

Game Artificial Intelligence

(CS 4731/7632)

Instructor: Stephen Lee-Urban

<http://www.cc.gatech.edu/~surban6/2018-gameAI/> (soon)

Piazza

T-square

What's this all about?

- Industry standard approaches to employing “AI” in modern computer games
- Distinctions between Game AI as a discipline and standard AI as a discipline
- Go beyond industry standard Game AI to look at emerging techniques

About the rest

- Self⁺
- Teaching Philosophy
- Syllabus
- Course Trajectory & Structure
 - (see webpage)

Course Topics

- State of the industry (standard practice)
 - Movement and path planning
 - Decision making
 - Strategy
- Procedural Content generation
- Advanced topics (/Case studies)
 - Believable characters and storytelling
 - Game analytics
 - Reinforcement learning; camera control

Prerequisites

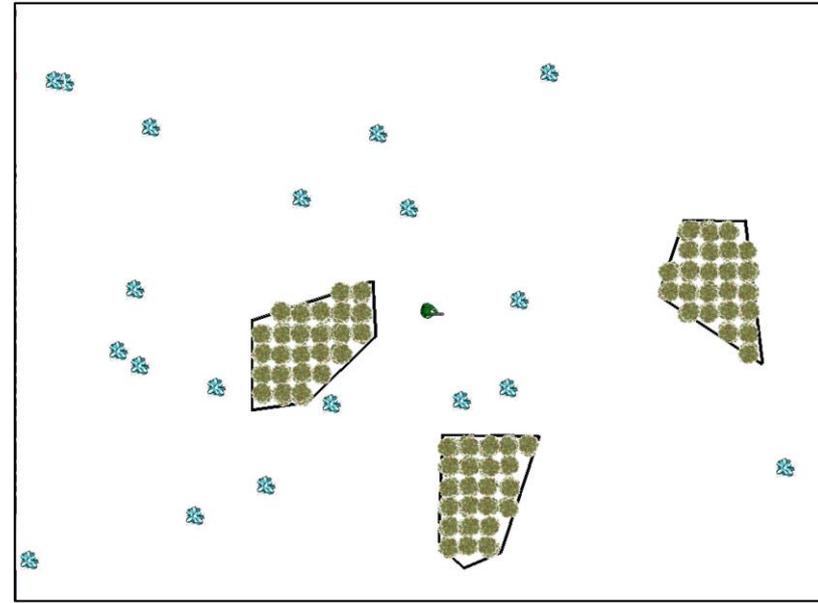
- Intro to AI course
- Data structures
- Comfort with “no right answer”
- Python familiarity

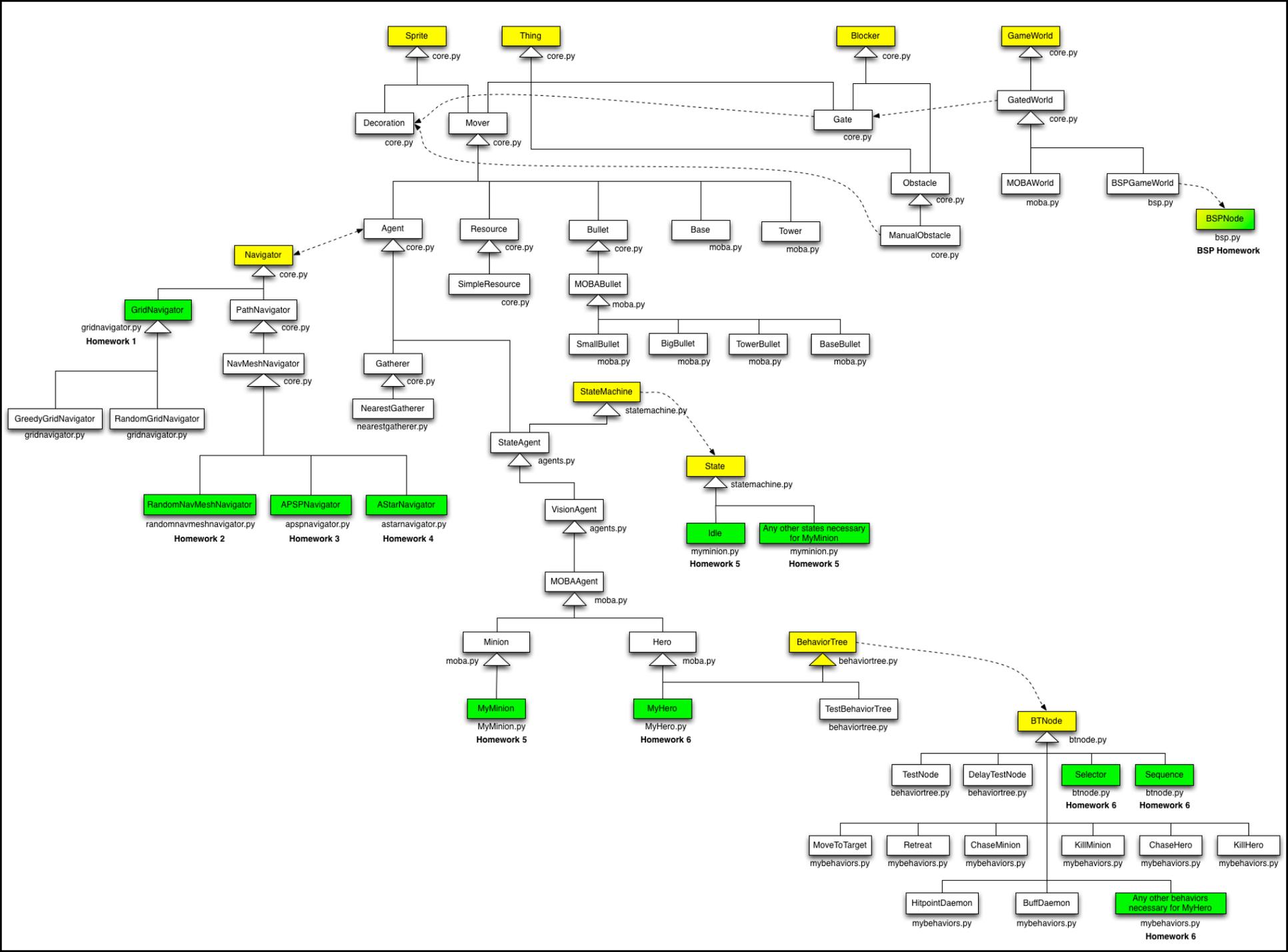
Homework Assignments

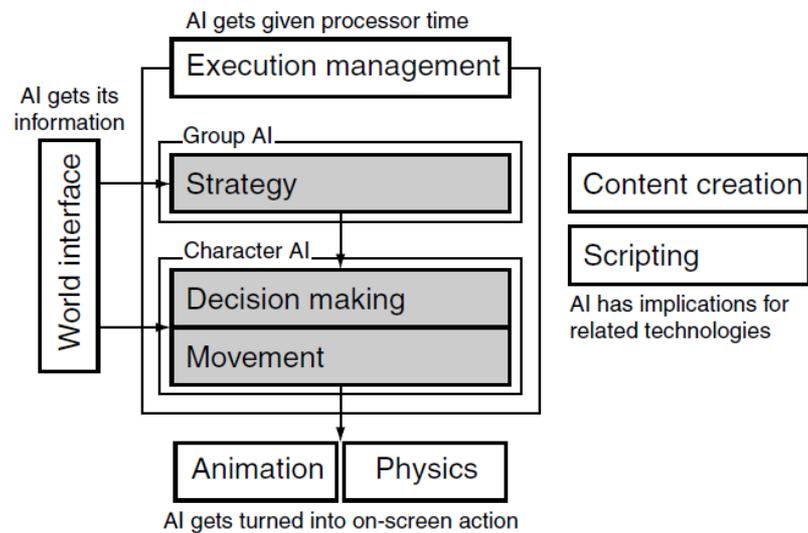
- Custom game engine:
 - <http://game-ai.gatech.edu>
- Homeworks progressively build on each other
- Concludes with an AI that can play a Multiplayer Online Battle Arena (MOBA)
- Approximately every 1-2 weeks
- First homework due next week (1/22)

Assignments & Grading

- Homework sequence (70%):
 - 1 Grid navigation
 - 2 Path network navigation
 - 3 Nav mesh generation
 - 4 A* pathfinding
 - 5 Minion Agents
 - 6 Hero Agents
 - 7 SMB level generation
 - 8 RL (7k), Squad or Camera (4k)
- Exams (15% each)
- Participation and Quizzes (-10%)



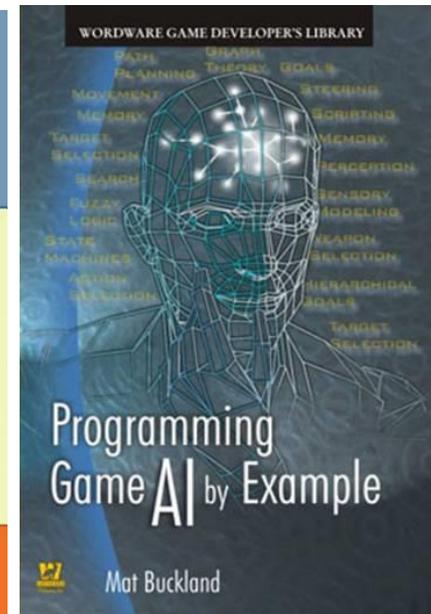
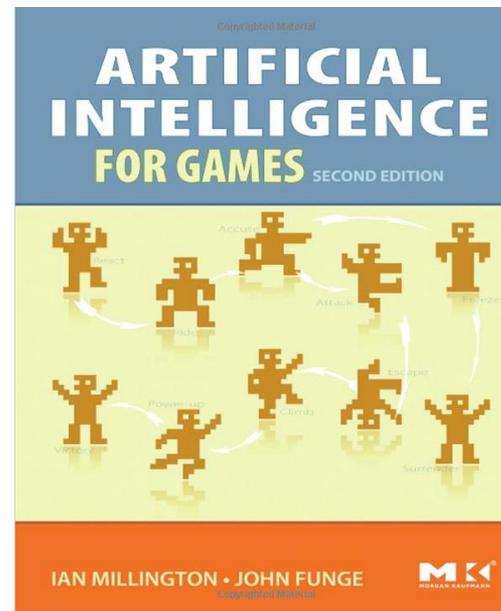




M&F Fig 1.1

Optional Textbooks

- Millington and Funge, *Artificial Intelligence for Games 2nd ed.*
- Buckland, *Programming Game AI by Example*



Artificial Intelligence

- Getting a computer to do something that a “reasonable person” would think requires intelligence

Important Dates

- 1/15 Official Institute Holiday
- 1/22 Verification of Student Participation in Class
- 3/14 Grade Mode and withdrawal deadline
- 3/19 to 3/23 Spring break
- 4/23 Final instructional class days
- 4/26 to 5/3 Final exams
- 5/5 End of term
- 5/7 Grade submission deadline

What this class is about

- **AI for games**
 - Ways in which AI can—and is used to—enhance game play experiences
 - Set of algorithms, representations, tools, and tricks that support the creation and management of real-time digital experiences
- In the game development industry, AI is the set of tricks and techniques to bring about a particular game design
- “Game AI is game design”

What this class is about

- How a game design can be brought into existence through the application of algorithms that are often thought of as intelligent
- About making the entities/opponents/agents/companions/etc. in games **appear** intelligent
- Not a substitute for an Intro to AI course
- Not going to teach good game design

What this class is NOT about

- **AI in games**
 - John Laird and Michael van Lent (2000): Games are perfect test-beds for “human level” AI
 - AI should play games as if human
 - Vision
 - Decision making in real-time
 - Handling uncertainty
 - Learning
 - Opponent modeling
 - Demonstrated with an AI agent that played Quake

Goals of AI

Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally

Goals of Game AI

- To support the player's experience in a game
- Note: this might mean doing simple AI, or things that academic researchers marginally consider AI

What is a game?

- A system of rules
- A goal

Types of games?

First Person Shooter



Real Time Strategy (RTS)



Role Playing Games (RPGs)



Platformer

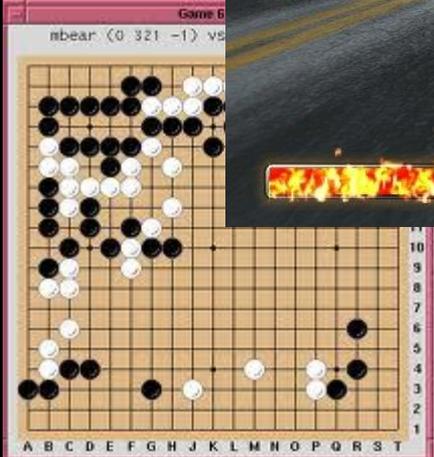
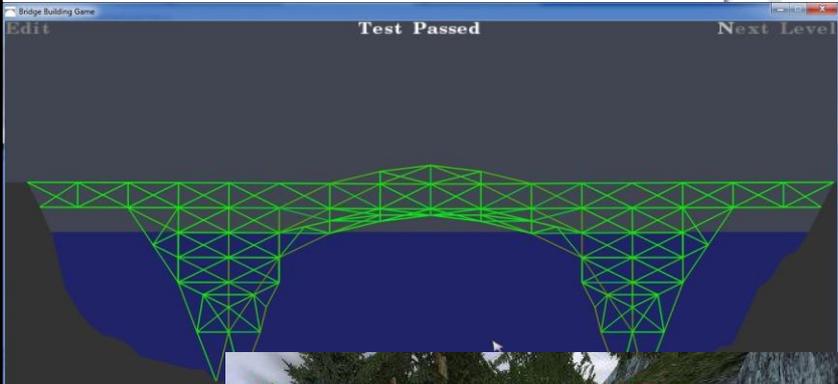


God Games



Sports Games





What brought you here?

General functions of Game AI?

- Do anything a player or game designer cannot or will not do
 - NPC (companion or opponent) Strategy
 - “ Decision making
 - “ Movement
- Content creation & scripting
 - Easing the cost of development
- Tailoring/adapting to player individual differences

Why AI in games?

Automation—because you need other people to do things, but don't always have those people

- Opponents
- Companions
- NPCs (shopkeepers, farmers, villains)
- Dungeon master?
- Plot writer?
- Game designer?

Goals of Game AI

- Kill you good
- Make non-player characters (NPCs)—opponents, companions, etc.—look convincing
 - Believable characters
- Play like a human
- **Make game more enjoyable**

Why distinct from “academic AI”?

- Resource limits
- Complexity fallacy ([G.O.L.](#))
- Fun vs. smart: goal is not always to beat the player
- Optimal/rational is rarely the right thing to do

Common “AI” Tricks

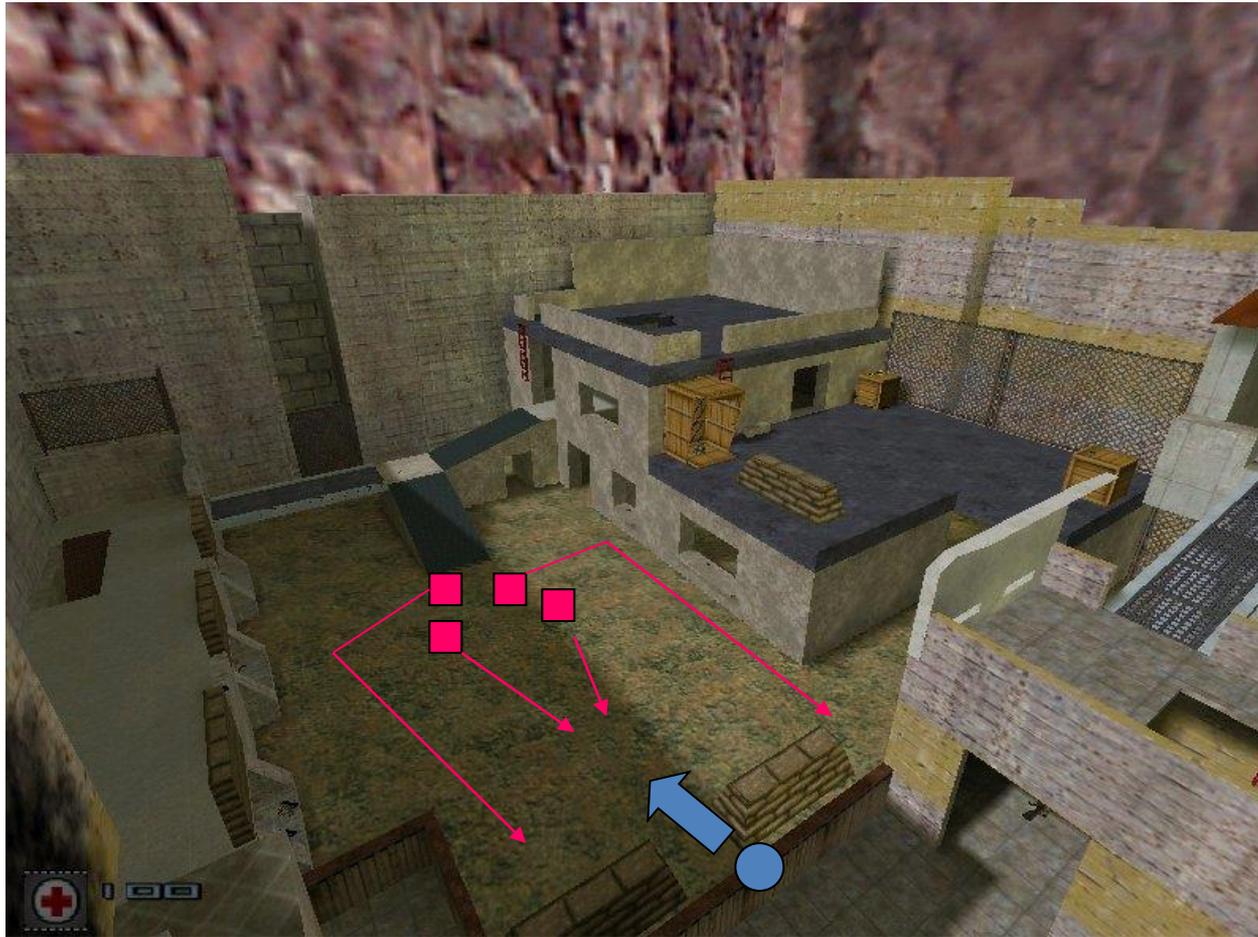
- Move before firing – no cheap shots
- Be visible
- Have horrible aim (being Rambo is fun)
- Miss the first time
- Warn the player
- Attack “[kung fu](#)” style (Fist of Fury; BL vs School)
- Tell the player what you are doing (especially companions)
- React to own mistakes
- Pull back at the last minute
- Intentional vulnerabilities or predictable patterns

Half-life: Freemans' Marine Encounter

- Do they attack Kung-Fu style?



Half-Life Kung-Fu Attack



- Actually no more than 2 marines are attacking at any time

- The other marines take cover, move around etc.

- When one of the attacking marines run out of ammo, is wounded, dies, etc., one of the others take his place

- Some reactions are hard-coded and scenario-dependent

Common Game AI techniques

- Path planning, obstacle avoidance
- Decision making
 - Finite state machines
 - Trigger systems
 - Behavior trees
 - Robotics architectures
- Scripting
- Command hierarchies—strategic, tactical, individual combat
- Emergent behavior—flocking, crowds
- Formations
- Smart environments
- Terrain analysis—finding resource, ambush points
- Dynamic difficulty adjustment

Cheating

Intelligent vs. random

The screenshot shows a turn-based battle in the game *Puzzle Quest: Challenge of the Warlords*. The title bar at the top reads "PUZZLE QUEST CHALLENGE OF THE WARLORDS". The battle is titled "The Missive".

Left Panel (Enbria):
27 of 62
Enbria
Knight
Level: 3
HP: 3, MP: 3, SP: 9, EP: 1
Gold: 232, Gems: 141
Broken Shield
Skills: Thrust (6/6), Divine Right (6/6), Challenge (6/6)

Right Panel (Thiel):
8 of 33
Thiel
Level: 3
HP: 3, MP: 0, SP: 5, EP: 4
Gold: 12, Gems: 16
Skills: Sneak Attack (5/5), Steal (6/6)

Central Battle Grid:
A 10x10 grid of puzzle pieces. Pieces include: blue circles with a cross, yellow circles with a cross, red circles with a cross, green circles with a cross, purple stars, gold coins, and skulls. A large white lightning bolt strikes the grid, with numbers indicating damage: +1, +8, and +1.

Bottom Center: Turn: 21