MSCS Mess

This Week's Colloquium

Title:	Permutation, Coagulation, and Fragmentation
Speakers:	Tom Halverson
Time:	1:30 pm Tuesday, March 20 (Treats at 1:15)
Place:	SC 182

Abstract: We will begin by shuffling cards in a very dumb and slow way. This method of shuffling, which can be viewed as a random walk on permutations, has some nice properties and will lead us through a beautiful story involving permutation, probability, matrix algebra, graph theory, and some abstract (yet concrete) algebra. Ultimately, we will generalize our shuffling to a random walk on set partitions using "coagulation" and "fragmentation," and we will discover a rather startling conjecture. This talk will mostly be elementary with very few prerequisites, though some eigenvalues and vectors will pop up here and there.

About the Presenter: Tom Halverson graduated from St. Olaf in 1986, one of more than 100 math majors who graduated that year. He went on to the University of Wisconsin Madison, where he earned his PhD in mathematics. From graduate school he went directly to a job at Macalester College, where he has now worked for 14 years. His research is in algebra and combinatorics, especially in the intersection of the two fields.

A Math-tastic Class for next semester...

Math 382: Topics in Analytical Math (Research Seminar): If you have always wanted to make your mark in mathematics by discovering a new theorem or developing a new algorithm, this course is for you! Math 382 - Topics in Analytical Mathematics will be offered by Jill Dietz and Tina Garrett (Fall '07).

This course will offer students the opportunity to learn research methods and work on research projects in mathematics. Professors Dietz and Garrett will suggest projects from group theory, number theory, partition theory, combinatorics, graph theory and other subjects, and students will do the research in teams. The entire class will meet one day a week to learn about research methods and report on team progress, and each team will meet independently with Professor Dietz or Garrett one hour per week. This is a rare and exciting opportunity to do research during the academic year.

The course is open to anyone who has taken

either ERA or Abstract Algebra. Please see either Professor Dietz or Garrett if you have any questions about the course.

Top Ten Excuses for Not Finishing the Math Homework...

1. I accidentally divided by zero and my paper burst into flames.

2. Isaac Newton's birthday.

3. I could only get arbitrarily close to my textbook. I couldn't actually reach it.

4. I was watching the World Series and got tied up trying to prove that it converged.

5. I have a solar powered calculator and it was cloudy.

6. I locked the paper in my trunk but a four-dimensional dog got in and ate it.

7. I couldn't figure out whether i am the square of negative one or i is the square root of negative one.

8. Someone already published it so I didn't take the time to write it up.

9. I had too much pi and got sick.

10. I could have sworn I put the homework inside a Klein bottle, but this morning I couldn't find it.

Problem of the Week (POW)

Who's got the button? A rotating square table has a button at each corner. Each button controls a switch that's either on or off, and changes every time the button is pressed. The switches start in an unknown configuration. Alonzo presses a subset of the buttons, and then Bridget spins the table. They continue in this way. If the four switches are all on, a light goes on and Alonzo wins. Find a winning strategy for Alonzo.

Submit all solutions before the appearance of the next problem to Josh Laison in person, by e-mail (laison@stolaf.edu), or by blimp message. The first correct solution gets a prize; all correct solutions get fame and glory.

Solution to Toad in a Field. Congratulations to Paul Tveite, who found a jumping strategy which uses at worst 111 jumps, and won a snow penguin construction kit, and to Bjorn Paulson and Reid Price, who also had solutions in the 110's.

We imagine the toad at the center of a circle of radius 100 feet, with the fly at some point on the circumference. At the start, the toad doesn't know whether every jump will bring it closer or further from the fly. Since we're interested in the worst-case scenario, we assume that every jump the toad makes will in fact bring it further. The toad starts by jumping East. Since it's jumping away from the fly, this leaves an arc of length very close to 200pi/2+1=100pi+1 on the circumference of the circle (almost exactly half of the circumference) that the fly could now be in. From this point on, we observe that with every jump, the toad can cut the size of the arc where the fly can be exactly in half. It does this by jumping such that the perpendicular bisector of the line segment traversed in the jump cuts this arc in half. There are actually two such jumps for every position. For simplicity's sake we choose the jump that leaves us closest the center of the circle. After the first jump, it makes such a jump 8 times, putting it at a total of 9 jumps. This will have narrowed the arc length of the possible fly positions to extremely close to

$(100\pi+1)/2^8$, which is approximately 1.231 feet. Call this arc of the circle A. Assuming that the toad jumped away from the fly on each of its 9 jumps, it will be no more than 100+the sum from n=1 to 9 of $(\sin(\pi/2^n))$ feet from the midpoint of A. This number is slightly less than 102.5. The toad now takes 102 jumps towards the midpoint of A. The toad is now within 1 foot of an arc of the circle of length $2\cos(\arcsin .5)=\sqrt{3}$, about 1.732. Since this arc contains A, the toad can now eat the fly, giving a total of 111 jumps.

For an extra challenge, try the situation where the toad is exactly 2 feet from the fly, and find a jumping strategy using only 5 jumps.

Improvement on Jumping Mad: Congratulations to Bjorn Paulson, who improved Thomas McConville's solution to Jumping Mad by four moves:

After "b E2-B2-B4" instead of moving w D2-B2, move

w D2 B2 B5 D5 D3
b B4 B2 D2 D5 B5
w D3 D5
b B5 E5.

This decreases the number of moves made from 39 moves to 35 moves.

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