Interested in Grad School?

On Tuesday, three Carleton alums, Becky Patrías, Jon Hahn, and Christina Knudson, will return to the CMC to discuss graduate studies at the University of Minnesota. Becky and Jon are in the mathematics PhD program and Christina is working on her PhD in statistics. They will talk about how to apply, how to get in, how to choose a program, and any number of other burning questions you might have about what awaits you post-Carleton. We’ll gather in CMC 206 at 4pm on Tuesday, October 23.

Career Opportunities

MathPath Camp Counselor: Spend July with the brightest young minds, earn money, and learn more math. MathPath is the national summer camp for middle school age students who are highly gifted in mathematics. It is at Macalester College, in St. Paul, from June 30 to July 28 this summer. Counselors receive a $3,000 salary, meals, housing, and travel reimbursement. Apply by January 31 at: www.mathpath.org/FacultyandStaff.htm

Teacher-Intern Program: Groton School, a coed boarding school of 370 students in grades 8-12, located in Groton, MA, is offering the Charles C. Alexander Teaching-Intern Program. Interns’ responsibilities include supervising teaching, class observation, and teaching or assisting in at least one other class. Fields open to interns are English, Mathematics, History, Classics, French, Spanish, Biology, Chemistry, Physics, Religion, and the Arts. Interns also help coach athletics during at least two seasons and assist in dormitory supervision. This is a one-year salaried position that includes room and board. To apply submit a cover letter, resume (indicating education, previous employment, interests, and athletic experience), transcript, and three letters of recommendation to the Charles C. Alexander Teacher-Intern Program, Groton School, 282 Farmers Row, PO Box 991, Groton, MA 01450-0991 before January 1, 2013. Questions: contact Ms. Rita Lalli at 978-448-7502 or in-tern@groton.org.

Research Analyst: The Federal Reserve Bank of New York is looking for candidates with records of superior scholarship and academic curiosity. Research Analysts play an integral role in both the policy and research functions of the Research and Statistics Group. They assist economists in analysis and long-term academically oriented research projects. Applications are accepted on a rolling basis at: www.newyorkfed.org/careers.

NSF Graduate Research Fellowship Program: The NSF awards up to 2,000 fellowships each year to future leaders in science, technology, engineering, and mathematics. Fellowship benefits include a 30,000 dollar annual stipend, 12,000 dollar annual cost-of-education allowance to the institution, and international research and professional development opportunities. Application deadlines vary by field, most are in November. For more information and to apply, visit: nsf.gov/grfp.

Undergraduate Research Conference: Viterbo University’s 10th Annual Seven Rivers Undergraduate Research Symposium is slated for Friday, November 9, 2012. The deadline to register and submit abstracts is Friday, October 26, 2012. For more information and to register, visit: http://www.viterbo.edu/sevenrivers/.
**Women in Math Conference:** Registration for the 15th Nebraska Conference for Undergraduate Women in Mathematics is now open, but will close as soon as the conference is full. The conference will be January 25-27, 2013. The bulk of the program will be undergraduate research talks and there will also be a poster session. Expect lectures from Professor Rekha Thomas (University of Washington) and Dr. Cathy O’Neil (Independent consultant and math blogger of Mathbabe.org), and representatives from the NSF, NSA, and other women mathematicians. Lodging and meals are provided and travel can be reimbursed. For more information and to register, visit: http://www.math.unl.edu/~ncuwm.

**Winter Term Course Offerings**

**Math 206:** Tour of Mathematics (1 credit; S/Cr/NC)
**Prerequisites:** None
**Professor:** Mark Krusemeyer
**Class Time:** Fri 3:30pm-4:30pm, CMC 209
**Description:** Are you considering a math major, but wondering just what will follow after all the calculus and linear algebra, or where the frontiers of mathematical knowledge are to be found? Are you already a major who would enjoy some fresh perspectives on, and new insights into, your chosen subject? Come join us for a series of lectures on a variety of mathematical topics, with emphasis on exciting ideas, concepts and results rather than on systematic coverage of any particular subject (we have other courses for that). Although this course has been offered yearly, there should be no overlap in lectures with last winter’s offering, so you can “repeat” once if you took the 2012 Tour.

**Math 236:** Mathematical Structures
**Prerequisites:** Math 232 or consent
**Professor:** Eric Egge
**Class Time:** 3a, CMC 319
**Description:** If mathematics is a city, then this course is all about how we build its various parts. We’ll study set theory and axiomatic systems, which are the raw materials that go into every building. We’ll learn about techniques for discovering (or inventing) proofs, common methods of proof, and how to write good proofs; these are the construction methods we use to build everything in the city. And we’ll study some fascinating problems and results that everyone should know, such as the many sizes of infinity; these are our city’s major landmarks, our Opera House, Temple Mount, Golden Gate Bridge, or Forbidden City. Math 236 is the first course that suggests what being a math major (as opposed to a math user) is all about. If you are considering majoring in math, then this course should help you decide. This course is also a prerequisite for many upper level mathematics courses, so taking it gives you the keys to a whole new mathematical world.

**Math 241:** Ordinary Differential Equations
**Prerequisites:** 232 or consent
**Professor:** Mark Krusemeyer
**Class Time:** 3a, CMC 209
**Description:** In calculus you may well study separable first-order differential equations for a bit, but that's just the tip of the iceberg! In any field where mathematics is applied, you are likely to find equations relating unknown functions and their derivatives. Over the centuries, following the lead of Newton, Leibniz, and the Bernoullis, mathematicians have come to grips with many such equations. Naturally, they prefer to get exact solutions if possible, and we'll look at some of the systematic methods (and a few of the clever ad hoc tricks) that have been developed to find solutions. On the other hand, there are times when finding an exact solution is too difficult, or even potentially misleading, for instance, because the mathematical model that leads to the differential equation is imprecise to begin with. In such cases, it is often best to concentrate on the qualitative behavior of solutions; for example, you might try to predict what will happen in the long run. In this course, you'll find plenty of calculus-style computation, including ample opportunity to brush up on your techniques of integration (Mathematica can help with some of that), but also a few theoretical discussions, some geometric ideas, and a bit of mathematical modeling. The textbook we’ll be
using, which was written by a close (younger!) relative, does not presuppose much linear algebra, but concepts from linear algebra, ranging from vector spaces of functions through linear transformations and kernels to eigenvalues and eigenvectors, will be mentioned and used with some regularity in class.

**Math 245:** Applied Regression Analysis  
**Prerequisites:** Math 215 (AP stats 4/5) or Math 275  
**Professor:** Laura Chihara  
**Class Time:** 4a, CMC 102  
**Description:** On the night of January 27, 1986, engineers at Morton Thiokol teleconferenced with engineers and managers at the Marshall Space Flight Center and Kennedy Space Center to determine whether it was too cold (31°F) to launch space shuttle Challenger. Data from previous flights seemed to suggest that temperature had an effect on the integrity of the O-ring seals on the booster rockets, but the final recommendation was to launch the Challenger on schedule. Could a statistical analysis of the pre-accident data predict the catastrophic failure of the shuttle? In this class, we will investigate the Challenger data and in general, learn statistical model building and model checking techniques. We will use the software package R to aid in the modeling.

**Math 251:** Chaotic Dynamics  
**Prerequisites:** Math 236 or consent  
**Professor:** Sam Patterson  
**Class Time:** 4a, CMC 210  
**Description:** Dynamics is the mathematical study of systems that change with time. While dynamic natural processes have been studied using mathematical models since the time of Galileo, most of those models have been linear models because those are the ones that could be solved. Recently, however, attention has been turned to non-linear dynamical systems. This gave rise to the remarkable discovery that even very simple, deterministic, dynamical systems can exhibit astoundingly rich and even unpredictable behavior. In this course we develop the tools to understand the basic examples of Discrete Non-linear Dynamical Systems. Point-set topology, one of our critical tools, will be developed as needed.

**Math 275:** Introduction to Statistical Inference  
**Prerequisites:** Math 265  
**Professor:** Katie St. Clair  
**Class Time:** 2a, CMC 206  
**Description:** Statistics is the art and craft of studying data and understanding variability. Though mathematics (in particular, probability) governs the underlying theory, statistics is driven by applications to real problems. We will cover basic statistical inference as well as modern computational approaches, all in the context of analyzing data and investigating interesting questions that arise in scientific (natural and social) and societal settings. The R statistical software package will be used.

**Math 331:** Real Analysis II  
**Prerequisites:** Math 321  
**Professor:** Gail Nelson  
**Class Time:** 3a, CMC 210  
**Description:** In this, the second course of the analysis sequence, we will delve even deeper into the properties of functions. Specific topics will include Lebesgue measure, the Lebesgue integral, an introduction to general measure theory, and Banach and Hilbert spaces. Not only is this your chance to “integrate” your knowledge of functions, it is also an opportunity to better your understanding of the legal interchange of limit operations. And, of course, the Cantor set will make its usual appearance! The flavor of the course will be similar to a graduate-level course in analysis. If there is a possibility that you are headed for graduate school in mathematics or a related field, this course comes highly recommended.

**Math 342:** Abstract Algebra I  
**Prerequisites:** Math 236 or consent  
**Professor:** Mark Krusemeyer  
**Class Time:** 5a, CMC 319  
**Description:** Abstract algebra is a fascinating area of pure mathematics that has applications in several directions which you might not expect.
For example, the ways of describing symmetry that we will look at are used in theoretical physics (among other things, to predict the existence of elementary particles) and in quantum chemistry. But they can also be used in the study of artistic patterns, such as wallpaper patterns or Escher’s “regular division drawings”. We will explore exotic settings for arithmetic, once thought to be of purely theoretical interest, which in the last sixty years have found numerous applications to such things as the design of error-correcting codes. If time permits, we may see how famous construction problems from ancient Greek geometry were shown to be unsolvable, about 2000 years after they were first proposed! All this will be done using algebraic structures such as groups, rings, and fields, but we’ll see what those technical terms mean during the course itself. To get a preview, have a look at the highly entertaining textbook we’ll use, Gallian’s *Contemporary Abstract Algebra*.

**CS 252: Algorithms**

**Prerequisites:** CS 201 and either CS 202 or Math 236

**Professor:** David Liben-Nowel

**Class Time:** 1a, Weitz 230

**Description:** What with Halloween here and all, you start to wonder: suppose that, after you don your Steve Poskanzer costume and head out into the night, you want to hit all of the houses of Carleton’s political science professors while you’re trick-or-treating. (They have the best candy.) But you’re feeling lazy, so you want to be sure that your route is as efficient as possible. So you decide to write a program to solve this problem. How would you go about designing a solution for this problem? How fast can your program be? Sadly, some problems are just plain hard. How do you solve the easy problems? How do you identify the hard problems? How do you deal with a hard problem when you’re confronted with it? CS 252, which counts toward both mathematics and computer science majors, is concerned with developing techniques for the design and analysis of algorithms. We will cover several major algorithm design techniques, with applications to a variety of CS and non-CS do-

mains, and algorithmic techniques for intractable problems.

**PROBLEMS OF THE WEEK**

1. Find all real functions $f$ such that $f(x + 2) = f(x)$ and $f'(x) = f(x + 1) - 2012$ for all real number $x$.
2. Let $a$ be a positive integer. Show that there exists integers $x$ and $y$ with $x^2 - y^2 = a^3$.

Correct solutions to the first of last week’s problems came from Matt Cotter, Pete McNeely, the duo of Ben Strasser and Christophe Detier. The anonymous *Der Bauer* also came through on that problem. Matt Cotter also correctly solved problem two. Our Oconomowoc friend also had *Mathematica* analyze both problems.

This week’s prize winner is the team of Ben and Christophe. I will leave it to them to figure out how they will share the prize. In any case, one of them should stop by CMC 217 to retrieve the reward from the BBOP. Congratulations to them and to all who came up with solutions. As always, to be mentioned in the next week’s Gazette your solution must get to me by Tuesday night.

- Gail Nelson