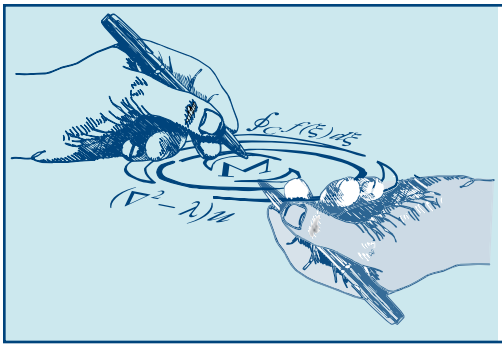
Spring 2006



Reckonings

Reckonings: (n. pl.)
1. Computations or summations
2. Acts of thought or reasoning
3. The newsletter of the Department of Mathematical Sciences at the University of Delaware

Chair's Message

Peter Monk

Following the surprise departure of our chair, Phil Broadbridge, to Australia last spring for family reasons, I was asked by Dean Apple to serve as Interim Chair for the 2005-2006 academic year. Thanks to Phil's impetus and planning, we are having a busy year! In particular we have an extensive hiring program underway. Driven by undergraduate enrollment, we are hiring two continuing non-tenure track teaching faculty. As a result of a generous endowment from the Hollowell family we are seeking to appoint the Hollowell Chair in Mathematics Education. Research needs will lead to the hiring of a number of post-docs and finally, of course, we are searching for a replacement Chair for the department (a search of particular importance to me).

Besides our hectic recruiting schedule, we have also been busy planning for an external Academic Program Review for the entire department. These reviews take place approximately every five years as directed by the Provost's office. Our review involves writing an extensive self-study document (around 200 pages long) describing our activities over the last five years, the structure of the department, and an outline of future plans. The review takes place in the Spring 2006 semester with a visit to our Department from a panel of distinguished mathematicians who subsequently will write the review.

The writing of the Academic Program Review self study document has been a great help to me as I try to come quickly up to speed with the very diverse activities of our department. I would like to share some of the data from the report with you. First and foremost we are the most important department in the University from the point of view of student education. This outrageous claim requires justification! Quite simply we teach more student credit hours per year than any other department (27,806 hours per year in the 2004 academic year compared to 27,274 hours per year for our nearest competitor, Foreign Languages and Literature). Of the roughly 9,000 students taking our courses each year, over 5,000 are taught by our 10 professional Continuing Non-Tenure Track faculty in the pre-calculus, business calculus and statistics courses. The

continued on page 2

Note: The Alumni Day reception on April 29 has been moved to Gore rotunda and Gore 104

An Invitation to UD Mathematics Alumni Day 2006

Dear Mathematics Alumni and Friends of the Mathematics Department,

We cordially request your attendance at our first Mathematics Alumni Day reception on April 29, 2006 from 2:00 to 4:00 in Kirkbride 006. In our efforts to renew and strengthen our ties to alumni, we are hosting a casual reception with light refreshments. Student research posters will be on display. In addition to meeting with our faculty and students, we will be conducting tours of the Math Department's Modeling Experiment and Computation Laboratory, and our computer classrooms. Spouses and children are welcome. Every April, the Department of Mathematical Sciences celebrates Math Awareness Month by arranging a special lecture series around the central theme. The theme this year is "Internet Security." On April 28, the day before the reception, we will be hosting a special lecture entitled "Cloning Real-World Payment Tokens" by Daniel Bailey, Senior Research Scientist at RSA Laboratories. His lecture will be in Kirkbride 006 and will be accessible to the general public. There will be a reception afterward. For those traveling with children, University of Delaware Ag Day runs from 10:00 until 4:00 on the 29th at the Agriculture School on south campus. If you have children, this is a great opportunity to go for a hay ride, visit the petting zoo or play with a bees' nest (male bees only so there are no stingers).
Please RSVP by April 21 via phone to Michele Schwander at (302) 831-2653, or email to alumni@math.udel.edu. Please indicate the number of people attending and whether you plan to attend the reception, the Math Awareness Month lecture or both.

engineering mathematics sequences, courses for our own majors and of course our graduate courses. Indeed, it is probable that almost every student in the University passes through our department at some point in their academic career (often more than once).

The number of majors in programs in Mathematical Sciences has shown solid growth over the last five years. The main engines of growth have been the Mathematics Education major (we are responsible for the training of high-school mathematics teachers) and our joint Mathematics and Economics degrees. Our majors enjoy the use of our undergraduate lounge that has been furnished and equipped in part by generous donations from faculty and alumni. This is a popular facility with wireless Internet access, computers and facilities for study.

Another facility that has become popular with our majors, and many from outside the department, is the Modeling, Experiment and Computation Lab (MEC) run by Professor Pelesko. This innovative facility is particularly useful for project based learning and undergraduate research activities. Projects range from impedance imaging through dominos to studying the collective behavior of ants! Several undergraduate research projects have been completed, including the publication of results in research journals. The MEC lab is supported mainly by the department and from gifts.

Besides teaching undergraduate courses, our 31 Tenure and Tenure-Track faculty are heavily involved in research and graduate education (both teaching graduate courses and advising PhD candidates). Typically the research faculty publishes around 80 papers in scholarly journals every year and is active in grant applications to support this enterprise. Particular mention should be made of the recent five year $2.4 million grant to Professor Jinfa Cai in Mathematics Education for a comparative study of middle school mathematics curricula (joint with Marquette University). This grant will fund two post-docs as well as undergraduate assistants.

Our graduate students, besides being a great source of energy and enthusiasm for mathematics also greatly benefit undergraduate education. As Teaching Assistants most of them spend a great deal of time helping undergraduates master a subject that few find easy (although we hope all appreciate and some come to love mathematics). Indeed an expansion of the TA program, and more generally an increase in the graduate population through non-teaching funding, is a priority for us. This will help to meet our increased teaching needs as well as extend the range of graduate courses we can offer.

Although not directly the chair's responsibility I must also mention that no less than four faculty are in the promotion process this year. The Promotion & Tenure under Professors Braun (chair) and Lazebnik (secretary) has certainly had a busy time!

With a new permanent chair next year and the enthusiasm and dedication of our faculty, graduate students and staff I am sure the department will go from strength to strength in the next five years. If you would like to be part of this exciting enterprise, please see our website: www.math.udel.edu.

As a postscript, I would like to express my thanks to Professor David Edwards who has served as Temporary Associate Chair of the department (responsible for teaching) this year. He has been very active in planning for our future teaching needs and has helped me with countless suggestions and reports. I would also like to thank the office staff who have helped so much with every aspect of department administration.

From the Editors

Dear Math Department Alumni, Students and Friends,

It is our pleasure to distribute our second regular edition of Reckonings to our alumni. As in previous years, we are reporting on retirements, new hires and other significant news items in the department. In this issue, we are pleased to feature some of the work of our faculty and alumni. George Trimble, our featured alumni, provided some of his work on computer architecture. Profs. Braun and Sturm have contributed features on tear film modeling and population genetics. Prof. Schleiniger describes our recent success in creating interdisciplinary undergraduate programs and describes our latest endeavor to create a new degree program combining mathematics and biology. The editors would like to thank all of the contributors including Rich Braun, Bob Gilbert, Philippe Guyenne, Peter Monk, Rodrigo Platte, Gilberto Schleiniger, Katy Sharpe, Cliff Sloyer and George Trimble. For a more complete picture of department activities, we hope you will take a look at our department web page (www.math.udel.edu) where you will find more information about the activities of our faculty and students.

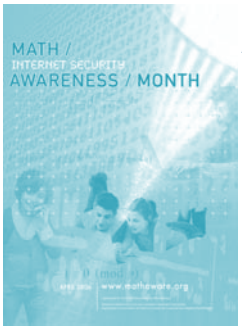
Most importantly, this newsletter is also an invitation to come back and visit the department at our first Mathematics Alumni Day on April 29. Many of you have opted to receive this newsletter in electronic form rather than the more expensive print version. If you are willing to accept future issues of the newsletter in electronic form, please send a note with your preferred email address to alumni@math.udel.edu. We look forward to staying in touch.

Yours truly,

Lou Rossi

Anja Sturm

Brief News Items from the Math Department



Math Awareness Month April 2006 on Internet Security

Public lectures will be held at the University of Delaware on *"Internet Security"* which is this year's theme of Math Awareness Month. The lecture series is designed to improve understanding of the role of mathematics in different settings. The talks are planned for a general audience with no specific mathematical preparation:

Renate Scheidler (University of Calgary) will talk on *"Cryptography -- the Art of Secret Writing -- From Old to New"* on April 21, 3:30 - 4:30 PM in 104 Gore Hall.

Daniel Bailey (RSA Laboratories) will talk on *"Authenticating Pervasive Devices with Human Protocols"* on April 27, 4:00 - 5:00 PM in 114 Purnell and on *"Cloning Real-World Payment Tokens"* on April 28, 4:00 - 5:00 PM in 006 Kirkbride Hall.

UD Math launches expansive curricular study of middle school mathematics

UD Mathematics Professor ***Jinfa Cai*** and Marquette Professor ***John Moyer*** have been awarded a $2.4 million grant over the next 5 years by the National Science Foundation (NSF) in order to study middle school mathematics curricula. The grant is a longitudinal project that analyzes the effect of using the Connected Mathematics Project (CMP) curriculum on algebraic learning. The CMP curriculum is a complete middle school mathematics program that was developed and revised with the support from NSF.

The research will be conducted in 12 middle schools of the Milwaukee Public Schools. Six of the schools that have adopted the CMP curriculum will be randomly selected and compared to six non-CMP schools with comparable ethnicity, family incomes, accessibility of resources, and test results.

Lillian Russell retires

Statistics instructor ***Lillian Russell*** retires this August after 29 years of service to the department. She and her husband have purchased an 11 acre farm just a few miles from campus over the Pennsylvania line where she raises and shows border collies and golden retrievers. Her immediate plans include returning to school to study either animal science or veterinary technology where she sees a natural fit between her hobby and her professional interests.

Tony Seraphin promoted to assistant professor.

Tony Seraphin has been promoted from Instructor to the rank of Assistant Professor. He will be taking over the duties of retiring statistics instructor Lillian Russell and now enjoys a joint appointment in the Department of Geography where he collaborates with faculty on teaching and research projects.

Special issue of Computing and Visualization Science dedicated to Professor George Hsiao on his 70th Birthday

The December 1, 2005 issue of *Computing and Visualization Science*, featuring articles on fast boundary element methods, was dedicated to our very own Professor George Hsiao on his 70th birthday and included an editorial on Hsiao's seminal work in this area of research.

Professor Cook appointed to Fields Institute Advisory Board and elected SIAM Secretary

Professor ***L. Pamela Cook*** has been appointed to a five year term on the Fields Institute for Mathematical Research Scientific Advisory Panel. The goal of the Fields Institute in Toronto is to "enhance mathematical activity in Canada by bringing together mathematicians from Canada and abroad, and by promoting contact and collaboration between professional mathematicians and the many diverse users of mathematics." Professor Cook has also been elected Secretary of the Society for Industrial and Applied Mathematics (SIAM). SIAM represents more than 10,000 mathematicians. In addition to holding an annual meeting and many specialized conferences, short courses, and workshops, SIAM publishes 11 peer-reviewed research journals and approximately 25 books per year.

Professor Pelesko named to editorial board

Professor ***John Pelesko*** recently joined Editor-in-Chief Professor *L. Pamela Cook* on the editorial board of the Society for Industrial and Applied Mathematics' (SIAM) *Journal on Applied Mathematics* (SIAP). SIAP is SIAM's flagship journal and is regarded as one of the top journals in applied mathematics worldwide.

Convocation 2005

In the past year the Department of Mathematical Sciences graduated six students with a Bachelor of Science in Mathematics, nine students with a Bachelor of Science in Math and Economics, eight students with a Bachelor of Arts in Math Education, and three students with a Bachelor of Arts in Mathematics. Eleven students obtained a Masters in Math or Applied Math, and two students finished their PhD in Applied Mathematics. The commencement and convocation ceremonies were held on Saturday, May 28th, and were well attended, with nearly 240 people attending the departmental convocation ceremony. A photo album of the events can be found online at www.math.udel.edu/news/conv05s/index.html.

UD Teams Score Meritorious Ratings in 2005 international Mathematical Contest in Modeling

Both UD teams scored meritorious ratings in the 2005 international Mathematical Contest in Modeling. One team consisting of ***Janine Janoski, Anu Pakanati*** and ***Sumanth Swaminathan*** modeled the impact of a dam failure. The other team consisting of ***Dan Cargill, Ki-Yong Kim*** and ***Geoff Oxberry*** modeled traffic flow through congested toll plazas. Both teams were coached by Professor ***Louis Rossi***. The meritorious rating is the second highest designation for an entry. Of the 664 entries, only 85 received meritorious ratings, placing our students in the top 13 percent worldwide. Only 10 teams received an outstanding mark which is the highest honor.

Maki and Driscoll take top honors at Computational Science poster contest

Graduate student ***Kara Maki*** and Professor ***Tobin Driscoll's*** poster entitled *"Why it is safe to Use Gaussian Elimination with Partial Pivoting"* won First Prize at the Computational Science Day 2006 held at the University of Delaware.

Mathematical Modeling of the Human Tear Film

Richard Braun

Every time you blink, a thin fluid film is left behind that covers the front of your eye. This tear film performs a number of functions: a smooth optical surface, defense against inflammation and foreign particles, and lubricating the eye's surface, to name a few.

When the tear film is not healthy, a variety of maladies may occur. Dry eye is a collection of symptoms that clearly involves the tear film; dry eye may arise from a shortage of tear fluid for each blink, from too much evaporation of the tear film, or a combination of both. Once this shortage of tear fluid persists, pain and inflammation of the eye follow. Millions suffer from the spectrum of dry eye conditions, and many use a variety of eye drop products with different properties to help alleviate their conditions. Understanding the dynamics of healthy and unhealthy tear films may help lead to better understanding of the progression and treatment of dry eye and other conditions.

What can mathematical modeling say about this situation? The tear film is a multilayer fluid; the main component of the film is the middle aqueous layer that is primarily water with some mucins and other chemicals inside it. The other layers are an outermost oily layer that suppresses evaporation and a mucus layer that helps ensure that the tear film wets the surface of the eye. Under some conditions, we can replace the two layers with boundary conditions and focus our study on the dynamics of the aqueous layer; this step alone is major progress in the modeling of the problem because significant decisions were made about the relative importance of what happens in the tear film.

An important observation is that the tear film is very thin (about 5×10^{-6} meters) compared to its length (about 10^{-2} meters); for such a thin fluid, many terms in the full governing equations become negligible, and to a good approximation we can reduce the problem in its simplest form to a single nonlinear partial differential equation with appropriate boundary conditions. We have once again made a modeling decision in this process, and that is to use the geometry of the film (its thinness) to simplify the fluid dynamics to a single equation and one that is much easier to solve than the original problem. Generalizing the problem slightly may require solving two or more partial differential equations, but this is still a vast simplification compared to the original problem.

What can be done with these simple models, in the face of the complicated blink process in our eyes and in either the healthy or unhealthy case?

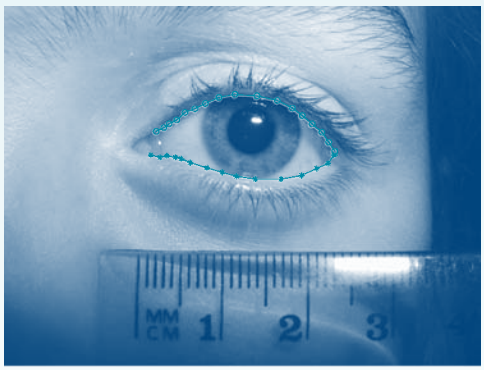
On sabbatical in 2002, I visited the University of Southampton and worked with Dr. Alistair Fitt of the Faculty of Mathematical Sciences there to study tear film drainage with evaporation. In a joint paper, we showed that evaporation, though measured values appear to have a small contribution in changing the tear film thickness, can actually work with the surface tension of the tear film to be important in some instances in tear film thinning. To our knowledge, this was the first theoretical support for what many opthalmologists and optometrists believe is an important cause of dry eye conditions.

That work was noticed by biophysicist and optometrist Dr. Ewen King-Smith at Ohio State University; in his lab, optical interferometry and similar methods are used to visualize the tear film evolution *in vivo*. Discussions with Dr. King-Smith have lead to many new challenges to try to explain his fascinating images of the tear film. For example, a bubble may form in the lipid layer during the blink process and burst just after the upper lid opens; the resulting dynamics are being modeled by Visiting Assistant Professor Michael Sostarecz, Professor Pam Cook and me; we expect at least a pair of papers to result from this work.

Many blinks are not complete blinks; that is, many times our eyelids don't fully close when our tear film is refreshed.

A one-equation model problem developed by me for multiple blink cycles predicts the development of a bump in the tear film that occurs from a half blink caught on film by Dr. King-Smith at OSU. These blink models are introducing new mathematical challenges for the numerical methods that solve the partial differential equations; Associate Professor Toby Driscoll and I have submitted a proposal to investigate new methods for these problems.

There is also some benefit for students in the classroom. To further study tear film evolution in more realistic eye-shaped domains, we need to describe the eye shape in the computer; this is readily accomplished using a digital photo and Matlab image processing software. In my numerical methods classes, students have interpolated photos of their own eyes in projects; a photo of my younger daughter's eye, similar to those used in the project is shown here. In the near future, I hope to use such interpolated eyelid shapes to specify stationary and moving eyelids for more sophisticated and mathematically challenging computations of tear film dynamics. I also hope that the result of those and other computations help us to better understand and treat dry eye and other anterior eye conditions.



Prof. Braun's research involves modeling the tear film covering the human eye. In this image from a class project in numerical analysis, a sixth degree polynomial fit to the eyelid shapes is shown. He is in the process of incorporating this typical human geometry into his computational model.

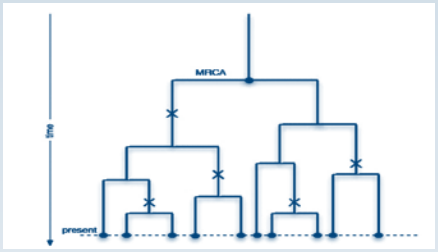
Mathematical Models for Gene Evolution and Genealogies

Anja Sturm

In the last couple of decades, Mathematics has fast become a major part of a natural science that has traditionally been thought of as not so mathematical: Biology. With the advent of vastly improved quantitative techniques and means for data collection Biology as a science has experienced a boom. Mathematical analysis of biological systems has taken center stage.

This is certainly true for the part of Biology that I have mainly been interested in in my own research, which is Genetics. Here, recent progress in molecular biology and new technologies in genotyping have led to an explosion in the availability of DNA sequence data. The applications are numerous and tantalizing: Reconstructing genealogies sheds light onto the origin and history of humans and other species and exposes evolutionary forces at work. It is also of immense practical importance in deciphering the human genome. For example, through association mapping, which entails comparison of reconstructed genealogies, genes that are causative factors for diseases can be located and identified on the genome. Understanding the basis of the disease in turn makes it possible to develop novel therapies.

Genetic information is particularly well suited for mathematical analysis. Some complications aside, the mechanisms that



govern which genes are passed on from one generation to the next are relatively simple and mathematically tractable even though they are not entirely predictable: Inheritance patterns are random on a molecular level and since we are (in most cases) unable to directly observe evolution and interaction of individuals there is also a random element on the level of populations. This is why most models in population genetics are of a probabilistic nature.

In its simpler form, mathematical modeling in Genetics reaches back at least to seminal work by Feller (1951), who used a diffusion approximation (a stochastic process limit with the population size tending to infinity) to model the evolution of gene frequencies in large populations. Equally influential was the work by Kingman (1981), who introduced the so called coalescence process, which describes the genealogy of a random gene sample from the current (large) population (see figure). Here, the coalescent follows distinct ancestral lineages into the past: each pair of lineages coalesces (or merges) independently at a stochastic rate until the most recent common ancestor (MRCA) of the genetic information in question is reached. The mathematical analysis of population genetics models makes it possible to draw conclusions about genetic evolution and variation. For example, estimates of the time to the MRCA are also indicators of the genetic variation within the population selected at present. This is because more mutations, occurring at random times along the ancestral lineages (crosses), may have occurred within that population the longer ago it descended from a common ancestor. Through comparison of model predictions to observed data the mathematical theory forms the basis for gene data analysis.

Current research focuses on expanding this mathematical theory by incorporating complicating factors into these simple models for gene evolution and gene genealogies. Important influences that I am particularly interested in include population substructure, population interaction like competition and subsequent selection and recombination (linked genes) as well as changing environmental conditions and fluctuating population sizes. All of these factors have been shown to have a significant impact in certain situations and challenges still remain in their analysis.

New Interdisciplinary Major Program in the Works

Gilberto Schleiniger

The Department of Mathematical Sciences, following a very successful interdisciplinary program offered jointly with the Department of Economics, the BS in Math and Economics, is in the planning stages of a new program, a Bachelor of Science in Quantitative Biology, to be offered jointly with the Department of Biological Sciences. Faculty in the Departments of Biological Sciences, Chemical Engineering, Chemistry and Biochemistry, and Mathematical Sciences have collaborated enthusiastically on this new program to be proposed for implementation within the next academic year.

The main goal of this program is to prepare students to pursue graduate degrees in biology, systems biology, or biomathematics, or to join biomedical science research groups. The need for students with this kind of undergraduate education is clearly documented in the National Research Council report Bio 2010 – "Transforming Undergraduate Education for Future Research Biologists." The proposed program aims at providing the students with a solid foundation in biology, chemistry and mathematics, with an emphasis on preparation for a research career in biological and biomedical sciences. This new program will bring to potential biology majors a needed emphasis on education in mathematics and the physical sciences, while providing potential math and engineering majors with an interest in biological sciences a greater appreciation of quantitative biology. The design of the program includes integrative seminars to stress and highlight the links between the biology and the mathematics that students will learn, an introductory course in systems biology, and a two-semester capstone experience involving research projects at the interface of mathematics and biology leading to a senior thesis.

The currently offered BS in Math and Economics was designed primarily for students who desire to pursue graduate studies in economics, but enough flexibility was built into the program to accommodate students with an interest in economics who opt for graduate studies in mathematics. The workplace environment for

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economists is favorable to those with a stronger mathematical foundation, so even those students who choose to join the workforce after graduating stand to benefit from their more rigorous and complete mathematical background. We believe that this Math and Economics program will increase in popularity as more potential college students learn about its existence. We have every reason to believe the new Quantitative Biology program will achieve the same success, once it is in place. For further information on these programs, contact the Department of Mathematical Sciences, or send an e-mail to schleini@math.udel.edu.

New Hire: Dr. Phillippe Guyenne

Dr. Philippe Guyenne received his PhD from the University of Nice--Sophia Antipolis, France, in 2000. He also did his undergraduate work in Nice. Before joining the University of Delaware, he was a Postdoctoral Fellow at the Department of Mathematics and Statistics at McMaster University, Canada. He also held visiting positions at the Center for Mathematics and its Applications, Ecole Normale Superieure de Cachan, France, and at the Fields Institute for Research in Mathematical Sciences, Canada.

Dr. Guyenne's research interests are in Applied and Computational Mathematics with emphasis on free-boundary problems and nonlinear waves. He is especially interested in the modeling and numerical simulation of surface water waves, with applications to oceanography and coastal engineering. Such waves are described by nonlinear partial differential equations which can be solved using elaborate numerical methods.

In his free time, Dr. Guyenne enjoys traveling, listening to music and watching movies. He also enjoys all sorts of aquatic activities and looks forward to exploring the beaches on the East Coast.

Mr. ***Jae Yong Lee***, a graduate student in the department of mathematics, unexpectedly died during the Spring semester 2005. He is missed by his friends, peers and mentors here in the department. He is survived by his wife Emily Jihyun Park who bequeathed his books to our department library.

Featured Graduate Student: Rodrigo Platte

Rodrigo Platte is originally from Brazil and obtained his Bachelor of Sciences in Mathematics from Universidade Federal do Rio Grande do Sul. He also obtained a Master degree in Applied Mathematics from the same university. He arrived at the University of Delaware in August of 1999 and obtained his Ph.D. in August of 2005. He recently started a position as a Visiting Assistant Professor at Arizona State University.

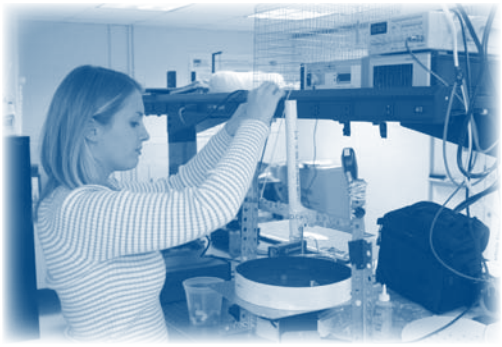
During his second year at the University of Delaware, he had the opportunity to work in a research project in collaboration with The DuPont Company. The project was under the supervision of Dr. Schleiniger and Dr. Nwankwo (Dupont) and focused on mathematical models for polymer characterization via piezoelectric sensors. Under the guidance of his Ph.D. adviser, Dr. Driscoll, he investigated several properties of radial basis function methods for PDEs and wrote a dissertation entitled "Accuracy and stability of global radial basis functions methods for the numerical solution of partial differential equations." Rodrigo says that graduate school was a great experience for him: "It was a real pleasure working with Dr. Driscoll, I've learned a lot more about research from him than just writing a thesis." The research results in his thesis have been published in three research papers. Lately, he has also had the opportunity to work with Dr. Rossi on an algorithm that may be used as part of Rossi's code for fluid computations via particle methods.

Rodrigo also enjoyed his teaching experience at UD. He emphasizes that he learned a lot from experienced professors as a teaching assistant and points out that the teaching opportunities offered by the department for those graduate students wishing to teach during the summer and winter are excellent. Thanks to his commitment and talent for teaching he received a university wide award for excellence in teaching as a teaching assistant.

Rodrigo would like to thank all faculty, staff, and graduate students at the Department of Mathematical sciences for their friendship and support: "I will cherish the many good memories I have had since we arrived in Newark."

Featured Undergraduate: Kathryn Sharpe

Our featured undergraduate in this issue is Kathryn Sharpe who has two majors, the BS program in Mathematics



and the BA program in Computer Science. Ms. Sharpe is from Wilmington Delaware, and chose UD in part for its strong reputation and in part for its proximity to home and family. She always enjoyed mathematics and chose to major in mathematics because it was her favorite class in high school. Still, she admits it did not always come easily in college, especially when she faced formal proofs for the first time. During her freshmen year, she also found herself interested in computer science, so rather than graduating early, she chose to take her time and add a Computer Science major.

Ms. Sharpe took full advantage of undergraduate research opportunities in the Math Department. She spent the summer of her sophomore year working with Profs. John Pelesko and Lou Rossi in the Modeling Experiment and Computation Laboratory. (For more information about the MEC Lab, please see our 2005 Newsletter.) She developed course modules for the department's modeling course by studying how starch is gelatinized in rice at different temperatures, and why warm water sometimes freezes faster than cold water. For the last year, she has been writing a senior thesis under the supervision of Prof. Pelesko. Her thesis involves two projects. One of them studies models of rotating fluid columns. The other focuses on self-assembly and trying to understand structures that emerge from disordered magnetic cubes. The work involves modeling, experiments and computation.

Both projects have piqued her interest well beyond the requirements of the thesis program. She comments, "Elements of both projects interest me enough to continue working with them beyond what I have or will have completed when I graduate." While research and discovery is its own reward, Ms. Sharpe's hard work has paid off in more tangible ways. She has been awarded a prestigious Harward Fellowship by the University Honors Program. This award is given to a small number of Honors Degree with Distinction candidates each year based on their academic accomplishments. Only seven such fellowships were awarded this year. The award includes a $500 prize and recognition at the Honors Day Ceremony.

When she has free time, Ms. Sharpe enjoys spending time with her family and crafts including knitting, sewing, and scrapbooking, but more recently her mind is on graduate school applications. Her career goal is to complete a doctoral degree and teach at a university. As this issue moves into production, she has been accepted into two mathematics graduate programs, and she is weighing her options.

2005 Student Award Recipients

The BAXTER-SLOYER GRADUATE TEACHING AWARD recognizing graduate teaching assistants in mathematical sciences who have demonstrated superior effectiveness in teaching and in the performance of their responsibilities was this year awarded to *Jason Jacobs* and *Nakia Rimmer.*

Kathryn Sharpe has been named a HARWARD FELLOW by the University Honors Program. This prestigious award is given to a small number of Honors Degree with Distinction candidates each year based on their academic accomplishments. Only seven such fellowships were awarded this year.

The STEPHEN J. WOLF MEMORIAL SCHOLARSHIP awarded to a student entering the senior year majoring in mathematics who has demonstrated both love and talent for the subject was presented to *Janine Janoski*.

The OUTSTANDING STUDENT TEACHER AWARD for an undergraduate student who has demonstrated outstanding performance in student teaching went to *Gregory Deveney* and *Tammy Garber.*

The Mathematical Sciences Department FACULTY RECOGNITION OF A GRADUATING SENIOR 2005 was given to *Jessica Belden.*

The WILLIAM D. CLARK PRIZE award for a senior majoring in mathematics who has shown unusual ability in the area was this year presented to *Richard Seagraves*.

The following students were elected to PI MU EPSILON, a math honorary society consisting of students who have excelled in Mathematics: *Michael Birenbaum, Melody Casagrande, Michael Casey, Robert DeMarco, Chelsea Erickson, Tammy Garber, Alison Gordon, Chana Kuhns, Evan Mackey, Matthew Matheson, George Mitesser, Todd Molnar, Denise Murray, Tapan Patel, Robin Prescott*, and *Christina Zlogar.*

The CARL J. REES AND ELEANOR K. REES SCHOLARSHIP which is awarded to undergraduate students majoring in mathematics upon academic performance went to *Michael Birenbaum, Robert DeMarco, Kathleen Fagan, Nicole Ferrise, Jackson Kantruss, Karen Katz, Matthew Kistler, Chana Kuhns, Matthew Matheson, Stephanie Merkler, George Mitesser, Todd Molnar, Denise Murray, Emily Pretz, Daniel Roche, Kathryn Sharpe, Bonard Timmons,III, and Matthew Wells.*

Featured Alumni: George Trimble

Our featured alumni this year is George Trimble, a man with a long association with mathematics and computing machinery. Mr. Trimble entered computational mathematics on the ground floor and was involved in the design of virtually every computer made by IBM in the early days. He retains a keen interest in computer architecture and is writing a book *A History of Computers: An Architectural Viewpoint* on the subject spanning the early history of computer architecture from punch cards to calculators. Mr. Trimble has graciously agreed to contribute a self-contained excerpt from his book for our newsletter (see Objectives).

Ready for the future: George Trimble in 1948

Mr. Trimble completed a BA in liberal arts from St. John's College in Annapolis, MD in 1948 under its Great Books program. Interestingly, the Great Books program was (and is) a response to overspecialization in higher education. All students from 1937 on have taken the same courses. Students at St. John's learned mathematics by reading Euclid, Aristotle and Newton rather than modern mathematics texts. He entered the University of Delaware's Master's program in Mathematics to strengthen his background, but he had also started working at the Aberdeen Proving Ground in the Computing Laboratory where the newly invented ENIAC was housed and they needed mathematicians to run it. At this time, Prof. Carl Rees and the Director of the Computing Laboratory started a joint program where courses were given during working hours at Aberdeen. Classes were taught by professors who were accredited at UD and credits for the courses were good towards his Master's degree at UD. He completed his Master's degree in 1951.

At that time (1950-51) there were several experimental computers being developed at universities in their electrical engineering departments. All had courses on computers, but they were on engineering, not on programming, and computer science was not even thought of yet. In fact, the Computing Laboratory, Dr. R. F. Clippinger in particular, selected Mr. Trimble for a program to send him to college for training. There were no colleges in the United States at that time that had any such courses. He ended up picking Cambridge in England, where one of the early computers was built, but the Korean conflict caused cancellation of all such plans. He eventually left Aberdeen, joined IBM in their labs in Endicott, NY. He left IBM in 1956 to join Computer Usage Company, the world's first software company, as Corporate Technical Director, and eventually became an independent consultant.

Reflecting on his education at UD, Mr. Trimble comments, "What this means is that Dr. Rees effectively introduced the first non-engineering computer courses into the UD curriculum and I believe it was the first in the USA. They included numerical analysis, numerical solution of differential equations, how to program specific computers (ENIAC, EDVAC, ORDVAC), problem analysis, and flow charting methods. It seems to me that this would be worth recording in the history of UD somehow."

OBJECTIVES *ARCHITECTURAL VIEWPOINT*

George Trimble

The term architecture is typically applied to buildings. The *Merriam-Webster Unabridged On-Line Dictionary, © 2003 Merriam-Webster, Inc.* gives a general definition of architecture as:

"A unifying or coherent form or structure."

This definition can apply to many different areas, e.g., buildings, landscaping, bridges, production lines, etc., where a variety of components are put together in some systematic fashion to accomplish an overall utilitarian or aesthetic function. The definition given in this dictionary which applies to computers is:

"The manner in which the components of a computer or computer system are organized and integrated."

There are several different levels at which one can look at a computer's architecture. The lowest level is the component, such as electromechanical relay, vacuum tube, transistor, resistor, capacitor, etc. This is essentially a hardware oriented level and changes as the technology changes. For example, the first integrated circuits contained some twenty to thirty transistors on a chip, then hundreds of transistors on a chip, then thousands, and on to millions. Much has been written about this level of computer structure and the tremendous technological advances that have been made.

At the opposite extreme is the "user" level, in terms of instruction sets, detailed characteristics of input/output devices, data/instruction flow, and other characteristics of a system that a programmer needs to know in order to be able to write application code for the system. This type of information is contained in the user programming manuals and hardware specifications provided with specific systems.

This book approaches the architecture from an intermediate level. It examines the "functional units" which have evolved over the years and shows how they have been integrated into computers to overcome shortcomings that have been impediments to their performance and efficiency. Most, if not all, of these improvements have had a significant impact on the software; in fact, software inefficiencies have been the driving force behind the development of this hardware. As an example, main memory size and cost has been a major problem. The ENIAC memory cost was about $200 per bit. That cost has been reduced to $0.000000000005 per bit and memory size has increased to multi-gigabits.

From Young Turk to Old Guard: A Nifty Fifty

Professor Cliff Sloyer looks back on an impressive 50 years of teaching and research focused on Mathematics Education and Mathematical Modeling. He started teaching at Lehigh University as a graduate student in 1956. Of teaching his first class he remembers that many of the students were veterans of the Korean War whose background in Math was good but removed by several years. This led to him developing a new course designed for similar students to bring their mathematical skills "up to snuff."

During the early 1960s, he was asked to develop graduate courses in Linear Algebra and Statistics for the scientists and engineers at the Western Electric Research Center in Princeton, which had formed a cooperative graduate program with Lehigh University where he was a full time Instructor at the time.

Cliff notes that this experience -unlike the previous textbook training- made him aware of mathematical modeling. Many of the students at the Center were involved in contracts with government agencies and would drop by his office to ask questions about certain mathematical problems they encountered in the models they were woking on: "My office at the Center contained a desk, a conference table for 8-12 people, and a 'real, working' fireplace. Such luxuries have not been granted since that time."

Upon receiving his Ph.D from Lehigh in 1964, Cliff Sloyer came to the University of Delaware and began pushing for more model building in the curriculum. Due to previous experience at Lehigh he was invited to work with secondary teachers in Connecticut at Wesleyan University during the summer of 1965 (this association with Wesleyan continued until the mid 1980s) and subsequently as a liaison of UD's Mathematics Department with John Brown (College of Education) and secondary teachers in the State of Delaware.

During the early 1970s, Cliff collaborated with Richard Crouse (College of Education) on the writing of a text for secondary teachers titled *Mathematical Questions from the Classroom* and with Willard Baxter (Dept. of Mathematics) on an undergraduate text titled *Calculus with Probability* for students in the life and management sciences. The latter text involved an increased focus on modeling.

In the 1970s and the 1980s the University of Delaware received numerous grants from the National Science Foundation for teacher education. Grants in the 70s provided for academic-year courses and workshops for secondary teachers to update their content knowledge, increase their knowledge of applications of mathematics and make them aware of technologies available. Portions on applications of mathematics were later published in a book titled *The Fantastiks of Mathematiks*. During the 1980s, relatively large NSF grants also supported several hundred talented secondary students in addition to about two dozen teachers to work on the teaching and learning of new and powerful topics in the applied mathematical sciences such as dynamic programming, information theory, cluster analysis, and pattern recognition.

In the latter part of the 1980s the National Council of Teachers of Mathematics developed "standards" for the teaching of mathematics at various levels. During the summers of the early 1990s Cliff Sloyer was on the writing team at the Connecticut Business and Industry Association in Hartford which had received an NSF grant to test and evaluate materials for secondary students based on these standards. The texts, known as *MATH Connections*, were published in the late 1990s and became standard texts for secondary students at a number of sites across the country.

Cliff has enjoyed the opportunity to travel as part of his profession. He has been an invited speaker at various national and international conferences such as one in Germany and NCTM meetings throughout the United States. Partially as a result of a PR presentation in Denmark, the sixth International Conference on the Teaching of Mathematical Modeling and Applications was held at the University of Delaware in 1993. In addition to scholarly activities, Cliff served as Assistant Chairperson under Willard Baxter from 1969-1975, Acting Chairperson in 1978, and Associate Chairperson under Phil Broadbridge from 2002-2005.

Outside of mathematics, Cliff's interests focused on music particularly of large jazz ensembles such as the Kenton band. In the 1960s he organized and directed the first jazz ensemble at Lehigh University known as the Jazz Moderns and then also the first jazz ensemble at the University of Delaware. Delaware now has two jazz ensembles directed by members of the Music Department.

Cliff would like to thank his colleagues, students, and especially his family for "making this a nifty fifty."

To Our Generous Donors, Thank You!

The faculty and students of the Department of Mathematical Sciences would like to extend their gratitude to alumni who supported our students last year by designating our department when donating money to the University of Delaware. Your contributions help support students through a number of critical activities and programs. Among other things, your donations help support summer undergraduate research stipends, merit-based graduate and undergraduate fellowships, and facilities in the undergraduate lounge.

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