Game AI

Yusuf Pisan
What is Game AI?

Techniques to produce the illusion of intelligence in the behaviour for NPCs

Everything from chasing and evading to neural networks in games

Techniques for emulating the behavior of other players or the entities

*Caveat: Need to define AI, define game*
Artificial Intelligence

Machines as intelligent as human beings will exist in less than 20 years

AI Pioneers, Dartmouth College, 1956
Artificial Intelligence

*Machines as intelligent as human beings will exist in less than 20 years*  
Al Pioneers, Dartmouth College, 1956

But, they got funding! Millions of dollars!

The Golden Years: ELIZA, STUDENT, STRIPS, SHRDLU, …  
AI Winter → Expert System Boom → Second AI Winter →  
1995-2015: AI behind the scenes → 2015-present AI in News
Moravec's paradox
Easy for you, hard for the computer

https://youtu.be/g0TaYhpOfo
Boston Dynamics (Bought by Google 2013)

https://youtu.be/M8YjvHYbZ9w

https://youtu.be/R7ezXBEBe6U
Early AI for Games
Traditional AI vs Game AI

Optimal solutions

Blackbox solutions are OK

Human-like solutions

Storytelling is part of games, AI needs to be understood
## Traditional AI vs Game AI

<table>
<thead>
<tr>
<th>Traditional AI</th>
<th>Game AI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal solutions</td>
<td>Human-like solutions</td>
</tr>
<tr>
<td>Blackbox solutions are OK</td>
<td>Storytelling is part of games, AI needs to be understood</td>
</tr>
<tr>
<td>Neural networks</td>
<td>A* for pathfinding</td>
</tr>
<tr>
<td>Learning systems</td>
<td>Finite State Machines</td>
</tr>
<tr>
<td>Qualitative and Analogical Reasoning</td>
<td></td>
</tr>
<tr>
<td>Natural language</td>
<td></td>
</tr>
</tbody>
</table>
Game AI

Design

Player Experience

Coding
Where is the AI?

Board games - Chess, Monopoly, Settlers of Catan, Civilization

Simulation games - Racing, SimCity, FIFA, Star Wars, Blackjack, Halo

....

Most games have some form of AI

Visible: Opponents, sidekicks, neutrals

Not so visible: Game director, terrain generation, matchmaker, designer tools

Cheating / Non-Cheating - Cheaters always get caught!
Overview

Game AI - Sunset Overdrive

Adam Noonchester @ Insomniac Games
Talk at AIIDE and at GDC

https://www.youtube.com/watch?v=ZIAmoRsu3Z0 *

Game AI - Common Techniques

Game AI - Research & Future

*All the slides are online: http://bit.ly/uwb20170306
Enemies of Sunset Overdrive

Force the players to use the traversal system


Player can jump on cars, grind on wires, bounce on walls and grind on wires

Enemies are more limited

How should the enemies move?
What underlying structures are needed?
Melee Enemies

Blending Animation: Vault System

Lots of Enemies

Problem 1: Player much faster and more mobile than the enemies

Problem 2: Chase the player

Techniques Combined
Ranged Enemies

How to determine their accuracy?

- in range, out of range
- on screen, off screen
- close up to player
Game AI - Common Techniques - FSM

Finite State Automata
Easy to implement and modify

Problems?
Common Techniques - Algorithms

MinMax - perfect information games

Alpha-Beta Pruning - cut away branches without considering further

Hierarchical Concurrent State Machines - Left for Dead

AI Planners - F.E.A.R.

Behaviour Trees - Halo 2

Trigger Systems - If/then rules

Flocking - Birds
Common Techniques - Path Finding

Getting from point-A to point-B is still a problem for NPCs

Navigation meshes - an overlay on the pretty landscape

Waypoints - travel between waypoints and then use navmeshes

A* - large CPU, unrealistic paths

Potential Fields - attract and repel

Probabilistic Road Maps (Navmesh+Visibility Graph+Randomness)

Randomly Exploring Randomized Trees (RRTs)
Common Techniques - Sensing

Sight - Ray Trace / Ray Cast to see if player is visible

Sound - Most games still ignore it

Smell - Call of Duty 4

Touch - Collision detection (don’t go through walls!)

Taste - Not there yet
Common Techniques - Strategy

Overlord
Units move in a pyramid formation

Healing
Scouting
Supporting fire
Sacrifice

© 2009 Codemasters®
Common Techniques - Opportunities

BioShock Infinite's Elizabeth
http://www.ign.com/articles/2013/04/08/whatever-happened-to-video-game-ai

http://www.ign.com/videos/2013/03/01/bioshock-infinite-the-revolutionary-ai-behind-elizabeth

Sims - Objects advertising opportunities (2000)
Advanced Techniques

Creatures
Norns had neural networks as brains - could be trained
Advanced Techniques

Black & White

Creatures can be taught complex behaviours
Game AI - Research - Social Simulation
Research - Mario AI Competition
Research - Procedural Content Generation

Daylight - levels and enemy positions

AI director of Left 4 Dead - spawns zombies according to a tension model

Sonancia - sound for horror
Learning

Human-level control through deep reinforcement learning (2015)

Google DeepMind @ London

http://googleresearch.blogspot.com/2015/02/from-pixels-to-actions-
Experiments: Base Case

A top-down sneaking game where the player directly manipulates the planner’s underlying state via in-game mechanisms. The player navigates the base, looking for a computer console to inspect and modify the underlying declarative state and open the final exit.
Experiments: iGiselle

An interactive narrative in which the player influences an AI experience manager and branching narrative choices by assuming dance positions perceived by the Microsoft Kinect.
Experiments: Sarah & Sally

A puzzle-platformer with a cooperative AI sidekick that telegraphs its search state in-game, set in a problem space designed to highlight and simplify AI search while creating perceived complexity for the human player.
Experiments: Sure Footing

An infinite runner building on rhythm-based approaches to real-time procedural level design.
Experiments: Walden

A game, simulates the experiment in living made by Henry David Thoreau allowing players to walk in his virtual footsteps...

OCTOBER 8, 2017

WALDEN WINS INDIECADE DEVELOPERS CHOICE AWARD

IndieCade has a very special place in our hearts, as it was the first place where designer Tracy Fullerton spoke about the early prototyping of Walden, a game, and also the first public showing of the game as a work in progress in 2014.
Commercial Experiments: Journey

An anonymous online adventure to experience a person’s life passage and their intersections with other’s. [ThatGameCompany]

https://youtu.be/PjqAN7apHKM
Serious Games: My Spa Resort

A game developed by Igniteplay to promote healthy eating and exercise
Serious Games: Crystal Island

Learning experiences that are motivating for 21st century learners and aligned with Common Core State Standards for English language arts

STUDENTS EXPLORE AN IMMERSIVE VIRTUAL ENVIRONMENT
UTS: JoggAR

A mixed-modality AR approach for technology-augmented jogging
UTS: BeFaced

A Game for Crowd-sourcing Facial Expression Recognition

Participants were briefed on the structure of the playtest before starting.
**UTS: Step Kinnnection**

An exergame for the elderly
UTS: Automated Terrain Analysis

Gathering terrain knowledge to help AIs plan better
**UTS: sPeaK-MAN**

A Pac-Man-like game with a core gameplay mechanic that incorporates vocalisation of words generated from a pool commonly used in clinical speech therapy sessions.
Your Next Game: Wattam

Keita Takahashi (Katamari Damacy, Noby Noby Boy) and Robin Hunicke (Journey, The Sims2) -- Release date sometime in 2018
https://store.steampowered.com/app/702680/Wattam/
Final Words

Games are a very large part of entertainment.

Games are a significant part of training and simulations.

Games are a growing part of education.

Games need AI to manage complexity and for realistic intelligent characters.