What Can I Do with a Math Degree?

Math Modeler, Boeing Phantom Works

- **Company Overview:** Boeing (`http://www.boeing.com`) is the world's leading aerospace company and the largest manufacturer of commercial jetliners and military aircraft combined. Additionally, Boeing designs and manufactures rotorcraft, electronic and defense systems, missiles, satellites, launch vehicles and advanced information and communication systems. Phantom Works is the advanced research and development unit at Boeing and the catalyst of innovation for the Boeing enterprise. You can work with the Phantom Works team in Arizona, California, Missouri, Pennsylvania, Washington state, and Washington D.C..
- **Job Description:** Interprets and formulates problems in mathematical or computational terms. Develops algorithms and evaluates resources to solve mathematical problems. Assists with mathematical research. Presents results of research in appropriate forums. Contributes to development of research proposals. Influences colleagues and direct customers to use appropriate mathematical tools and processes to accomplish business objectives. Develops algorithms, and codes, tests, and maintains mathematical software tools. Develops and maintains documentation to support tools and assists in developing training.

Problem of the Month

- **November Problem:** Let $f : \mathbb{R} \to \mathbb{R}$ be continuous, with $f(x)f(f(x)) = 1$ for all $x \in \mathbb{R}$. If $f(1000) = 999$, find $f(500)$.* Mids who submit a correct solution (answer + explanation) to the editor via email will be entered in a random drawing for Math Department swag.
- **September Solution:** The river flows at 3 miles per hour. A correct solution was submitted by MIDN 4/C Spencer Ewing. Come claim your prize!

Contact the Editor

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*Source: Leningrad Math Olympiad, 1988.

The Math News†

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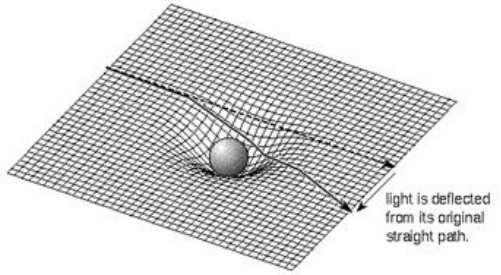
String Theory

by Assoc. Prof. Amy Ksir (`ksir@usna.edu`)

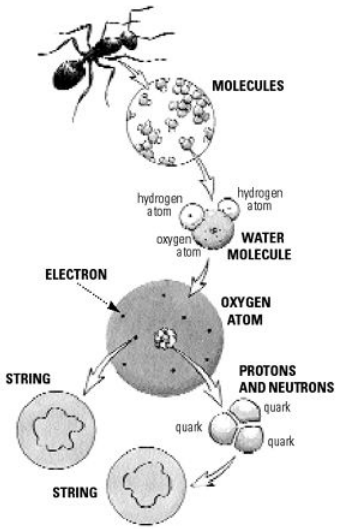
What shape is the universe? Does it go on forever? What are black holes, really, and how do we understand them? How can the whole universe be expanding? Will it keep expanding forever, or end in a "big crunch"? What does it mean that "time is the fourth dimension"? What is string theory, and why does it predict that the universe is actually ten-dimensional? How could that possibly be true, and how could we possibly tell if it was?



General relativity is the theory of physics developed by Einstein in 1915 to describe the relationship between the curvature of spacetime and gravity. The basic idea is that massive objects actually curve spacetime. Imagine four people holding the corners of a blanket, with a basketball making a dent in the middle. If a marble is rolled along the blanket, it will not roll in a straight line, but tend to curve towards the basketball. In a similar way, light rays bend as they come past heavy objects like stars and planets.

Einstein realized that he could not describe gravity using flat geometry. He worked with the mathematicians of the day, including David Hilbert and Emmy Noether, to understand the mathematics of non-Euclidean geometry and how it could be applied to physics. Einstein wrote, "I have become imbued with great respect for mathematics, the subtler part of which I had in my simple-mindedness regarded as pure luxury until now."

†On the cover: The USNA seal (left) and the Mandelbrot set (right).



Seventy years later, **string theory** became popular as a possible way to unify general relativity with quantum mechanics. The idea behind string theory is that instead of viewing the fundamental particles of nature as tiny billiard balls, we should picture them as little strands of spaghetti known as strings. Each quark, electron, or photon is represented by a string vibrating a certain way, and different modes of vibration give these elementary particles their different properties. String theory has not yet been tested by experiments, but it does solve some of the fundamental problems with theoretical physics. One of the predictions it makes is that there are six extra hidden dimensions in the universe. Again, understanding the geometry of curved spaces became important—these extra dimensions may be "curled up" so tightly that we can't see them.

By studying the geometry of curved spaces, we can understand properties of black holes, the big bang (and possible "big crunch"), and the shape of the universe. In Spring 2008, Associate Professor Amy Ksir will be teaching a course (SM 472A) in which these fascinating ideas will be explored. Ksir does research in algebraic geometry, and her Ph.D. thesis and postdoctoral work were on applications of algebraic geometry to string theory.

Math in the News: NUMB3RS Season Four

CBS's popular drama NUMB3RS about Los Angeles-based FBI agent Don Eppes (Rob Morrow) and his mathematician brother Charlie (David Krumholtz) enters its 4th season. The show, which airs Friday nights at 10pm, depicts how cutting-edge mathematics can help solve complex crimes. It has succeeded in making mathematics accessible and interesting, as a regular viewership of 12 million people will attest. Mathematical consulting for the show is provided by Wolfram Research, the maker of *Mathematica*. To learn more about "The Math behind NUMB3RS", visit `http://numb3rs.wolfram.com`.

Faculty Profile: LCDR Kyle Caudle, USN

LCDR Kyle Caudle's home town is Des Moines, Iowa. He majored in Math at Western State College in Gunnison, Colorado, and it was at Western that he also competed on the cross-country and track & field teams—training in the thin mountain air. Following graduation, LCDR Caudle earned his commission through the Officer Candidate School program. As a nuclear-trained officer, he served on the USS ENTERPRISE (CVN 65) and then received his surface warfare qualification as a member of the USS HAYLER (DD 997) wardroom. LCDR Caudle first became interested in teaching when he was assigned to teach math at the Naval Academy Preparatory School (NAPS) in Newport, RI.

Upon completion of his teaching tour at NAPS, LCDR Caudle entered the Naval Reserve in order to attend graduate school (George Mason University) and perform statistical consulting (Naval Sea Systems Command in Washington, D.C.). He returned to active duty in 2001 to join the mathematics faculty at USNA, where he teaches a wide variety of math courses.

LCDR Caudle's research interests are in analyzing massive data streams, whereby large volumes of continuously arriving data are used to update probability models. In particular, he uses wavelet analysis of internet header data to detect network attacks and malfunctions.

LCDR Caudle lives in Cape St. Claire with his wife Mary. He has three children: Tim (15), Lindsey (4), and Zachary (18 months). Running is still a major part of LCDR Caudle's active lifestyle. He recently competed in the 1500m at the U.S. Masters in Orono, Maine, where he placed 8th in 4:20.14. His next major competition is the U.S. Masters cross-country nationals in West Chester, Ohio, on December 8th. To top it off, LCDR Caudle, who has played the violin since high school, is a member of the Anne Arundel Community College Orchestra.