SP.268 Syllabus

Instructors: Melissa Gymrek, Jing Li
Faculty Supervisor: Erik Demaine

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Contact Information

Melissa Gymrek - mgymrek@mit.edu
Jing Li - lijing@mit.edu
Erik Demaine - edemaine@mit.edu

Course Description

We will explore the mathematical strategies behind popular games, toys, and puzzles. Topics covered will combine basic fundamentals of game theory, probability, group theory, and elementary programming concepts. Each week will consist of a lecture and discussion followed by game play to implement the concepts learned in class. Class time TBA, but will most likely be Wednesday evenings 7-9pm.

Objectives

Students will learn to apply mathematical strategies to both play and implement their own games. This year the course will try to focus on some open problems in the field of combinatorial game theory. Most of all, we will have fun while playing games and learning math concepts at the same time!

Materials

There is no textbook for this class, but students are expected to read the weekly course notes. Occasional outside readings will be assigned.

Grading/Expectations

The course is pass/fail, with grades based 30% on attendance and participation and 70% on completion of a final project. The project will be either in the form of a paper or a coding project.

Weekly Schedule

Week	Topic	Assignment Due
02-03	Theory of Impartial Games	
02-10	Surreal Numbers	
02-17	Dynamic Programming and Impartial Games	
02-24	AI Topics (Chinese Checkers, GO)	
03-03	Connect Four	
03-10	Rubik's Cube and Group Theory	Project Ideas
03-17	Probability Topics/Monopoly	
03-24	*Spring Break*	
03-31	Games on Graphs	Project Checkpoint I
04-07	Blackjack/poker/card games (guest lecture)	
04-14	Game of Life	Project Checkpoint II
04-21	NP-completeness	
04-28	Constraint Logic	
05-05	Dots and boxes	
05-12	Present Projects	Projects

Final Project Guidelines

Possible Projects

Projects will be completed alone or with a partner, with the exception of the research paper option, which must be done individually.

- **Research Paper - Game** Pick a game not covered extensively in class and investigate applications of math topics to game strategies. The paper should include the basic rules of play, the math behind possible strategies, and how to implement the strategies. The final draft should be 10 pages or more (before graphics are added). Graphics and visual aids are highly encouraged, but should not make up the majority of the paper. The content of the paper will vary with the topic, but we will talk about the minimum amount to be covered.

- **Research Paper - Toy or Puzzle** Similar to above. Pick a toy or logic puzzle with some interesting math behind it and formalize the strategy in a research paper.

- **Coding Project** Implement a game discussed in class or another game or puzzle as a computer game.

- **Create Your Own Mathematical Game or Toy** This could be a board game, computer game, physical toy, or whatever your imagination might come up with! This option would include a 3-5 page writeup of the rules and math behind your invention.

- **Explore an Open Problem in the Field** Explore either one of the open problems we discuss in class, or another open problem in the field of combinatorial game theory or a related topic. Tell us about what has been explored so far, the complexity of the problem, hypotheses, attempts, etc.

Deadlines

1. **Project Idea 03-10** A short verbal confirmation of a project idea.

2. **Checkpoint I 03-31** A short one-page proposal including project choice, topic, and plan of acion to complete the project. This can be changed later but at this point you need to present something that indicates that you have at least thought about the final project.

3. **Checkpoint II 04-14** For those writing papers: have an outline and some sources picked out. For those coding projects: have an outline of how you plan to code the game. For example, present a diagram

of the classes and objects to be used and some pseudocode for player strategies, etc.

4. **Final Deadline 05-12** Present your project! These will be 10-15 minute presentations per group.

Grading

Grading will be as follows:

Checkpoint I - 10%

Checkpoint II - 10%

Final Project - 80%

- On Time - 20%
- Creativity/Depth - 20%
- Writing Quality (paper)/ Implementation (Coding or Game Creation) - 20%
- Presentation - 20%

Recommended Readings

Readings are not necessary to understand the topics in class, but offer a chance to further explore the games we encounter. Both are available at the Hayden Library and will be kept in Melissa's ESG mailbox.

Winning Ways For Your Mathematical Plays - Berlekamp, Conway, Guy
On Numbers and Games - Conway