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Mathematics Capstone Courses

Each Midshipman majoring in Math or Applied Math takes a capstone course in the spring semester of the senior year. The topics of the capstone course change year to year. Two recent topics are cryptography and lasers.

— **Cryptography** — The making and breaking secret codes has been of great military importance since Julius Caesar used simple substitution codes to send messages to distant armies. Modern methods of encryption and decryption rely on more sophisticated mathematical techniques, mostly from number theory, matrix theory, and probability.

— **Lasers** — The course begins with mathematical models of light propagation using differential equations. Then the design of a laser beam is discussed and measurements taken in an experimental phase. Next, the theory is explored using MATLAB, a powerful suite of mathematical software. Finally, each student reads a research article on lasers and light propagation. This class is taught by professors from the Mathematics and Engineering Departments.

Mathematics Faculty Profile

Dr. Stephen Pankavich was born in Paducah, Kentucky. He soon moved to Pittsburgh, where he would spend the next 25 years of his life. He earned both his B.S. (in 2000) and his Ph.D. (in 2005) in Mathematical Sciences from Carnegie Mellon University. He was a Zorn Postdoctoral Fellow at Indiana University from 2005–2008, and then a tenure-track Assistant Professor at the University of Texas at Arlington from 2008–2010. He arrived at the Naval Academy this semester. He currently teaches two sections of Calculus I (SM121).

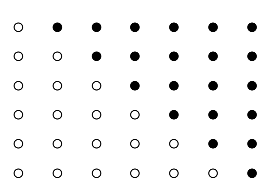
Dr. Pankavich has authored or co-authored fifteen research articles within the fields of partial differential equations, mathematical physics, and computational chemistry. Much of his research focuses on the mathematics describing electric and magnetic fields. His non-mathematical interests include music, wine, tennis, art—and most things Pittsburgh. He is currently learning to play the piano.

Proof Without Words

Theorem. *The sum of the first n positive integers is given by the formula*

$$1+2+3+\cdots+n=\frac{n(n+1)}{2}.$$

Proof. Stare at the following diagram!



Note. This is an instance of a *proof without words.* Let us include a few words anyway to help you understand the significance of the diagram. If we count by rows, the total number of white dots is $1+2+3+\cdots+6$. Similarly, the number of black dots is $1+2+3+\cdots+6$. So the total number of dots in the rectangular array is $2(1+2+3+\cdots+6)$. However, the white and black dots together form a 6-by-7 rectangle. So $1+2+3+\cdots+6$ must equal half of $6\cdot 7$. The same argument works for any n, where the two regions of dots form a rectangle of size n by $n+1$. We conclude that $2(1+2+3+\cdots+n)=n(n+1)$. Divide by 2 to get the formula in the theorem.

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