* (in five parts)

March 2002

Vivian Morley, Cornell University: *Semi-analytic sets*

Vivian Morley, Cornell University: *Subanalytic sets* (in two parts)

Noam Greenberg, Cornell University: *Measurability and inaccessability*

Christopher Hardin, Cornell University: *Barendregt on combinatory logics and algebras*

April 2002

Russell Miller, Cornell University: *Ritt's algorithm for systems of algebraic differential equations* (in two parts)

Christopher Hardin, Cornell University: *Combinatory logic according to Barendregt* (in two parts)

Russell Miller, Cornell University: *Ritt's algorithm for arbitrary systems of algebraic PDEs*

Antonio Montalban, Cornell University: *Model theory of differential algebra* (in two parts)

May 2002

Sergey Slavnov, Cornell University: *Multiplicative linear logic and symplectic manifolds*

Oliver Club

September 2001

Andrei M. Raigorodskii, Moscow State University (Russia): *On the Borsuk partition problem*

Warwick Tucker, Cornell University: *Using a computer to do rigorous mathematics*

Tom Graber, Harvard University: *Rationally connected varieties*

October 2001

Victor Palamodov, Tel Aviv University (Israel): *Inverse problems and Gabor analysis*

Alexey Glutsyuk, Ecole Normale Supérieure de Lyon (France): *Simultaneous uniformization*

Milen Yakimov, Cornell University: *Geometry of Poisson-Lie groups and representation theory of Hopf algebras*

Askold Khovanskii, University of Toronto (Canada): *Parshin's symbols, toric geometry and product of the roots of a system of equations*

November 2001

James Yorke, University of Maryland: *Plato's problem: can we understand reality when seeing only shadowy images*

Ludmil Katzarkov, University of California at Irvine: *New examples of non-Kühler homotopy types*

Alexei Sossinski, Independent University of Moscow (Russia): *Could the Poincare conjecture be false?*
Sorin Popescu, SUNY at Stony Brook: *Geometry and algebra of modular varieties*

December 2001
Michael Thaddeus, Columbia University: *Mirror symmetry and Langlands duality*

January 2002
Peter Ozsvath, Princeton University: *Holomorphic disks and low-dimensional topology*
Sue Whitesides, McGill University (Canada) and Cornell University: *Recent themes in algorithmic graph theory*

February 2002
Gregory Lawler, Cornell University: *Conformally invariant measures*
Bruce Kleiner, University of Michigan: *Quasiconformal geometry in metric spaces*
Stephanie van Willigenburg, Cornell University: *The algebra of card shuffling*
Yves Le Jan, Université Paris Sud (France): *Brownian flows*

March 2002
Jacques Hurtubise, McGill University (Canada): *Integrable systems and surfaces*
Irina Mitrea, Cornell University: *On the spectral radius conjecture in two dimensions*
Sigurdur Helgason, MIT: *Eigenspace representations*

April 2002
Morris Hirsch, University of California at Berkeley: *Solvable Lie group actions on surfaces*
Daniel Dix, University of South Carolina: *Protein folding from a dynamical systems viewpoint*
Charles Dunkl, University of Virginia: *Complex reflection groups and nonsymmetric Jack polynomials*
Shuguang Wang, University of Missouri at Columbia: *Gauge theory and real structures*

May 2002
Dusa McDuff, SUNY at Stony Brook: *The topology of groups of symplectomorphisms*

Olivetti Club

September 2001
Sam Hsiao, Cornell University: *The upper bound conjecture and the importance of being Cohen-Macauley*
G. Christopher Hruska, Cornell University: *Hyperbolic groups and their boundaries*
Noam Greenberg, Cornell University: *The constructible universe and the continuum hypothesis*

October 2001
Sarah Spence, Cornell University: *Generalized coset codes and lattices*
Kristin Camenga, Cornell University: *Ramsey theory on graphs and hypergraphs*
Nelia Charalambous, Cornell University: *A classification of three-dimensional noncompact manifolds with nonnegative curvature*
Ryan Budney, Cornell University: *Symmetry in topology*

November 2001
Leah Gold, Cornell University: *The number of lines on a nonsingular cubic surface*
Fernando Schwartz, Cornell University: *Soap bubbles*
Steve Morris, Cornell University: *J-holomorphic curves and bubbling in symplectic topology*
Suzanne Hruska, Cornell University: *A tour of the Mandelbrot set*

December 2001
Todd Kemp, Cornell University: *Integrals and derivatives*

January 2002
Joseph Miller, Cornell University: *Computable analysis: Brouwer's theorem and fixable sets*
David Revelle, Cornell University: *There ain't no way to measure that there table!*

February 2002
Jason Martin, Cornell University: *An algebraic version of Dynkin's $\pi - \lambda$ theorem*
James Belk, Cornell University: *Amenability and the Banach-Tarski paradox*
Lee Gibson, Cornell University: *The rabbit in the woods, or the method of enlargement of obstacles*

March 2002
G. Christopher Hruska, Cornell University: *Isolated flats, or nearly hyperbolic spaces*
Serguei Slavnov, Cornell University: *Between logic and mathematics*
Treven Wall, Cornell University: *A survey of some good elliptic curve cryptosystems, -or- Wow, algebra really can be useful!*

April 2002

Todd Kemp, Cornell University: *Vector fields on spheres: an analytic approach*

Alan Demlow, Cornell University: *Localization in finite element methods, -or- How local can you go?*

Will Gryc, Cornell University: *Wavelets and multiresolution analysis*

Fernando Schwartz, Cornell University: *The Riemannian Penrose conjecture and some other cool stuff from general relativity*

Gil Rosenberg, Cornell University: *Frege structures: balancing the axiom of abstraction with the rules of logic*

Probability Seminar

September 2001

Jason Schweinsberg, Cornell University: *Applications of the continuous-time ballot theorem to Brownian excursions and fragmentation processes*

Richard Durrett, Cornell University: *Rigorous results for the NK model*

Jeremy Staum, Cornell University: *Importance sampling with non-equivalent measures*

October 2001

Jan Hannig, Colorado State University: *Integrated Brownian motions and exact L_2-small balls*

Vadim Kaloshin, MIT: *Dynamics of the oil spill*

David Revelle, Cornell University: *Heat kernel asymptotics on the lamplighter group*

November 2001

Alexander Bendikov, Cornell University: *The dichotomy problem for Gaussian measures on groups*

Philip Protter, Cornell University: *Complete financial markets with hidden arbitrage*

Vlada Limic, Cornell University: *A threshold routing queueing system in heavy traffic*

Arnaud de la Pradelle, University of Paris VI (France): *The Ito-Skorohod formula for fractional Brownian motion*

December 2001

Shane Henderson, Cornell University: *Nonexistence of a class of random variable generation schemes*

Akira Saskai, University of British Columbia (Canada): *Mean-field critical behavior for the contact process*

January 2002

Pierre Tarres, École Polytechnique Fédérale de Lausanne (Switzerland): *Reinforced random walks*

February 2002

Richard Durrett, Cornell University: *Shuffling chromosomes*

Philip Protter, Cornell University: *Pricing American options with the Longstaff Schwartz algorithm*

Zhongmin Qian, CNRS (France) and Cornell University: *Stochastic calculus for some Gaussian processes*

March 2002

Gregory Lawler, Cornell University: *The scaling limit of loop-erased walk on the square lattice*

Thomas Mikosch, University of Copenhagen (Denmark): *Some estimation problems for GARCH models*

Gena Samorodnitsky, Cornell University: *Tails of solutions of certain nonlinear stochastic differential equations driven by heavy tailed Lévy motions*

April 2002

Esa Nummelin, University of Helsinki (Finland): *Large deviations of price equilibria of random economic systems*

Lee Gibson, Cornell University: *The method of enlargement of obstacles*

Dan Stroock, MIT: *Differential geometry of the space of probability measures*

David Revelle, Cornell University: *Rate of escape of random walks on groups*

Sylvie Méléard, Université Paris X (France): *Convergence from Boltzmann to Landau processes with soft potential and particle approximations*

Smorgasbord Seminar (MATH 402)

September 2001

Laurent Saloff-Coste, Cornell University: *Shuffling cards and random walks on finite groups*

Ravi Ramakrishna, Cornell University: *A geometric proof of the 4 squares theorem*

Richard Durrett, Cornell University: *Evolution on random landscapes*

Russell Miller, Cornell University: *Noncomputable sets and unsolvable problems*

October 2001

Edward Swartz, Cornell University: *Introduction to matroids*

Konstantin Rybnikov, Cornell University: *Perfect lattices and perfect ellipsoids*

John Guckenheimer, Cornell University: *The forced van der Pol equation*

Robert Strichartz, Cornell University: *Scales that specify the smoothness of functions*

November 2001

Clifford Earle, Cornell University: *How to build a Riemann surface*

James Conant, Cornell University: *Euler's formula and regular polyhedra*

José F. Escobar, Cornell University: *Introduction to the calculus of variations*

Yulij Ilyashenko, Cornell University: *Bifurcations and systems with different time scales*

December 2001

Michael Stillman, Cornell University: *Computing in algebraic geometry*

Topology and Geometric Group Theory Seminar

September 2001

Kai-Uwe Bux, Cornell University: *Finiteness properties of Korelli groups*

Ferenc Gerlits, Cornell University: *Counting graphs with combinatorial species and Feynmann rules*

G. Christopher Hruska, Cornell University: *The relative hyperbolicity of groups with isolated flats*

October 2001

Arthur Bartels, University of Muenster (Germany): *Groups of finite asymptotic dimension and algebraic K-theory*

G. Christopher Hruska, Cornell University: *The relative hyperbolicity of groups with isolated flats*

Dmitri Kozlov, KTH Stockholm (Sweden) and the University of Bern (Switzerland): *Combinatorics of resonances*

Sue Whitesides, McGill University (Canada) and Cornell University: *Embedding problems for paths and cycles with direction constrained edges*

James Conant, Cornell University: *Infinitesimal operations on graphs*

November 2001

Peter Kahn, Cornell University: *Pseudohomology and homology*

Ryan Budney, Cornell University: *Electrostatic potentials on configuration spaces: CW decompositions and compactifications*

James Conant, Cornell University: *Graph homology, configuration spaces and Vassiliev invariants*

Laura Anderson, SUNY at Binghamton: *Combinatorial construction of bundles*

December 2001

Kai-Uwe Bux, Cornell University: *Finiteness properties of Houghton braid groups*

Ryan Budney, Cornell University: *Representations of mapping class groups*

January 2002

Peter Ozsvath, Princeton University: *Holomorphic disks and invariants of low-dimensional manifolds*

February 2002

Ryan Budney, Cornell University: *The Lawrence-Krammer representation is unitary*

Bruce Kleiner, University of Michigan: *Euclidean laminations in 3-manifolds*

Martin Bridson, Imperial College, Oxford (England): *Curvature and decision processes*

David Benbennick, Cornell University: *Algorithms in knot theory*

March 2002

Matthew Horak, Cornell University: *Ribbon graph subcomplexes of outer space*

Dev Sinha, University of Oregon and Brown University: *New perspectives on (self-)linking*

Allen Hatcher, Cornell University: *Topological moduli spaces for knots*

April 2002

Dan Ramras, Cornell University: *Connectivity of the coset poset*

Marshall Cohen, Cornell University: *The Freiheitsatz*

Tobias Ekholm, Uppsala University (Sweden): *Embeddedness of minimal surfaces of total boundary curvature less than 4π*

Tadeusz Januszkiewicz, SUNY at Binghamton: *Equivariant cohomology of buildings*

John Hubbard, Cornell University: *A proof of Thurston's hyperbolization theorem for 3-manifolds which fiber over the circle*

G. Christopher Hruska, Cornell University: *Convergence groups and isolated flats*

May 2002

Thang Le, SUNY at Buffalo: *On quantum and finite type invariants of integral homology 3-spheres*

Undergraduate Mathematics Club

September 2001

John Hubbard, Cornell University: *Newton's method as an approach to differential calculus*

October 2001

Scott Bailey, Cornell University: *The Jacobian of a graph*

Daniel Ramras, Cornell University: *Algebra and combinatorial topology*

S. Alex Smith, Cornell University: *Harmonic structures on fractals*

Edward Swartz, Cornell University: *Embedding graphs in surfaces*

November 2001

Birgit Speh, Cornell University: *Why I like Lie groups*

December 2001

Warwick Tucker, Cornell University: *An introduction to interval arithmetic*

January 2002

Robert Strichartz, John Guckenheimer and John Hubbard, Cornell University: *Research Experiences for Undergraduates information session*

February 2002

Sarah Spence, Cornell University: *Coding theory and cryptography: putting mathematics to work!*

March 2002

Richard Durrett, Cornell University: *Shuffling chromosomes*

April 2002

Eva Tardos, Cornell University: *Games on networks*

Walter Whiteley, York University (Canada): *To see like a mathematician*

Jordan Ellenberg, Princeton University: *The mathematics of 'Set' -or- Everything I know about Fourier analysis I learned from playing cards*

VIGRE Interdisciplinary Colloquium

In connection with the department's VIGRE grant, this monthly colloquium is held with the purpose of introducing graduate students and professors in the department to some of the possible applications of mathematics, by inviting faculty from other departments at Cornell to give talks. Since the idea of the talk is to expose the audience to research possibilities, speakers are asked to talk about something that has not yet reached a definitive final form and to indicate open problems.

September 2001

Robert Jarrow, Cornell University (Johnson School of Management): *Second generation Heath-Jarrow-Morton term structure models*

October 2001

Ron Elber, Cornell University (Computer Science): *The design and application of folding potentials*

Carlos Castillo-Chavez, Cornell University (Biometrics and T&AM): *Questions and challenges posed by the transmission dynamics of tuberculosis*

November 2001

Richard Guy, University of Calgary (Canada): *Unsolved problems in combinatorial games*

Richard Rand, Cornell University (T&AM): *Recent advances in parametric excitation*

December 2001

Viet Elser, Cornell University (Physics): *Dynamical systems approach to phase retrieval*

2001–2002 Faculty Publications

Yuri Berest and George Wilson, *Ideal classes of the Weyl algebra and noncommutative projective geometry* (with G. Wilson), IMRN **26** (2002), 1347–1397.

Louis Billera, Susan Holmes and **Karen Vogtmann**, *Geometry of the space of phylogenetic trees*, Advances in Applied Mathematics **27** (2001), 733–767.

Louis Billera and Persi Diaconis, *A geometric interpretation of the Metropolis-Hastings algorithm*, Statistical Science **16** (2001), 335–339.

Louis Billera, Sam Hsiao and Stephanie van Willigenburg, *Peak quasisymmetric functions and Eulerian enumeration*, Advances in Mathematics, to appear.

Kai-Uwe Bux, *Finiteness properties of soluble S-arithmetic groups — a survey*; in Proceedings of the conference "Groups: Geometric and Combinatorial Aspects," Bielefeld, 1999, to appear.

James Conant, *On a theorem of Goussarov*, J. Knot Theory Ramifications, to appear.

Károly Bezdek and **Robert Connelly**, *The Kneser-Poulsen conjecture in the plane*, Crelle's Journal, to appear.

Robert Connelly and N. Khamsemanan, *Unit distance preserving functions from Euclidean spaces*, Beiträge zur Algebra und Geometrie, to appear.

Robert Connelly, Konstantin Rybnikov and Stanislav Volkov, *Percolation and the loss of tension in an infinite triangular lattice*, J. Statist. Phys. **105** no. 1–2 (2001), 143–171.

Károly Bezdek, Grigoriy Blekherman, **Robert Connelly** and B. Csikus, *The polyhedral Tammes problem*, Arch. Math. (Basel) **76** no. 4 (2001), 314–320.

Martin Dindos, *Existence and uniqueness for a semilinear elliptic problem on Lipschitz domains in Riemannian manifolds*, Comm. PDE **27** (2002), 219–281.

Martin Dindos and Marius Mitrea, *Semilinear Poisson problems in Sobolev-Bessov spaces on Lipschitz domains*, Publicacions Mathematiques, to appear.

Richard Durrett and **Vlada Limic**, *On the quantity and quality of single nucleotide polymorphisms in the human genome*, Stoch. Proc. Appl. **93** (2001), 1–24.

Persi Diaconis and **Richard Durrett**, *Chutes and ladders in Markov chains*, J. Theor. Prob. **14** (2001), 899–926.

Arkendra De, **Richard Durrett**, Michael Ferguson and Suzanne Sindi, *The equilibrium distribution for a generalized Sankoff-Ferretti model accurately predicts chromosome size distributions in a wide variety of species*, J. Appl. Prob. **38** (2001), 324–334.

Chip Aquadro, Peter Calabrese and **Richard Durrett**, *Dynamics of microsatellite divergence under stepwise mutation and proportional slippage/point mutation models*, Genetics **159** (2001), 839–852.

Richard Durrett and Nancy Sundell, *Exponential distance statistics to detect the effects of population subdivision*, Theor. Pop. Biol. **60** (2001), 107–116.

Richard Durrett, *Mutual invadability implies coexistence in spatial models*, Memoirs of the AMS **156** no. 740 (2002).

K. Y. Chen, **Richard Durrett** and Steve Tanksley, *A simple formula useful for positional cloning*, Genetics **160** (2002), 353–355.

Richard Durrett, Harry Kesten and **Vlada Limic**, *Once edge-reinforced random walk on a tree*, Probab. Theory Rel. Fields, to appear.

Linda Buttel, **Richard Durrett** and Simon Levin, *Competition and species packing in patchy environments*, Theor. Pop. Biol., to appear.

Ted Cox and **Richard Durrett**, *The stepping stone model: new formulas expose old myths*, Ann. Appl. Prob., to appear.

Eugene Dynkin, *Branching exit Markov systems and superprocesses*, Annals of Probability **29** no. 4 (2001), 1833–1858.

Eugene Dynkin, *Diffusions, Superdiffusions and Partial Differential Equations*, Colloquium Publications, American Mathematical Society, 2002.

Clifford Earle and Nikola Lakic, *Variability sets on Riemann surfaces and forgetful maps between Teichmüller spaces*, Ann. Acad. Sci. Fenn. Math., to appear.

Clifford Earle, *Schwarz's lemma and Teichmüller contraction*, Contemporary Math., to appear.

Clifford Earle, Vladimir Markovic and Dragomir Saric, *Barycentric extension and the Bers embedding for asymptotic Teichmüller space*, Contemporary Math., to appear.

Clifford Earle, L. A. Harris, **John Hubbard** and Sudeb Mitra, *Schwarz's lemma and the Kobayashi and Carathéodory pseudometrics on complex Banach manifolds*; in Kleinian Groups and Hyperbolic Three-Manifolds, Cambridge University Press, to appear.

John Benedetto and **Matthew Fickus**, *Finite normalized tight frames*, Advances in Computational Mathematics, to appear.

Vesselin Gasharov, Takayuki Hibi and **Irena Peeva**, *Resolutions of a-stable ideals*, J. Algebra, to appear.

Marc Chardin, **Vesselin Gasharov** and **Irena Peeva**, *Maximal Betti numbers*, PAMS, to appear.

Vesselin Gasharov, Irena Peeva and Volkmar Welker, *Coordinate subspace arrangements and monomial ideals*, Proceedings of the Osaka Meeting on Computational Commutative Algebra and Combinatorics, Advanced Studies in Pure and Applied Mathematics, to appear.

Fernando Galaz-Fontes, **Leonard Gross** and Stephen Sontz, *Reverse hypercontractivity over manifolds*, Arkiv für Mathematik **39** (2001), 283–309.

Thomas Deck and **Leonard Gross**, *Hankel operators over complex manifolds*, Pacific J. Math., to appear.

John Guckenheimer, Kathleen Hoffman and Warren Weckesser, *Global analysis of periodic orbits in the forced van der Pol equation*; in Global Analysis of Dynamical Systems (H. Broer, B. Krauskopf and G. Vegter, eds.), IOP Press, 2001, pp. 261–276.

John Guckenheimer and **Yulij Ilyashenko**, *The duck and the devil: canards on the staircase*, Moscow Mathematical Journal **1** no. 1 (2001), 27–47.

John Guckenheimer, Review of Stephen Smale biography by Steve Batterson, Am. Math. Monthly **108** (2001), 107–109.

John Guckenheimer, *Computing periodic orbits*; in Fluid Mechanics and the Environment: Dynamical Approaches (J. Lumley, ed.), 2001, pp. 107–120.

John Guckenheimer, *Numerical analysis of dynamical systems*, Handbook of Dynamical Systems, Elsevier, 2002.

John Guckenheimer, *Bifurcation and degenerate decomposition in multiple time scale dynamical systems*; in Nonlinear Dynamics and Chaos: Where do we go from here?, IOP Press, 2002.

John Guckenheimer and Ricardo Oliva, *Chaos in the Hodgkin-Huxley model*, SIAM J. App. Dyn. Systems (2002).

Allen Hatcher, *Algebraic Topology*, Cambridge University Press, 2002.

Gabor Domokos and **Timothy Healey**, *Hidden symmetry of global solutions in twisted elastic rings*, J. Nonlinear Science **11** (2001), 47.

Timothy Healey, *Material symmetry and chirality in nonlinearly elastic rods*, Math. Mech. Solids, to appear.

Timothy Healey and Kevin MacEwen, *A simple approach to the 1:1 resonance bifurcation in follower-load problems*, Nonlinear Dynamics, to appear.

David Henderson and Daina Taimina, *Geometry* (invited signed article), Hutchinson Encyclopedia of Mathematics.

David Henderson, Review of *Geometry: Euclidean and Beyond* by Robin Hartshorne, Bull. AMS, to appear.

David Henderson, Review of *Where Does Mathematics Come From?* by Lakoff and Nunez, Mathematical Intelligencer **24** no. 1, to appear.

David Henderson, *Differential geometry* (invited signed article), Encyclopedia Britannica, to appear.

David Henderson and Daina Taimina, *Non-Euclidean geometry* (invited signed article), Encyclopedia Britannica, to appear.

John Hubbard, Dierk Schleicher and Scott Sutherland, *How to really find roots of polynomials by Newton's method*, Inventiones Mathematicae **146** (2001), 1–33.

Xavier Buff, Christian Henriksen and **John Hubbard**, *Farey curves*, J. Exper. Math. **10** no. 4 (2001).

John Hubbard and Ralph Oberste-Vorth, *Linked solenoid mappings and the non-transversality locus invariant*, Indiana Math. J. **50** no. 1 (2001).

John Hubbard, *A first look at differential Galois theory*, Gazette de la Société Mathématique de France, to appear.

John Hubbard and Karl Papadantonakis, *Exploring the parameter space for Hénon mappings*, Experimental Mathematics, to appear.

John Hubbard, *A proof of Kolmogorov's theorem on the conservation of invariant tori*, Journal of Nonlinearity, to appear.

J. T. Gene Hwang and Ming Yang, *An optimality theory for mid p-values in* 2×2 *contingency tables*, Statistica Sinica **11** (2001), 807–826.

J. T. Gene Hwang and Dan Nettleton, *Investigating the probability of sign inconsistency in the regression coefficients*, Genetics **160** (2002), 1697–1705.

J. T. Gene Hwang and Shyamal D. Peddada, *Classification of pixels in a noisy grayscale image of polar ice*, IEEE Trans. Geoscience & Remote Sensing, to appear.

Yulij Ilyashenko and A. Panov, *Some upper estimates of the number of limit cycles of planar vector fields with applications to Lienard equation*, Moscow Mathematical Journal **1** no. 4 (2001), 1–17.

F. Dumortier, **Yulij Ilyashenko** and Christiane Rousseau, *Normal forms near a saddle-node and applications to finite cyclicity of graphics*, Ergodic Theory and Dynamical Systems, to appear.

Yulij Ilyashenko, *Centennial history of Hilbert's 16th problem*, Bulletin of the AMS, to appear.

Harry Kesten and J. van den Berg, *Randomly coalescing random walk in dimension* ≥ 3; in In and Out of Equilibrium, Proceedings of a Conference in Mambucaba, Brazil, to appear.

Gregory Lawler, Oded Schramm and Wendelin Werner, *Values of Brownian intersection exponents I: half-plane exponents*, Acta Math. **187** (2001), 237–273.

Gregory Lawler, Oded Schramm and Wendelin Werner, *Values of Brownian intersection exponents II: plane exponents*, Acta Math. **187** (2001), 275–308.

Gregory Lawler, Oded Schramm and Wendelin Werner, *The dimension of the Brownian frontier is 4/3*, Math. Res. Let. **8** (2001), 401–411.

Gregory Lawler, Oded Schramm and Wendelin Werner, *Values of Brownian intersection exponents III: two-sided exponents*, Ann. Inst. Henri Poincaré **38** (2002), 109–123.

Gregory Lawler, Oded Schramm and Wendelin Werner, *One arm exponent for critical 2D-percolation*, Journal of Probability **7** no. 2 (2002).

Gregory Lawler, Oded Schramm and Wendelin Werner, *Sharp estimates for Brownian non-intersection probabilities*; in In and Out of Equilibrium, Birkhäuser, 2002.

Gregory Lawler, Oded Schramm and Wendelin Werner, *Analyticity of intersection exponents for planar Brownian motion*, Acta Math., to appear.

Irina Mitrea, *On the spectra of elastostatics and hydrostatics layer potentials on curvilinear polygons*, Journal of Fourier Analysis and Applications **8** (2002).

Vladimir Brayman, Wolf Kohn and **Anil Nerode**, *Control synthesis in hybrid systems with Finsler dynamics*, invited paper for Chern volume, Houston Journal of Mathematics **28** no. 2 (2002), 353–375.

Bakhadyr Khoussainov and **Anil Nerode**, *Automata theory and its applications*, to appear.

Grigori Milstein and **Michael Nussbaum**, *Maximum likelihood estimation of a nonparametric signal in white noise by optimal control*, Statistics and Probability Letters **55** no. 2 (2001), 193–203.

Ion Grama and **Michael Nussbaum**, *Asymptotic equivalence of nonparametric regression*, Mathematical Methods of Statistics **11** no. 1 (2002), to appear.

Karen Ames, **Lawrence Payne** and J. C. Song, *Spatial decay in the pipe flow of a viscous fluid interfacing a porous medium*, Math. Models and Methods in Appl. Sciences **11** (2001), 1547–1562.

Lawrence Payne and P. W. Schaefer, *Eigenvalue and eigenfunction inequalities for elastically supported membranes*, ZAMP **52** (2001), 888–895.

Lawrence Payne and P. W. Schaefer, *Decay results for the heat equation under radiation boundary conditions*, Math. Ineq. and Appl. **4** (2001), 573–584.

Changhao Lin and **Lawrence Payne**, *Continuous dependence on spatial geometry for the generalized Maxwell-Caltaneo system*, Math. Methods in Appl. Sci. **24** (2001), 1113–1124.

Lawrence Payne and J. C. Song, *Growth and decay in generalized thermoelasticity*, Int. J. Eng. Sci. **40** (2002), 385–400.

Irena Peeva and **Michael Stillman**, *Toric Hilbert schemes*, Duke Math. J. **111** (2002), 419–449.

Irena Peeva, *Resolutions and lattices*, Special Issue for Jan-Erik Roos's anniversary in Homology Homotopy Appl., to appear.

Ravi Ramakrishna, *Deforming global Galois representations*, Annals of Mathematics, to appear.

Deepak Ramani and **Richard Rand**, *Nonlinear normal modes in a system with nonholonomic constraints*, Nonlinear Dynamics **25** (2001), 49–64.

Richard Rand, Igor Rozhkov and Alexander Vakakis, *Nonlinear modal interactions in the oscillations of a liquid drop in a gravitational field*, Int'l Journal of Nonlinear Mechanics **36** (2001), 803–812.

Richard Rand and Randolph Zounes, *Subharmonic resonance in the nonlinear Mathieu equation*, Int'l Journal of Nonlinear Mechanics **37** (2002), 43–73.

Leslie Ng and **Richard Rand**, *Bifurcations in a Mathieu equation with cubic nonlinearities*, Chaos, Solitons and Fractals **14** (2002), 173–181.

Waldemar Hebisch and **Laurent Saloff-Coste**, *On the relation between elliptic and parabolic Harnack inequalities*, Annales de l'Institut Fourier **51** (2001), 1437–1481.

Alexander Bendikov and **Laurent Saloff-Coste**, *Central Gaussian semigroups of measures with continuous densities*, J. Functional Analysis **186** (2001), 206–268.

Alexander Bendikov and **Laurent Saloff-Coste**, *On the absolute continuity of Gaussian measures on locally compact groups*, J. Theoretical Probability **14** (2001), 887–898.

Thierry Coulhon, Ilkka Holopainen and **Laurent Saloff-Coste**, *Harnack inequality and hyperbolicity for subelliptic p-Laplacians with applications to Picard type theorems*, Geometric and Functional Analysis **11** (2001), 1139–1191.

Laurent Saloff-Coste, *Probability on groups: random walks and invariant diffusions*, Notices of the AMS **48** no. 9 (2001), 968–977.

Laurent Saloff-Coste, *Aspects of Sobolev Type Inequalities*, London Mathematical Society Lecture Note Series **289**, Cambridge University Press, 2002.

Alexander Grigor'yan and **Laurent Saloff-Coste**, *Dirichlet heat kernel in the exterior of a compact set*, Comm. Pure and Applied Mathematics **LV** (2002), 93–133.

Alexander Bendikov and **Laurent Saloff-Coste**, *Gaussian bounds for derivatives of central Gaussian semigroups on compact groups*, Transactions of the AMS **354** (2002), 1279–1298.

Alexander Grigor'yan and **Laurent Saloff-Coste**, *Hitting probabilities for Brownian motion on Riemannian manifolds*, Journal de Mathématiques Pures et Appliquées **81** (2002), 115-142.

Christophe Pittet and **Laurent Saloff-Coste**, *On random walk on wreath products*, Annals of Probability, to appear.

Christophe Pittet and **Laurent Saloff-Coste**, *Random walk on abelian-by-cycle groups*, Proceedings of the AMS, to appear.

Alexander Bendikov and **Laurent Saloff-Coste**, *On the hypoellipticity of sub-Laplacians on infinite dimensional compact groups*, Forum Mathematicum, to appear.

W. Hoffmann, **Alfred Schatz, Lars Wahlbin** and G. Wittum, *Asymptotically exact a posteriori estimators for the pointwise gradient error on each element in irregular meshes; Part I: A smooth problem with globally quasi-uniform meshes*, Math. Comp. **70** no. 235 (2001), 897–909.

Alfred Schatz and **Lars Wahlbin**, *Asymptotically exact a posteriori estimators for the pointwise gradient error on each element in irregular meshes; Part II: the piecewise linear case*, to appear.

Alfred Schatz and **Lars Wahlbin**, *Pointwise error estimates for differences in piecewise linear finite element approximation*, to appear.

Jason Schweinsberg, *Applications of the continuous-time ballot theorem to Brownian motion and related processes*, Stoch. Process. Appl. **95** (2001), 151–176.

Jason Schweinsberg, *An $O(n^2)$ bound for the relaxation time of a Markov chain on cladograms*, Random Struct. Alg. **20** (2002), 59–70.

James P. Hobert and **Jason Schweinsberg**, *Conditions for recurrence and transience of a Markov chain on $Z+$ and estimation of a geometric success probability*, Ann. Statist., to appear.

Richard Shore and Ted Slaman, *A splitting theorem for n-REA degrees*, Proc. Amer. Mathematical Society **129** (2001), 3721–3728.

Samuel Buss, Alexander Kechris, Anand Pillay and **Richard Shore**, *The prospects for mathematical logic in the twenty-first century*, Bulletin of Symbolic Logic **7** (2001), 169–196.

Denis Hirschfeldt, Bakhadyr Khoussainov, **Richard Shore** and A. Slinko, *Degree spectra and computable dimension in algebraic structures*, Annals of Pure and Applied Logic **115** (2002), 71–113.

Richard Shore and Yue Yang, *A nonlow$_2$ r.e. degree with the extension of embeddings properties of a low$_2$ degree*, Mathematical Logic Quarterly **48** (2002), 131–146.

Richard Shore, *Computable structures: presentations matter*, Proceedings of the Int'l Cong. LMPS, Krakow, Poland, to appear.

Chi-Tat Chong, **Richard Shore** and Yue Yang, *Interpreting arithmetic in the r.e. degrees under Σ_4-induction*; in Reverse Mathematics (S. Simpson, ed.), Lecture Notes in Logic, 2001.

Victor Guillemin, Lisa Jeffrey and **Reyer Sjamaar**, *Symplectic implosion*, Transformation Groups, to appear.

Eric Bedford and **John Smillie**, *Polynomial diffeomorphisms of $\mathbb{C}^2$ VIII: Quasi-expansion*, Amer. J. Mathematics **124** (2002), 221–271.

Jürgen Rohlfs and **Birgit Speh**, *Pseudo Eisenstein series and the cohomology of arithmetic groups I*, Manuscripta Mathematica, to appear.

David Eisenbud, Daniel Grayson, **Michael Stillman** and Bernd Sturmfels, eds., *Computations in Algebraic Geometry with Macaulay 2*, Springer-Verlag, 2001.

Michael Stillman, Bernd Sturmfels and Rekha Thomas, *Algorithms for the Toric Hilbert Scheme*, Springer-Verlag, 2001.

Nina Huang and **Robert Strichartz**, *Sampling theory for functions with fractal spectrum*, Experimental Mathematics **10** (2001), 619–638.

Robert Strichartz, *Harmonic mappings of the Sierpinski gasket to the circle*, Proceedings American Mathematical Society **30** (2001), 619–638.

Robert Meyers, **Robert Strichartz** and Alexander Teplyaev, *Dirichlet forms on the Sierpinski gasket*, Pacific Journal of Mathematics, to appear.

Scott Bailey, Theodore Kim and **Robert Strichartz**, *Inside the Lévy dragon*, American Mathematical Monthly, to appear.

Bryant Adams, S. Alex Smith and **Robert Strichartz**, *The spectrum of the Laplacian on the pentagasket*, Conference Proceedings, to appear.

Anders Öberg, **Robert Strichartz** and Andrew Q. Yingst, *Level sets of harmonic functions on the Sierpinski gasket*, Arkiv für Matematik, to appear.

Robert Strichartz, *Function spaces on fractals*, Journal of Functional Analysis, to appear.

Edward Swartz, *Matroids and quotients of spheres*, Mathematische Zeitschrift (2002).

James Sethian and **Alexander Vladimirsky**, *Ordered upwind methods for static Hamilton-Jacobi equations*, Proc. Nat'l Acad. Sci. USA **98** no. 20 (2001), 11069.

James Sethian and **Alexander Vladimirsky**, *Ordered upwind methods for hybrid control*, Proceedings of the 5th International Workshop on Hybrid Systems: Computation and Control, Stanford, CA, USA, March 25–27, 2002 (LNCS 2289).

Martin Bridson and **Karen Vogtmann**, *The symmetries of Outer space*, Duke Mathematical Journal **106** no. 2 (2001), 391–409.

Sava Krstic, Martin Lustig and **Karen Vogtmann**, *An equivariant Whitehead algorithm*, Proceedings of the Edinburgh Mathematical Society **44** (2001), 117–141.

Karen Vogtmann, *Automorphisms of free groups and Outer space*, Geometriae Dedicata, to appear.

Ricardo Nochetto and **Lars Wahlbin**, *Positivity preserving finite element approximation*, Math. Comp., to appear.

Nikolai Bakaev, Vidar Thomée and **Lars Wahlbin**, *Maximum-norm estimates for resolvents of elliptic finite element operators*, Math. Comp., to appear.

Jerry Farlow, James Hall, Jean Marie McDill and **Beverly West**, *Differential Equations and Linear Algebra*, Prentice Hall, 2002.

Milen Yakimov, *Symplectic leaves of complex reductive Poisson-Lie groups*, Duke Mathematical Journal **112** (2002), 453–509.

F. Alberto Grünbaum and **Milen Yakimov**, *Discrete Darboux transformations from Jacobi polynomials*, Pacific J. Math. **204** (2002), 395–431.

Nikolai Reshetikhin and **Milen Yakimov**, *Quantum invariant measures*, Comm. Math. Phys. **224** (2001), 399–426.

Timothy Hodges and **Milen Yakimov**, *The double and dual of a quasitriangular Lie bialgebra*, Math. Res. Lett. **8** (2001), 91–105.

The Faculty and their Research

Dan M. Barbasch, Professor; Ph.D. (1976) University of Illinois; Representation theory of reductive Lie groups.

Yuri Berest, Assistant Professor; Ph.D. (1997) Université de Montreal (Canada); Mathematical physics and algebraic geometry.

Louis Billera, Professor; Ph.D. (1968) City University of New York; Geometric and algebraic combinatorics.

James H. Bramble, Professor Emeritus; Ph.D. (1958) University of Maryland; Numerical solutions of partial differential equations.

Kenneth S. Brown, Professor; Ph.D. (1971) Massachusetts Institute of Technology; Algebra, topology, group theory.

•**Stephen U. Chase**, Professor; Ph.D. (1960) University of Chicago; Non-commutative algebra, homological algebra, Hopf algebras, group theory.

Marshall M. Cohen, Professor; Ph.D. (1965) University of Michigan; Topology, geometric (and combinatorial) group theory.

Robert Connelly, Professor; Ph.D. (1969) University of Michigan; Discrete geometry, computational geometry and the rigidity of discrete structures.

R. Keith Dennis, Professor; Ph.D. (1970) Rice University; Commutative and non-commutative algebra, algebraic K-theory, group theory, mathematical bibliography.

Richard Durrett, Professor; Ph.D. (1976) Stanford University; Problems in probability theory that arise from ecology and genetics.

Eugene B. Dynkin, A. R. Bullis Chair and Professor; Ph.D. (1948), Dr. of Science (1951) Moscow University; Probability theory, Lie groups.

Clifford J. Earle, Professor; Ph.D. (1962) Harvard University; Complex variables, Teichmüller spaces.

José F. Escobar, Professor; Ph.D. (1986) University of California at Berkeley; Partial differential equations; differential geometry.

Roger H. Farrell, Professor Emeritus; Ph.D. (1959) University of Illinois; Mathematical statistics, measure theory.

Leonard Gross, Professor; Ph.D. (1958) University of Chicago; Functional analysis, constructive quantum field theory.

John M. Guckenheimer, Professor; Ph.D. (1970) University of California at Berkeley; Dynamical systems.

Allen Hatcher, Professor; Ph.D. (1971) Stanford University; Geometric topology.

Timothy Healey, Professor and Chair of Theoretical and Applied Mechanics; Ph.D. (1985) University of Illinois; Nonlinear elasticity, nonlinear analysis, partial differential equations.

David W. Henderson, Professor; Ph.D. (1964) University of Wisconsin; Geometry, educational mathematics.

John H. Hubbard, Professor; Doctorat d'Etat (1973) Université de Paris Sud; Analysis, differential equations, differential geometry.

J.T. Gene Hwang, Professor; Ph.D. (1979) Purdue University; Statistics, confidence set theory.

Yulij Ilyashenko, Professor; Ph.D. (1969) Moscow State University; Dynamical systems.

•**Peter J. Kahn**, Professor; Ph.D. (1964) Princeton University; Symplectic topology/geometry.

•**Harry Kesten**, Goldwin Smith Professor; Ph.D. (1958) Cornell University; Probability theory, limit theorems, percolation theory.

Dexter Kozen, Professor of Computer Science; Ph.D. (1977) Cornell University; Computational theory, computational algebra and logic, logics and semantics of programming languages.

•**Gregory Lawler**, Professor; Ph.D. (1979) Princeton University; Probability, statistical physics.

G. Roger Livesay, Professor Emeritus; Ph.D. (1952) University of Illinois; Differential topology, group actions.

•**Michael D. Morley**, Professor; Ph.D. (1962) University of Chicago; Mathematical logic, model theory.

Anil Nerode, Goldwin Smith Professor; Ph.D. (1956) University of Chicago; Mathematical logic, recursive functions, computer science, mathematics of AI, control engineering.

Michael Nussbaum, Professor; Ph.D. (1979) Academy of Sciences Berlin (Germany); Mathematical statistics.

Lawrence E. Payne, Professor Emeritus; Ph.D. (1950) Iowa State University; Partial differential equations, ill-posed and nonstandard problems.

•**Irena Peeva**, Assistant Professor; Ph.D. (1995) Brandeis University; Commutative algebra and algebraic geometry.

Richard Platek, Associate Professor; Ph.D. (1966) Stanford University; Mathematical logic, recursion theory, set theory, computer science.

Philip Protter, Professor of Operations Research and Industrial Engineering; Ph.D. (1975) University of California at San Diego; Stochastic analysis, stochastic numerical analysis, stochastic finance theory and Markov processes.

Ravi Ramakrishna, Assistant Professor; Ph.D. (1992) Princeton University; Algebraic number theory.

Richard Rand, Professor of Theoretical and Applied Mechanics; Sc.D. (1967) Columbia University; Applied mathematics and differential equations.

James Renegar, Professor of Operations Research and Industrial Engineering; Ph.D. (1983) University of California at Berkeley; Optimization algorithms.

•**Oscar S. Rothaus**, Professor; Ph.D. (1958) Princeton University; Several complex variables, combinatorics, Sobolev inequalities.

Laurent Saloff-Coste, Professor; Ph.D. (1983) and Doctorat d'Etat (1989) Université Paris VI; Analysis, potential theory, stochastic processes.

Alfred H. Schatz, Professor; Ph.D. (1964) New York University; Numerical solutions of partial differential equations.

Shankar Sen, Professor; Ph.D. (1967) Harvard University; Algebraic number theory.

•**Richard A. Shore**, Professor; Ph.D. (1972) Massachusetts Institute of Technology; Mathematical logic, recursion theory, set theory.

•**Reyer Sjamaar**, Associate Professor; Ph.D. (1990) Rijksuniversiteit te Utrecht (RUU), the Netherlands; Symplectic geometry.

John Smillie, Professor and Chair; Ph.D. (1977) University of Chicago; Dynamical systems.

Birgit E. Speh, Professor; Ph.D. (1977) Massachusetts Institute of Technology; Lie groups, automorphic forms, representation theory.

Michael E. Stillman, Professor; Ph.D. (1983) Harvard University; Algebraic geometry, computational algebra.

•**Robert S. Strichartz**, Professor; Ph.D. (1966) Princeton University; Harmonic analysis, partial differential equations, analysis on fractals.

Moss E. Sweedler, Professor Emeritus; Ph.D. (1965) Massachusetts Institute of Technology; Algebra, algorithms.

Karen Vogtmann, Professor; Ph.D. (1977) University of California at Berkeley; Topology, geometric group theory.

Lars B. Wahlbin, Professor; Ph.D. (1971) University of Göteborg, Sweden; Numerical solutions of partial differential equations.

James E. West, Professor; Ph.D. (1967) Louisiana State University; Geometric topology, infinite-dimensional topology.

•*Faculty on sabbatical or other leave during all or part of the 2001–2002 academic year.*

Faculty Profiles

Allen Back

Acting Professor of Mathematics
Director of the Mathematics Instructional Computing Lab

My original training was primarily in differential geometry and secondarily in topology. The most interesting portion of my earlier work was related to the role of compact Lie group actions in differential geometry, especially curvature realizability questions. I've been impressed by a variety of recent progress in this area (e.g. Einstein metrics and positive Ricci curvature on many cohomogeniety one manifolds) and have been working on what further directions may now be fruitful.

Besides equivariant differential geometry, other areas of past work and interest include transformation groups, homotopy theory, dynamical systems, some parts of mathematical physics, geometric modeling and robotics. My work as director of the Instructional Computing Lab has also meshed with a longstanding interest in the use of computers for mathematical enrichment.

Awards and Honors: Putnam Exam Honorable Mention (1969 and 1970). NSF Graduate Fellowship (1971). NSF Research Grant (1980).

Professional Activities: Assist in REU Program (1994–present). Assist in Math Explorers Club Program (2000–present).

Invited Lectures: Mathematicians and Education Reform, Ithaca (1995). SIAM Special Session on Dynamical Systems Software, Philadelphia (1993). Oberwolfach Equivariant Differential Geometry Conference (1983). Syracuse Topology Conference (1981). AMS Special Session on Equivariant Geometry, San Francisco (1980). University of Waterloo Math Colloquium (1979).

Selected Publications:

Mathematics and tensegrity (with R. Connelly), American Scientist, March-April (1998), 142–151.

dstool: computer assisted exploration of dynamical systems (with J. Guckenheimer, M. Myers, F. J. Wicklin and P. Worfolk), Notices Amer. Math. Soc. **39** (1992), 303–309.

Equivariant geometry and Kervaire spheres (with Wu Yi Hsiang), Trans. Amer. Math. Soc. **304** no. 1 (1987), 207–227.

Pontryagin forms on homogeneous spaces, Comment. Math. Helv. **57** no. 3 (1982), 349–355.

Rational Pontryagin classes and killing forms, J. Differential Geom. **16** no. 2 (1981), 191–193.

Involutions on Grassmann manifolds, Ph.D. Thesis, Berkeley, 1977.

Graeme Bailey

Professor of Computer Science
Director of the Computer Science MEng Program
Adjunct Professor of Mathematics

Originally working in low-dimensional topology and combinatorial group theory, through an odd mixture of circumstances I have become actively involved in research in mathematics and medicine. One of two ongoing research projects in this area is the modelling of lung inflation, together with a research group at the Class One Trauma Center in Syracuse. This is in the early stages of a program to extend to various pathologies affecting elasticity and aimed towards effective clinical treatments. We've been fortunate to have made some significant advances in answering some questions which had remained unsolved for over 30 years. The other project is in understanding deformations of transmembrane proteins used in cell-signalling processes. This is a carefully constrained version of the protein-folding problems which have been exciting the mathematical biology community in recent years; the application of a topological viewpoint in collaborating with molecular pharmacologists and structural biologists has already yielded some intriguing insights. With the recent successes at Syracuse in determining scroll waves with the thickness of cardiac muscle, I've become interested again in modelling dynamic aspects of cardiac electrophysiology.

Outside the primarily research front, this past year I've given a number of invited talks to student and alumni groups, was voted ACSU "Faculty of the Year," received the Kenneth A. Goldman Excellence in Teaching award, served on the Rhodes, Marshall, Churchill and Fulbright Fellowship committees for the nth year — again the university was successful in having several winners — was involved in continuing university discussions on developing more vital faculty/student interactions (serving on the University Program House Committee and the North Campus Committee), was the fac-

ulty advisor for the Judo Club, remained involved with Cornell EMS, enjoyed my eleventh year as a Faculty Fellow at Risley and gave the usual plethora of concerts.

Awards and Honors: Kendall S. Carpenter Advising Award, 2002.

Administrative Activities: Member of the Board of Directors for Engineers Without Borders, the West Campus Housing Operations Committee, the Faculty in Residence Committee, the Marshall and Rhodes Scholarship Selection Committees, the Masters of Engineering Committee, the Full Tuition Awards Committee, the Fullbright Committee, the Downtown Partnership COPC, the Advisory Committee for Health Careers, the Arts' College's Chairs Committee, the Slope Day Committee and the Advisory Board for CURIE (persuading high school girls to consider engineering). Risley Faculty Fellow. Advisor to the Cornell Lunatics Club, the Judo Club. Contributor to the Math Explorer's Club, the Association for Undergraduate Computer Scientists [ACSU]. One of the invited fascilitators for ENG College Summer LEADER-SHAPE Program. One of the judges for last year's first offering of the graduate research symposium (Engineering College graduate students).

Dan Barbasch

Professor of Mathematics

My research is in the field of representation theory of reductive Lie groups. I am particularly interested in the classification of the unitary dual for groups over local fields, and its relation to the orbit structure of the Lie algebra. Furthermore I am interested in the relation of these representations to problems arising from number theory, more precisely automorphic forms.

Professional Activities: Referee for *Transactions of the AMS*, *American Journal of Mathematics* and the National Science Foundation.

Invited Lectures:

Unitary representations and endoscopy, AMS Regional Conference, Maryland.

Selected Publications:

The dual reductive pairs correspondence for complex groups (with J. Adams), J. Func. Anal. **132** (1995).

The dual reductive pairs correspondence for odd orthogonal groups (with J. Adams), J. Func. Anal. (1996).

Unitary spherical spectrum for split classical p-adic groups, Acta Applicandae Mathematicae **44** (1996).

The spherical dual for p-adic groups (with A. Moy), Proc. of Conf. in Cordoba, Argentina.

Local character expansions (with A. Moy), Ann. Sci. de L'Ecole Norm. Sup. (1997).

The associated variety of an induced representation (with M. Bozicevic), Proc. AMS (1998).

The associated variety of unipotent representations, preprint.

Classification of 1-K type representations (with A. Moy), Proc. AMS, to appear.

Yuri Berest

Assistant Professor of Mathematics

My interests are in mathematical physics, algebraic geometry and noncommutative algebra. To be a bit more specific, let me mention a few different topics that I am trying to bring together in my research.

The Nature of Wave Fronts. The mathematical problem has a practical origin: to understand what happens when a short signal (light or sound, say) is omitted from point A, travels through a medium and arrives at point B. There are many possibilities. There could be focusing, diffraction, persistence of faint echoes or still a short ('clean-cut') signal at B. Analysis is difficult because explicit solutions are usually not available, and because the wave front may have complicated geometry. My efforts in this direction focus on the study of propagation of 'clean-cut' wave signals (in particular, the conditions under which such signals could exist). Posed by J. Hadamard more than 80 years ago, this classical problem still remains unsolved even in the simplest cases (for example, for analytic wave operators on flat spaces).

Integrable Systems. This field has seen remarkable development during the past thirty years. 'Integrable systems' is an imprecise term, covering ordinary and partial differential equations, statistical mechanics models, Yang-Mills theories, string theory, random matrices — almost any problem that 'looks complicated' but can be solved more or less explicitly. Miraculously, the explanations for solvability always turn out to be related, even when the underlying (physical or mathematical) models appear to have nothing in common.

Noncommutative Algebra and Algebraic Geometry. In recent years, there have been a number of important applications of techniques and ideas from algebraic geometry to noncommutative algebra. By efforts of M. Artin and his collaborators a far-reaching noncom-

mutative version of projective algebraic geometry has been developed. Roughly speaking, the key idea behind this generalization is to view the category of graded modules modulo torsion over a noncommutative graded ring as the noncommutative analogue of a projective variety. This intuition has led to a remarkable number of nontrivial results in noncommutative algebra and representation theory. It turns out that the geometry of noncommutative projective surfaces is intrinsically related to certain integrable systems. My current research project (pursued jointly with G. Wilson) is aimed at clarifying this relation. Remarkably, the link to integrable systems sheds new light on some old and (traditionally perceived as) difficult questions in algebraic geometry. One of our recent results is a complete classification of rings of global differential operators on affine algebraic curves.

Awards and Honors: Canadian Mathematical Society Doctoral Prize (1998). A. P. Sloan Research Fellowship (2001).

Professional Activities: Editor of the *Journal of Nonlinear Mathematical Physics*. Reviewer for *Mathematical Reviews*. Referee for the NSF and several journals.

Selected Publications:

Hadamard's problem and Coxeter groups: new examples of Huygens' equations (with A. P. Veselov), Func. Anal. and Appl. **28** no. 1 (1994), 3–12.

Huygens' principle and integrability (with A. P. Veselov), Russian Math. Surveys **49** no. 6 (1994), 7–77.

Lacunae of hyperbolic Riesz kernels and commutative rings of partial differential operators, Lett. Math. Phys. **41** no. 3 (1997), 227–235.

Huygens' principle in Minkowski spaces and soliton solutions of the Korteweg-de-Vries equation (with I. Loutsenko), Comm. Math. Phys. **190** no. 1 (1997), 113–132.

Hierarchies of Huygens' operators and Hadamard's conjecture, Acta Appl. Math. **53** no. 2 (1998), 125–185.

Classification of rings of differential operators on affine curves (with G. Wilson), Internat. Math. Res. Notices **2** (1999), 105–109.

The problem of lacunas and analysis on root systems, Trans. Amer. Math. Soc. **352** no. 8 (2000), 3743–3776.

Automorphisms and ideals of the Weyl algebra (with G. Wilson), Math. Ann. **318** no. 1 (2000), 127–147.

Ideal classes of the Weyl algebra and noncommutative projective geometry (with G. Wilson), IMRN **26** (2002), 1347–1397.

Louis J. Billera

Professor of Mathematics
Director of Graduate Studies

For some time, my research has centered on combinatorial properties of convex polytopes and their relations to algebraic and geometric questions. Some problems are related to the facial structure of polytopes, for example, enumeration of faces or identification of their lattice structure. Others have to do with subdivisions of polytopes, how they might depend on the geometry (as opposed to the combinatorics) of the underlying set, or how the algebraic properties of objects related to a given subdivision, for example the algebra of smooth piecewise polynomial functions (splines) defined on it, might depend on both combinatorial and geometric issues.

A common theme in much of this has been the construction of polytopes to given specifications: for example the construction with Carl Lee of polytopes satisfying the conditions of McMullen's g-conjecture, showing these conditions to be sufficient to describe the enumeration of faces of all simplicial convex polytopes; or the construction with Bernd Sturmfels of fiber polytopes, showing that certain sets of polyhedral subdivisions of polytopes themselves had the structure of convex polytopes; or the construction with A. Sarangarajan of faces of the traveling salesman polytope, showing this polytope to have every possible 0-1 polytope as a low-dimensional face.

More recently, my attention has turned to applying these ideas to an interesting problem arising in biology (structure of phylogenetic trees) and to connections, via duality of Hopf algebras, with various algebras of quasisymmetric functions.

Professional Activities: Member of the editorial boards of *Discrete and Computational Geometry* and the *Journal of Algebraic Combinatorics*. Served on the NSF Panel for grants in combinatorics from the Algebra, Number Theory and Combinatorics Program.

Invited Lectures: Delivered lectures on quasisymmetric functions and Eulerian enumeration at: AMS regional meeting (Williamstown, Virginia, October 2001), University of Miami (March 2002), CombinaTexas (Denton, Texas, March 2002), University of Washington (Seattle, April 2002), University College (London, England, May 2002).

Delivered colloquium talks on geometry of the space of phylogenetic trees at: University of Miami (March 2002), MIT (March 2002), University of Washington (Seattle, April 2002).

Selected Publications:

Linear inequalities for flags in graded partially ordered sets (with G. Hetyei), J. Comb. Theory, Series A, **89** (2000), 77–104.

Monotonicity of the cd-index for polytopes (with R. Ehrenborg), Math. Z. **233** (2000), 421–441.

Noncommutative enumeration in graded posets (with N. Liu), J. Algebraic Combinatorics **12** (2000), 7–24.

Decompositions of partially ordered sets (with G. Hetyei), Order **17** (2000), 141–166.

Geometry of the space of phylogenetic trees (with S. Holmes and K. Vogtmann), Advances in Applied Mathematics **27** (2001), 733–767.

A geometric interpretation of the Metropolis-Hastings algorithm (with P. Diaconis), Statistical Science **16** (2001), 335–339.

Peak quasisymmetric functions and Eulerian enumeration (with S. Hsiao and S. van Willigenburg), Advances in Mathematics, to appear.

James H. Bramble

Professor Emeritus of Mathematics

For the past 25 years I have been interested in the development of the theoretical foundation of finite-element methods for the approximation of solutions of elliptic and parabolic partial differential equations. Recently I have concentrated on questions concerning rapid solution of large-scale systems that result from such approximations. Such a question is: Among all the theoretically good approximations to a general class of problems, are there some that can be solved efficiently by taking advantage of modern computer architectures such as parallelism? Answers to questions like this one can bring many problems into the realm of practical feasibility. My current research interest is the design of approximations to solutions to problems in partial differential equations that adequately describe the problem and that can be efficiently solved using modern computing power.

Professional Activities: Distinguished Professor of Mathematics at Texas A&M University.

Invited Lectures:

Interpolation between subspaces of Hilbert spaces and multilevel scales and norms, invited address, symposium honoring John Osborn, University of Maryland, College Park, September 2000.

Selected Publications:

Multigrid methods (with X. Zhang); a chapter in the Handbook for Numerical Analysis (P. Ciarlet and J. L. Lions, eds.), North Holland, 2001.

Kenneth Brown

Professor of Mathematics

Until recently my main interests have been algebra and topology. I have especially enjoyed using topological methods to study infinite discrete groups. In some of my early work, for instance, I studied Euler characteristics of groups. I obtained formulas relating the Euler characteristic (a topological concept) to purely algebraic properties of groups. When applied in special cases, these formulas unexpectedly led to new results in algebraic number theory. Later, I found topological methods for studying two interesting families of groups: infinite simple groups, and groups which can be presented by means of a complete rewriting system.

I have recently incorporated methods of probability theory into my research. In work with L. Billera and P. Diaconis, for example, we combine tools from geometry, topology, and probability to analyze an interesting family of random walks.

Awards and Honors: Clark Teaching Award, Cornell University (1987).

Professional Activities: Referee for various journals and government agencies. Served on the committee to select algebra speakers for the 1982 Int'l Congress of Mathematicians and on the organizing committees for many conferences on topological methods in group theory.

Invited Lectures:

Cohomology of infinite groups, International Congress of Mathematicians, Helsinki (1978).

Buildings lecture series, Univ. Hong Kong (June 1999).

Selected Publications:

Euler characteristics of discrete groups and G-spaces, Invent. Math. **27** (1974), 229–264.

Cohomology of Groups, Springer-Verlag, New York, 1982 (Graduate texts in mathematics 87).

Buildings, Springer-Verlag, New York, 1989.

Random walks and hyperplane arrangements (with P. Diaconis), Ann. Prob. **26** (1998), 1813–1854.

Semigroups, rings and Markov chains, J. Theoretical Probability **13** (2000), 871–938.

Kai-Uwe Bux

H. C. Wang Assistant Professor of Mathematics

The underlying idea of geometric group theory is that groups are meant to act on geometric objects. The properties of the action can be used to study both the group and the geometry. From this point of view, the first step in understanding a group is to find a space on which it acts "nicely." Classical examples of this technique include the work on arithmetic and S-arithmetic groups by means of buildings and symmetric spaces, the study of mapping class groups via Teichmüller theory, and the results about outer automorphism groups of free groups via their actions on Culler-Vogtmann spaces.

Once a space X and an action $G \to \mathrm{Aut}(X)$ are chosen, there is still the problem of understanding the space. In this context, combinatorial Morse theory is an important tool: If there is a real-valued function $f : X \to \mathbf{R}$ on the space, whose level sets are invariant with respect to the group action, then the homotopy type of the space and of the sublevel sets $f^{-1}(-\infty, t]$ can be understood in terms of incremental changes as the value of t varies.

I have applied some of these ideas to solvable S-arithmetic groups over global function fields in order to determine their finiteness properties and geometric invariants — finiteness properties and geometric invariants extend and refine the notions of finite generation and finite presentability of groups.

Invited Lectures: Last year, I gave invited talks at Binghamton University (December 2001) and at the University of Virginia at Charlottesville (April 2002).

Selected Publications:

Finiteness properties of some metabelian S-arithmetic groups, Proceedings of the London Mathematical Society **75** (1997), 308–322.

The Bestvina-Brady construction revisited — geometric computation of Σ-invariants of right angled Artin groups (with C. Gonzalez), Journal of the London Mathematical Society (2) **60** (1999), 793–801.

Orbit spaces of subgroup complexes and Morse theory, Topology Proceedings **24** (Spring 1999), 39–51.

Finiteness properties of soluble S-arithmetic groups – a survey; in Proceedings of the conference "Groups: Geometric and Combinatorial Aspects," Bielefeld, 1999, to appear.

Stephen U. Chase

Professor of Mathematics

With the exception of my early work on module theory, homological algebra, and abelian groups, the enduring theme of my mathematical interests and research has been the Galois theory of rings and fields, and variations of these theories in which the role of the classical Galois group is played by some related algebraic structure such as a restricted Lie algebra, group scheme, Hopf algebra, or groupoid. This work impinges upon and utilizes techniques from other areas in which I also have strong interests, such as category theory and homological algebra, group theory, group schemes and Hopf algebras, representation theory, algebraic K-theory, and algebraic number theory.

Following a period in my career in which the main focus of my research was the Galois module structure of algebraic integers, I have returned to investigations in pure algebra; these involve primarily Hopf algebras (especially quantum groups and Tannakian reconstruction) and, more recently, finite groups (especially the structure of p-groups).

Selected Publications:

Galois theory and Galois cohomology of commutative rings (with D. K. Harrison and A. Rosenberg), Amer. Math. Soc. Memoir **52** (1965).

Hopf Algebras and Galois Theory (with M. E. Sweedler), Lecture Notes in Math **97**, Springer-Verlag, 1969.

Infinitesimal group scheme actions on finite field extensions, Amer. J. Math. **98** (1976), 441–480.

Ramification invariants and torsion Galois module structure in number fields, J. Algebra **91** (1984), 207–257.

Marshall M. Cohen

Professor of Mathematics

I work in the closely related fields of geometric topology, combinatorial group theory and geometric group theory. Much of my work has dealt with the introduction of combinatorial and algebraic themes into geometric problems or geometric themes into combinatorial and algebraic problems. The work has involved the intermingling of topological manifolds, combinatorial topology, the foundations of piecewise linear topology, simple-

homotopy theory, automorphisms of free groups, and spaces of length functions on groups. Currently the second best description of me is *geometric group theorist*.

The title which I most covet is that of *teacher*. The writing of a research paper and the teaching of freshman calculus, and everything in between, falls under this rubric. Happy is the person who comes to understand something and then gets to explain it.

In addition to research and teaching, I deeply value and enjoy my role as a faculty advisor to undergraduates.

Awards and Honors: Winner of the Dean's Award for Advising in 1992, the first year in which this award was given. (It is now called the Robert A. and Donna B. Paul Award for Excellence in Advising.)

Professional Activities: Member of the AMS and MAA.

Selected Publications:

Simplicial structures and transverse cellularity, Annals of Math. (2) **85** (1967), 218–245.

A Course in Simple-Homotopy Theory, Graduate Texts in Mathematics **10**, Springer Verlag, 1973.

Whitehead torsion, group extensions and Zeeman's conjecture in high dimensions, Top. **16** (1977), 79–88.

What does a basis of $F(a, b)$ look like? (with W. Metzler and A. Zimmermann), Math. Ann. **257** (1981), 435–445.

On the dynamics and the fixed subgroup of a free group automorphism (with M. Lustig), Inv. Math. **96** (1989), 613–638.

Very small group actions on R-trees and Dehn twist automorphisms (with M. Lustig), Topology **34** (1995), 575–617.

The conjugacy problem for Dehn twist automorphisms of free groups (with M. Lustig), Commentarii Mathematici Helvetici **74** (1999), 179–200.

The surjectivity problem for one-generator, one-relator extensions of torsion-free groups (with C. Rourke), Geometry and Topology **5** (2001), 127–142.

James Conant

VIGRE Assistant Professor of Mathematics

I am interested in essentially all areas of mathematics although I tend to do research in areas closely related to low-dimensional topology, and especially to Vassiliev knot and three-manifold invariants. One of my favorite results, which is joint with Peter Teichner, is a characterization of when two knots share Vassiliev invariants up to a given degree in terms of ambient cobordism by certain 2-complexes called gropes. This can be found in our preprint *Grope cobordism of classical knots,* available at arxiv.org. I am currently thinking about graph homology and operads. Karen Vogtmann and I have a preprint on the subject, *A Lie bialgebra structure on graphs and graph homology,* which is also available at arxiv.org.

Awards and Honors: Member of the Max-Planck-Institut, Bonn (summer 2001).

Administrative Activities: Organizer of the Topology Seminar (spring 2002).

Invited Lectures: *Junge Topologen* conference, University of Munster (Sep. 2001). AMS special session in low dimensional topology, San Diego (Jan. 2002). Conference on quantum topology, University of Warwick, England (Mar. 2002).

Selected Publications:

On a theorem of Goussarov, J. Knot Theory Ramifications, to appear.

Robert Connelly

Professor of Mathematics

Discrete geometry, with emphasis on the geometry of rigid and flexible structures, is my main area of interest. A tensegrity is a structure composed of sticks held in mid-air with strings which, nevertheless, holds its shape. This can be modeled very nicely as a configuration of points with upper and lower bounds on the distances between certain pairs of points. This in turn leads to interesting problems in, and applications to, distance geometry and the theory of packings and coverings of spheres as well as applications to robotics, protein folding, motion planning and percolation problems in physics and probability.

Another subject of interest is the theory of flexible surfaces. There are triangulated surfaces that flex, keeping their edges at a fixed length, and it has recently been shown that such surfaces maintain a fixed volume while they flex. There is no perfect mathematical bellows. This is also related to a polynomial that relates the volume of the surface to the lengths of its edges. This is at the intersection of discrete geometry, algebraic geometry and topology.

Professional Activities: Member of the AMS and the MAA. Reviewer for the *Mathematical Reviews*. Ref-

eree for various journals. Editor for *Beiträge für Algebra und Geometrie*. Organized the Fourth Geometry Festival (with K. Bezdek, A. Bezdek and K. Boroczky), Budapest, Hungary (1999). Organized a workshop on discrete geometry (with B. Erdahl, W. Whiteley and M. Senechal) at the AMS Conference in Lowell, MA (Apr. 2000).

Invited Lectures:

The bellows conjecture, Conference on Discrete and Computational Geometry, Ascona, Switzerland (June 1999); Case Western, Ohio (Aug. 1999); University of Illinois at Urbana-Champaign (Aug. 1999).

Symmetric tensegrities, ICAAM Conference at Edinburgh, Scotland (July 1999), University of Laramie (Aug. 1999).

Two-distance functions, Budapest, Hungary (July 1999).

Two-distance preserving functions, University of Illinois at Urbana-Champaign (Aug. 1999); Western Washington University (Nov. 1999); Technical University of Vienna, Austria (Dec. 1999).

Tension percolation, Geometry Festival at Budapest, Hungary (Nov. 1999); ETH Zurich, Switzerland (Dec. 1999).

Several talks on *Rigidity* and *The carpenter's rule problem*, Workshop on Discrete and Computational Geometry (associated with McGill Univ., Canada) at Barbados (Jan.–Feb. 2000).

The carpenter's rule problem, Reed College (2000).

Selected Publications:

Rigidity; Chapter 1.7 in Handbook of Convex Geometry (P. M. Gruber and J. M. Wills, eds.), North Holland, 1993, pp. 223–271.

Higher-order rigidity — What is the proper definition? (with H. Servatius), Discrete Comput. Geom. **11** (1994), 193–200.

Finite and uniform stability of sphere coverings (with A. Bezdek and K. Bezdek), L. Fejes Tóth Festschrift, Special Volume of Discrete and Comput. Geom. **13** no. 3–4 (1995), 313–319.

Globally rigid symmetric tensegrities (with M. Terrell), Structural Topology **21** (1995), 59–78.

Second-order rigidity and prestress stability for tensegrity frameworks (with W. Whiteley), SIAM J. Discrete Mathematics **9** no. 3 (1996), 453–491.

The bellows conjecture (with I. Sabitov and A. Walz), Contrib. to Alg. and Geom. **38** no. 1 (1997), 1–10.

Finite and uniform stability of sphere packings (with A. Bezdek and K. Bezdek), Discrete and Comput. Geom. **20** (1998), 111–130.

Mathematics and tensegrity (with A. Back), American Scientist March-April (1998), 142–151.

Tensegrity structures: why are they stable?; in Rigidity Theory and Appl. (M. F. Thorpe and P. M. Duxbury, eds.), Kluwer Academic/Plenum, 1999, 47–54.

Tension percolation (with K. Rybnikov and S. Volkov), submitted.

Straightening polygonal arcs and convexifying polygonal cycles (with E. Demaine and G. Rote), in preparation.

R. Keith Dennis

Professor of Mathematics

Most of my research has been in the field of algebraic K-theory. This field is, in some sense, a fancy generalization of linear algebra to arbitrary rings. As such, it has applications in many other areas of mathematics such as topology, algebraic geometry, and even the theory of Markov processes. I have been most interested in the computational aspects of the subject, in particular the computation of quotients of rings of algebraic integers and in the computation of the Whitehead group for finite abelian groups.

Parts of this work have involved the use of computers to understand a number of examples before formulating and proving the general results. This work has led to the study of questions about group rings, number theory, and theory of finite groups. My current interest lies in studying a number of problems relating to commutators, structure, and invariants of finite groups which can be investigated by computer computations.

While I was executive editor of *Mathematical Reviews*, I became interested in problems dealing with mathematical communication, databases and mathematical bibliography, and how to convert the older mathematical literature into searchable electronic form. I have mainly been involved with these issues during the last several years.

Professional Activities: Served on the board of advisors for the American Institute of Mathematics (AIM). Chaired the AIM Library Board. Part of the project to digitize the *Duke Mathematics Journal*. Coeditor with B. Wegner on the Jahrbuch Project (www.eims.de/projects/JFM). Served on the committee to arrange digitization of the *Pacific Journal of Mathematics*. Co-organizer of the workshop "Linking and Searching in Distributed Digital Libraries," University of Michigan, Ann Arbor, March 18–20, 2002.

Administrative Activities: Worked with the University Librarian on Project Euclid.

Invited Lectures: *A global mathematics library: how to get there?*, CEIC meeting, Vancouver, Quebec, Canada (Feb. 2002).
An international project to construct a global mathematics library, workshop in Ann Arbor, Michigan (Mar. 2002).

Selected Publications:
Noncommutative Algebra (with B. Farb), Springer-Verlag, 1993.
Homogeneous functions and algebraic K-theory (with Reinhard Laubenbacher), to appear.
The number of groups of order N, to appear.
Totally non-abelian finite groups, in preparation.
Generic product decompositions of finite groups, in preparation.

Martin Dindoš

H. C. Wang Assistant Professor of Mathematics

In my research I study problems that originate in harmonic analysis and partial differential equations. In particular, I am interested in problems that contain interplay of both of these fields, such as use of harmonic analysis to study elliptic linear and nonlinear partial differential equations. Harmonic analysis is well suited for studying PDE on rough domains and with rough coefficients where others (less powerful tools) fail.

Sometimes I am interested in questions that originate purely in harmonic analysis such as in my thesis where I studied Hardy spaces on manifolds. In this setting many new phenomena not seen in R^n appear due to the presence of non-Euclidean metric. The study of harmonic functions and various spaces on manifolds also brings certain unexpected benefits. For example the development of layer potential theory on domains in Riemannian manifolds helped to remove certain superficial topological assumptions previously thought to be necessary in R^n. Recently I began to work on problems related to fluid mechanics.

Selected Publications:
Limits of transfinite convergent sequences of derivatives, Real Analysis Exchange **22** no. 1 (1996/97), 338–345.
On series with alternating signs in the Euclidean metric, Real Analysis Exchange **25** no. 2 (1999/2000), 599–616.
Existence and uniqueness for a semilinear elliptic problem on Lipschitz domains in Riemannian manifolds, Comm. PDE **27** no. 1–2 (2002), 219–281.
Semilinear Poisson problems in Sobolev-Besov spaces on Lipschitz domains (with M. Mitrea), Publicacions Mathematiques, to appear.

Richard Durrett

Professor of Mathematics

My research concerns problems in probability theory that arise from ecology and genetics. Most of my efforts in the first direction have been with Simon Levin in Ecology and Evolutionary Biology at Princeton, with whom I have collaborated since 1987. My recent work primarily concerns applications to genetics, which these days is more fashionably called genomics. As the recent publications cited below indicate, I have worked with Chip Aquadro in Molecular Biology and Genetics on microsatellites (DNA repeat sequences), helped Steve Tanksley in Plant Breeding to solve a problem he was interested in, and have worked on various topics with Ted Cox at Syracuse, NSF postdoc Vlada Limic, graduate student Nancy Sundell, and REU particpants Arkendra De, Mike Ferguson, and Suzanne Sindi. In between these numerous trips to the dark side, I have on occasion worked on problems in pure mathematics in collaboration with Persi Diaconis or Vlada Limic and Harry Kesten. The final two publications are on the topic that is the center of my current research: building models to understand how genomes involve due to large scale processes: inversions, translocations, and chromosome fissions and fusions. This topic is not only important for comparative genomics but also leads to some unexpected connections between random walks on the permutation group and the Erdos-Renyi theory of random graphs.

Professional Activities: Associate Editor of *Notices of the American Mathematical Society* and the *Journal of Theoretical Probability*. Elected fellow of the American Academy of Arts and Sciences, 2002.

Selected Publications:
Stochastic spatial models, SIAM Review **41** (1999), 677–718.
Distribution and abundance of microsatellites in the yeast genome can be explained by a balance between slippage events and point mutations (with C. F. Aquadro, S. Kruglyak and M. Schug), Mol. Biol. Evol. **17** (2000), 1210–1219.

Probability Theory: An Introduction to its Applications; in Mathematics Unlimited 2001 and Beyond, Springer-Verlag New York, 2001, pp. 393–405.

Dynamics of microsatellite divergence under stepwise mutation and proportional slippage/point mutation models (with P. Calabrese and C. F. Aquadro), Genetics **159** (2001), 839–852

On the quantity and quality of single nucleotide polymorphisms in the human genome (with V. Limic), Stoch. Proc. Appl. **93** (2001), 1–24.

Exponential distance statistics to detect the effects of population subdivision (with N. Sundell), Theor. Pop. Biol. **60** (2001), 107–116.

The equilibrium distribution for a generalized Sankoff-Ferretti model accurately predicts chromosome size distributions in a wide variety of species (with A. De, M. Ferguson and S. Sindi), J. Appl. Prob. **38** (2001), 324–334.

Chutes and ladders in Markov chains (with P. Diaconis), J. Theor. Prob. **14** (2001), 899–926.

Mutual invadability implies coexistence in spatial models, Memoirs of the AMS **156** no. 740 (2002).

A simple formula useful for positional cloning (with K. Y. Chen and S. D. Tanksley), Genetics **160** (2002), 353–355.

Competition and species packing in patchy environments (with L. A. Buttel and S. A. Levin), Theor. Pop. Biol., to appear.

Once edge-reinforced random walk on a tree (with H. Kesten and V. Limic), Prob. Th. Rel. Fields, to appear.

The stepping stone model: new formulas expose old myths (with J. T. Cox), Ann. Appl. Prob., to appear.

Shuffling chromosomes, J. Theor. Prob., to appear.

Bayesian estimation of the number of inversions in the history of two chromosomes, J. Comp. Bio., submitted.

Eugene B. Dynkin

Professor of Mathematics

A. R. Bullis Chair

Lie groups were the main subject of Dynkin's earlier research. "Dynkin's Diagrams" are widely used by mathematicians and physicists. After 1954, probability theory became the central field of his interests. Principal efforts were devoted to Markov processes and their connections with potential theory and partial differential equations. Other work includes research in mathematical statistics (sufficient statistics, exponential families), optimal control (optimal stopping, control with incomplete data) and mathematical economics (economic growth and economic equilibrium under uncertainty). More recently, he has been working on the relationship between Markov processes and random fields which arise in statistical physics and quantum field theory. Since 1988, branching measure-valued processes have become the main subject of his research (the name "superprocesses" suggested by him for these processes is now standard in mathematical literature). He established connections between superdiffusions and a class of nonlinear partial differential equations that makes it possible to apply powerful analytic tools for investigating the path behavior of superdiffusions and that provides a new probabilistic approach to problems on nonlinear PDEs. Since 1996 the main efforts were devoted to new directions in this field: the description of all positive solutions of a certain class of nonlinear equations and the study of boundary singularities of such solutions. A systematic and improved presentation of the results is contained in a monograph published in 2002 in the Colloquium Publications Series by the American Mathematical Society.

Professional Activities: Served on the advisory board of *Probability Theory and its Applications* and *Mathematics in Operations Research*. Scientific advisor of the International Center for Mathematical Sciences, Edinburgh, Great Britain.

Invited Lectures: Delivered an invited lecture at the International Conference on Potential Theory and Related Fields, Bielefeld, Germany, March 2001. Gave a plenary address at the conference "Perspectives in Partial Differential Equations and Probability," Minneapolis, Minnesota, May 2001.

Selected Publications:

Fine topology and fine trace on the boundary associated with a class of semilinear differential equations (with S. E. Kuznetsov), Comm. Pure Appl. Math. **51** (1998), 897–936.

Probability and nonlinear analysis, Canadian Mathematical Society Conference Proceedings **28** (2000), 139.

Rough boundary trace for solutions of $Lu = \psi(u)$ (with S. Kuznetsov), Probability Theory and its Applications **45** (2000), 740.

Selected Papers of E. B. Dynkin with Commentary, AMS and International Press (A. Onishchik, G. Seitz and A. Yushkevich, eds.), 2000.

Branching exit Markov systems and superprocesses, Annals of Probability **29** no. 4 (2001), 1833–1858.

Diffusions, Superdiffusions and Partial Differential Equations, Colloquium Publications, AMS, 2002.

Clifford Earle

Professor of Mathematics

Most of my research concerns invariants belonging to Riemann surfaces. I am especially interested in learning how these invariants change when the complex structure of the Riemann surface is modified. A useful technique is to consider a family of Riemann surfaces depending holomorphically on some parameters and to study how the invariants of the surface change as we move about in the parameter space. Quasiconformal maps and Kleinian groups have proved to be fundamental tools for the construction of good parameter spaces, so I have studied and used them extensively.

Professional Activities: Managing editor of *Proceedings of the American Mathematical Society* through January 31, 2001. One of three U.S. members of the organizing committee for the Second Iberoamerican Congress on Geometry, Guanajuato, Mexico, January 2001.

Administrative Activities: Served on the Arts College Ad Hoc Committee on Faculty Salaries.

Invited Lectures: Symposium on Kleinian groups and hyperbolic geometry, University of Warwick, England (Sep. 2001). Analysis and hyperbolic geometry seminar, University of Warwick, England (Feb. 2002). Mathematics Colloquium, University of Warwick, England (Feb. 2002). Mathematics Colloquium, University of Southern California (Apr. 2002). Topology Seminar, California Institute of Technology (Apr. 2002).

Selected Publications:

A fibre bundle description of Teichmüller theory (with J. Eells), J. Differential Geometry **3** (1969), 19–43.

A fixed point theorem for holomorphic mappings (with R. S. Hamilton), Global Analysis, Proc. Symp. Pure Math., Vol. XVI, Berkeley, Calif. (1968), Amer. Math. Soc., Providence, 1970, pp. 61–65.

Conformally natural extension of homeomorphisms of the circle (with A. Douady), Acta Math. **157** (1986), 23–48.

Quasiconformal Isotopies (with C. McMullen), Holomorphic functions and moduli, Vol. I, Math. Sci. Res. Inst. Publ. 10, Springer, New York-Berlin, 1988, pp. 143–154.

Teichmüller disks and Veech's $\mathcal{F}$-structures (with F. P. Gardiner), Extremal Riemann surfaces, Contemp. Math. **201** (1997), 165–189.

José F. Escobar

Professor of Mathematics

My research has focused on the study of linear and non-linear partial differential equations arising in differential geometry. The basic purpose of geometry is to give a good description of a class of geometric objects. The geometric objects I study are the so-called Riemannian manifolds. These are spaces endowed with analytical structures, like the metric which provide us with a way to measure lengths and angles. It is natural to study deformations of these structures to realize what properties in the space remain stable under such perturbations. The description of all these deformations is usually governed by differential equations. The curvature tensor of a Riemannian manifold (a measure for the "non-euclideanness" of a Riemannian space) usually makes such equations non-linear, although as in physics, most of them are of variational nature. I have been able to develop the existence theory of solutions to semilinear elliptic equations with non-linear boundary conditions. These equations appear in the problem of conformal deformation of a Riemannian metric on a manifold with boundary and in some non-linear problems in physics.

Awards and Honors: Presidential Faculty Fellowship (1992–1999), created by President Bush to be given to 15 scientists in the nation each year. Colciencias Award, Category A (1996). Alejandro Angel Escobar Foundation: Mention of Excellence in Science (1995).

Professional Activities: Member of the AMS and the Colombian Mathematical Society. Correspondent member of the Colombian Academy of Sciences. Chairman of III Escuela de Verano en Geometría Diferencial, Ecuaciones en Derivadas Parciales y Análisis Numérico, Universidad de los Andes, Bogotá, Colombia (1995). Chairman of Physical Sciences, Mathematics and Engineering Panel for the 1995, 1996, 1997 & 1998 Ford Foundation Dissertation and Postdoctoral Fellowships.

Editorial Board of the Electronic Journal of Differential Equations since 1993 and Revista Colombiana de Matemáticas since 1992. International editor of Innovación y Ciencia since 1992. Referee for the Journal of the AMS, Journal of Diff. Geometry, Duke Mathematical Journal, Indiana Mathematical Journal, Proceedings

of the AMS, Communications in Analysis and Geometry, among others, and the NSF.

Invited Lectures:

Conformal geometry, US-Chinese Conference on Recent Developments in Differential Equations and Applications, Hangzhou, P. R. China (1996).

The geometry of the first Steklov eigenvalue, Southern California Geometry Analysis Seminar, Irvine, California (1998).

An isoperimetric inequality and the Steklov eigenvalue, Brazilian School of Geometry, Belo Horizonte, Brazil (1998).

New results on conformal deformation of metrics, Workshop on Geometric Partial Differential Equations, Pacific Institute, UBC, Vancouver, Canada (2001).

Selected Publications:

Conformal metrics with prescribed scalar curvature (with R. Schoen), Invent. Math. **86 (2)** (1986), 243–254.

Uniqueness theorems on conformal deformations of metrics, Sobolev inequalities and an eigenvalue estimate, Comm. on Pure and Appl. Math. **43** no. 7 (1990), 857–883.

Conformal deformation of a Riemannian metric to a scalar flat metric with constant mean curvature on the boundary, Ann. Math. **136** (1992), 1–50.

The Yamabe problem on manifolds with boundary, J. Diff. Geom. **25** (1992), 21–84.

A comparison theorem for the first non-zero Steklov eigenvalue, J. Funct. Analysis **178** (2000), 143–155.

Conformal metrics on the ball with zero scalar curvature and prescribed mean curvature on the boundary (with G. Garcia), preprint 2002.

Roger Farrell

Professor Emeritus of Mathematics

Retired as of July 1, 1999, I am still semi-active in the department and try to come in most days to audit classes and work some in the Math Support Center. I am not active in research.

My research concerned the application of decision theory methods to statistical problems to try and characterize completely good and bad methods of estimation and testing. Useful decision theory methods can involve development of inequalities, compactification of spaces, and study of the way sequences of measures converge.

Professional Activities: Member of the IMS, AMS and ASA. Occasional reviews for *Mathematical Reviews* and occasional refereeing.

Selected Publications:

Multivariate Calculation, Springer-Verlag, 1985.

Proof of a necessary and sufficient condition for admissibility in discrete multivariate problems (with L. D. Brown), J. Mult. Anal. **24** (1988), 46–52.

All admissible linear estimators of the vector of Gamma state parameters with application to random effects models (with W. Klonecki and S. Zontek), Ann. Statist. **17** (1989), 268–281.

A lower bound for the risk in estimating the value of a probability density (with L. D. Brown), Jour. Amer. Statist. Assoc. **85** (1990), 1147–1153.

Estimations of accuracy in testing (with J. T. G. Hwang, G. Casella, C. Robert and M. T. Wells), Ann. Statist. **20** (1992), 490–509.

Spitzer and Bohnenblust, revisited (1997), preprint.

Matthew C. Fickus

VIGRE Assistant Professor of Mathematics

The field of harmonic analysis is composed of many branches. In the same way one may decompose a harmony into pure tones, linear algebra provides a formalism for breaking vectors apart into basis elements. My interests lie in further developing the theory of bases in both the pure and applied (signal processing) setting.

Specifically, I am studying bases of complex exponential functions on fractal measures with the goal of generalizing Fourier series. I also am interested in frames, a way of performing basis-type decompositions which allow redundancy. My hope is that redundant frame decompositions may be used to build error correction directly into Fourier and wavelet transforms, and thus help bridge the gap between channel and source coding.

Invited Lectures: AMS Spring Southeastern Sectional Meeting (Mar. 2002). DIMACS Workshop on Source Coding and Harmonic Analysis (May 2002).

Selected Publications:

Finite normalized tight frames (with J. Benedetto), Advances in Computational Mathematics, to appear.

Vesselin Gasharov

H. C. Wang Assistant Professor of Mathematics

My work is in commutative algebra and algebraic combinatorics. I am especially interested in the interplay of ideas and the rich connections between these two fields. More specifically, I am interested in Hilbert functions, symmetric functions, free resolutions, total positivity, Schubert varieties, toric varieties, Gröbner bases theory and monomial ideals.

Professional Activities: Coorganizer of a special session in Algebraic and Geometric Combinatorics at the AMS Meeting in Providence, RI (1999). Referee for various journals.

Selected Publications:

Incomparability graphs of $(\mathbf{3}+\mathbf{1})$*-free posets are s-positive*, Discrete Math. **157** (1996).

Complete intersection dimension (with L. Avramov and I. Peeva), Publ. Math. IHES **86** (1997).

On the Neggers-Stanley conjecture and the Eulerian polynomials, J. Combin. Theory (A) **82** (1998).

Factoring the Poincaré polynomials for the Bruhat order on S_n, J. Combin. Theory (A) **83** (1998).

Hilbert functions and homogeneous generic forms II, Compositio Mathematica **116** (1999).

The lcm-lattice in monomial tesolutions (with I. Peeva and V. Welker), Math. Res. Lett. **6** (1999).

Rationality for generic toric rings (with I. Peeva and V. Welker), Mathematische Zeitschrift **233** (2000).

Deformations of codimension 2 toric varieties (with I. Peeva), Compositio Mathematica **123** (2000), 225–241.

Sufficiency of Lakshmibai-Sandhya singularity conditions for Schubert varieties, Compositio Mathematica **126** (2001), 47–56.

Resolutions of a-stable ideals (with T. Hibi and I. Peeva), J. Algebra, to appear.

Leonard Gross

Professor of Mathematics

My research could, for the most part, be described as analysis over infinite dimensional spaces. This has sometimes been motivated by problems of mathematical physics, specifically statistical mechanics and the problem of existence of quantum fields. There is usually a naturally arising probability measure on the infinite dimensional space of interest to me which links functional analytic questions to probability theory. In recent years, I have been interested in properties of the Dirichlet form associated to pinned Brownian motion on loop groups. A long range goal is proof of a Hodge-deRham theorem for these manifolds of maps. This has led, most recently, to a study of Dirichlet forms in holomorphic function spaces over a complex manifold.

Awards and Honors: Guggenheim Fellow (1974–75). Humboldt Prize (1993). Bourbaki Lecture, Paris, France (1998).

Professional Activities: Editorial boards of the *Journal of Functional Analysis*, *Reviews in Mathematical Physics*, *Potential Analysis*, *Soochow Journal of Mathematics*, *Revista Colombiana de Matemématicas* and *Electronic Research Announcements of the American Mathematical Society*. Board of Governors of the Institute of Mathematics and Its Applications, Minnesota (1989–91). Co-organizer of special session at American Mathematical Society meeting (Apr. 1998). Co-organizer of satellite of IMP, Warwick, UK (July 2000). Co-organizer of satellite of ICM, Beijing (Aug. 2002).

Invited Lectures:

Quantization on compact Lie groups and the universal enveloping algebra, Von Neumann Symposium, MIT (1994).

Hilbert spaces of holomorphic functions on complex Lie groups, Taniguchi Symposium, Warwick, England (1994).

The mathematical ramifications of Wiener's program in statistical physics, Wiener Centenary Symposium, Lansing, MI (1994).

Hall's transform via the Segal-Bargmann Map, London Mathematical Society (1995).

Hall's transform and quantum mechanics, Probability Towards 2000, Columbia University (1995).

Hilbert spaces of holomorphic functions on complex Lie groups, Paris, France (1996); Bochum, Germany (1996); Mannheim, Germany (1996).

Hypercontractivity over complex manifolds, Paris (1998); London (1998).

Analysis on loop groups, Kusadaci, Turkey (1998).

Dirichlet forms in holomorphic function spaces, Northwestern University (June 2000), University of Warwick (July 2000), New Orleans AMS meeting (Jan. 2001), Washington University (March 2001).

Selected Publications:

Abstract Wiener spaces, Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability, Vol 2, pt. 1 (1965), 31–41.

The Cauchy problem for the coupled Maxwell and Dirac equations, Comm. Pure App. Math. **19** (1966), 1–15.

Existence and uniqueness of physical ground states, J. Func. Anal. **10** (1972), 52–109.

Logarithmic Sobolev inequalities, Amer. J. Math. **97** (1975), 1061–83.

Convergence of $U(1)_3$ lattice gauge theory to its continuum limit, Comm. Math. Phys. **92** (1983), 137–162.

A Poincaré lemma for connection forms, J. Func. Anal. **63** (1985), 1–46.

Logarithmic Sobolev inequalities on loop groups, J. Func. Anal. **102** (1991), 268–313.

Uniqueness of ground states for Schrödinger operators over loop groups, J. Func. Anal. **112** (1993), 373–441.

A local Peter-Weyl theorem, Trans. AMS **352** (1999), 413–427.

Hypercontractivity over complex manifolds, Acta Math. **182** (1999), 159–206.

John Guckenheimer

Professor of Mathematics

Dynamical systems theory studies long time behavior of systems governed by deterministic rules. Even the simplest nonlinear dynamical systems can generate phenomena of bewildering complexity. Formulas that describe the behavior of a system seldom exist. Computer simulation is the way to see how initial conditions evolve for particular systems. In carrying out simulations with many, many different systems, common patterns are observed repeatedly. One of the main goals of dynamical systems theory is to discover these patterns and characterize their properties. The theory can then be used as a basis for description and interpretation of the dynamics of specific systems. It can also be used as the foundation for numerical algorithms that seek to analyze system behavior in ways that go beyond simulation. Throughout the theory, dependence of dynamical behavior upon system parameters has been an important topic. Bifurcation theory is the part of dynamical systems theory that systematically studies how systems change with varying parameters.

My research is a blend of theoretical investigation, development of computer methods and studies of nonlinear sytems that arise in diverse fields of science and engineering. Much of the emphasis has been upon studying bifurcations. My current work focuses upon algorithm development for problems involving periodic orbits and systems with multiple time scales. Current and recent application areas include the neurosciences, animal locomotion and control of nonlinear systems.

Professional Activities: Chair, SIAM Activity Group on Life Sciences. Managing editor, DSWeb: a website in preparation by SIAM. Theory Division Review Committee, Los Alamos National Laboratory. AAAS Mathematics Section nominating committee. SIAM, Science Policy Committee.

Administrative Activities: Faculty on Computing and Information Founders Committee. Transition Committee, Biological Statistics and Computational Biology Department. Faculty Senate. University Appeals Panel. Chair of Mathematics Department Education Committee.

Invited Lectures: Gave invited lectures at the University of Arizona (Feb. 2001), the Howes Memorial Conference, Berkeley (March 2001), the University of California at Davis (three talks, Feb. and May 2001), the Colston Conference, Bristol, England (June 2001), the SIAM Annual meeting, San Diego (July 2001), the Fields Institute (two talks in different workshops, Dec. 2001) and IMPA (three talks, Jan. 2002).

Selected Publications:

Global analysis of periodic orbits in the forced van der Pol equation (with K. Hoffman and W. Weckesser); in Global Analysis of Dynamical Systems (H. Broer, B. Krauskopf and G. Vegter, eds.), IOP Press, 2001, pp. 261–276.

The duck and the devil: canards on the staircase (with Y. Ilyashenko), Moscow Math. J. **1** (2001).

Review of Stephen Smale biography by Steve Batterson, Am. Math. Monthly **108** (2001), 107–109.

Computing periodic orbits; in Fluid Mechanics and the Environment: Dynamical Approaches (J. Lumley, ed.), 2001, pp. 107–120.

Numerical analysis of dynamical systems; in Handbook of Dynamical Systems, Elsevier, 2002.

Bifurcation and degenerate decomposition in multiple time scale dynamical systems; in Nonlinear Dynamics and Chaos: Where do we go from here?, IOP Press, 2002.

Chaos in the Hodgkin-Huxley model (with R. Oliva), SIAM J. App. Dyn. Systems (2002).

Allen E. Hatcher

Professor of Mathematics

A common thread through much of my research is the idea of studying the space of all topological objects of a certain kind, for example, the space of all finite polyhedra, the space of all diffeomorphisms of a manifold, or the space of all knots. Recently I have also been writing a couple of graduate-level textbooks in topology.

Timothy J. Healey

Chair and Professor of Theoretical and Applied Mechanics

I am interested in nonlinear elasticity and nonlinear analysis, with applications to flexible structures and solids, including biological filaments and martensitic phase transitions. The subject is a rich source of unsolved nonlinear problems in applied analysis and computation. The two primary goals of the work are to uncover new physical and/or mathematical phenomena and to develop efficient solution strategies for the analysis of such problems.

Selected Publications:

Global continuation via higher-gradient regularization and singular limits in forced one-dimensional phase transitions (with H. Kielhöfer), SIAM J. Math. Anal. **31** (2000), 1307.

Hidden symmetry of global solutions in twisted elastic rings (with G. Domokos), J. Nonlinear Science **11** (2001), 47.

Material symmetry and chirality in nonlinearly elastic rods, Math. Mech. Solids, to appear.

A simple approach to the 1:1 resonance bifurcation in follower-load problems (with K. MacEwen), Nonlinear Dynamics, to appear.

David W. Henderson

Professor of Mathematics

I would classify my work as pertaining to aspects of mathematics that impinge on the teaching and learning of mathematics — the emphasis is on the mathematics not on education. My main theme is that we should enliven our conception of what "proof" is and that proofs should be a central part of mathematics teaching at all levels, where my definition of "proof" is: A convincing communication that answers — Why?

In addition, I am currently involved in extensive curriculum innovation projects in undergraduate mathematics. My first book, *Experiencing Geometry on Plane and Sphere*, published in August 1995, has been requested by faculty in 50 countries so far and has been translated into Portugese. My second book *Differential Geometry: A Geometric Introduction* appeared in July of 1997, and is now being used around the world. My third book, *Experiencing Geometry in Euclidean, Spherical and Hyperbolic Spaces*, appeared in summer 2000. It is an extensive revision and expansion of my first book. Other books are in process.

Professional Activities: Served on the National Advisory Board for NSF's CCLI-EMD project. Referee and reviewer for various journals and publishers. Led an NSF-sponsored week-long workshop (*Teaching Undergraduate Geometry*) for mathematics professors at colleges and universities. (The workshop, June 2001, was the seventh such workshop that I have led at Cornell.)

Administrative Activities: Faculty member of the Visual Studies Program, the South Asia Program, and the graduate fields of Education and Mathematics. Member of the University Faculty Committee on Affirmative Action, College Scholars Advisory Board, and Cornell Teacher Education.

Invited Lectures:

Educational mathematics, invited talk to T&AM Seminar, Cornell University (Nov. 2001).

Shape of space, Saturday workshop for teachers, Cornell University (Dec. 2001).

Calculus concepts in secondary mathematics, Saturday workshop for teachers, Cornell University (Feb. 2002).

How can we encourage students to think like a mathematician?, invited 1-hour plenary address, Canadian Mathematics Society Summer Meeting, Quebec City, Canada (June 2002).

Experiencing geometry, invited 2-hour workshop, Canadian Mathematics Society Summer Meeting, Quebec City, Canada (June 2002).

Misconceptions about isometrically embedding the hyperbolic plane in Euclidean 3-space, Janos Bolyai Con-

ference on Hyperbolic Geometry, Budapest, Hungary (July 2002).

Increasing creativity with alive mathematical reasoning, International Conference on the Gifted Student and Increasing Creativity in Mathematics Education, Riga, Latvia (July 2002).

Selected Publications:

Differential Geometry: A Geometric Introduction, Upper Saddle River, NJ: Prentice-Hall, 1998.

Square roots in the Sulba Sutra; a chapter in Geometry at Work: Papers in Applied Geometry (C. A. Gorini, ed.), MAA Notes **53**, 2000, 39–45.

Experiencing Geometry in Euclidean, Spherical and Hyperbolic Spaces (with D. Taimina), Upper Saddle River, NJ: Prentice-Hall, 2001.

Crocheting the hyperbolic plane (with D. Taimina), Mathematical Intelligencer **23** no. 2 (2001), 17–28.

Differential geometry; invited signed article in Encyclopaedia Britannica, to appear in fall 2002.

Non-Euclidean geometry (with D. Taimina); invited signed article in Encyclopaedia Britannica, to appear in fall 2002.

Geometry (with D. Taimina); invited signed article for The Hutchinson Encyclopedia of Mathematics, accepted Dec 2001.

Review of *Where Does Mathematics Come From?* by Lakoff and Nunez, Mathematical Intelligencer **24** no. 1 (2002), 75–78.

Review of *Geometry: Euclid and Beyond* by Robin Hartshorne, Bulletin of the AMS, accepted, publication expected fall 2002.

John Hubbard

Professor of Mathematics

Differential equations are the main way in which mathematical models of real systems are constructed, and understanding their behavior is the main contribution a mathematician can make to applications. I am interested in understanding the behavior of differential equations and their close relatives: iterative systems. In particular, I try to see how such systems behave in the complex domain, largely because complex analysis brings new and powerful techniques to bear on the problems.

The availability of powerful computers and computer graphics has changed the way this sort of research is done. In the course of investigations of even such simple iterative systems as quadratic polynomials, amazing pictures show up, rather as artifacts to be investigated than as man-made objects. I anticipate that this sort of experimental mathematics will become a major trend.

Most of my research over the last five years has been devoted to dynamics in several complex variables. I have co-authored four foundational papers in the field. I am also writing three books on a very advanced level, one giving a treatment of Teichmüller space and its applications in theorems of Bill Thurston, the second on dynamics of one complex variable, and the third on differential geometry.

During the summer I also directed an NSF-funded REU program for four students (two from Harvard, one from Cornell, one from Iowa). The resulting presentation by one of these students at the MAA MathFest in Toronto was chosen as one of the outstanding talks at the MAA Student Paper Sessions. During the school year I continued to work with undergraduates on research projects. One of these students, a physics major, was selected as a Merrill Presidential Scholar, and named me as "the faculty member who has had the most positive influence on his education at Cornell."

Of the papers accepted for publication in the past year, two stand out. *A compactification of Hénon mappings in $\mathbb{C}^2$ as dynamical systems* (with P. Papadopol and V. Veselov), which will appear in Acta Mathematica, builds a bridge between dynamics and algebraic or analytic geometry. The paper uses blow-ups to show that there is a topology on $\mathbb{C}^2 \sqcup S^3$ homeomorphic to a 4-ball such that the Hénon mapping extends continuously. In doing so it proves a result suggested by Milnor, involving embeddings of solenoids in S^3 which are topologically different from those obtained from Hénon mappings. I am currently exploring the application of this method to other problems.

The forced damped pendulum: chaos, complication and control, which will appear in the American Mathematical Monthly, shows how a computer can yield amazing but rigorous results about differential equations using methods accessible to undergraduates. It explores the dynamics of the forced pendulum, as described by the differential equation $x'' + Fx' + \sin \omega x = A \cos t$, for the parameter values $F = 0.1$, $\omega = 1$ and $A = 1$. This pendulum has an attracting periodic oscillation of period 2π, but if you color the plane of initial conditions $x(0)$, $x'(0)$ according to how many times the pendulum goes over the top before settling down to this oscillation, the corresponding "basins of attraction" are extremely wild; in fact they form "lakes of Wada": every point in the boundary of one basin is in the boundary of all the infinitely many others.

I spent the spring semester on leave in Marseille, France, and took advantage of it to give a number of lectures in Paris and other French cities, and to give invited lectures at meetings in Pisa and Crete.

J. T. Gene Hwang

Professor of Mathematics

In recent years, I have been focusing mainly on the theory of statistical intervals. Statistical intervals, such as confidence intervals, prediction intervals and tolerance intervals, are one of the major areas in statistics. By providing intervals, statisticians demonstrate the possible range of the interested parameters or future observations.

Much of my research is stimulated by scientific and engineering applications. Although my primary interest is in theory, the solutions often can be used directly in application. My recent joint work with the National Institute of Standards and Technology is one example.

Another recent endeavor is in genetics statistics. I have published a paper on identification of quantitative trait loci (QTL) and have begun working on other statistics problems related to microarray analysis.

Awards and Honors: I. W. Burr Award (1979). NSF grant awards,1980–1996. IMS Fellow (1988). Elected Member of the Int'l Statistical Institute (1989). Senior Research Fellowship at NIST (Sept. 1–Nov. 30, 1993).

Professional Activities: Referee for *JASA*, *Ann. Stat.*, *J. Multivariate Analysis*, *Sankhya*. Member of the ASA and ICSA. Served as statistical consultant for the National Institute of Standards and Technology (NIST).

Invited Lectures: Delivered colloq. talks at Academia Sinica, Taiwan (Aug. 2000); Dong-Hua University, Taiwan (Aug. 2000); and Iowa State University (Oct. 2000).

Selected Publications:

Construction of improved estimators in multiparameter estimation for discrete exponential families (with Malay Ghosh and Kam-Wah Tsui), Ann. Stat. **11**, no. 2, (1983), 351–367. Discussions by James O. Berger, H. M. Hudson and Carl Morris. Reply with Ghosh and Tsui, 375–376.

The nonexistence of $100\,(1-\alpha)\%$ *confidence sets of finite expected diameter in errors-in-variables and related models* (with L. Gleser), Ann. Stat. **15** (1987), 1351–1362.

Estimation of accuracy in testing (with G. Casella, C. Robert, M. Wells and R. Farrell), Ann. Stat. **20**, (1992), 490–509.

Is Pitman closeness a reasonable criterion? (with C. Robert and W. E. Strawderman), JASA **88** (1993), 57–63. Discussed by 8 statisticians. Reply, 74–76.

Confidence interval estimation subject to order restrictions (with S. D. Peddada), Ann. Stat. **22** (1994), 67–93.

Confidence intervals associated with tests for bioequivalence (with J. Hsu, H. K. Liu and S. J. Ruberg), Biometrika **81** (1994), 103–114.

Fieller's problems and resampling techniques, Statistica Sinica **5** (1995), 161–171.

Optimal confidence sets, bioequivalence and the limacon of Pascal (with L. D. Brown and G. Casella), JASA **90** (1995), 880–890.

Maximum likelihood estimation under order restricted parameters by the prior feedback method (with C. Robert), JASA **91** (1996), 167–172.

An unbiased test for the bioequivalence problem (with L. D. Brown and Axel Munk), Ann. Stat. **25** (1997), 2345–2367.

Prediction intervals in artificial neural network (with A. Adam Ding), JASA **92** (1997), 748–757.

Prediction intervals, factor analysis models and high-dimensional empirical linear prediction (HELP) (with A. Adam Ding), JASA **94** (1999), 446–455.

An optimality theory for mid p-values in 2×2 *contingency tables* (with M. Yang), Statistica Sinica **11** (2001), 807–826.

Investigating the probability of sign inconsistency in the regression coefficients (with D. Nettleton), Genetics **160** (2002), 1697–1705.

Classification of pixels in a noisy grayscale image of polar ice (with S. Peddada), IEEE Transactions on Geoscience and Remote Sensing, to appear.

Yulij Ilyashenko

Professor of Mathematics

My research interests are several branches of dynamical systems, both in real and complex domains. They include: limit cycles in real and complex planes; analytic differential equations, with relations to complex analysis and algebraic geometry; local and nonlocal bifurcations and so on. Some main objects to study are: (1) Limit cycles of polynomial vector fields in the real plane. For instance, in *Finiteness Theorems for Limit Cycles* I proved that for a fixed polynomial vector field the number of limit cycles is finite. (2) Geometric properties of foliations determined by analytic vector fields in the complex plane. (3) Bifurcations of planar polycycles (separatrix polygons). (4) New nonlocal bifurcations in higher-dimensional spaces, and many others.

Professional Activities: Editor-in-Chief of the *Moscow Mathematical Journal* (www.ams.org/distribution/mmj). Member of the editorial boards of *Functional Analysis and Its Applications*, *Dynamical and Control Systems*, *Ergodic Theory and Dynamical Systems*, *Proceedings of the Moscow Mathematical Society* and *Mathematical Enlightenment*.

Administrative Activities: Coorganizer of the Math in Moscow program; president of the Independent University of Moscow.

Invited Lectures: Delivered a talk at the Harvard-MIT-Brandeis-Northeastern Colloquium, November 2000.

Selected Publications:

Hilbert type numbers for Abel equations, growth and zeros of holomorphic functions, Nonlinearity **13** (2000), 1337.

Some properties of skew products over a horseshoe and solenoid (with A. Gorodetski), Proceedings of the Steklov Institute **231** (2000), 96.

The duck and the devil: canards on the staircase (with J. Guckenheimer), Moscow Math. J. **1** (2001), 37.

Normal forms near a saddle-node and applications to finite cyclicity of graphics (with F. Dumortier and C. Rousseau), Ergodic Theory and Dynamical Systems, to appear.

Peter J. Kahn

Professor of Mathematics

I am a differential and algebraic topologist focusing currently on symplectic topology/geometry. Specifically, I am interested in various problems on the interface of this area with algebraic topology, for example, the topology of symplectomorphism groups.

Awards and Honors: Humboldt Senior Scientist Award, 1975–76 and Summer 1981.

Professional Activities: Member of the AMS, MAA and AAAS. Reviewer for *AMS Reviews* and *Zentralblatt*. Referee for the *AMS Proceedings*.

Administrative Activities: Member of the Education Policy Committee (1991–93). Chair of the Committee on Quantitative and Formal Reasoning (1991–). Author of report on the Cornell Mathematics Major (1993). Chair of the Department of Mathematics (1993–95). Associate Dean of the College of Arts and Sciences (1995–97, summer and fall 1999). Chair of the Mathematics Major Committee (2000–2001, spring 2002).

Selected Publications:

Characteristic numbers and oriented homotopy type, Topology **3** (1965), 81–95.

Self-equivalences of $(n-1)$*-connected* $2n$*-manifolds*, AMS Bull. **72** (1966), 562–566.

Chern numbers and oriented homotopy type, Topology **7** (1968), 69–93.

The non-finite homotopy type of some diffeomorphism groups, (with P. Antonelli and D. Burghelea), Topology **11** (1972), 1–49.

The Concordance-Homotopy Groups of Geometric Automorphism Groups (with P. Antonelli and D. Burghelea), Springer Lecture Notes **215** (1972).

Mixing homotopy types of manifolds, Topology **14** (1975), 203–216.

Homotopy-dimension and simple cohomological dimension of spaces (with K. Brown), Comment. Math. Helv. **52** (1977), 111–127.

Counting types of rigid frameworks, Inventiones Math. **55** (1979), 297–308.

Steenrod's Problem and k-Invariants of Certain Classifying Spaces, Springer Lecture Notes **967** (1982).

Equivariant homology decompositions, AMS Trans. **298** (1986), 245–271.

Rational Moore G-spaces, AMS Trans. **298** (1986), 273–287.

A paradigm for robust geometric algorithms (with J. Hopcroft), Algorithmica **7** (1992), 339–380.

Pseudohomology and homology, preprint 2001, 35pp.

Pseudohomology and Steenrod homology, in preparation.

Harry Kesten

Goldwin Smith Professor of Mathematics

I am a probabilist. My main research interests are percolation theory and random walks, and in general I like to dabble in models inspired by statistical mechanics.

One model I have recently worked on can be viewed as a model for the spread of a rumor. There are two kinds of particles, A-particles (corresponding to the people in the know) and B-particles (people who have not heard the rumor). The A-particles perform independent (continuous time) random walks on $\mathbb{Z}^d$ with distribution F_A and similiarly the B-particles perform independent random walks with distribution F_B. The only interaction between all the particles is that when a B-particle meets an A-particle it turns into an A-particle and continues forever as an A-particle. We start with indepen-

dent Poisson numbers of B-particles at the sites of $\mathbb{Z}^d$ and a single A-particle at the origin. How fast does the set of A-particles grow with time? In other words, what is the set of people who heard the rumor by time t, for large t? It is expected that this set grows linearly with t, but so far results are known only if $F_A = F_B$, or if the B-particles do not move at all.

Awards and Honors: Awarded the 2001 Leroy P. Steele Prize for Lifetime Achievement. Tage Erlander Professor in Sweden for 2002.

Professional Activities: Member of the editorial board of the *Indiana Journal of Mathematics* and the *New York Journal of Mathematics*. Honorary board member of *Journal d'Analyse Mathématique*.

Invited Lectures: Delivered lectures at various Swedish universities in connection with Erlander Professorship.

Selected Publications:

Once edge-reinforced random walk on a tree (with R. Durrett and V. Limic), Probab. Theory Rel. Fields **122** (2002).

Randomly coalescing random walk in dimension $\geq$ 3 (with J. van den Berg); in In and Out of Equilibrium, Proceedings of a Conference in Mambucaba, Brazil, to appear.

Branching random walks with catalysts (with V. Sidoravicius), Probab. Theory Rel. Fields, submitted.

Dexter Kozen

Professor of Computer Science
Joseph Newton Pew, Jr., Professor in Engineering
www.cs.cornell.edu/kozen/

My research interests include the theory of computational complexity, especially complexity of decision problems in logic and algebra, program logic and semantics, and computational algebra. Recent work includes: new polynomial-time algorithms for type inference in type systems with subtypes and recursive types; algorithms solving systems of set constraints as used in program analysis; a unification algorithm for set constraints and a new constraint logic programming language based on set constraints; development of the theory of rational spaces and their relationship to set constraints; an algorithm for decomposition of algebraic functions; a new polynomial-time algorithm for resolution of singularities of plane curves; efficient algorithms for optimal transmission of encoded video data; optimality results for digital interleavers; and complexity and completeness results for Kleene algebras with tests. Recently I have begun to investigate the application of Kleene algebra and the modal mu-calculus to problems in software security.

Professional Activities: Program committee of Foundations of Software Science and Computation Structure, Mathematical Foundations of Computer Science. Editorial board of the *Journal of Relational Methods in Computer Science*, the *Journal of Algorithms* (special issue). Supervisory Board, Centre for Basic Research in Computer Science (BRICS), Aarhus University.

Awards and Honors: Class of 1960 Scholar, Williams College.

Administrative Activities: College of Engineering Undergraduate Admissions Committee. University Arbitration Panel. Faculty advisor for Men's Rugby, Football Club and Johnson School of Management Rugby.

Invited Lectures:

Parikh's Theorem in commutative Kleene algebra, FLOC '99, Trento, Italy (July 1999).

On Hoare logic and Kleene algebra with tests, FLOC '99, Trento, Italy (July 1999).

On Hoare logic, Kleene algebra and types, International Congress for Logic, Methodology and Philosophy of Science, Kracow, Poland (Aug. 1999).

On the completeness of prepositional Hoare logic, RelMiCS 5 Conference, Quebec City, Canada (Jan. 2000).

Language-based security, 24th Conference on Mathematical Foundations of Computer Science, Wroclaw, Poland (Sept. 1999); Dartmouth College (March 2000).

Selected Publications:

Parikh's theorem in commutative Kleene algebra (with M. Hopkins), Proc. Conference Logic in Computer Science (LICS '99), IEEE (1999), 394–401.

On Hoare logic, Kleene algebra and types, Cornell University, Computer Science, TR99-1760 (1999); in Proc. Conference Logic in Computer Science (LICS '99), IEEE (1999), 167–172.

Language-based security; in Proc. Conference of Mathematical Foundations of Computer Science (MFCS '99), ed. M. Kutylowski, L. Pacholski, and T. Wierbicki, volume 1672 of Lecture Notes in Computer Science, Springer-Verlag (1999), 284–298.

On the completeness of propositional Hoare logic (with J. Tiluryn), Cornell University, Computer Science, TR99-1766 (1999).

Certification of compiler optimizations using Kleene algebra with tests (with M. Patron), Cornell University, Computer Science, TR99-1779 (1999).

On the completeness of prepositional Hoare logic (with J. Tiluryn); in Proc. of the Fifth International Seminar Relational Methods in Computer Science (RelMiCS 2000), ed. J. Desharnais (2000), 195–202.

Dynamic Logic (with D. Harel and J. Tiluryn), MIT Press, Cambridge, MA, 2000.

Gregory F. Lawler

Professor of Mathematics

I study random walk and Brownian motion with an emphasis on problems arising from statistical physics. A particular interest is the self-avoiding walk and other models of walks with strong interactions.

My recent work, done in collaboration with Oded Schramm and Wendelin Werner, concentrates on the scaling limit of lattice models in two dimensions. These models have been conjectured to have conformally invariant scaling limits, and theoretical physicists have used nonrigorous techniques to predict "critical exponents" for these models. We have established a number of these results recently. For example, we have shown that the dimension of the outer boundary of planar Brownian motion is 4/3, establishing a conjecture of Benoit Mandelbrot.

Awards and Honors: Sloan Fellow (1986). Fellow of the IMS (1992).

Professional Activities: Chair of the AMS Editorial Boards Commmittee (2000). Associate editor of *Combinatorics, Probability and Computing*.

Invited Lectures: Workshop on Percolation, MSRI (2001). Mathematical Physics Workshop, Mambucaba, Brazil (2001). Conference on Random Walks and Geometry, Vienna, Austria (2001). Mini-course, Mittag-Leffler Institute, Sweden (2001). Invited talks at: Iowa State University; Georgia Institute of Technology; IMPA, Brazil; Royal Institute of Technology (KTH), Sweden; Uppsala University, Sweden; Gotëborg University, Sweden; and University of Helsinki, Finland (2001).

Selected Publications:

Values of Brownian intersection exponents I: half-plane exponents (with O. Schramm and W. Werner), Acta Math. **187** (2001), 237–273.

Values of Brownian intersection exponents II: plane exponents (with O. Schramm and W. Werner), Acta Math. **187** (2001), 275–308.

The dimension of the Brownian frontier is 4/3 (with O. Schramm and W. Werner), Math. Res. Let. **8** (2001), 401–411.

Values of Brownian intersection exponents III: two-sided exponents (with O. Schramm and W. Werner), Ann. Inst. Henri Poincaré **38** (2002), 109–123.

One arm exponent for critical 2D-percolation (with O. Schramm and W. Werner), Journal of Probability **7** no. 2 (2002).

Sharp estimates for Brownian non-intersection probabilities (with O. Schramm and W. Werner); in In and Out of Equilibrium, Birkhäuser, 2002.

Analyticity of intersection exponents for planar Brownian motion (with O. Schramm and W. Werner), Acta Math., to appear.

Vlada Limic

H. C. Wang Assistant Professor of Mathematics

I enjoy studying probabilistic models. My thesis was on characterization of certain coalescence processes, which are a model of infinitely many dust particles merging together over a long period of time and forming meteors, planets, etc. I am also interested in problems related to queues and queueing systems. Stochastic queueing systems are models of a factory production cycle, or a telephone exchange or the internet. These mathematical realizations are still quite complicated to analyze directly, so it is important to find useful approximations in order to answer questions about the qualitative behavior of the corresponding queueing system. During the past year, Rick Durrett got me interested in several problems motivated by genetics, and I also became interested in random walks with reinforcement, which are a model of thinking process and memory.

Selected Publications:

The entrace boundary of the multiplicative coalescent (with D. Aldous), EJP **3** (1998), paper 3.

On the behavior of LIFO preemptive resume queues in heavy traffic, ECP **5** (2000), paper 2.

A LIFO queue in heavy traffic, Ann. Appl. Prob., to appear.

On the quantity and quality of single nucleotide polymorphisms in the human genome (with Rick Durrett), Stoch. Processes Appl. (2001).

G. Roger Livesay

Professor Emeritus of Mathematics

My major area of research is in topology, 3-dimensional manifolds with finite cyclic fundamental groups.

Anita Mareno

VIGRE Assistant Professor of Mathematics

My most recent work involves the use of the Leray-Schauder degree to prove the existence of global solution continua to various boundary value problems in higher-gradient 3D nonlinear elasticity. In classical nonlinear elasticity the complementing condition fails for certain boundary value problems and due to a natural growth condition on the material response function, the governing equations exhibit singular behavior; the existence of classical smooth solutions to the equilibrium equations has yet to be shown. In my work, the higher-order term in the response function effectively regularizes an ill-posed problem.

This research has prompted my interest in various problems in degree theory (in a more general sense) and in particular, its applications to PDEs with nonlinear boundary conditions. I am also interested in obtaining existence results for higher-order systems of PDEs with nonstandard boundary conditions. For these types of systems, I am currently investigating whether or not the trivial solution to these equations is unique under certain constraints on the geometry of the domain. For this purpose, I am exploring symmetry methods and developing generalized Rellich-type identities. In general, I am also interested in overdetermined systems of fourth-order PDEs and problems pertaining to phase transitions in elasticity.

Selected Publications:

Numerical simulation of blow-up of a 2D generalized Ginzburg-Landau equation (with C. Bu and R. Shull), Applied Math Letters **9** no. 6 (1996), 13–17.

Uniqueness of classical solutions in higher-gradient nonlinear elasticity, Journal of Elasticity, submitted.

Some global continuation results in higher-gradient nonlinear elasticity (with T. Healey), to be submitted.

Russell Miller

VIGRE Assistant Professor of Mathematics

I study computability theory, the branch of mathematical logic concerned with finite algorithms and the mathematical problems which such algorithms can or cannot solve. By relativizing, one forms a partial order of the degrees of difficulty (the *Turing degrees*) of such problems. Computable model theory, one of my specialties, applies such techniques to general mathematical structures such as trees, linear orders, groups and graphs. Other interests of mine include automorphisms of the lattice of computably enumerable sets (i.e., sets whose elements can be listed by an algorithm) and undecidability of the partial order of Turing degrees of those sets. Finally, one can use computability-theoretic approaches to consider randomness, the question of what we mean when we say that a particular set or real number is "random," and I have begun examining questions in this area.

Selected Publications:

The Δ^0_2-spectrum of a linear order, Journal of Symbolic Logic **66** (2001), 470–486.

Definable incompleteness and Friedberg splittings, Journal of Symbolic Logic, to appear.

Orbits of computably enumerable sets: low sets can avoid an upper cone, Ann. Pure & Applied Logic, to appear.

Irina Mitrea

H. C. Wang Assistant Professor of Mathematics

My specific interests are in the general areas of real and harmonic analysis and partial differential equations. I am particularly interested in the study of PDE problems arising from mathematical physics with emphasis on the study of fluid dynamics, elasticity and electromagnetism.

One of the main themes of my work deals with understanding the nature of the boundary integral operators associated with the aforementioned PDE problems in irregular domains.

Awards and Honors: Alfred P. Sloan Dissertation Fellow (1999–2000). Clay Mathematics Liftoff Fellowship (2000). Eugene B. Fabes Outstanding Thesis Award, University of Minnesota (2000). AWM-NSF Mentor Travel Award (2002).

Invited Lectures: Delivered invited talks at the University of Chicago, University of Rochester, University of Arkansas and University of Montreal (Canada).

Selected Publications:

Monogenic Hardy spaces on Lipschitz domains and compensated compactness (with M. Mitrea), Complex Variables Theory Appl. **35** no. 3 (1998), 225–282.

On the boundedness singular integrals (with E. Fabes and M. Mitrea), Pacific J. Math. **189** no. 1 (1999), 21–29.

Spectral radius properties for layer potentials associated with the elastostatics and hydrostatics equations in nonsmooth domains, Journal of Fourier Analysis and Applications **5** no. 4 (1999), 385–408.

On the spectra of elastostatics and hydrostatics layer potentials on curvilinear polygons, Journal of Fourier Analysis and Applications **8** (2002), to appear.

Michael Morley

Professor of Mathematics

Professor Morley's primary interest and contribution to the department lies in his devotion to the students. His skill, wisdom, commitment and sensitivity in advising is very well-known throughout the Arts College. Comments about Michael Morley speak to his devotion: "[Mike Morley] is exactly the sort of advisor that Cornell needs..."; "...has a creative and total commitment to taking care of students..."; "...has been available to everyone's advisees who wander in unhappy." These comments speak eloquently of Prof. Michael D. Morley.

Professor Morley's primary research interests lie in the areas of advanced mathematical logic and model theory.

Awards and Honors: Robert A. and Donna B. Paul Award for Excellence in Advising (1996).

Professional Activities: President of the Association for Symbolic Logic (1986–89).

Administrative Activities: Department advising committee (1995–). Associate Chair and Director of Undergraduate Studies (1984–95).

Anil Nerode

Goldwin Smith Professor of Mathematics

Anil Nerode's work ranges over several areas of mathematical logic, including computability, computable algebra and automata, and in the last ten years also over control theory and hybrid systems. The variety of control theory introduced by Nerode and his co-worker Kohn is based on controls as connections in Finsler geometries and their jet space extensions. To get an idea of this work, see the 2002 volume of the *Houston Journal of Mathematics* dedicated to S. S. Chern.

In logic, Nerode and Khoussainov have a recent book on automata and their applications and a recently published paper in the *Annals of Pure and Applied Logic* on constructive concurrent dynamic logic. He continues to supervise graduate students in recursive algebra and analysis and in hybrid systems. He has produced 42 Ph.D.s as major advisor. See his web site, www.math.cornell.edu/~anil/ for a biography and bibliography.

Michael Nussbaum

Professor of Mathematics

My research program focuses on developing a better theoretical understanding of the asymptotic theory of statistical experiments, in connection with statistical smoothing and curve estimation and nonparametric inference for stochastic processes. Current topics include Gaussian and Poisson approximation of nonparametric experiments in the Le Cam sense, constructive realization of equivalence, asymptotic risk bounds for density estimation and nonparametric regression, nonparametric models for point processes, diffusion processes and autoregression, functional limit theorems for empirical processes, statistical treatment of inverse and ill-posed problems.

Awards and Honors: Fellow of the Institute of Mathematical Statistics.

Professional Activities: Member of the editorial boards of *Annals of Statistics*, *Annales de l'Institut Henri Poincaré*, *Probabilités et Statistiques* and of *ESAIM*, *Probability and Statistics*.

Invited Lectures:

Nonparametric function estimation, neural nets and risk asymptotics, summer course at Oberwolfach, Germany (DMV-seminar), jointly with A. Barron, Yale and Laszlo Gyorfi, Budapest (June 2000).

Selected Publications:

Asymptotic equivalence of density estimation and Gaussian white noise, Ann. Stat. **24** (1996), 2399–2430.

Asymptotic equivalence for nonparametric generalized linear models (with I. Grama), Probability Theory and Related Fields **111** (1998), 167–214.

Diffusion limits for nonparametric autoregression (with G. Milstein), Probability Theory and Related Fields **112** (1998), 167–214.

The asymptotic minimax constant for sup-norm loss in nonparametric density estimation (with A. Korostelev), Bernoulli **5** no. 6 (1999), 1099–1118.

Minimax risk: Pinsker bound; in Encyclopedia of Statistical Sciences, Vol. 3 (S. Kotz, ed.), John Wiley, New York (1999), 451–460.

Lawrence Payne

Professor Emeritus of Mathematics

My research interests lie in several areas of partial differential equations: isoperimetric inequalities, ill-posed and nonstandard problems, growth decay and/or blowup of solutions, and applications to various problems in solid and fluid mechanics. Recent interests include the study of overdetermined systems and Saint Venant type problems for nonlinear equations.

Invited Lectures: Delivered talks in Zürich and Basel in Switzerland in May 2001; also a talk in Durham, England in May 2001. Gave a talk at the University of Tennessee in November 2001.

Selected Publications:

Remarks on ill-posed problems in partial differential equations, Symposium on Trends in the Application of Mathematics to Mechanics (2000), 1–9.

Spatial decay in the pipe flow of a viscous fluid interfacing a porous medium (with K. A. Ames and J. C. Song), Math. Models and Methods in Appl. Sciences **11** (2001), 1547–1562.

Eigenvalue and eigenfunction inequalities for elastically supported membranes (with P. W. Schaefer), ZAMP **52** (2001), 888–895.

Decay results for the heat equation under radiation boundary conditions (with P. W. Schaefer), Math. Ineq. and Appl. **4** (2001), 573–584.

Continuous dependence on spatial geometry for the generalized Maxwell-Caltaneo system (with C. H. Lin), Math. Methods in Appl. Sci. **24** (2001), 1113–1124.

Growth and decay in generalized thermoelasticity (with J. C. Song), Int. J. Eng. Sci. **40** (2002), 385–400.

Irena Peeva

Assistant Professor of Mathematics

My research is on problems at the interface between commutative algebra, algebraic geometry, computational algebra, topological combinatorics, and noncommutative algebra. I have worked on problems involving free resolutions, toric varieties, Hilbert schemes, complete intersections, subspace arrangements, monomial resolutions, Castelnuovo-Mumford regularity, Koszul algebras, shellings, and Grobner basis. My major research interests are focussed on the properties and applications of minimal free resolutions.

Awards and Honors: Alfred P. Sloan Research Fellowship (1999–2001). C. L. E. Moore Instructorship at MIT (1995–1998). Alfred P. Sloan Doctoral Dissertation Fellowship (1994–1995).

Professional Activities: Coorganizer of a special session at the AMS Meeting in Montreal, May 2002. Referee for various journals.

Invited Lectures:

Quadratic relations, Stockholm, Sweden (Oct. 2000).

Topics in classical algebraic geometry, Oberwolfach, Germany (June 2000).

Commutative algebra and algebraic geometry, CIRM-Luminy, France (June 2000).

Selected Publications:

Complete intersection dimension (with L. Avramov and V. Gasharov), Publications Mathematiques IHES **86** (1997), 67–114.

Generic lattice ideals (with B. Sturmfels), J. American Mathematical Society **11** (1998), 363–373.

How to shell a monoid (with V. Reiner and B. Sturmfels), Math. Annalen **310** (1998), 379–393.

The lcm lattice in monomial resolutions (with V. Gasharov and V. Welker), Mathematical Research Letters **6** (1999), 521–532.

Deformations of codimension 2 toric varieties (with V. Gasharov), Comp. Math. **123** (2000), 225–241.

Finite regularity and Koszul algebra (with L. Avramov), Amer. J. Math. **123** (2001), 275–281.

Toric Hilbert schemes (with M. Stillman), Duke Math. J. **111** (2002), 419–449.

Richard A. Platek

Associate Professor of Mathematics

Professor Platek founded Odyssey Research Associates (ORA), Inc., an Ithaca based private research and development organization, in 1982 and currently serves as CEO. ORA is primarily concerned with applying the techniques of mathematical logic to software development in order to increase assurance that resulting systems are correct. These techniques include: the development of formal specification languages; the development of formal semantics for requirements, specifications, and implementations of languages; the development of sound logics for these semantics; and the implementation of these concepts in software tools and verification environments. ORA is particularly concerned with hardware/software system safety and security. ORA's personnel is largely drawn from the academic community with a strong logic contingent. ORA tools are based on a variety of ideas in the forefront of applied logic.

Professor Platek is the senior technical advisor on all projects at ORA. As such he frequently presents the results and current status of projects at numerous meetings, symposiums, etc. Most recently, he is an invited speaker at the 12th International Conference on Automated Deduction, CADE-12, in the summer of 1994.

Professor Platek and ORA are recognized in technology policy making circles as leading advocates for increased rigor in software engineering with mathematical logic playing the primary role as the underlying scientific discipline.

Ravi Ramakrishna

Assistant Professor of Mathematics

My research is in Galois theory. This is the branch of mathematics concerned with symmetries of solutions of equations. There is an object that encodes all symmetries of solutions to all equations, the absolute Galois group of the rational numbers. I study this object and its relations with number theory. The study of these symmetries has gained an increasingly important role in number theory in recent years. In particular, Galois theory played an important role in the solution of Fermat's Last Theorem.

Professional Activities: Referee/reviewer for the *American Journal of Mathematics*, the *Journal of Number Theory*, *Mathematical Research Letters* and *Mathematical Reviews*.

Administrative Activities: Regional representative for the Budapest Semesters in Mathematics Program.

Invited Lectures: Delivered invited talks at the University of Michigan, September 2000; Binghamton University, September 2000; Boston University, December 2000; The Tata Institute of Fundamental Research, January 2001; the University of Toronto, Canada, January 2001; and the University of Utah, March 2001.

José Ramírez

H. C. Wang Assistant Professor of Mathematics

My main focus of research is on the intersection between analysis (PDEs) and probability. I study parabolic operators. The main objective is to try to prove "Gaussian type bounds" on heat kernels, that is, transition probabilities for the associated processes. The premise here is that there should be some kind of (Gaussian) universality in the behavior of such processes when time is made small. The particularities of different generators (operators) are mainly given through a metric. The need for a very general setting led me to work on Dirichlet spaces.

Another problem of interest to me is that of studying the asymptotics of the distribution of the lowest eigenvalue for one dimensional Schrödinger operators with random potential. I have also started to wander into the problem of recurrence of certain reinforced random walks, that is random processes that like to travel through places that they already visited.

Selected Publications:

Short time asymptotics in Dirichlet spaces, Comm. Pure Appl. Math. **54** (2001), 259–293.

Richard H. Rand

Professor of Theoretical and Applied Mechanics

My research involves using perturbation methods and bifurcation theory to obtain approximate solutions to differential equations arising from applications in nonlinear dynamics and biology.

Current projects include applications to submarine dynamics, effects of biorhythms on retinal dynamics and cardiac arrythmias. These projects are conducted jointly with graduate students at Cornell and with experts in the respective application area.

Selected Publications:

Nonlinear Vibrations, a downloadable book located at www.tam.cornell.edu/randdocs/.

Nonlinear normal modes in a system with nonholonomic constraints (with D. V. Ramani), Nonlinear Dynamics **25** (2001), 49–64.

Nonlinear modal interactions in the oscillations of a liquid drop in a gravitational field (with I. Rozhkov and A. F. Vakakis), International Journal of Nonlinear Mechanics **36** (2001), 803–812.

Subharmonic resonance in the nonlinear Mathieu equation (with R. S. Zounes), International Journal of Nonlinear Mechanics **37** (2002), 43–73.

Bifurcations in a Mathieu equation with cubic nonlinearities (with L. Ng), Chaos, Solitons and Fractals **14** (2002), 173–181.

James Renegar

Professor of Operations Research and Industrial Engineering

I am currently devoting the majority of my research efforts to devising new algorithms for linear programming, i.e., for solving systems of linear inequalities. Unlike the situation for linear equations, surprisingly basic problems remain unresolved for linear inequalities. For example, it is unknown whether there exists an algorithm which can solve a general system of linear inequalities using a number of arithmetic operations which is bounded polynomially in the number of variables and the number of inequalities in the system. By contrast, elementary Gaussian elimination (i.e., high-school mathematics) solves a system of n linear equations in n unknowns in roughly n^3 operations.

I am also interested in devising algorithms for more general problems involving hyperbolic polynomials. (A hyperbolic polynomial p is a real multivariate polynomial for which there exists a vector v such that all univariate polynomials obtained by restricting p to lines in the direction v have only real roots.) These polynomials have played an especially important role in optimization in recent years.

Professional Activities: Associate editor for the *SIAM Journal on Optimization*.

Invited Lectures: Semiplenary speaker at the 17th International Symposium on Mathematical Programming.

Oscar Rothaus

Professor of Mathematics

I spent most of the fall term on sabbatic in France, visiting Paris, l'Institut Henri Poincaré, Toulouse, Université Paul Sabatier, and Strasbourg, Université Louis Pasteur. I attended lectures and lectured myself at Toulouse and Strasbourg, principally on log-Sobolev inequalities and incidentally on coding theory.

After several years' research on log-Sobolev inequalities, I am returning to an earlier interest in combinatorics, in this instance linear coding theory. I am working on the fundamental problem of finding the parameters for optimal linear codes and have achieved significant progress, but I am not yet ready to publish. I have found peculiar connections to my earlier work on "bent" functions.

Selected Publications:

A combinatorial problem in the symmetric group (with J. Thompson), Pac. Jour. Math. **18** (1966), 175–178.

On bent functions, Jour. Comb. Theory A **20** no. 3 (1976), 300–305.

On the non-triviality of some groups given by generators and relations, Ann. Math. **106** (1977), 599–612.

Lower bounds for eigenvalues of regular Sturm-Liouville operators and the logarithmic Sobolev inequality, Duke Math. Jour. **45** no. 2 (1978), 351–362.

Analytic inequalities, isoperimetric inequalities and logarithmic Sobolev inequalities, J. Func. Anal. **64** (1985), 296–313.

Semigroups of finite matrices, Semi-Group Forum **49** (1994), 59–65.

Herbst inequalities for super contractive semigroups (with L. Gross), Jour. Math. Kyoto Univ. **38** no. 2 (1998).

Sharp log-Sobolev inequalities, PAMS **126** no. 10 (1998), 2903–2904.

Konstantin Rybnikov

H. C. Wang Assistant Professor of Mathematics

My research focuses on combinatorial and geometric properties of graphs and polyhedra. These properties are studied from the viewpoints of combinatorics, computational geometry, rigidity theory, and geometry of numbers.

In combinatorics one of my main interests is the theory of k-stresses for piecewise-linear manifolds and its relations to the combinatorics of convex polytopes. I am especially interested in how the theory of stresses on polyhedra relates to the lower bound type results (e.g., $g_2 > 0$) and the problem of reconstruction of convex polytopes from partial geometric or combinatorial information. A major focus of this research is on relating the numbers of faces and chains of faces in polytopes to rigidity properties of their skeletons. Another focus is on the reconstruction of polytopes or their face-lattices from partial information such as, for instance, the polytope graph. Algorithmic and combinatorial information sought here may be of value to various areas of applied mathematics and computer science dealing with linear programming and reconstruction of polyhedral scenes. Now I am also interested in gain graphs; they are important to polyhedral geometry, in particular, to generalizations of Maxwell-Cremona correspondence that I have constructed.

Rigidity and flexibility properties of graphs are of importance to many fields of engineering, physics, computational chemistry, molecular biology, etc. Since 1998 I, with my coauthors, have been working on rigidity related geometric properties of infinite random graphs. We have analyzed percolation of the loss of tension for 2D continuous media and lattices in the plane.

Lattices and quadratic forms are fundamental mathematical objects important to number theory, the theory of finite groups, error-correcting codes, cryptography, and crystallography. One of my principal lines of research is the study of Delaunay polytopes and tilings of lattices and their relationship to the reduction theories for quadratic forms, in particular to the theory of perfect and extreme forms.

Selected Publications:

On the density of three-dimensional compacta, Doklady Mathematics **48** (1993), 110–113.

Generatrice: the problems of Maxwell and Voronoi (with S. Ryshkov), Doklady Mathematics **54** (1996), 614–617.

The theory of quality translation with applications to tilings (with S. Ryshkov), Europ. J. Combin. **18** no. 4 (1997), 431–445.

Stresses and liftings of cell-complexes, Discrete and Comput. Geom. **21** (1999), 481–517.

On traces of d-stresses in the skeletons of lower dimensions of homology d-manifolds (with R. Erdahl and S. Ryshkov), Europ. J. Combin. (2000), accepted.

Laurent Saloff-Coste

Professor of Mathematics

I am an analyst who enjoys touching on other areas including probability theory and geometric group theory. I study different aspects of heat diffusion on manifolds from the point of view of both partial differential equations and stochastic processes. I am mainly interested in those properties that relate to the large scale geometry of the underlying space. For instance, I have recently been trying to understand how heat diffusion is affected by the existence of more than one end on a manifold. Potential theory and functional analysis often provide the framework and tools to study these properties.

I also work on random walks on groups. For instance, card shuffling methods can be modelized as random walks on the symmetric group. In this example, the group is finite but, in general, it can be infinite. What interests me most in this subject is relating the behavior of random walks to the algebraic structure of the group and to the geometry of its Cayley graphs.

Random walks on finite groups are special examples of finite Markov chains. In the past 10 years, I have worked on quantitative estimates for ergodic finite Markov chains. Some of the most interesting examples of such chains are connected to combinatorial problems that are not tractable by deterministic algorithms but for which a reasonable stochastic algorithm exists. These stochastic algorithms often involve a finite Markov chain as one of the main building blocks. In this context, obtaining quantitative estimates is essential.

Professional Activities: Editor for *Mathematische Zeitschrift*. Associate Editor of *Stochastic Processes and their Applications*, the *European Series of Industrial and*

Applied Mathematics (Probability and Statistics), and *Annales de la Faculté des Sciences de Toulouse*.

Selected Publications:

Bounds for Kac's master equation (with P. Diaconis), Comm. Math. Physics **209** (2000), 729–755.

On the stability of the behavior of random walks on groups (with C. Pittet), J. Geometric Analysis **10** (2001), 713–737.

On the relation between elliptic and parabolic Harnack inequalities (with W. Hebisch), Annales de l'Institut Fourier **51** (2001), 1437–1481.

Harnack inequality and hyperbolicity for subelliptic p-Laplacians with applications to Picard type theorems (with T. Coulhon and I. Holopainen), Geometric and Functional Analysis **11** (2001), 1139–1191.

Central Gaussian semigroups of measures with continuous densities (with A. Bendikov), J. Functional Analysis **186** (2001), 206–268.

Probability on groups: random walks and invariant diffusions, Notices of the AMS **48** (2001), 968–977.

Aspects of Sobolev-Type Inequalities, London Mathematical Society Lecture Note Series **289**, Cambridge University Press, 2002.

Dirichlet heat kernel in the exterior of a compact set (with A. Grigor'yan), Comm. Pure Appl. Math. **55** (2002), 93–133.

Alfred H. Schatz

Professor of Mathematics

My field of research is numerical analysis. I have been principally involved in the analysis and construction of finite element methods for the approximate solution of partial differential equations. In particular I have been investigating both the local behavior of such matters and another phenomena associated with them called superconvergence. Many physical problems have solutions that are smooth in some places and are nonsmooth (having singularities) in others. In the numerical solution of these problems, the singular part of the solution is not only difficult to approximate but often lowers the quality of (pollutes) the approximation even where the solution is nice. I have been involved in understanding this phenomena and finding a way to improve the approximations.

Another facet of the research is to find properties of the computed approximate solutions which, when taken into account, can be used to produce better approximations than one has before. These are so called superconvergent approximations and their importance resides in the fact that the original approximations are usually difficult to obtain but usually the new approximates may be orders of magnitude better and easily computed from them.

Selected Publications:

Superconvergence in finite element methods and meshes which are locally symmetric with respect to a point (with I. Sloan and L. Wahlbin), SIAM Journal of Numerical Analysis, to appear.

Interior maximum norm estimates for Ritz Galerkin methods part II (with L. Wahlbin), Mathematics of Computation, to appear.

Some new error estimates for Ritz Galerkin methods with minimal regularity assumptions (with J. Wang), Mathematics of Computation, submitted.

Jason Schweinsberg

H. C. Wang Assistant Professor of Mathematics

I work in probability theory. Much of my research has focused on stochastic processes involving coalescence. One can think of coalescent processes as modeling a system of particles in which the particles start out separated and then merge into clusters as time goes forward. The probabilistic behavior of a coalescent process is determined by the rates at which clusters merge.

Coalescent processes can be used to model the ancestral structure of a population. In this application, the "particles" represent individuals in the current generation, and the merging of particles corresponds to the merging of ancestral lines going backward in time. The ancestral structure of many populations can be described by Kingman's coalescent, in which each pair of particles is merging at rate one. I have studied primarily alternative models of coalescence called "coalescents with multiple collisions" in which many particles can merge together at once. These coalescent processes can be used to model populations which have a few very large families. They can also be used to model "selective sweeps," in which a selectively favorable mutation sweeps through the entire population within a short time. In my thesis, I studied "coalescents with simultaneous multiple collisions," in which many particles can merge together at one time and many such mergers can occur simultaneously.

I have recently worked on some problems involving fragmentation processes, which can be viewed as coales-

cent processes run in reverse. I have also done some research related to reversible Markov chains. Some of this work has focused on the link between the recurrence and transience of reversible Markov chains and the notion of P-admissibility in statistical decision theory.

Awards and Honors: NSF Postdoctoral Fellowship (2001–2004).

Selected Publications:

A necessary and sufficient condition for the Lambda-coalescent to come down from infinity, Electron. Comm. Probab. **5** (2000), 1–11.

Coalescents with simultaneous multiple collisions, Electron. J. Probab. **5** (2000), 1–50.

Applications of the continuous-time ballot theorem to Brownian motion and related processes, Stochastic Process. Appl. **95** (2001), 151–176.

An $O(n^2)$ bound for the relaxation time of a Markov chain on cladograms, Random Struct. Alg. **20** (2002), 59–70.

Conditions for recurrence and transience of a Markov chain on $Z+$ and estimation of a geometric success probability (with J. Hobert), Ann. Statist., to appear.

Shankar Sen

Professor of Mathematics

Most of my research concerns invariants associated with representations of Galois groups of p-adic fields and algebraic number fields. These invariants, though of an arithmetic nature, are related to classical invariants arising in complex algebraic geometry; their study should shed light on geometric aspects of equations over number fields or p-adic fields. Recently, I have studied families of Galois representations depending analytically on p-adic parameters, and how the invariants for such families change with the parameters. Techniques from p-adic analytic function theory and functional analysis have proved useful in this connection.

Invited Lectures: Delivered a talk at the Nottingham conference on Number Theory (1996); at Cambridge University, England (1996); at a Conference on Arithmetic, Algebra and Geometry, Braga, Portugal (1997); and at the Durham conference on Group Theory and Number Theory (3 lectures, 1997).

Selected Publications:

Lie algebras of Galois groups arising from Hodge-Tate modules, Annals of Math. (1973).

On explicit reciprocity laws, J. Reine Angew Math. (1980 & 1981).

Continuous cohomology and p-adic Galois representations, Inventiones Math. (1980).

Integral representations associated with p-adic field extensions, Inventiones Math. (1988).

The analytic variation of p-adic Hodge structure, Annals of Math. (1988).

An infinite-dimensional Hodge-Tate theory, Bulletin Math. Soc. France (1992).

Galois cohomology and Galois representations, Inventiones Math. (1993).

Richard A. Shore

Professor of Mathematics

My major research interests have centered around analyzing the structures of relative complexity of computation of functions on the natural numbers. The primary measure of such complexity is given by Turing reducibility: f is easier to compute than g, if there is a (Turing) machine which can compute f if it is given access to the values of g. I have also worked with various other interesting measures of complexity that are defined by restricting the resources available primarily in terms of access to g. The general thrust of my work has been to show that these structures are as complicated as possible both algebraically and logically (in terms of the complexity of the decision problems for their theories). These results also allow one to differentiate among different notions of relative complexity in terms of the orderings they define.

Another major theme in my work has been the relationship between these notions of computational complexity and ones based on the difficulty of defining functions in arithmetic. Restricting the computational resources more directly in terms of time or space leads out of recursion theory and into complexity theory. Relaxing the restrictions by allowing various infinitary procedures leads instead into generalized recursion theory or set theory.

The methods developed in these investigations are also useful in determining the effective content of standard mathematical theorems (when can existence proofs be made effective) and the inherent difficulty of combinatorial theorems in proof theoretic terms. Recently, I have also been working on issues in effective model theory and algebra connected with the problem of how the computational properties of algebraic structures can vary with different (but always computable) presentations of the models.

Professional Activities: Editor of the North-Holland book series Studies in Logic and the Foundations of Mathematics. President of the Association for Symbolic Logic.

Invited Lectures: Spoke at a special session on reverse mathematics, ASL, Philadelphia, PA, March 2001.

Selected Publications:

α-recursion theory; in Handbook of Mathematical Logic (J. Barwise, ed.), North-Holland, 1977, pp. 653–680.

The homogeneity conjecture, Proceedings of the National Academy of Sciences **76** (1979), 4218–4219.

Definable degrees and automorphisms of $\mathcal{D}$ (with L. Harrington), Bull. Amer. Math. Soc. (NS) **4** (1981), 97–100.

The degrees of unsolvability: the ordering of functions by relative computability; in Proc. Inter. Congress of Mathematicians (Warsaw) (1983) PWN-Polish Scientific Publishers, Warsaw 1984, Vol. 1: 337–346.

The structure of the degrees of unsolvability; in Recursion Theory (A. Nerode and R. A. Shore, eds.), Proceedings of The Symposia in Pure Mathematics **42**, AMS, Providence, R. I. (1985), 33–51.

Recursive limits on the Hahn-Banach theorem (with A. Nerode and G. Metakides), Contemporary Mathematics **39** (1985), 85–91.

On the strength of König's theorem for infinite bipartite graphs (with R. Aharoni and M. Magidor), J. Comb. Theory (B) **54**, (1992), 257–290.

The p-T-degrees of the recursive sets: lattice embeddings, extension of embeddings and the two quantifier theory (with T. Slaman), Theoretical Computer Science **92** (1992), 263–284.

Logic for Applications (with A. Nerode), Texts and Monographs in Computer Science, Springer-Verlag, New York, 1993; second edition, Graduate Texts in Computer Science, Springer-Verlag, New York, 1997.

Definability in the recursively enumerable degrees (with A. Nies and T. Slaman), Bull. Symb. Logic **2** (1996), 392–404.

Defining the Turing jump (with T. Slaman), Math. Research Letters **6** (1999), 711–722.

On the solution of the Goncharov-Ash problem and the spectrum problem in the theory of computable models (with B. Khoussainov), Dokl. Akad. Nauk **371** (2000), 30–31 (Russian); English version: Doklady Mathematics **61** (2000), 178–179.

The prospects for mathematical logic in the twenty-first century (with S. Buss, A. Kechris and A. Pillay), Bulletin of Symbolic Logic **7** (2001), 169–196.

Reyer Sjamaar

Associate Professor of Mathematics

I study actions of Lie groups on symplectic manifolds. This is an area of differential geometry related to algebraic geometry and mathematical physics. Some of my recent work concerns moment polytopes and leads to improved versions of certain eigenvalue inequalities in matrix analysis.

Selected Publications:

Moment maps and Riemannian symmetric pairs (with L. O'Shea), Math. Ann. **317** no. 3 (2000), 415–457.

Coadjoint orbits, moment polytopes and the Hilbert-Mumford criterion (with A. Berenstein), J. Amer. Math. Soc. **13** no. 2 (2000), 433–466.

John Smillie

Professor of Mathematics

My area of interest is dynamical systems. I have done work on polygonal billiards and dynamics of flows on Teichmüller space; analysis of algorithms; and diffeomorphisms of surfaces. I am currently working on complex dynamics in two dimensions.

Professional Activities: Served on the NSF Panel on Dynamical Systems and Ergodic Theory.

Selected Publications:

Polynomial diffeomorphisms of $\mathbb{C}^2$ VI: connectivity of J (with E. Bedford), Annals of Mathematics **148** (1998), 695–735.

Polynomial diffeomorphisms of $\mathbb{C}^2$ VII: hyperbolicity and external rays (with E. Bedford), Ann. Scient. Ec. Norm. Sup. **4** (32) (1999), 455–497.

Billiards on rational-angled triangles (with R. Kenyon), Comment. Math. Helv. **75** (2000), 65–108.

The dynamics of billiard flows in rational polygons; in Encyclopedia of Mathematical Sciences, vol. 100 (edited by Yu. Sinai), Springer-Verlag, 1999.

Polynomial diffeomorphisms of $\mathbb{C}^2$ VIII: quasi-expansion (with E. Bedford), Amer. J. Mathematics **124** (2002), 221–271.

Real polynomial diffeomorphisms with maximal entropy I: tangencies, preprint.

Lawren Smithline

VIGRE Assistant Professor of Mathematics

I study p-adic modular forms. This area of number theory generalizes classical modular forms, which have starred in the resolution of long-standing problems such as Fermat's Last Theorem. The methods of p-adic analysis bridge algebraic geometry and classical analysis.

The combinatorial properties of the Atkin U operator have held special interest for me. Their structure makes computer experiments easy. The data suggest properties of the operator which result from the mode of generation, rather than the particular parameters derived from the modular forms. As described in recent seminars and a forthcoming paper, the U operator is an example of a compact operator with rational generating function.

Administrative Activities: Selection committee for the Ithaca High School senior math prize. Co-organizer of a special seminar for very able high schoolers next year.

Invited Lectures: Gave a talk at the Quebec-Vermont number theory seminar (Apr. 2002) and at the Canadian Number Theory Association (May 2002).

Avery Solomon

Senior Lecturer of Mathematics

My position involves me in mathematics, math education and outreach programs in several area schools. I teach courses in mathematics at Cornell and teach a variety of sections of the special course Math 508 — *Mathematics for Secondary Teachers* — both at Cornell and at local sites within a 50 mile radius of Ithaca. My position in the Cornell Teacher Education program in the Department of Education has involved me in supervising student teachers and co-teaching the math/science methods course Educ 602.

In addition to these courses, I am the director of the Cornell/Schools Mathematics Resource Program (CSMRP). Through this program I organize and co-teach Saturday workshops and summer programs, consult with school districts, work with teachers directly to develop curriculum and programs, visit classrooms and occasionally teach classes in middle schools or high schools, teach workshops in schools and at BOCES.

For the past eight years the CSMRP has held teacher workshops meeting four Saturdays a year. These workshops focus on both content and pedagogy, giving teachers a chance to immerse themselves for a time in mathematical problems, share ideas, and get inspiration for their classes. We often examine basic mathematics concepts from a more mature standpoint, and also present interesting and relevant topics to get teachers interested in their own mathematical explorations, as well as presenting new curricula and introducing software environments as teaching tools. We now have a core group of about 25 teachers, and a larger group of about 50 others who are part of our e-mail list and occasionally attend.

Our week long summer institute for mathematics teachers, given for the past eleven years, has recently focused on teaching geometry, especially exploring geometry on spheres and other surfaces, and *Geometer's Sketchpad* software.

Our program in the classrooms focuses on a few exemplary teachers, supporting their efforts to develop modules and activities in the classroom, and share these with other teachers through visits, workshops, and actual classroom intervention. One of our middle school teachers taught a model two-week unit at two different middle schools while the 7th and 8th grade teachers watched, and then they taught the lessons to their other sections. Math lab activities and structure developed with high school teachers is being used in classrooms in several districts.

My current interests include developing exploratory units for high school mathematics, the use of *Sketchpad* as an environment for learning geometry, and integrating mathematics and philosophy in a humanist context. A long range plan is to produce materials for a manual for 6-12 mathematics teachers which would provide essential insights into selected topics, interrelations and meanings. This text would also serve pre-service teachers of mathematics, helping them to look back at their own pre-college experiences from a more mature standpoint. I am interested in studying the role of intuition in mathematical exploration, and in continuing to pursue the relation of philosophy and mathematics as a route to self-knowledge.

Grants: Twelve DDE Title IIA grants awarded by the New York State Department of Education to support in-service programs for teachers, 1986–present. Participant in UFE grant through NSF for enhancement of college teaching, with David Henderson, 1995–present.

Articles/Videos:

A manual of mathematics labs to accompany Course I mathematics (with Amy Davis of Moravia High School), self published.

Puppies Pen, a video of a pilot intervention program for Middle School Mathematics.

Levels of knowledge submitted for publication in Parabola, 1997.

A constructivist dilemma: an episode from middle school mathematics.

Geometric patterns in nature, being prepared for publication.

Proportions and levels of meaning in mathematics; in For the Learning of Mathematics, 1991.

What is a line?; in For the Learning of Mathematics, 1991.

A fractal outline of a fractal course, AMTYS journal, 1989.

Birgit Speh

Professor of Mathematics
Director of Undergraduate Studies

I am interested in representation theory of semisimple Lie groups as well as in arithmetic groups and analytic number theory. In the last few years most of my work concerned the cohomology of arithmetic groups, the Arthur Selberg trace formula and its application to problems in automorphic forms and number theory.

Professional Activities: Editor of the *Journal of Representation Theory* and the *New York Journal of Mathematics*. Served on the AMS Committee on Academic Freedom, Tenure and Employment Security.

Invited Lectures: Delivered a lecture at Analytic and Geometric Aspects of the Langlands Program, Tel Aviv University, March 2001 and at the Max Plank Institut fuer Mathematik, June 2001.

Selected Publications:

Absolute convergence of the spectral side of the Arthur Selberg trace formula for GL(n) (with W. Mueller), preprint.

Pseudo Eisenstein series and the cohomology of arithmetic groups II (with J. Rohlfs), preprint.

Michael Stillman

Professor of Mathematics

My main areas of interest are computational algebra and algebraic geometry, commutative algebra, and algebraic geometry. My original interest in computational methods was their application to problems in algebraic geometry. Since then, my work has proceeded in several related directions. I have studied the complexity of the algorithms (mainly Gröbner bases). I have been developing algorithms for computing in commutative algebra and algebraic geometry. For example, I have developed algorithms for manipulating line bundles in algebraic geometry (with M. Brundu), computing Hilbert functions (with D. Bayer), and finding integral closures of polynomial rings.

My original interest in these methods was to actually use them in my research in algebraic geometry. D. Bayer (of Columbia) and I have designed and implemented a specialized computer algebra system, which we call "Macaulay," which includes many of these algorithms. Hundreds of researchers use this system. The latest version includes algorithms for a large number of useful operations in algebraic geometry (written with D. Eisenbud).

Selected Publications:

A criterion for detecting m-regularity (with D. Bayer), Invent. Math. **87** (1987), 1–11.

A theorem on refining division orders by the reverse lexicographic order (with D. Bayer), Duke Math. J. **55** (1987), 321–328.

Determinantal equations for algebraic curves of high degree (with D. Eisenbud and J. Koh), Amer. J. Math. **110** (1988), 135–147.

On the complexity of computing syzygies (with D. Bayer), J. Symbolic Comp. **6** (1988), 135–147.

Computing the equations of a variety (with M. Brundu), Trans. AMS (1991), to appear.

Some matrices related to Green's conjecture (with D. Bayer), Sundance Conference Proceedings on Free Resolutions (1991), to appear.

Robert S. Strichartz

Professor of Mathematics

Mathematics is an adventure. As a research mathematician, I have wandered along many paths, always enjoying the discoveries that have come my way and never knowing exactly where I might be heading next. I have certainly not been following a geodesic! Perhaps its has been just a random walk. Yet sometimes I think there

has been some purpose behind it, to bring me to the work I am doing today. So here is a synopsis of where I have been and what it might add up to.

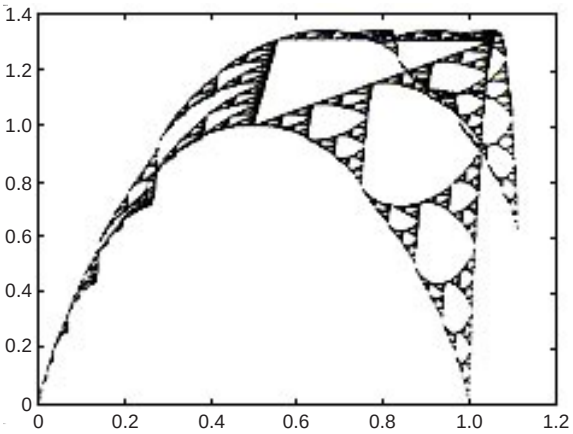
In my thesis I studied Sobolev spaces, an important class of function spaces useful in the theory of partial differential equations, and gave an important characterization of Sobolev spaces with smoothness coefficient not equal to an integer. In my early work I studied applications of harmonic analysis to wave equations and made contributions to the theory of pseudo-differential operators and harmonic analysis on semi-simple symmetric spaces.

Beginning in the 1980s, my work became more geometric. I applied harmonic analysis to integral geometry, in which the central problem is to reconstruct a function from its integrals over geometrically simple sets such as straight lines or planes. I used Riemannian geometry as a kind of metaphoric prism to understand the significance and relationships among the basic concepts and constructions of harmonic analysis. I also studied a generalization of Riemannian geometry which I am trying to call "Sub-Riemannian" (as opposed to the unwieldy name "Carnot-Caratheodory"). This geometry is related to sub-elliptic differential equations, and arises naturally in the theory of nilpotent Lie groups.

In the 1990s I began working on fractal geometry and the theory of wavelets. The underlying theme in both these areas is the idea of *self-similarity*, in which the whole is written as a sum of parts, each of which is similar to the whole. I have developed the idea of a Fractal Plancherel Theorem, both in the general case and for self-similar measures, in which I showed how the fractal properties of a measure show up in the asymptotic behavior of its Fourier transform.

In connection with this work I have become involved with what might be called "experimental mathematics." The idea is to use computer experiments to explore mathematical problems, with the goal of generating interesting conjectures that can then be proven using conventional mathematical reasoning. My experimental research has been done in collaboration with undergraduate students, with the support of the REU (Research Experiences for Undergraduates) Program sponsored by the NSF. Starting in the summer of 1994, I have directed an REU site program at Cornell.

Recently, I have been working on analysis on fractals. The idea is to develop the analog of calculus for functions defined on fractals and to study the resulting fractal differential equations that might be used to model physical processes taking place in fractal objects. Through the work of Jun Kigami, it is possible to define the analog of a Laplacian on some fractals as a limit of difference quotients. This Laplacian has some strange properties, such as: 1) there exist localized eigenfunctions; 2) there exist harmonic functions locally constant, but not globally constant; 3) if the Laplacian of u is defined, then the Laplacian of u^2 is not defined (unless u is constant); 4) the associated wave equation does not have a finite propogation speed. I have been working on learning more about this Laplacian, and I have developed tools of numerical analysis to approximate solutions to various fractal differential equations. The graph of the ground state eigenfunction on the Sierpinski gasket is shown below.



In addition to my research, I have maintained an interest in mathematical exposition. I received a Lester Ford Award from the Mathematical Association of America in 1983 for expository writing, and in 1982 I won the first prize in the French Museum Competition sponsored by the Mathematical Intelligencer. I have published two textbooks, *A Guide to Distribution Theory and Fourier Transforms* and *The Way of Analysis*, based on course notes that have been used at Cornell for many years in Math 413, 414, 422 and 615.

Edward Swartz

VIGRE Assistant Professor of Mathematics

My research centers on the interplay between matroids, geometry/topology and algebra. Matroids are combinatorial abstractions of linear independence. Their enumerative properties have applications in a variety of fields, including graph coloring and flows, linear coding, arrangements of hyperplanes, and problems in reliability theory. My interest in matroids originally started with the discovery of a close connection between matroids and quotients of spheres by elementary abelian p-groups. More recently, I have used face rings to establish a matroid analog of the g-theorem for simplicial polytopes.

Selected Publications:

Matroids and quotients of spheres, Mathematische Zeitschrift (2002).

g-elements of matroid complexes, submitted.

h-vectors of $k - CM$, broken circuit and independence complexes, preprint.

Moss Sweedler

Professor Emeritus of Mathematics

First I worked in the area of Hopf algebras and wrote *Hopf Algebras*, which came to be the standard reference book on the subject. H. Allen and I used Hopf algebras to prove a 25 year old conjecture of Jacobson. Over the ensuing years until about the mid eighties, I worked and published in the areas of commutative algebra and algebraic geometry, real-algebraic geometry, homological algebra, algebraic groups, purely inseparable field extensions and general positive characteristic phenomena, simple algebras and generalizations of the Brauer group, and differential algebra. Since the mid eighties I have primarily worked in the area of computer algebra, especially computational commutative algebra. This has produced both theoretical and applied results with applications beyond mathematics, such as to error control codes and resulted in my position as Director of the Army Center of Excellence for computer algebra.

Maria S. Terrell

Senior Lecturer of Mathematics
Director of Teaching Assistant Programs

As the director of teaching assistant programs, I am interested in providing opportunities for our graduates students to explore and develop their ideas about learning and teaching mathematics. I have organized workshops for teaching assistants at Cornell, and at regional and national meetings. I am currently working on a project to create materials for calculus instruction to enhance classroom discussion of concepts.

My research area is the geometry of rigid structures. I am interested in some questions about the rigidity of symmetric tensegrities.

Robert E. Terrell

Adjunct Associate Professor of Mathematics
www.math.cornell.edu/~bterrell

Bob Terrell enjoys teaching mathematics and has written software for teaching partial differential equations. He was once an engineer, and might be the only member of the department with patents on machinery.

Harrison Tsai

H. C. Wang Assistant Professor of Mathematics

I am interested in the application of algebraic algorithms in mathematics and science. In the past, my research has been in the development of algorithms for finding algebraic solutions to systems of linear partial differential equations. Currently, I am becoming interested in the optimization of polynomials. For polynomials with many variables, heuristic methods are necessary for practical purposes and the behavior of algorithms can be unpredictable. However, for certain special classes of polynomials, algorithms can be robust. I am interested in identifying such situations and investigating their relevant mathematical properties.

Awards and Honors: NSF Postdoctoral Fellowship (2000–2003). Japan Society for the Promotion of Science (JSPS) Fellowship (spring 2001, Kobe University).

Selected Publications:

Polynomial and rational solutions of holonomic systems (with T. Oaku and N. Takayama), Journal of Pure and Applied Algebra, to appear.

Computing homomorphisms between holonomic D-modules (with U. Walther), Journal of Symbolic Computation, to appear.

D-modules on smooth toric varieties (with M. Mustata, G. Smith and U. Walther), Journal of Algebra, to appear.

Algorithms for associated primes, Weyl closure and local cohomology of D-modules, Proceedings of Guanajuato conference on local cohomology, to appear.

Warwick Tucker

H. C. Wang Assistant Professor of Mathematics

Mainly, I have been studying auto-validating algorithms for ordinary differential equations. In particular, I have focused on Taylor methods using automatic differentiation tools combined with interval arithmetic. In a second project, I have been collaborating with Mike Coleman of Cornell's Human Power and Robotics Lab on a project on passive dynamic walking. In a third project, I have been working with the Cornell Big Red Artificial Intelligence Navigator team. The goal of this project is to "advance the state-of-the-art Autonomous Underwater Vehicles (AUVs) by challenging a new generation of engineers to perform realistic missions in the underwater environment." The competition is to be held July 11–15, 2001, and takes place at the United States Naval Academy in Annapolis, Maryland.

Awards and Honors: The Swedish Mathematical Society's Wallenberg Prize.

Professional Activities: Reviewer for *Mathematical Reviews*. Referee for *Foundations of Computational Mathematics*. Supervised Ben Szekely, a Math 420 student, on a project aimed at visualizing ODEs using Java.

Invited Lectures: Delivered invited talks at the University of Maryland, Penn State University, Queen Mary's College (UK) and at Cornell's CAM Colloquium. Invited lecturer at the conference "Recent Trends in Dynamics," University of Porto, Portugal, 2001.

Selected Publications:

Computational algorithms for ordinary differential equations, EQUADIFF 99, World Scientific, Singapore, 2000.

A rigorous ODE solver and Smale's 14th problem, Foundations of Computational Mathematics, to appear.

Alexander Vladimirsky

H. C. Wang Assistant Professor of Mathematics

My research is mostly focused on design of Ordered Upwind Methods (OUMs). Numerical schemes for nonlinear static PDEs often require solving coupled systems of non-linear discretized equations. OUMs use partial knowledge of the direction of information flow to decouple those systems: solving the discretized equations one at a time is much more efficient. My thesis was devoted to construction of OUMs for the PDEs arising in the anisotropic exit-time optimal trajectory problems. These methods were later extended to a wider class of problems in anisotropic control theory and front propagation. I am currently collaborating with John Guckenheimer to build OUMs for the computationally intensive problems in dynamical systems (e.g., grid representation of invariant manifolds for systems with multiple time scales).

I am also fascinated by the phenomenon of "anisotropy" and its different manifestations in wave physics, crystallography, and optimal control. A naïve statement of Huygens' principle can be extended to construct the wave fronts expanding in inhomogeneous anisotropic media; however, its efficient usage for computational purposes can be problematic. The questions of direct computational interest include first-arrival times (e.g., when will a spreading fire reach a certain location?), multiple arrivals (e.g., aftershocks of earthquakes), and asymptotic behavior (e.g., what will be the ultimate shape of a growing crystal?).

Awards and Honors: NSF Postdoctoral Research Fellowship, 2001–2004. Bernard Friedman Memorial Prize in Applied Mathematics, University of California at Berkeley, 2001.

Selected Publications:

Fast methods for the Eikonal and related Hamilton-Jacobi equations on unstructured meshes (with J. A. Sethian), Proc. Nat'l Acad. Sci. USA **97** no. 11 (2000), 5699.

Ordered upwind methods for static Hamilton-Jacobi equations (with J. A. Sethian), Proc. Nat'l Acad. Sci. USA **98** no. 20 (2001), 11069.

Ordered upwind methods for hybrid control (with J. A. Sethian), Proceedings of the 5th International Workshop on Hybrid Systems: Computation and Control, Stanford, CA, USA, March 25–27, 2002 (LNCS 2289).

Karen Vogtmann

Professor of Mathematics

A fundamental technique for studying a group G is to view G as a group of automorphisms of geometric object C. Geometric and topological properties of C can then be used to study algebraic properties of G. Beautiful classical examples of this are the theory of arithmetic and S-arithmetic groups acting on homogeneous spaces and buildings, including work of Borel and Serre on cohomological properties of these classes of groups, and the theory of groups of surface homeomorphisms acting on the Teichmüller space of the surface. My main area of research interest is in developing geometric theories for other classes of groups. In particular, I have worked with orthogonal and symplectic groups, SL_2 of rings of imaginary quadratic integers, groups of automorphisms of free groups, and mapping class groups of surfaces.

Awards and Honors: NSF Visiting Professorships for Women, Cornell University (1984–85). Invited hour address, AMS Summer Meeting, Provo, Utah (1986). NSF Career Advancement Award, MSRI (1989). Research Professorship, MSRI (1995).

Professional Activities: Executive committee of the AMS. Referee for professional journals. Chair of the Committee on Meetings and Conferences of the AMS. Research board of the American Institute of Mathematics.

Selected Publications:

Spherical posets and homology stability for $O_{n,n}$, Topology **20** (1981), 119–132.

Moduli of graphs and automorphisms of free groups (with M. Culler), Inventiones **84** (1986), 91–119.

Equivariant outer space and automorphisms of free-by-finite groups (with S. Krstic), Comment. Math. Helvetici **68** (1993), 216–262.

A group-theoretic criterion for property FA (with M. Culler), Proc. AMS **124** no. 3 (1996), 677–683.

Cerf theory for graphs (with A. Hatcher), Jour. London Math. Soc. **58** part 3 (1998), 633–655.

Whitehead's algorithm for surface groups (with G. Levitt), Topology **39** no. 6 (2000), 1239–1251.

The symmetries of Outer space (with M. Bridson), Duke Mathematical Journal **106** no. 2 (2001), 391–409.

Geometry of the space of phylogenetic trees (with L. Billera and S. Holmes), Advances in Applied Math **27** (2001), 733–767.

Lars B. Wahlbin

Professor of Mathematics

At present one can compute "solutions" to very tough nonlinear, singular problems on, say, a supercomputer. Most often, numerical analysis does not furnish theorems that cover a practical situation, but it provides insight into the behavior of the relevant numerical method on carefully chosen model problems with, at best, some of the most pertinent difficulties of the real problem present.

My work in numerical analysis is aimed at gaining a fundamental understanding of numerical methods. Such insight is also necessary for constructing better algorithms. My particular interest is in methods for partial differential equations, and lately I have been studying the precise and detailed behavior of the finite-element methods in a variety of problems; the most interesting ones contain singularities of various degrees of nastiness.

Professional Activities: Editor for *Mathematics of Computation*.

Selected Publications:

Local behavior in finite element methods; in Handbook of Numerical Analysis (P. G. Ciarlet and J. L. Lions, eds.), Vol. II (Part 1), North Holland (1991), 353–522.

Superconvergence in Galerkin Finite Element Methods, Springer Lecture Notes in Mathematics **1605**, Springer-Verlag New York, 1995.

Beverly H. West

Senior Lecturer of Mathematics

My chief interest is in mathematics teaching, particularly of differential equations, multivariable/vector calculus and dynamical systems (both real and complex). I use interactive computer graphics, writing, student interaction, and many choices within assignments to reach and empower a diverse student audience.

Awards and Honors: Invited address, *Computer graphics in mathematics education*, at the Grand Opening of Fields Institute, Waterloo, Ontario (1992). Plenary address, *Computer graphics in differential equations*, at Seventh International Congress on Mathematical Education (ICME7), Quebec (1992). Guest Editor of The Col-

lege Mathematics Journal for Nov. 1994 issue devoted to innovations in the teaching of differential equations.

Professional Activities: Member of the MAA, SIAM, AWM, NYAS, NCTM, and CODEE (NSF Differential Equations Consortium with Harvey Mudd College, Rensselaer Polytechnic Institute, St. Olaf College, Washington State University and West Valley Community College to promote computer graphics experimentation in differential equations courses and provide workshops).

National Advisory Board for Silvia Heubach's California State University at Los Angeles NSF project on An Innovative Modeling Approach at the Freshman/Sophomore Level (1997–99) and for J. McDill's Cal Poly San Luis Obispo NSF project on interactive business calculus.

Two intensive consulting trips to Olin College of Engineering about inventing the appropriate mathematics curriculum for their innovative college — dynamical systems with technology and qualitative analysis were the focus of their request for expertise.

Invited Lectures:

MAA Short Course on Teaching Differential Equations (with Paul Blanchard et. al.; July 1999).

Successful take-home examinations: multivariable calculus and differential equations, International Conference on Technology in Collegiate Mathematics (ICTCM), San Francisco (Nov. 1999).

Real time dynamics: why it makes a difference (with J. McDill), International Conference on Technology in Mathematics Teaching (ICTMT), Plymouth, England (Aug. 1999) and MAA Winter Meetings (Jan. 2000); Women in Science Delegation to Egypt.

Selected Publications:

*Analyzer** (with D. Alfors), an exhaustive software package for studying functions of a single variable (1990 EDUCOM/NCRIPTAL Distinguished Mathematics Software Award), Addison Wesley, 1992.

MacMath (with J. Hubbard), 12 interactive graphics programs for the Macintosh, to accompany the Differential Equations texts, second edition, Springer-Verlag, 1994; new expanded version in progress.

A new look at the Airy equation with fences and funnels (with J. Hubbard, J. McDill and A. Noonburg), College Math. J. (1994); Proc. Organic Mathematics Project (1996); CECM, Simon Fraser Univ. (1997).

Differential Equations: A Dynamical Systems Approach (with J. Hubbard), Springer-Verlag; Part I: One-Dimensional Equations, 1991, 1997; Part II: Higher-Dimensional Equations, 1995.

Interactive Differential Equations (with S. Strogatz, J. M. McDill, J. Cantwell and H. Hohn), a CD-ROM with laboratory workbook, Addison Wesley Interactive, 1996, 1.1 for Mac and 2.0 for Windows, 1997.

ODE Architect (with C•ODE•E, NSF Consortium for ODE Experiments), John Wiley and Sons, 1998. An interactive teaching, learning and research environment on CD Rom with Companion Book of 269 pages. This package won an Invision '98 award as one of "The 9 Best CD-Roms on the Planet" (against all sorts of nonmathematics competitors)!

Technology in differential equations courses: my experiences, student reactions, a chapter for an MAA volume on teaching differential equations "in the new millenium" (M. Kallaher, ed.).

Differential Equations and Linear Algebra (a combined text with J. Farlow, J. Hall and J. McDill), Prentice Hall, 2002.

James West

Professor of Mathematics

My research has focused on the topology and symmetries of manifolds of finite and infinite dimensions, and on the related topics of polyhedra, absolute neighborhood retracts, function spaces and spaces of sets.

An example of the interplay between these theories is that manifolds modeled on the Hilbert cube appear naturally in several ways as limits of stabilization processes for finite-dimensional objects, and, unlike standard function space stabilization, retain more of their important properties, e.g., simple homotopy type. Study of the Hilbert cube manifolds has produced several of the initial breakthroughs in introducing control into the homeomorphism theory of finite-dimensional manifolds. This in turn, has been useful in analyzing the failure of the classical matrix algebra to describe equivariant homeomorphisms and homotopy types of manifolds with locally linearizable transformation groups, which in turn has led to new results on the topological classification of linear representations of finite groups. I have been involved in these studies.

Professional Activities: Member of the editorial board of *Fundamenta Mathematicae*.

Administrative Activities: Faculty reader of Arts College freshman admissions applications.

Invited Lectures: Delivered an invited talk at the Universidad Nacional Autónoma de México.

Milen Yakimov

H. C. Wang Assistant Professor of Mathematics

The main area of my research is representation theory and its applications. More concretely I study quantized universal enveloping algebras and affine Kac-Moody algebras. I am interested in the interplay between their categories of representations (extending the work of D. Kazhdan and G. Lusztig) as well as developing theory of Harish-Chandra modules for those. Primarily categories $\mathcal{O}$ in the sense of J. Bernstein, I. Gelfand, and S. Gelfand for those were studied so far. From another side I work on the approach to representations of Hopf algebras through the geometry of the related quasiclassical structures Poisson-Lie groups ("Kirillov-Kostant orbit method"). The latter turns out to be much richer than the geometry of the coadjoint orbits in Lie algebras and is very interesting by itself. I am also working on applications of Hopf algebras and Poisson-Lie groups to quantum and classical completely integrable systems. Large part of my research dealt with applications of techniques of completely integrable systems (e.g., Bäcklund-Darboux transformations, W-symmetries) and representation theory ($W_{1+\infty}$ and Weyl algebras) to the so-called "bispectral problem." I am also interested in applications of representations of Hopf algebras to topology and mathematical physics. In the field of deformation quantization I studied in detail the question of quantization of classical completely integrable systems via Fedosov quantization.

Awards and Honors: Clay Foundation Liftoff Mathematician, Summer 2001.

Professional Activities: Referee for several journals.

Invited Lectures: Oliver Club, Cornell University Mathematics Department (Oct. 2001). AMS meeting, Williamstown (Oct. 2001). Conference on representations of loop groups, IPAM, UCLA (Nov. 2001). Yale University Geometry, Symmetries and Physics seminar (Nov. 2001).

Selected Publications:

Symplectic leaves of complex reductive Poisson-Lie groups, Duke Math. J. **112** (2002), 453–509.

Discrete Darboux transformations from Jacobi polynomials (with F. A. Grünbaum), Pacific J. Math. **204** (2002), 395–431.

Quantum invariant measures (with N. Reshetikhin), Comm. Math. Phys. **224** (2001), 399-426.

The double and dual of a quasitriangular Lie bialgebra (with T. Hodges), Math. Res. Lett. **8** (2001), 91–105.

Deformation quantization of Lagrangian fiber bundles (with N. Reshetikhin); in Conférence Moshé Flato 1999, vol. 2, Kluwer Acad. Publ., 2000, 269–288.

Highest weight modules over the $W_{1+\infty}$ algebra and the bispectral problem (with B. Bakalov and E. Horozov), Duke Math. J. **93** no. 1 (1998), 41–72.

Bispectral algebras of commuting ordinary differential operators (with B. Bakalov and E. Horozov), Comm. Math. Phys. **190** no. 2 (1997), 331–373.

Visiting Faculty Program Participants

Béla Bajnok

Gettysburg College

I spent the fall of 2001 and the spring and summer of 2002 at the Cornell Mathematics Department as a visiting associate professor. I am fortunate to have been able to take part in this wonderful opportunity. The Visiting Faculty Program is a unique adventure for mathematicians on sabbatical or other leave from their home institution to advance their teaching and research activities at a leading university.

I enjoyed the amazing array of seminars, lectures, and other academic and cultural events that Cornell had to offer. I am grateful for the opportunity to interact with a wonderful faculty and to use Cornell's unsurpassed Mathematics Library. Teaching such responsive, motivated, and interesting students was a delight; I especially enjoyed and learned from my many discussions on teaching and curriculum with Maria Terrell. I also extend my thanks to the staff members of the department; this cheerful and professional group helped to make my visit enjoyable and successful.

Carolyn DeSilva

Gettysburg College

As my two years at Cornell as a visiting associate professor come to an end, it's pleasant to reflect on my experiences here as a teacher and mathematician, colleague (and temporary resident of a singularly quirky town). Good times, for the most part, with a few truly memorable moments and maybe a couple best forgotten.

The good times (and some of the great) include teaching Cornell students. I've particularly relished the cultural diversity among the student population and the intellectual climate on campus. It goes without saying that the majority of students are extremely bright, hard-working, respectful and attentive. Beyond those qualities, I discovered them to be warm, funny, modest, intensely concerned about the world we all live in, and possessed with social consciences. Maybe they'll clean up after us.

Even though I've been teaching for a long, long time (as they say, since before dirt), I recognize and appreciate what I've learned here in working with Cornell faculty, other visiting faculty, graduate students and undergraduates. Being part of a large community of mathematicians has been intellectually stimulating and challenging. I return to my home institution energized and renewed in my dedication to the profession. (I give it three months.) I cherish the friendships begun here. (These will last.)

The support staff in the Mathematics Department are first-rate (and all deserve massive raises). I'm grateful for their help, their patience and good humor.

Goodbye and good luck to all.

Staff Profiles

Administration

Linda Clasby, Assistant to the Chair (2001): Linda provides administrative support to the chair of the Mathematics Department. She maintains the chair's calendar, screens calls and schedules appointments. She works with the chair to compile committee assignments, coordinates faculty searches, maintains sabbatical records, processes academic personnel forms and maintains academic personnel files. She assists foreign nationals in obtaining proper visa status, arranges lectures and accommodations for prospective faculty/visitors and schedules benefits counseling for new academic employees.

Arletta Havlik, Department Registrar (1968): Arletta provides secretarial and administrative support for the instructional and research programs of the Mathematics Department faculty. Her responsibilities include coordinating the paperwork, course enrollments and inquiries pertaining to enrollment in math courses, and she oversees the department's presence at the central course exchange each semester. In her role as department registrar, she coordinates course enrollments, evaluations and grade submissions. She is the primary technical typist for the department and prepares complex documents involving sophisticated typesetting software (TEX), which involves designing, editing and formatting. Arletta also provides back-up receptionist support.

Joy Jones, Building Coordinator (1980): Joy is the building coordinator and copyroom specialist for the department. She coordinates the day-to-day service operations provided to faculty, visitors, staff and students. She orders supplies, processes purchase orders, and performs records and facilities maintenance, information gathering and data input. Joy assists the accounts coordinator with travel reimbursements, cash deposits, records management and accounts payable. She oversees the mailroom operations, maintains repair and renovation records and secures the building at night. Joy is the person you would call to report any building issues (e.g., repairs, heating and cooling). In addition, she coordinates the refreshments for the weekly seminar series.

Michelle Klinger, Web and Database Administrator (1993): Mikki assists the director of undergraduate studies and the director of teaching assistant programs with various parts of our teaching effort. She works directly with the teaching assistant coordinator to generate the department course schedules. Mikki oversees room assignments and changes, course file management, and screens inquiries pertaining to course offerings. She also acts as back-up technical typist, processing original entry and editing of highly technical mathematical manuscripts. Mikki is the editor of the annual report, and she generates department database directories and reports. Mikki is our web administrator and designer, and she updates and maintains many of our department web pages.

Gayle Lippincott, Accounts Coordinator (1998): Gayle provides administrative, financial and non-academic personnel support for the department. In accordance with university and agency regulations, she develops research budgets and oversees proposal submissions to the Office of Sponsored Programs. She monitors account transactions, approves expenditures, and maintains account information and records. She also processes non-academic appointments, maintains non-academic personnel records, oversees time collection, processes payroll vouchers and distributes paychecks. Gayle assists the administrative manager in the day-to-day operations of the department and serves as acting manager when the administrative manager is unavailable. She is the functional supervisor for the administrative staff.

Brenda Smith, Undergraduate Coordinator (2001): Brenda is the primary resource person for the undergraduate program, which includes approximately 140 majors. The undergraduate coordinator acts as liaison between faculty and their advisees, both majors and over 200 freshmen and sophomores with undeclared majors. She coordinates the application process for the summer Research Experience for Undergraduates (REU) program and maintains various department web pages. She coordinates the annual capital equipment inventory. She is also the department receptionist, conducts the annual faculty recruitment effort and provides administrative support both for the undergraduate program and the administrative manager.

Donna Smith, Graduate Field Coordinator (1997): Donna is responsible for the administration of the department's graduate program, beginning with the admissions process and continuing through graduation. She provides primary support to the director of graduate studies, maintains matriculated student records, processes appointments and generally oversees the administrative functions of the graduate program, consisting of approximately 63 graduate students. She works with the administrative manager and the director of teaching assistant programs to monitor the annual teaching

assistant budget. In addition, she coordinates, schedules, plans and oversees all department social functions. Donna provides backup support to the accounts representative for the department's time collection and payroll effort, and serves as the department's telephone coordinator.

Catherine Stevens, Teaching Program Coordinator (1969): Cathy performs a variety of administrative functions in support of our teaching program. She assigns office space and works with the chair and the director of undergraduate studies to compile teaching assignments. She oversees textbook ordering, issues keys and maintains the department's access device log for keyholders. Cathy plays a key administrative role in overseeing the summer session course offerings, including budget development, teaching assistant assignments and grader support. In addition, she is the editor of the department newsletter, *Math Matters*.

Colette Walls, Administrative Manager (1996): Colette directs the financial, personnel, facilities, communications and funds procurement operations. Her responsibilities include planning, managing and evaluating the administrative operations. She assists the chair (and others) in administering selected academic activities including the course count, budget process, leave replacement funding and TA budget. She maintains, monitors and reconciles departmental appropriated, gift and endowment accounts, and acts as liaison with central college and university offices. She oversees and participates in the publication of newsletters, the annual report and various external surveys, and generates a variety of department, college and university reports. Colette supervises the administrative support staff. She is responsible for maintaining the department's web-based *Survival Manual for Faculty and Teaching Assistants*.

Computer Support

Douglas Alfors, Computer Consultant and Advisor (1998): Doug provides organizational and administrative computer support for the Department of Mathematics. He has primary responsibility for the administrative computer server, including backup, software and hardware installation, operations, inventory and security. He provides computer consulting, including diagnostic and troubleshooting support for department members. Doug assists the network administrator in maintaining the department's computer network.

Robert Terrell, Network Administrator (1997): As network administrator, Bob is responsible for the department computer servers, including networking, backup, software and hardware installation, operations and security. He maintains some of the department's web pages, provides maintenance for the department computer systems — including UNIX, SUN, Macintosh and PC operating systems — and provides computer consulting, diagnostic and troubleshooting support for department members.

Mathematics Support Center

Douglas Alfors, Director (1983): Doug directs and coordinates MSC academic support for mathematics, principally for introductory courses. Such support includes the interviewing, hiring and supervision of student tutors; the day-to-day running of the MSC office; preparation and distribution of written support capsules; and planning and conducting various workshops on topics of common interest (e.g., graphing, infinite series, integration, etc.). He also oversees the use of the computers in the MSC.

Richard Furnas, Teaching Associate (1981): Richard has been a mainstay of the Mathematics Support Center since its inception in the early 1980s. He serves as a tutor, review session leader and general Macintosh guru. Graduate students from other departments often benefit from his counsel on the use of a variety of mathematical techniques in their field of research. Dick also assisted this year in the instruction of MATH 105 (*Finite Mathematics for the Life and Social Sciences*) and MATH 171 (*Statistical Theory and Application in the Real World*).

Mathematics Instructional Computer Lab

Allen Back, Director (1993): Allen is responsible for the primary computer instruction laboratory for the teaching of mathematics. The lab is a teaching arm of the Mathematics Department, and the director addresses pedagogic issues in appropriate instructional uses of computers, acting as a resource person in all related areas. He is responsible for the installation and upkeep of hardware and software, as well as addressing all personnel issues of the lab including selection, training and supervision. Allen also contributes to the development of sample materials, assignments, and help documentation and software of interest to faculty and staff. He gives demonstrations, helps with software use, serves as an advisor on technical issues and assists in relevant grant proposals.

Mathematics Library

Steven Rockey, Mathematics Librarian (1972): Steve is in charge of the library and makes all policy, management and budget decisions. He is the contact for questions about book, journal or other format purchases for the library. Drawing on many years of experience in the library, he can often find an answer or solution for most any question or problem.

Natalie Sheridan, Access Services Supervisor (2001): Natalie oversees the operation of the Math Library's circulation and reserve services. She is also responsible for the hiring, training and supervision of student employees. Natalie can help you with reference questions and is in charge of the library when Steve is not available.