Summer Math Institute 2008

SMS's first annual Summer Math Institute for High School Teachers took place at RIT from June 30 through July 3. Dozens of high school teachers in Monroe County helped to design the workshop and fifty teachers – most from Monroe County, but some from such distant lands as Queens NY and Fairfax VA – attended the four day workshop.

The teachers who helped design the workshop stressed two topics: the ways in which high school mathematics is used in college courses, and the ways in which high school and college mathematics is used in business and industry. Their firmness and virtual unanimity in declaring these as the important topics was striking. The workshop addressed these topics in three basic types of session: discussions by college professors of how university classes build on high school mathematics, discussions by recent RIT graduates of their mathematical experiences in the industrial world, and discussions by seasoned professionals from business and industry.

The backbone sessions were those in which SMS professors discussed high school preparation for calculus, statistics, and discrete math. Some of the back-and-forth in these sessions was intense, and the SMS faculty learned at least as much from the teachers in the audience as they did from us. Complementary sessions in which Professors Savakis, Thurston, and Wagner discussed mathematics in

Engineering, Physics, and Economics, were full of novel applications of high school math.

Nathan Cahill of Carestream, Melissa Matthews of Capital One, Tiffany Bonus of KJT Group, all recent RIT math and stats graduates, discussed business and industrial applications of the mathematics they studied in school. Ryan Lewis and Ryan Galgon discussed co-op experiences at the National Geospatial Intelligence Agency and at Microsoft, respectively.

Perhaps the greatest wealth of applications of mathematics came in the sessions by mid-career professionals. Dr. Antonio Cabal of Merck discussed mathematical models of the mechanics and biochemistry of bone; Dr. Ammar Degani of Xerox discussed the mathematics of imaging science as it applies to printer design; Dr. John Hamilton of Eastman Kodak discussed digital cameras and the algorithms used in them. Dr. Roger Easton of CIS talked about his work on the imaging of ancient manuscripts, particularly the Archimedes Palimpsest, and Dr. Calvin Uzelmeier of the Rochester Museum of Science discussed museums and other resources for high school mathematics teachers. These sessions, along with sessions on computer visualization and placement exams, and a lively open discussion of calculator use rounded out the program.

For more information about upcoming SMIs, please contact Dr. David Ross at dsrsma@rit.edu.

SMS Newsletter

Contributors: Shelly Cicero, Matthew Coppenbarger, Patricia Diute, Akhtar Khan, Harry Schey, Paul Wilson; guest writers: Dennis Glanton, David Ross
Designer: Shelly Cicero
Editor: Paul Wilson
Editor-in-Chief: Sophia Maggelakis

To share information for upcoming editions, visit us on the web at math.rit.edu or stat.rit.edu, phone us at 585-475-2498 or email us at msc1511@rit.edu.

A Simple Philosophy of Education

Professor David Barth-Hart has been demonstrating his love of Number Theory and Abstract Algebra at RIT since December 1, 1983. He enjoys teaching theoretical courses and contrasts RIT's "high tech" focus with what he describes as his own "low tech" point of view. Marker and whiteboard are his tools. He likes to do things by hand and to impart his love of proof to students by showing them patient, methodical ways

of thinking.

His patient methods are tied to a wider work ethic: working on a 160 acre farm for ten years nourished his deep appreciation for wood, hand tools, and the beauty of economical thought. Fallen trees were used to fuel a wood stove; split wood presented unique beauty and grain. He is a collector of antique wood-working tools and has become a skillful woodworker using only hand tools that

he sometimes repairs himself.

The process of taking a tree to finished product with hand tools is, for Professor Barth-Hart, a model for his philosophy of education: learning through simplicity, work, patience, and mistakes. He says if you are willing to accept the challenges of hard work the rewards are boundless.

David Barth-Hart is currently Associate Head of SMS.

The preceding article is the first in a series about our senior faculty as suggested by our readers. Thank you for your input!

New SMS Faculty

Hasan Guclu

Dr. Hasan Guclu was born in Ankara, the capital of Turkey, where he attended Yamanlar, a private science high school focused on math and science, and participated in the International Physics Olympiads for high school students. After receiving Bachelor's and Master's Degrees in Physics from Middle East Technical University in Ankara he came to the United States in 2001. He earned a PhD in Physics at Rensselaer Polytechnic Institute in 2005 and won a Director's Funded Postdoctoral Fellowship at Los Alamos National Laboratory. After his three year post-doc he returned to upstate New York and joined SMS. His wife Sumeyye is an early childhood education expert and a Psychology major at RIT. They have an 18-month old daughter, Humera.

Hasan works on complex systems; he applies network/graph theory to parallel computing, communication networks, power grids, epidemiology, and social networks as well as material science and synchronization.

Hasan Guclu joins SMS as an assistant professor.

John Hamilton

Dr. John Hamilton joins the SMS this Fall as a visiting professor. John was an undergraduate at Cornell University (BA, mathematics) and took his MA and Ph.D. in Mathematics at Indiana University. His concentration area was functional analysis with minors in abstract algebra and quantum mechanics. In 1974 he took a position at the Kodak Research Labs where he ultimately became a Kodak Research Fellow.

In his 33 years at Kodak he developed image processing algorithms for digital cameras, collaborated on new sensor designs, and taught Kodak internal classes on Fourier methods in digital imaging and the mathematics of imaging science. He says he entered Kodak as a mathematician, left as an engineer, and enjoys the fact that at RIT he can combine both roles. John's research interests still include digital imaging, but he says the university playing field is large and he has many interests.

Akhtar Khan

Dr. Akhtar A. Khan joins the School of Mathematical Sciences as an Assistant Professor. He received his Ph. D. degree in Applied Mathematics from Michigan Technological University and has an M. Tech degree in Industrial Mathematics from Technological University of Kaiserslautern, Germany. Akhtar worked several years as researcher at the Department of Applied Mathematics, University of Erlangen-Nuremburg, Germany, taught for two years at the University of Wisconsin, and one year at Northern Michigan University. His research interests include inverse problems, set-valued optimization, variational inequalities and applications in bio-mathematics.

Fundraising Corner

Together we learn and grow.

This edition of the Fundraising Corner features a major initiative that has significantly impacted our student academic experiences!

Student Laboratory Technology Fund:

What do you think of when you hear the word "laboratory?" Beakers and Bunsen burners, scientists in white lab coats, right? When you add the words "mathematical sciences?" Today's science, technology, engineering and mathematics students think of computer labs, places where they can work on cutting edge computers with industry standard software packages, applying the theories learned in lectures to solve real-world problems. That is what we offer to all RIT majors taking a course in calculus or data analysis.

When we redesigned our calculus sequences in 2001, we implemented a pilot program incorporating two additional meeting hours per week. These additional hours were not for lecture or homework, but were designed for students to work in team settings to solve mathematical problems from a variety of real-world settings. This hands-on, technology lab setting allows students the experience of collaborating with peers to solve a problem using software such as Mathematica, SAS, or Minitab. Our pilot program has now become our standard. In addition to calculus, we recently adopted this lecture/workshop model in our data analysis courses and are looking to expand to other courses.

When we first implemented our 2001 calculus pilot, we converted three traditional classrooms, retrofitting them with team oriented round tables and computer stations. In 2006, we converted the Statistics Lab to combine hands-on lab time with the lecture portion of the class. As calculus and data analysis represent the largest course enrollments we offer to the institute, we have already maximized our use of these four rooms. We need more rooms and teamwork courses require continual upgrading of both the computers and software packages. Approximately $200,000 annually is needed to maintain this type of educational resource. Our Student Laboratory Technology Fund aims to provide the resources to continually upgrade the existing facilities and convert additional traditional classroom space to the high-tech training workshops needed to address the institute's growing student population and expand this successful program.

The SMS serves the needs of ~12,000 students annually by offering 425 courses

For more information about this or any of the SMS funding opportunities, please contact Sr. Director of Development Mark Gaul at 585/475-7047 or mark.gaul@rit.edu.
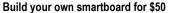
New SMS Lecturers

Don Reynolds

Don Reynolds joins the faculty of the School of Mathematical Sciences this Fall as a Lecturer. Don is an RIT graduate with a major in Applied Mathematics from SMS. He is a graduate student in the Center for Quality and Applied Statistics at RIT and plans on a doctorate in Statistics.

Build your own smartboard for $50
With a $40 Wii controller and a few hardware store parts Johnny Chung Lee offers step by step instructions for making a $5000 smartboard for about $50. His website (http://www.cs.cmu.edu/~johnny/projects/wii/) has instructions for creating 80% of a smartboard's capability (plus some great additional features) at 1% of the cost. Watch a demo at http://www.youtube.com/watch?v=QgKCrGvShZs&feature=related

Rachel Feustel

Rachel Feustel joins SMS as a Lecturer. After receiving an Applied Mathematics degree from SUNY IT, Rachel came to RIT as a graduate student in SMS with a particular interest in the Dynamical Systems concentration. She did her Masters thesis on 'Bifurcation scenarios in semiconductor lasers subject to optical injection' and, after receiving her Masters Degree, taught as an adjunct at both MCC and RIT.

Mystery Number
The 3D rendering code for the computer game Quake calculates reciprocals of square roots accurate to three decimal places using a single step of Newton's Method. The game's algorithm is up to four times faster than other algorithms and depends on using a certain very mysterious constant to make an optimal initial guess for Newton. The game developer, John Carmack, says he neither invented the algorithm nor found the number.

Teachers' Corner

You Can't Pass Calculus If You Can't Do Algebra
By Dennis Glanton

Those of us who teach calculus have groaned over them, complained about them, and come up with multiple (usually unsuccessful) ways to combat them. What are they? Algebra mistakes, algebra mistakes and more algebra mistakes. Teachers see every algebra calamity – errors in factoring, fractions, absolute values, radicals, exponents, logarithms, parentheses, canceling – errors you couldn't make up; errors which lead directly to disaster in calculus. Incorrect multiple choice answers generated by anticipating simple algebra mistakes lure too many students . A web search on Algebra mistakes in Calculus gets over 500,000 hits. Some of the more interesting sites are listed at the end of this article.

Before retiring as a high school math teacher and joining RIT's SMS I witnessed, over many years, a substantial de-emphasis on algebra skills in the NYS high school math curriculum. The cumulative result of

that de-emphasis is that many students who currently receive passing grades on the NYS Regents Exam in mathematics, students who go on to take college calculus, are weak in algebra. In June, 2008 for NYS' first year algebra course, Math A, a 43% raw score was counted as passing; on the Integrated Algebra Exam 34% was passing. (See the URL at the end of this article for further information on the scaling of raw scores.) Calculus is built on a dual foundation of algebra and geometry. The Regents Exams in algebra cover pre-calculus topics students ought to have mastered, so we have to wonder how a student who demonstrates 43% or 34% of the expected knowledge in algebra can later be expected to succeed in calculus. Too many students do poorly in college calculus, even some who, with the aid of calculators, have done well on the AP Calculus Exam.

With the thought that high school teachers might find it useful to have a list of common algebra mistakes and perhaps some strategies for correcting them, I volunteer to compile and organize a compendium of

errors. If you will send me (djgsma@rit.edu) examples of the algebra errors you encounter I'll try to put them together into one packet we can all use to help students improve their prospects of success in college calculus.

New York State Regents Exams:
http://www.nysedregents.org/testing/hsregents.html

Top Algebra Errors Made by Calculus Students by Thomas L. Scofield   Assistant Professor of Mathematics Calvin College:
http://www.calvin.edu/~scofield/courses/materials/tae/

Paul's Online Math Notes:
http://tutorial.math.lamar.edu/Extras/CommonErrors/CommonMathErrors.aspx and http://tutorial.math.lamar.edu/Extras/CommonErrors/AlgebraErrors.aspx

Algebra Review from Stewart Calculus Book:
www.stewartcalculus.com/data/default/upfiles/AlgebraReview.pdf

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Research Vignette

Professor Tamas Wiandt is involved in a variety of research topics that address both pure and applied mathematics in the areas of dynamical systems and non-linear differential equations.

In the field of pure mathematics he is investigating dynamical properties of closed relations on compact Hausdorff spaces. This is an interesting generalization of discrete dynamical systems and he is interested in attractor-repeller structures, Morse and Conley decompositions and generalized Liapunov functions of these objects. These functions can be used to prove the stability of certain fixed points in a dynamical system.

In the field of applied mathematics, Professor Wiandt studies systems of nonlinear delay-differential equations containing a considerable number of parameters; the Lang-Kobayashi equations. They describe the behavior of certain semiconductor lasers. The bifurcation properties exhibited by the system is quite impressive and uses both analytical and numerical methods to investigate these bifurcations.

He also collaborates with Professors Bill Basener, Mike Radin and Bernie Brooks to address population dynamics models, in which they are trying to establish results about how certain spatial considerations can change stability properties of a specific kind of a reaction-diffusion system.

Professor Wiandt's contributions and collaborations have greatly enhanced the SMS research portfolio.

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Two of the January Top Eight Problems

1.   Arrange the integers 1 through 34 in a sequence such that the sum of every pair on consecutive terms is a Fibonacci number. (*JRM, due 4/1/09.*)

2.   Let S be a set of n distinct points in the Euclidean plane such that each point has at least one neighboring point at distance 1 unit or less. For each fixed n, determine the maximum possible area of the convex hull of S. [The *convex hull* is the minimum convex set containing all points of S.] (*JRM, due 4/1/09.*)

If you have a question about any of these problems, contact your nearest or favorite math professor. If you would like to send your solution to the appropriate journal, contact Matt Coppenbarger (mecsma@rit.edu) for the email or snail-mail address.