GAME DESIGN I

A Course in Board Game Design
COURSE OBJECTIVES

- Build a Game
- Math & Mechanics
PEDAGOGY

MATHEMATICS

GAMES
PEDAGOGY: Strategies for Student Learning

MATHEMATICS

Game Building & Analysis
TENANT
LEARNING IS
CONNECTED
to stories

APPLICATION
Conjoining
Math & Game
Development

Dr. Jerome Bruner,
Educational Psychologist
Logistics

Hmwk Quiz Mini-Game Final Project

Grading Rubric

<table>
<thead>
<tr>
<th></th>
<th>Hmwk</th>
<th>Quiz</th>
<th>Mini-Game</th>
<th>Final Project</th>
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Class Time

- **< 1/3: Lecture/Discussion**
  - Terms, History, Math
  - Homework for Assessment
- **> 2/3: Manipulatives**
  - In-Class Games
  - Analyzing Influential Games
  - Experimentation
Mini-Games

- Math Concept/Tool
- Final Project

Project Milestones

Game Design
1. Create
2. Analyze
3. Modify
MATHMATICS

• Graph Theory & Tessellations
• Combinatorics
• Probability & Statistics
• Matrices
• Game Theory

Select Applications
>> Fundamental Math Tools
>> Board Games
Elfenland won the *Spiel des Jahres* award... the Nobel prize for Game Design.
Graph Theory & Elfenland
Matrices

1. Roll 4-sided Die
2. Begin on Square 1
3. Move according to the number rolled.
Transition Matrix

Stochastic Matrix

\[ T^n \] Calculates the probabilities of being in a given space after \( n \) moves.
On a side note.....

\[
T^3 = \begin{bmatrix}
1/64 & 0 & 0 & 1/64 & 3/64 & 3/32 & 5/32 & 3/16 & 5/32 & 3/32 & 3/64 & 1/64 \\
\end{bmatrix}
\]
Markov Chain

“a model used to describe an experiment or measurement that is performed many times in the same way, ... where the outcome of one trial depends only on the immediately preceding trial”

Broader Applications:

- Monopoly
- Chutes & Ladders
- Trivial Pursuit
Game Design

Mechanic: the game theory or mathematical tool within a game allowing for specific actions to be performed.

Matrices

1. Roll 4-sided Die
2. Begin on Square 1
3. Move according to the number rolled.

Transition Matrix

$T$ Calculates the probabilities of being in a given space after n moves.

MATHEMATICAL

Bridge between Math & Game Design
Game Mechanics Reduced (37)

**Action/Singing** - games including miming, mimicry, singing, humming

**Action Point Allowance System** - allotted number of points per turn to use on actions

**Area Enclosure** - players create area and surround area as they play

**Betting/Wagering** - place money on specific game outcomes, commodities, or resources.

**Card Drafting** - pick cards from some subset of the deck with a specific purpose

**Dice Rolling** - allows for randomness and may act as a counter

**Deck / Pool Building** - players have a personal deck/pool and must manage resources for actions

**Hand Management** - maximal management of cards in hand with respect to game rules and setting

**Grid Movement** - players move on a gridded board

**Modular Board** - modular boards utilized for increased variety in game play

**Memory** - players have to remember previous game occurrences

**Partnerships** - games with hard and fast rules regarding player alliances

**Pattern Building** - placement of game pieces in a certain order

**Player Elimination** - players eliminated over the course of the game and the game continues until only one player remains

**Press Your Luck** - keep going till the odds are too high, stop when player chooses

**Role Playing** - extension of variable player powers, players role play characters

**Route/Network Building** - players build connections/drawing lines between points shooting for the longest chain

**Set Collection** - players collect certain items

**Take That** - deliberate action taken against an opponent as the main part of the game

**Trick-taking** - used in card games, players take “tricks”, played cards, determined by specific game rules

**Variable Player Powers** - games offering a variety of abilities or paths for characters to win

**Worker Placement** - players place game pieces that can perform some action in order to accomplish a goal, ultimately, winning

**Action / Movement Programming** - players discretely plan moves in advance, then must play them out accordingly

**Area Control / Area Influence** - player with the most units in an area takes control of said area

**Area Movement** - board game is divided into specific areas with rules regarding moving in and out of those areas, may include counters/chits/units

**Auction/Bidding** - place a bid on items to strengthen game position, items can allow for future actions to be performed

**Cooperative Play** - players work as a team to beat the game

**Deck / Pool Building** - players have a personal deck/pool and must manage resources for actions

**Grid Movement** - players move on a gridded board

**Memory** - players have to remember previous game occurrences

**Pattern Building** - placement of game pieces in a certain order

**Pick-up and Deliver** - players pick up items in one location and drop them off in another which usually allows for actions to be taken

**Point to Point Movement** - players move from one point to another via connecting lines

**Rock-Paper-Scissors** - circular, non-transitive order of pieces beating other pieces

**Roll / Spin and Move** - roll dice or spin spinners, then move accordingly

**Simulation** - attempts to model actual events or situations

**Storytelling** - players create the story as they play based on certain markers in the game, alternatively, players experience a predetermined story

**Tile Placement** - game pieces (tiles) are placed in accord with game rules to earn victory points

**Trading** - players can exchange resources with each other

**Variable Phase Order** - turns aren’t played in the same manner each time

**Voting** - player votes can influence the outcome of game events
# Game Mechanics

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Math Concept

• Matrices

Math Calculations

• Powers of Matrices

Game Setting

• Applied in our Red Mini-Board Game

Progression of Complexity

Assisting Students
Multi-Functioning Instruments of Learning

1) Provide a Knowledge Basis
2) Demonstrations of Math

GAMES

1. Play the Game
2. Math Lesson
3. Connect New Content to the Game

Scaffolding: providing verbal support for student learning.

“Scaffolding” coined by Dr. Jerome Bruner.
Combinatorics
1. Settler’s of Catan
2. Carcassonne
3. Daytona 500
4. Dominion
5. Set
GAMES
Multi-Functioning Instruments of Learning

1) Provide a Knowledge Basis
2) Demonstrations of Math
3) Made-Up Games
Horse Race Game

1 2 3 4 5 6 7 8 9 10 11 12

Get Get Get

Spend Spend Lose Lose

HOSES SHOES  SPACES

1 1
2 3
3 5
4 8
CONCLUSION

Goals:
1. Build a Game
2. Identify the Mathematics

Building Connections:
1. Historical Anecdotes
2. Mathematical Game Analysis
Acknowledgements

• Dr. Porta, Professor of Mathematics
• Dr. Sharp, Professor of Mathematics Education
References


• Elfenland by AMIGO ISBN 1-892081-38-5

References cont’d


THANK YOU

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