The Concordia College Math/CS

$\ker \varphi = \{x \in G : \varphi(x) = 1\}$
$\ker T = \{v \in V : T(v) = 0\}$

Kernel

kernel, n.
The central component of an operating system.

Volume 2, No. 3 Friday, October 2, 2009

Math Club: Rubik's Cube Night

Date:	Monday, October 5, 2009
Time:	6:30 p.m.
Where:	Ivers 210
Food:	Snacks and pop

Learn how to solve the Rubik's Cube, the world's top-selling puzzle game! We'll also be discussing the mathematics behind this mind-bending, face-twisting puzzle. When the Rubik's Cube first came out, for example, its packaging boasted that it could attain "more than three billion possible states." Come see why J.A. Paulos described this claim in *Innumeracy* as "analogous to McDonald's proudly announcing that they've sold more than 120 hamburgers." As always, snacks will be provided!

K.N. Rao Mathematics Competition

Date:	Saturday, October 10, 2009
Time:	9:30 a.m. – 12:30 p.m.
Where:	NDSU, Minard Hall 334

The 25th annual K.N. Rao Mathematics Competition will be on Saturday, October 10, from 9:30 am to 12:30 pm. Students from Concordia, MSUM, and NDSU compete individually on a set of written problems. The top five winners receive both undying glory and gift certificates; last year Concordia's own Sam Benidt and Yinhan Liu were runners-up at this competition. The contest will be held at NDSU.

For more information, see the poster on the Math/CS bulletin board, or contact Dr. Biebighauser. To register for the exam, send your name, mailing address, and e-mail address to Dr. Biebighauser no later than Wednesday, October seventh.

High Performance Computing at the Oak Ridge National Laboratory

Speaker:	Olaf Storaasli '64
	Oak Ridge National Lab
Date:	Thursday, October 15, 2009
Time:	2:45 p.m.
Where:	Ivers 221

In the 1970's, the "coin of the realm" in high-performance computing was to achieve Millions of FLoating point Operations Per Second (MFLOPS) to solve scientific applications. In 1989, the next level of performance (1,000 MFLOPS) was achieved by Concordia graduate Olaf Storaasli '64 with a NASA-ODU team, who received Cray's 1st GigaFLOP Award for the static analysis of a "gigantic" Space Shuttle Solid Rocket Booster model with 54,000 equations.

In 1998, an Oak Ridge team using a Cray T3E broke the TeraFLOP (million MFLOPS) barrier. In 2008, two Department of Energy computers exceeded 1 PetaFLOP (billion MFLOPS), a phenomenal billion times faster than our early NASA leading-edge computers.

Along with theory and experiment, the Department of Energy views supercomputers as the third leg of scientific discovery. Further, as experimentation is costly and slow, an increasing number of significant discoveries are made using supercomputers.

Dr. Storaasli, a member of Concordia's Math/CS Hall of Fame, will describe the current top fleet of supercomputers and applications they are now solving. Based on his research in the Future Technologies Group at Oak Ridge, he will project the next level of supercomputers (ExaFLOP): their architecture, software, tools, and the performance they are expected to achieve to enable unparalleled scientific discoveries.

Tri-College Colloquium Talk

Speaker:	Oksana Bihun, Concordia
Title:	Optimal geometry distortion of diffeomorphisms between manifolds
Date:	Tuesday, October 6, 2009
Time:	3:30 p.m.
Where:	NDSU, Minard 303C
Food:	Refreshments

The problem of mapping of surfaces with minimal distortion of geometry arises in medical imaging, animation, and industry. While there is an extensive literature on numerical methods that lead to a small distortion map, the underlying mathematical problem is not well understood.

Each diffeomorphism h between two compact smooth n-manifolds M and N distorts the geometry of M in a certain way. We ask which diffeomorphisms produce the least distortion and introduce cost functionals that measure the distortion with respect to the change of volume, the distortion due to strain, and the distortion due to bending. We employ some important results on volume forms on manifolds, linearization via time dependent vector fields, some evolution operator theory, and methods of calculus of variations, to prove the existence of minimizers of the above cost functionals in certain classes of diffeomorphisms. We generalize our findings to the problem of minimal distortion morphing (through homotopies) of compact manifolds.

Problem Corner

Line segments $\overline{AB}$ and $\overline{CD}$ are diameters of a circle centered at O, and are perpendicular to one another. The chord $\overline{DF}$ intersects $\overline{AB}$ at E. If $DE = 7$ and $EF = 3$, find the area of the circle.

Send solutions to `ahendric@cord.edu` *or to Ivers 234G by Wednesday, October 14, 2009. Correct solutions will be published in the next issue.*

Solution to Last Issue's Problem

Problem: Recall that a *cubic number* is of the form k^3 for some integer k; for example, 8 and -27 are cubic numbers, but 4 is not. Prove that there exists no integer n such that both $n+15$ and n^2+75 are cubic numbers.

Solution: Suppose, for a contradiction, that both $n+15$ and n^2+75 are cubic numbers. Then so is their product

$$\begin{aligned}(n+15)(n^2+75) &= n^3+15n^2+75n+1125 \\ &= (n+5)^3+10^3.\end{aligned}$$

So $k^3 = (n+5)^3+10^3$ for some integers k and n. But by Fermat's Last Theorem, there is no solution in nonzero integers to this problem! Thus either $k=0$ or $n+5=0$. But if $k=0$ then $n+5=-10$, so $n=-15$ and $n^2+75=300$, which is not a cube; whereas if $n+5=0$, then $n+15=10$ is not a cube. In either case, we have a contradiction. We conclude that $n+15$ and n^2+75 cannot both be cubic numbers for any integer n.

Sadly, no correct solutions were submitted.

Fermat's Last Theorem, the fact that $x^n+y^n=z^n$ has no nonzero integer solutions if $n>2$, was stated by Pierre Fermat in 1637 but remained unproved until 1995. For this Problem Corner, though, we only needed to know that $x^3+y^3=z^3$ has no integer solutions, and that was proved by Euler in 1770.

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