Discrete Mathematics for Young Mathematicians

"The best way to learn is to do; the worst way to teach is to talk." - Paul Halmos, former Santa Clara University Professor of Mathematics

Discrete mathematics comprises a broad range of areas of mathematics that is rich with thought-provoking problems and offers countless opportunities to explore and learn advanced mathematics, and to develop powerful reasoning and problem solving techniques. In the Discrete Mathematics for Young Mathematicians courses I introduce topics in discrete mathematics and allow student to discover mathematics through stimulating, open-ended problems.

In a typical class period, I introduce the topic, define necessary mathematical terms and notation, and walk through some examples. I then hand out problem sets; most of class period is spent working on the problems. As students work on problems, I offer hints but I do provide answers: discovery is an incomparable learning method.

Depending on the class's progress on the problems, we may discuss the solutions at the end of class, or students may have to finish problems as homework. In the latter case, we discuss the solutions at the beginning of the next class. In the discussions, students are required to justify and prove results discovered or observed in solving the problems. In this class, the justification/proof of the solutions are as important as the solutions themselves.

In the end, students have the opportunity to work on some interesting, fun, and challenging problems, and to discover some very cool and useful mathematics!

The instructor for these programs is Fun Math Club founder Yul Inn. He has offered GATE math enrichment programs to schools and community organizations in the San Jose area since 2003. He has been an instructor in the Johns Hopkins University Center for Talented Youth summer programs and the Stanford University Pre-Collegiate Studies (formerly EPGY) Summer Institutes since 2005 and has been a mentor for award winning students in the Intel International Science and Engineering Fair. He also has hosted math nights at local schools and led math circles at Stanford and San Jose State.

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Past Course List

Each course on the next page has been offered in the past. New courses are created from time to time. Each has a set of core topics, and a set of advanced topics, that may be covered depending on the progress of the students:

1. Data Analysis, Probability, and Games*

Data analysis, probability, and game theory have wide applications in all areas of the "hard" sciences as well as fields such as political science, economics, psychology, etc. The core topics include elements of statistics and discrete probabilities, applying data analysis and probability to decision-making. Optional advanced topics come from advanced probability and game theory.

2. Logic, Sets, and Counting

This class covers basic techniques and terminology required when working with finite sets. The core topics include propositional logic, set theory, functions, and counting methods. Optional advanced topics come from combinatorial identities, Pascal's triangle, and recurrence formulas

3. Graph Theory

Graph theory deals with relations between objects. It has many applications in scientific, engineering and computer fields. Topics include directed and undirected graphs, Eulerian and Hamiltonian cycles, and trees. Optional advanced topics come from planar graphs, graph decompositions, and graph coloring.

4. Number Theory and Cryptography

Cryptoraphy deals with hiding information, both constructing the ciphers to hide the information, and methods for decoding information that has been hidden. Number theory concepts and methods form the base for much of cryptography. Core topics include divisibility, prime numbers, modular arithmetic, and traditional cryptography. Optional advanced topics come from public-key cryptosystems, hashing functions, and signature schemes.

5. Symmetry*

Symmetry is a multi-disciplinary topic that, from a mathematical point of view, is generally thought of as a geometric concept. This class explores "geometric" symmetry and its relation to algebra. Core topics include two and three dimensional symmetry and elements of group theory. Optional advanced topics come from permutation groups and advanced counting methods.

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* Although these areas don't strictly fall under discrete mathematics, they share many concepts and methods that are in discrete mathematics. The class focuses on the "discrete" aspects of these areas.