ARTIFICIAL INTELLIGENCE FOR GAMES
ANNOUNCEMENTS

• Week 7 (Next week):
  • Wednesday 4 – 6pm: Pre-Alpha Meeting with Elias during office hours
  • Wednesday 6 - 9pm: Shaders Workshop (Graphics)
  • Thursday 5 – 7pm: GDDC Playtesting sessions. Room BA2195

• Week 8 – Wednesday 6 – 9 pm:
  • Alpha Presentation @ UofT
ANNOUNCEMENTS

• Week 9:
  • Reading Week / Study Break

• Week 10 – Wednesday, Nov 13 & Thursday, Nov 14:
  • AM: Beta Presentation @ Ubisoft
  • PM: Guest Lecture on UI/UX tailored towards your games.
ANNOUNCEMENTS

• The project is worth 80% of the course mark
  • Peer evaluations are a large factor of how do you in the project

• Reflect on these questions:
  • Have I listened to the ideas of others?
  • Have I done my share of work? Have I done more? Have I done less?
    • Does my team agree with my assessment?
LET'S TALK ABOUT AI
ARTIFICIAL INTELLIGENCE

• AI is the field of creating intelligent behaviour in machines.
  • “Intelligence” understood to be measured relative to humans.
  • Labeled as gameplay from a developer’s point of view.

• How do you measure intelligence?
  • Combination of:
    • Perception
    • Processing
    • Expression
“The good news, Dave, is that the computer's passed the Turing test. The bad news is that you've failed.”
AREAS OF AI

- Perception
  - Language
  - Vision
- Processing
  - Searching
  - Planning
  - Game Trees
- Learning
  - Neural Networks
The purpose of AI is to create entities that are able to act independently of human interaction.

- In Games, these are usually called non-player characters or NPCs.
NPCs need to have the following properties:
AUTONOMY

No direct involvement to perform duties
• Paths are determined using waypoints for the NPCs to follow.

• The NPCs adapt to use those waypoints to:
  • Block the player from passing them
  • Pass the player
AUTONOMY – FORZA DRIVATARS

• Forza uses Machine learning to emulate real player behaviour in NPCs.
  • Collect data from human players
  • Apply data it to the course
  • Feed data to physics engine through a virtual controller

• Currently using **big data** to analyze **drivatars**
  • You might encounter friends drivatars in your races
EXAMPLE

Forza Drivatars
Perceive and react to environment

REACTIVITY
REACTIVITY – CIVILIZATION V

• Each Civ leader has a unique game plan
  • Depends on leader’s traits – Loyalty, forgiveness, competitiveness, etc
  • Traits ranking: 1 – 10

• Blackboard System
  • Specialists contribute to the engine’s decision – War AI, Trade AI, Science AI, etc
REACTIVITY – CIVILIZATION V

• AI must adapt to the environment's conditions
  • Produce more units during war
  • Figure out trade routes with allies
  • Naval vs ground exploration
EXAMPLE

Civilization V
Goal-directed behaviour

PROACTIVITY
EXAMPLE
Pro Evolution Soccer
SOCIABILITY

Interaction with other agents
EXAMPLE
The Sims
• RoboCup:
  • Robot soccer league.
  • By 2050, have a team of autonomous robots beat a team of humans.
MULTI AGENT APPLICATIONS

- Video Games:
  - Sports games. AI has to coordinate all team members not just single players
TYPES OF AI IN GAMES

• Natural Language
• Computer Vision
• Planning
• Machine Learning
Façade

NATURAL LANGUAGE
NATURAL LANGUAGE - FAÇADE

Façade is an interactive story where the player is invited to the apartment of Grace and Trip, a couple who has a relationship breakdown. The player can coach them using full typed sentences.
Innovations in Game AI:

• The player interacts with the game by tying text into a natural language parser.

• The underlying behavior language provides ways to specify the behavior of characters in terms of a dynamic story.

https://aigamedev.com/open/highlights/top-ai-games/#3Faade
EXAMPLE
Façade

grace, do you love me!
EXAMPLE

Just Dance
F.E.A.R.
&
The Division

PLANNING
F.E.A.R. First Encounter Assault Recon is a first-person shooter where the player helps contain supernatural phenomenon and, naturally, armies of cloned soldiers.
Innovations in Game AI:

• The AI uses a planner to generate context-sensitive behaviors, the first time in a mainstream game. This technology used as a reference for many studios still today.

• The enemies are capable of using the environment very cleverly, finding cover behind tables, tipping bookshelves, opening doors, crashing through windows…

• Squad tactics are used to great effect. The enemies perform flanking maneuvers, use suppression fire, etc.

https://aigamedev.com/open/highlights/top-ai-games/#2FEAR
EXAMPLE #1

F.E.A.R.
EXAMPLE #2
F.E.A.R.
The Division is an online only open world 3rd person shooter, where the player's goal is to save NYC after a pandemic halts all basic services.
Innovations in Game AI

• Player holds down cover button and character will automatically move to new cover spot
• Game draws a thin white line to indicate exactly how the player will get there
• Automatic process using AI
EXAMPLE

The Division
NEURAL NETWORKS

• Tries to loosely model how the brain neurons are connected to each other
• Each node is defined by its input function and an activation function that produces an output
• The goal of the neural network is to solve problems in the same way that the human brain would
• Useful when teaching an AI to “learn”
  • Reinforced learning used in games
MACHINE LEARNING – BLACK & WHITE

Black & White is a god game which includes elements of artificial life simulations and some strategy. The player rules over an island populated by various tribes, and can teach a large animal-like creature to do his/her bidding.
Innovations in Game AI

- The gameplay is focused on the interaction with a large AI creature which can learn from examples, and takes reward and punishment.
- The design integrates artificial life within the context of a strategy game.
- The engine uses a solid AI architecture, rooted in cognitive science.
- Machine learning techniques such as decision trees and neural networks are used with great success.

https://aigamedev.com/open/highlights/top-ai-games/#1BlackWhite
EXAMPLE
Black & White
Creatures is an artificial life program where the user ‘hatches’ small furry animals and teaches them how to behave. These “Norms” can talk, feed themselves, and protect themselves against vicious creatures.
MACHINE LEARNING – CREATURES

Innovations in Game AI

• It’s the first popular application of machine learning into an interactive simulation.

• Neural networks are used by the creatures to learn what to do.

• The game is regarded as a breakthrough in research, which aims to model the behavior of creatures interacting with their environment.

https://aigamedev.com/open/highlights/top-ai-games/#5Creatures
EXAMPLE
Creatures
EXAMPLE
Mar I/O
Plague Inc

AI IN MOBILE GAMES
Plague Inc. is a real-time strategy simulation game where the player creates and evolves a pathogen in an effort to destroy the world with a deadly plague. The game uses an epidemic model with a complex and realistic set of variables to simulate the spread and severity of the plague.
Innovations in Game AI:

- Different types of Plagues (viruses, bacteria, parasite). Each has their own behaviour.
- Developers modeled the spread of infectious diseases inside the game.
- Stayed at the top of the paid charts for over 2 weeks on both iPhone and iPad.
EXAMPLE

Plague Inc.
SOME USEFUL ALGORITHMS & DATA STRUCTURES
MINIMAX ALGORITHM

• Recursive algorithm for choosing the next move in a two-player game

• Works if algorithm has perfect information
  • Chess

![Minimax Tree](image)
"OK, IF I MAKE THIS MOVE, THEN MY OPPONENT CAN ONLY MAKE TWO MOVES AND EACH OF THOSE WOULD LET ME WIN. SO THIS IS THE RIGHT MOVE TO MAKE"

- Human thought process for Minimax
• Informed search algorithm (best-first search)
• Searches among all possible paths to solution
  • Performance implications?
• Minimize: f(n) = g(n) + h(n)
  • h(n) problem specific heuristic
• Widely used in games
  • Path finding and traversal
FINITE STATE MACHINES
BEHAVIOUR TREES

- Similar to FSM with the key difference that the main building block of a BT is a task rather than a state
- Controls the flow of the decision making of an AI entity
- Represented as
  - Root node – no parent, exactly 1 child
  - Control flow nodes – 1 parent, and at least 1 child
  - Execution nodes (tasks) – 1 parent, no children
- On each tick, execution nodes return
  - Running
  - Success
  - Failure
EXAMPLE

Behaviour Trees

- Sequence
  - Walk to Door
  - Selector
  - Walk through Door
  - Open Door
  - Sequence
  - Smash Door
  - Unlock Door
  - Open Door
  - Close Door
BEHAVIOUR TREES – ALIEN ISOLATION

• Horror/survival game based on the movie Alien

• Xenomorph BT can be outsmarted but,
  • It’s hard to predict where and when it might appear
  • It has strong sensing capabilities (hearing)
  • Director system to keep it near the player

• Problem: Too smart
EXAMPLE
Alien Isolation