Game Artificial Intelligence
( CS 4731/7632 )

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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
Prerequisites

• Intro to AI course
• Data structures
• Comfort with “no right answer”
Homework Assignments

• Custom game engine
• 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
Assignments & Grading

• Homework sequence (65%):
  – 1  Grid navigation
  – 1.5 Path networks
  – 2  Path networks + Navigation meshes
  – 3  All pair shortest path
  – 4  A*
  – 5  Minion Agents
  – 6  Hero Agents
  – 7  SMB level generation

• Capstone Project (25%)

• Exam (10%)

• Participation and Quizzes (-10%)
Optional Textbooks

• Millington and Funge, *Artificial Intelligence for Games*

• Buckland, *Programming Game AI by Example*
Artificial Intelligence

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

<table>
<thead>
<tr>
<th>Systems that think like humans</th>
<th>Systems that think rationally</th>
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<tr>
<td>Systems that act like humans</td>
<td>Systems that act rationally</td>
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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
General roles of Game 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
Sports Games
What brought you here?
Why AI in games?

• What is the “killer app” of 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
• Make game more enjoyable
• Play like a human
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 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