Mathematics Department

Temporarily at Preble Hall

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Profile of the Month
Commander Vincent van Joolen

Commander Vincent van Joolen reported onboard in August 2003 after completing his PhD in Applied Mathematics at the Naval Postgraduate School in Monterey, California. He is currently an Assistant Professor teaching Calculus and Differential Equation courses to Plebes and Youngsters. CDR van Joolen received a Bachelors Degree in Chemical Engineering at the University of California, San Diego in 1983. Shortly thereafter he was commissioned at the Naval Officer Candidate School, Newport, Rhode Island. He entered the Surface Line and has served as Division Officer on the USS ELLIOT (DD967), Chief Engineer on the USS CAYUGA (LST1186), and Executive Officer on the USS JUNEAU (LPD10). He completed three WESTPAC cruises which included operations off the coast of Somalia during the "Black Hawk Down" crisis. He is now part of the Permanent Military Professor cadre, a position that will keep him at the Academy until 2011.

CDR van Joolen's sea-shore rotation was somewhat atypical for the Navy. Instead of serving at shore commands, he was sent to various schools for further education. Before earning his PhD, he completed tours at: Naval Postgraduate School where he earned a Masters Degree in Applied Math, Defense Language Institute where he earned an instructor's rating in German, German Armed Forces Staff College, and Army War College where he earned a Masters in Strategic Thought (his "PhD in Thinkology" ☺).

CDR van Joolen's mathematical specialty is numerical solutions for partial differential equation. Since arriving at USNA, he has published five papers and presented his work at an international conference at Brown University. In his spare time he enjoys running, singing and acting. You can catch his next show in December at the Colonial Players Theater just off State Circle where he will be playing Fezziwig in a musical version of Dickens' "A Christmas Carol".

The symbol used on this current issue of Math News is one of the Platonic Solids. The Platonic solids, also called the regular solids or regular polyhedra, are convex polyhedra with equivalent faces composed of congruent convex regular polygons. There are exactly five such solids: the cube, dodecahedron, icosahedron, octahedron, and tetrahedron, as was proved by Euclid in the last proposition of the *Elements*. Ref. http://mathworld.wolfram.com/PlatonicSolid.html More on this in the next Math News Issue.

Math News

Mathematics Department

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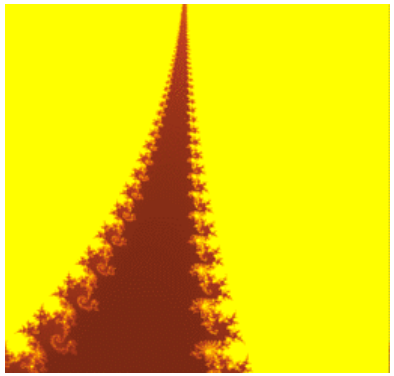
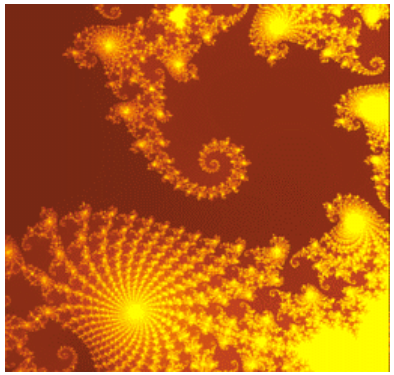
HOT OFF THE PRESS: Honors Math Student a World Class Athlete.

How much do you know about the Mandelbrot set?

(by Prof. M. Meyerson) The Mandelbrot set was discovered and first drawn on a computer by mathematician Benoit Mandelbrot about 20 years ago. It consists of those complex numbers, c, such that when the function given by $f(z) = z^2 + c$ is iterated, starting at $z = 0$, the resulting sequence does not go off to infinity. For example, $c = -1$ is in the Mandelbrot set since for $f(z) = z^2 - 1$ we have $f(0) = -1$, $f(f(0)) = 0$, $f(f(f(0))) = -1$, which does not go off to infinity. But $c = 1$ is not in the Mandelbrot set since for $f(z) = z^2 + 1$, $f(0) = 1$, $f(f(0)) = 2$, $f(f(f(0))) = 5$, which does go off to infinity. The Mandelbrot set acts as a sort of index for what are called Julia sets. For each complex c the set of all first points z_0 such that iterating $f(z) = z^2 + c$ starting at z_0 has a result not going off to infinity forms the Julia set for c. The elements of the Mandelbrot set turn out to be those values of c for which the Julia set is in a single connected piece. These sets are examples of "fractals".





Inside this issue:

What is **CRYPTOGRAPHY** ? The art of protecting information by transforming it (*encrypting* it) into an unreadable format, called cipher text. Only those who possess a secret *key* can decipher (or *decrypt*) the message into plain text. Encrypted messages can sometimes be broken by cryptanalysis, also called *codebreaking*, although modern cryptography techniques are virtually unbreakable.

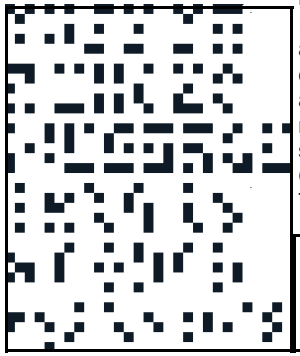
Mandelbrot Set (Continuation)

Many of them are so intricate and convoluted their dimension is fractional – bigger than one (the dimension of a smooth curve) and less than two (the dimension of a filled in region). They also have the property that their intricacies don't change even when magnified and looked at on arbitrarily small scales. Although these sets were first studied mathematically about a century ago, drawings of them have only been possible with the advent of computers.

ERROR-CORRECTING CODES AND CRYPTOGRAPHY AT THE USNA by Professor David Joyner

For many reasons, the U.S. Navy has a strong interest in electronic communication. Error-correcting codes and cryptography are two important facets of digital communications. At the USNA, there is no specific course on this but occasionally there are special topics courses and reading courses students can take. For example, next spring Professor George Nakos (winner of the 2003 USNA Teaching Excellence Award) will offer a special topics course on cryptography. Last spring I offered a special topics course on error-correcting codes. Currently, three mathematics majors - Wayne Irons, Clifton ("Clipper") Lennon, and Jason McGowan - are working on honors projects in the topic of error-correcting codes and one - Stephen McMath - is working on a Trident project in the area of cryptography.

What good is studying these topics for a midshipman? For one, you can (and I hope you do) ask the above-mentioned current midshipmen for their point-of-view. For the point-of-view of someone in the fleet, I asked a former student who is now in the Navy working in (on one of the few) Crypto billets. (Since the work is classified, I prefer leaving names out of this published version but if you are a midshipman who wishes contact information for further advice, please see me in person. You can email me at wdj@usna.edu to make an appointment.) Here is a direct quote from a recent email: "A Midn could potentially use his math degree to help design, build and procure Navy Cryptology system, including the oversight of software, hardware, and antennas. I have helped to develop specifications that our amplifiers, upconverters, antennas and overall systems have to meet. I have also been a member of a Technical Lead Team that evaluates various contractor's proposals trying to meet our required specifications. In all these cases, having a math background strongly helped me. I may not have integrated anything, but I could contribute to and understand the conversations. Often I am the only Navy representative and what I say is on behalf of the CO of my command. This is not an atypical



http://www.murky.org/cryptography/archives/puzzles/index.html

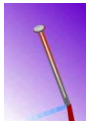
MATHEMATICALLY HOT!

Midn 1/C Matt Welch (25th Co) Math Honors student finished the race very close (essentially tied) with the winner of the 20-24 age group, and qualified for the 2005 Ironman World Championships in Kona, Hawaii by breaking the 10 hour barrier by over 5 minutes.

ERROR-CORRECTING CODES AND CRYPTOGRAPHY AT THE USNA (Continuation)

job for anyone in Cryptology. Math also helps one to understand the physics behind signals and why certain types are important, propagation, ducting etc. All of these things are vital to doing a good job on either an air, surface or sub platform."

Answers for last issue puzzles: Count the Streetlights . It 's 660 yards. There are 23 lamps on one side and 22 on the other side. There are 22 gaps between 23 lamps; therefore, the street is 22 times 30 yards long, or 660 yards. Question about the weather: There must have been 1/2(6+7-9) or 2 completely clear days, so there were 9+2 or 11 days in the period. Last issue's winners were MIDN 4/c Michael Pfaefflin and MIDN 2/C Daniel Ryan.



Nail Math

How long is an eightpenny nail in inches?

Question of the Month

Legally married in California, my neighbor has reached a square age. The product of the digits of this age is his wife's age. The age of their daughter is the sum of the digits of her father's age, and the age of their son is the sum of the digits of his mother's age. How old are they?

E-mail your answer to Prof. Garcia smg@usna.edu. Among those with the right answer, a randomly chosen midshipman will get a fantastic math water bottle.

"The dog is very smart. He feels sorry for me because I receive so much mail; that's why he tries to bite the mailman."
Einstein