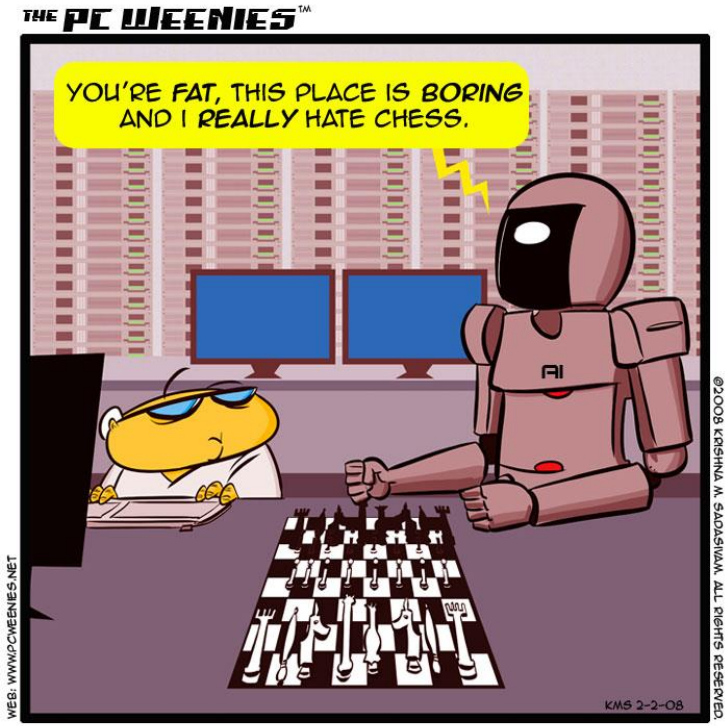
Artificial Intelligence

Lecture 01 - Introduction

Edirlei Soares de Lima
<edirlei.lima@universidadeeuropeia.pt>

What is Artificial Intelligence?

- Artificial intelligence is about making computers able to perform the **thinking tasks** that humans and animals are capable of.
  - Computers are very good at: arithmetic, sorting, searching, play some board games better than humans, ...
  - Computers are not very good at: recognizing familiar faces, speaking our own language, deciding what to do next, being creative, ...



HOW YOU'LL KNOW WHEN YOU'VE TRULY SUCCEEDED IN THE FIELD OF A.I. RESEARCH.

What is Artificial Intelligence?

- AI researchers are motivated by:
  - **Philosophy:** understanding the nature of thought and the nature of intelligence and building software to model how thinking might work.
  - **Psychology:** understanding the mechanics of the human brain and mental processes.
  - **Engineering:** building algorithms to perform human-like tasks.

- Academic AI *vs* Game AI:
  - **Academic AI**: solve problems optimally, less emphasis on hardware or time limitations;
  - **Game AI**: entertain player, have to work with limited time and hardware resources.

Academic AI – History

- **Early Days (time before computers):**
  - Philosophical questions:
    - What produces thought?
    - Could we give life to an inanimate object?
  - First programmable computers (1940s): war simulation, break enemy codes, …

- **Symbolic Era (1950s – 1980s):**
  - Symbolic systems: set of knowledge (symbols) + reasoning algorithm;
  - Expert systems: large database of knowledge + expert rules;
  - Trade-off: when solving a problem, the more knowledge you have, the less work you need to do in reasoning.

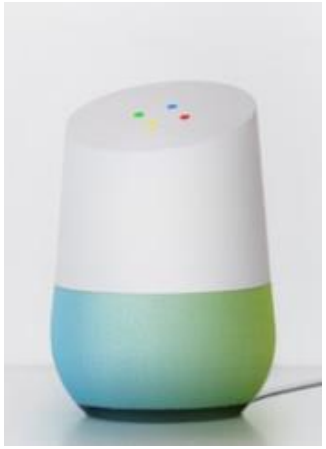
Academic AI – History

- **Modern Era:**
  - Increasing frustration with symbolic approaches (scalability problem);
  - Move towards natural computing (inspired by biology or other natural systems):
    - Neural networks (first suggested in 1943);
    - Genetic algorithms.
  - Key ingredient: ability to handle uncertainty.
  - Current research:
    - Machine learning;
    - Big data;
    - Deep learning;

Current AI Advancements

- Google & Uber Driverless Cars

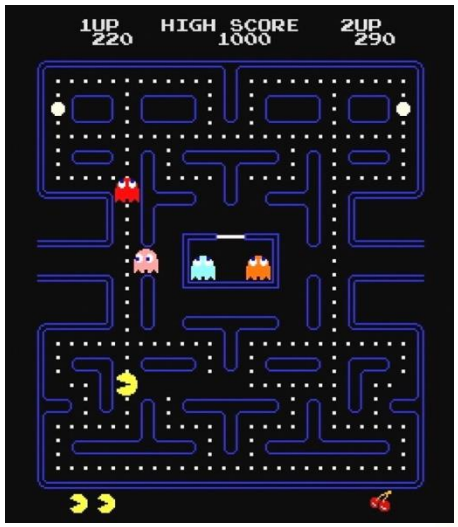
- Personal Assistants

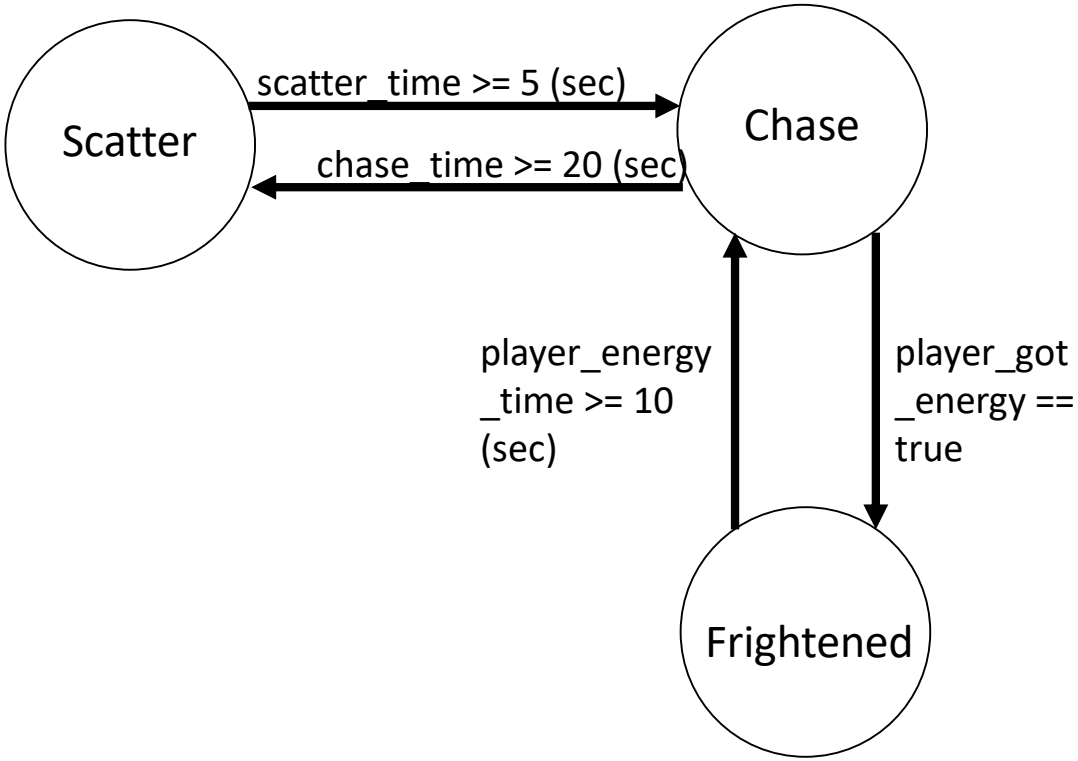


- Autonomous Robots

Game AI – History

- **Pac-Man (1979):**
  - Very simple AI technique (finite state machine);
  - Semi-random decisions;





Game AI – History

- **Goldeneye 007 (1997):**
  - Sense simulation system: characters could see their colleagues and would notice if they were killed;
  - Still relying on finite state machines with a small number of well-defined states;

  - Sense simulation was the topic of the moment:
    - Metal Gear Solid (1998);
    - Thief: The Dark Project (1998);

Game AI – History

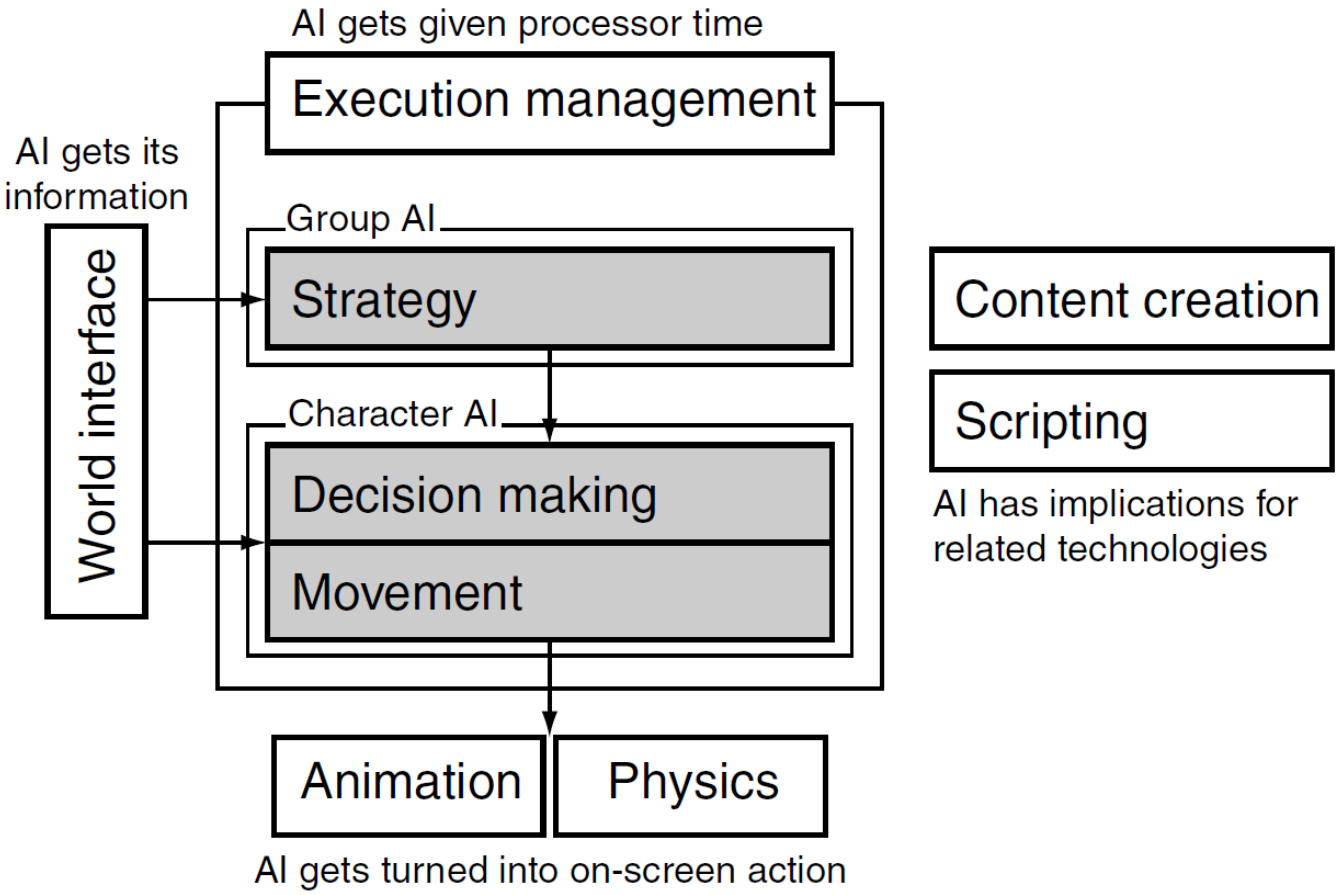
- **Warcraft (1994):**
  - One of the first times pathfinding was widely noticed in action;

- **Warhammer: Dark Omen (1998):**
  - Robust formation motion;
  - Emotional models of soldiers;

Game AI – History

- **Creatures (1996)** & **Black and White (2001):**
  - The first time neural networks were used in a game;
  - The neural network-based brain of each creature allowed them to learn what to do;
  - Made AI the selling point of the game;

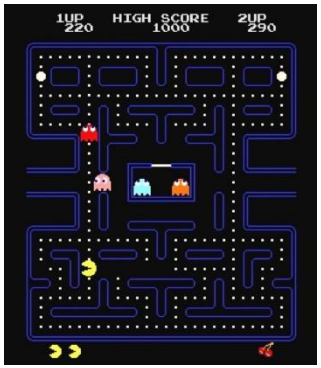
Game AI – Model



Complexity Fallacy

- It is a common mistake to think that complex AI equals better character behavior.

- **When simple things look good**: Pac-Man
  - Semi-randomly decisions at junctions;



  - Player comments:
    - "To give the game some tension, some clever AI was programmed into the game. The ghosts would group up, attack the player, then disperse. Each ghost had its own AI."
    - "The four of them are programmed to set a trap, with Blinky leading the player into an ambush where the other three lie in wait."

Complexity Fallacy

- It is a common mistake to think that complex AI equals better character behavior.

- **When complex things look bad**: Black and White [2001]
  - Neural Networks and Decision Trees allowed creatures to learn.
  - When many people first play the game, they often end up inadvertently teaching the creature bad habits, and it ends up being unable to carry out even the most basic actions.

Perception Window

- Most players will only come across some characters and enemies for a short time, which might not be enough for the player to understand the AI.
  - Make sure that a character's AI matches its purpose in the game and the attention it will get from the player.
  - A change in behavior is far more noticeable than the behavior itself.

Illusion of Intelligence

- "If it looks like a fish and smells like a fish, it's probably a fish."
  - if the player believes an agent is intelligent, then it is intelligent.

- For game AI the nature of the human mind is not the key point.
  - The AI characters must look right and demonstrate intelligent behavior.

- Sometimes, simple solutions are enough to create a good illusion of intelligence.
  - Halo [2001] – increasing the number of hit points required to kill enemies made testers thought the AI was very intelligent.

Illusion of Intelligence

- Player's perception of intelligence can be enhanced by providing visual and/or auditory clues about what the agent is "thinking".

- Animation is an excellent way to create a good illusion of intelligence.
  - The Sims [2000] – although it uses a complex emotional model for characters, most part the characters' behaviors is communicated with animations.

  - Triggering animations at the right moment is the key point.

Illusion of Intelligence

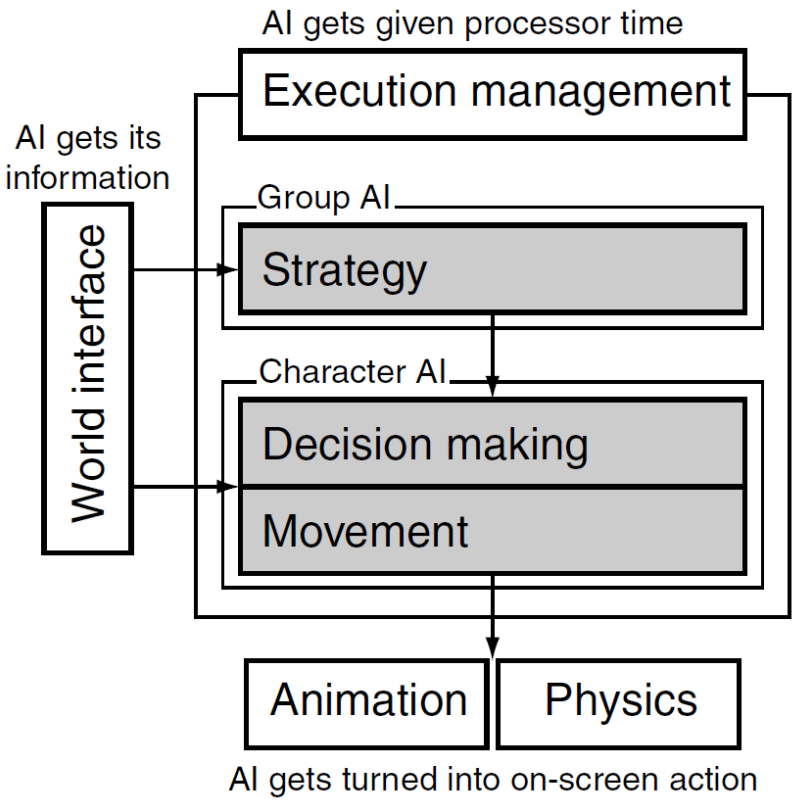
- The goal of game developers is to design agents that provide the illusion of intelligence, nothing more.

- Game developers rarely create great new algorithms and then ask themselves, “So what can I do with this?”
  - Instead, they start with a design for a character and apply the most relevant tool to get the result.

- Be careful to never break the illusion of intelligence:
  - Running into walls, getting stuck in corners, not reacting to obvious stimulus, seeing through walls, hearing a pin drop at 500 meters, …

Most Common Techniques

- Pathfinding
- Steering behaviours
- Finite state machines
- Automated planning
- Behaviour trees
- Randomness
- Sensor systems
- Machine learning



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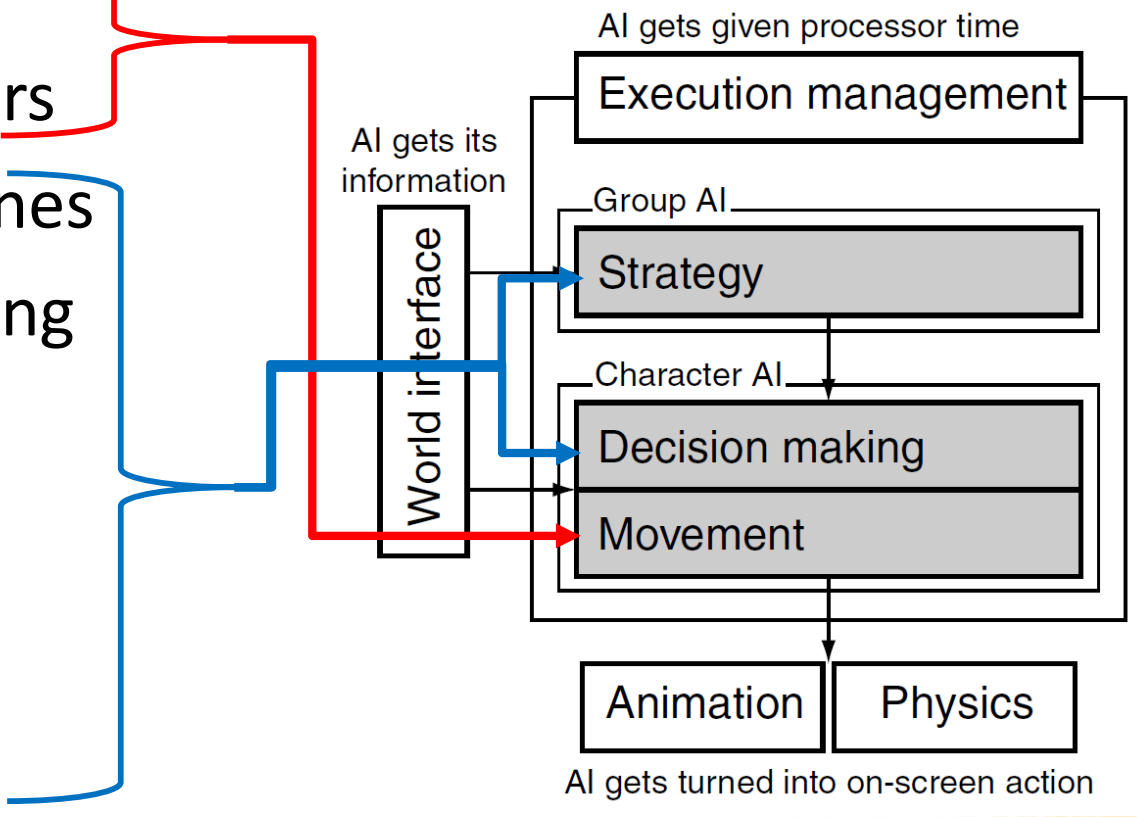
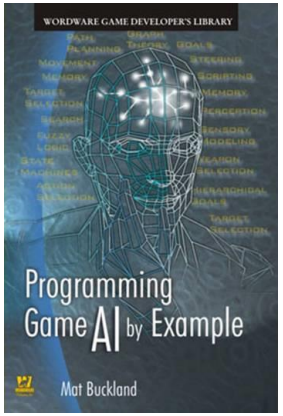


Further Reading

- Buckland, M. (2004). **Programming Game AI by Example**. Jones & Bartlett Learning. ISBN: 978-1-55622-078-4.

  – **Introduction**



- Millington, I., Funge, J. (2009). **Artificial Intelligence for Games** (2nd ed.). CRC Press. ISBN: 978-0123747310.

  – **Chapter 1: Introduction**

  – **Chapter 2: Game AI**