MSCS Mess

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This Week's Colloquium

Title:	From Medical Economics to the Family Trees of Turtles: Applying "Big Data" Technologies
Speaker:	Ben Le Cam '16 & Joseph Jung '16
Date:	Monday, October 6
Time:	3:30 pm
Location:	RNS 310

About the talk: Theres a lot of buzz about Big Data computations in the media these days. How does it relate to actual research projects carried out by St. Olaf students and faculty? This talk describes the work of St. Olaf CS students who are applying Big Data computing technologies to two local research efforts. One project examines the economic impact of medical mistakes on patients who each have multiple medical diagnoses; the other project investigates the genealogical relationships among populations of Minnesota turtles. The technologies involved and their connections to these problems will be described for a general MSCS audience.

Ben Le Cam 16 is a CS major and Management Studies concentrator who hails from France. His dual interests in CS and Management led him to take a semester-long ACM-sponsored semester in Chicago, where he developed an interest in the maker movement, in which people learn and solve problems by constructing physical objects using technologies ranging from screwdrivers to 3D printers. As a HiPerCiC Manager at St. Olaf, Ben takes a leading role in interdisciplinary undergraduate research in fields all across the campus involving CS.

Joseph Jung 16 is majoring in Physics, Mathematics, and CS. He got involved with the Medical Economics project while he was training as a CS Cluster Manager last summer, developing high-performance computations that power a custom web application created for the research team. He contributes to the WebMapReduce software that makes Hadoop mapreduce Big Data computations accessible to CS students as early as the introductory course.

This Week's Seminar

Title:	Gromov Hyperbolic Spaces: What are they and why should we care?
Speaker:	Bruce Hanson
Date:	Friday, October 3
Time:	3:30 pm
Location:	RNS 204

About the talk: What is a Gromov Hyperbolic Space, you ask? Roughly speaking it's a metric space with negative curvature, whatever that means. Generally you need a space with a lot of structure to define curvature, but Gromov found a way to do this in a much more general setting. I will explain what this means starting with the definition of a metric space and a rough introduction to curvature. It should be fascinating!

Bruce Hanson grew up in Duluth, attended St. Olaf College and got his PhD from the University of Wisconsin, Madison in 1982, the same year that he began teaching at St. Olaf. His research interests include quasiconformal mappings and analysis on metric spaces. Bruce has four sons: Shane, Anders, Mats and Leif and in his spare time he loves to sing, play guitar, ride his road bike and watch his sons compete in various sporting events.

Problem Solving!

The problem-solving group will be meeting again on Monday, 6:00-7:00 in RNS 206. Everyone is welcome and we hope to see you

there. If you are interested in problem-solving but can't make it to the meeting, you can find our problem sets and solutions on our website: http://pages.stolaf.edu/diveris/category/problem-solving/.

NUMS 2014 is Here!

On Tuesday, October 7, several St. Olaf and Carleton students will present their summer mathematics or statistics research at the 2014 Northfield Undergraduate Mathematics Symposium. This year, Carleton is hosting the event in the Center for Mathematics and Computing (CMC) 209. Come find out about the mathematics and statistics your classmates did this past summer, and enjoy the lively conversation at dinner. Even if you cant stay for the whole event, you can still join the fun for a couple of talks. The schedule of events is below, followed by titles and abstracts for all of the talks.

4:00 Uniquely Bipancyclic Graphs Zach Walsh, Carleton

4:30 A Mathematical Approach to Uncovering Regulatory Mechanisms in Calcium Homeostasis Ben Liska, St. Olaf

5:00 Lasagna Dinner and Conversation

5:45 Chermak-Delgado Lattices of Metacyclic p-Groups Kendra Johnson-Tesch and Brianne Power, St. Olaf

6:15 A Method for Combining Family-based Rare Variant Tests of Association Kaitlyn Cook, Carleton

Uniquely Bipancyclic Graphs

Zach Walsh, Carleton

A bipartite graph on n vertices, n even, is called uniquely bipancyclic (UBPC) if it contains precisely one cycle of length $2m$ for every $2 \leq m \leq n/2$. The concept of uniquely bipancyclic graphs was recently introduced by Dr. Walter Wallis of Northern Illinois University, who classified all UBPC graphs on at most 30 vertices. Namely, up to isomorphism, there is only one uniquely bipancyclic graph of order 4 and only one of order 8. There are precisely four uniquely bipancyclic graphs of order 14 and six of order 26.

We used computer programs to show that if $32 \leq n \leq 56$, and $n \neq 44$, then there are no UBPC graphs of order n. We also found the six non-isomorphic UBPC graphs of order 44.

A Mathematical Approach to Uncovering Regulatory Mechanisms in Calcium Homeostasis

Ben Liska, St. Olaf

Calcium is a mineral essential to many systems of life. As such, the body regulates levels of calcium in the blood plasma very tightly through a process known as calcium homeostasis. The controlling mechanisms in this process include parathyroid hormone, calcitonin, vitamin D, and the mineral phosphate. Much research has been done on the biology of this system but it is not understood completely. Recently, work has been done to mathematically model this system, however, these models are very complex. In this talk, we will provide a simplified mathematical model of calcium homeostasis that still captures biologically relevant mechanisms. Using the modeling software COPASI (Hoops 2006), we will show numerical simulations and comparisons to experimental data. An analysis of the stability of our nonlinear model provides insights into our dynamical system. We will conclude by showing ways we can predict how various diseases can disturb calcium homeostasis and provide suggestions for further investigation that could lead to effective treatments.

Chermak-Delgado Lattices of Metacyclic p-Groups

Kendra Johnson-Tesch
and Brianne Power, St. Olaf

The Chermak-Delgado measure of subgroup H in a finite group G is defined as $mG(H) = |H||C_G(H)|$. The subgroups with maximal Chermak-Delgado measure form a lattice of subgroups called the Chermak-Delgado lattice. This paper applies key properties of Chermak-Delgado lattices to split metacyclic p-groups. Moreover, we provide a complete Chermak-Delgado lattice for specific split metacyclic p-groups. Additionally, we describe a sublattice within the subgroup lattice of a split metacyclic p-group; we have reason to believe that this is a sublattice of the Chermak-Delgado lattice.

A Method for Combining Family-based Rare Variant Tests of Association

Kaitlyn Cook, Carleton

In statistical genetics, the current methods of detecting association between rare genetic variants and disease phenotypes often lack statistical power. To combat this lack of power, the use of pedigree data, in which rare variants are often more highly concentrated than in typical case-control data, has become increasingly popular. Methods for combining multiple gene-based tests of association into a single summary p-value are also a robust approach when little a priori knowledge is available about the underlying genetic disease model. However, to date, little consideration has been given to combining gene-based tests of association for the analysis of pedigree data. We propose a flexible framework for combining any number of family-based rare variant tests of association into a single summary statistic (p-value) and for

assessing the significance of that statistic.

and for Your Reading Pleasure...

a Math Joke

An engineer, a physicist and a mathematician are staying in a hotel.

The engineer wakes up and smells smoke. He goes out into the hallway and sees a fire, so he fills a trash can from his room with water and douses the fire. He goes back to bed.

Later, the physicist wakes up and smells smoke. He opens his door and sees a fire in the hallway. He walks down the hall to a fire hose and after calculating the flame velocity, distance, water pressure, trajectory, etc. extinguishes the fire with the minimum amount of water and energy needed.

Later, the mathematician wakes up and smells smoke. He goes to the hall, sees the fire and then the fire hose. He thinks for a moment and then exclaims, "Ah, a solution exists!" and then goes back to bed.

and a Riddle

What is it that you can keep after giving it to someone else?

(Last week's answer: Nothing)

(This week's answer to be found in the next Mess)

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If you would like to submit an article or event to be published in the Math Mess, e-mail greimann@stolaf.edu