Program
2012 Governor's Institute in Mathematical Sciences
June 17 - 22, 2012

Approximately 30 top Vermont mathematics students from grades 9-12 will participate in the **2012 UVM / GIV Mathematical Sciences Institute, June 17 - 22, 2012**. Participants will explore topics such as, robotics, mathematical games and mathematical problem solving. Students will visit

Mathematics of Cryptography

We live an information age, with technology increasingly integrated into our daily lives. As a result, the security of our information is of the utmost concern, even as the interconnectedness of the Internet makes our data more vulnerable to attack. The ability to encrypt secrets and to conduct a trusted exchange of digital information, once a subject of interest primarily to governments and the military, is now a matter of necessity for us all. The foundation of modern cryptography relies upon the difficulty of solving certain mathematical problems; this course is intended to address them from both a mathematical and algorithmic point of view. We will cover conventional encryption techniques through modern day ciphers, with an emphasis on the mathematical underpinnings. The class will be driven by applications and examples, and will be taught by John Voight, of the University of Vermont Department of Mathematics and Statistics.

Evolutionary Robotics

Building a robot is hard work: it requires an understanding of physics, biology, math, mechanical and electrical engineering, and computer science. So rather than build a robot by hand, could we get a computer to build a robot for us? In this course we explore how we can use computer programs known as `evolutionary algorithms' to create and compete virtual robots against one another, much like in Will Wright's 'Spore' computer game. Along the way, we'll learn much about biological evolution, computer simulation, and robotics. This course is taught by Josh Bongard of the UVM Computer Science Department.

Chaos, Fractals, and the Mathematics of Prediction

"Chaotic" is a term used to describe mathematical behavior that appears random, but may in fact be produced by a very simple equation. The "butterfly effect," whereby a butterfly flaps its wings in Brazil and causes a tornado in Texas two weeks later, is a metaphor for the implications of chaos in the Earth's atmosphere. This course will introduce students to the difficulties associated with modeling chaotic physical phenomena using bifurcation diagrams and fractals, drawing upon examples from the fields of astronomy, biology, physics, and atmospheric science. This course is taught by Chris Danforth of the UVM Mathematics Department.

The Connectedness of Everything: the Form and Function of Complex networks

Complex networks pervade the systems around, within, and between us. In this class, students will take a look at real examples of large-scale complex networks and play around with some key theoretical models. This course is taught by Peter Dodds of the UVM Mathematics Department.

Seven is more than six--the pigeonhole principle

Seven pigeons fly into six pigeonholes. It's obvious that one hole contains at least two pigeons. What is not so obvious is that similar elementary arguments show some unexpected results. How would you prove that among 502 positive integers there are always two so that either their sum or difference is divisible by 1000? Or at any

party with 20 people there are always two that have the same number of friends? This class will be taught by Dan Archdeacon, of the Department of Mathematics and Statistics.

The Pancake Problem and the Calculus of Finite Differences

What is the maximum number of pieces into which a pancake can be cut by 4 straight cuts, each of which crosses each of the others? What about 5 cuts or more? What if replaced the pancake with a doughnut or a cheesecake and asked the same question? Please bring a pencil, a ruler and a fork. This class will be taught by John Schmitt, of the University of Vermont Department of Mathematics at Middlebury College.

Sundials

A whirlwind tour of the world of sundials: history, explanation, and demonstrations, many handmade by the speaker. This course is taught by Bill Gottesman of Precision Sundials, of Burlington, Vermont.

Problem Solving Strategies, I and II

Session I is taught by Tony Trono, Director of GIV Math for many years and award-winning math team coach.

Session II is taught by Felix Wu, sophomore at Harvard, and GIV Math Alumnus.