

Introduction to Discrete Mathematics via Recreation

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Teaching time	Morning / Afternoon

Course Description:

This is an introduction to discrete mathematics, motivated by mathematical play. Number play is used to introduce Fibonacci numbers and recurrence relations. Pencil drawing puzzles are used to motivate graph theory and Eulerian traversals. Games are used to motivate optimization. Logical puzzles are used to motivate linear Diophantine equations and their solution using the Euclidean algorithm. Counting puzzles are used to motivate Permutation, Combinations and Pascal's triangle. Additional topics in number theory and discrete geometry and information theory will be covered.

Materials/Text:

Free online textbooks will be used, for example: <https://discrete.openmathbooks.org/dmoi3.html>

Requirements:

No prerequisites required. A computer with an internet connection will be beneficial.

Schedule:

1. Counting. Summations, permutations, counting subsets, Pascal's triangle, the binomial theorem
2. Fibonacci numbers, recurrence relations, problem solving with recurrences.
3. Solving first order and second order recurrence relations
4. The water jug problem: linear Diophantine equations.
5. Greatest common divisors and The Euclidean algorithm, the extended Euclidean algorithm.
6. Solving puzzles with modular arithmetic and the pigeonhole principle
7. Graphs, traversals. The Utilities puzzle and graph planarity, crossing numbers.
8. Geometrical puzzles. Geometric optimization and reflection.

Assignments:

1. Summations
2. Combinatorics
3. Making recurrence relations
4. Solving recurrence relations
5. Finding GCDs and solving linear Diophantine equations
6. Modular arithmetic puzzles
7. Graph theory problems

Personal project 1: using math contests or math fairs online, find a problem that interests you and learn the mathematics used to solve it and present this to the class

Personal project 2: create your own math puzzle motivated by an article read online or seen in the news

Evaluation:

Each assignment is worth 10% of the final grade (7 assignments = 70%)

Personal project 1 is worth 15%

Personal project 2 is worth 15%