COMP702: Classical Artificial Intelligence

1: What Is AI?

What is "Classical" AI?

What is AI?

✗ Simulating human brains or human intelligence

✓ Performing tasks by machine (or by software) which would ordinarily require human intelligence

✓ Making decisions to achieve goals

What is AI?

✗ Programming machines to learn by themselves

✓ Machine learning is an important sub-field of AI, but there are many other AI techniques

What is AI?

- ✗ Programming machines to possess general intelligence, self-awareness, consciousness
- ✓ Maybe one day, but for now this is pure sci-fi
- ✓ Programming machines to carry out (or learn to carry out) a specific type of task

What is classical AI?

- A.k.a. **Good Old Fashioned AI**
- A.k.a. **Symbolic AI**
- Based on symbolic ("human-readable") representations of problems, logical systems, search spaces
- As opposed to machine learning, evolutionary algorithms etc which tend to be "black boxes"

Applications of AI in games

- ▶ Enemies and other NPCs
- ▶ Opponents in {board, card, strategy} games
- ▶ Automated playtesting
- ▶ Directors, hints, adaptive difficulty
- ▶ Procedural content generation
- ▶ Content production tools
- ▶ Procedural narrative
- ▶ Agent-based simulations
- ▶ ...

Why game AI?

- ► Games are a useful testbed for new AI technologies
- ► Game theory is a useful mathematical abstraction for many types of problem
- ► Game AI is more than pure problem solving — game AI needs to create an entertaining experience
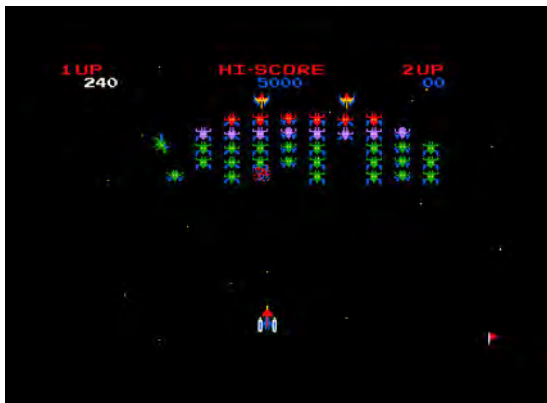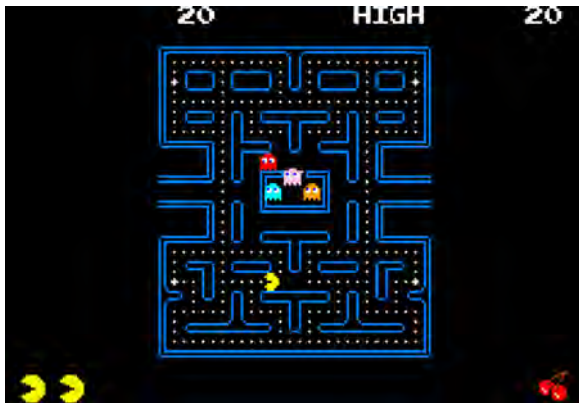
Nimrod (Ferranti, 1951)
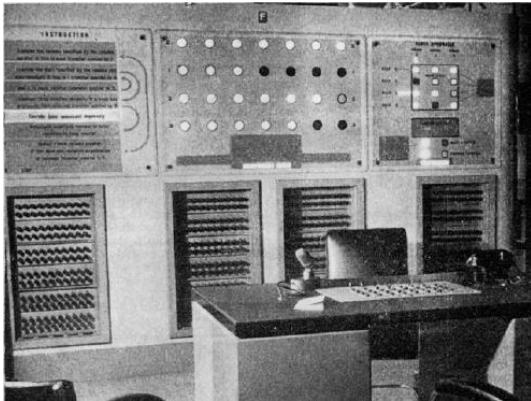
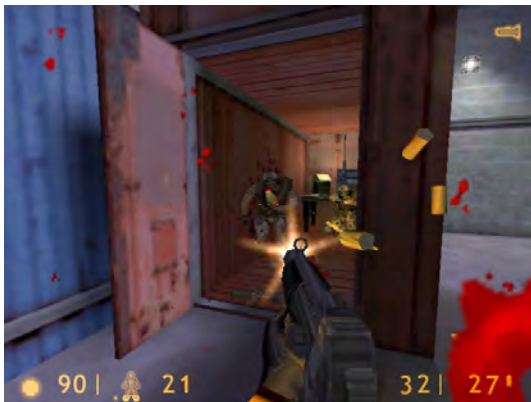# Samuel's Checkers program (IBM, 1962)

Galaxian (Namco, 1979)

Pac-Man (Namco, 1980)

Deep Blue (IBM, 1997)

Half-Life (Valve, 1998)

The Sims (Maxis, 2000)

Black & White (Lionhead, 2001)

Façade (Mateas & Stern, 2005)

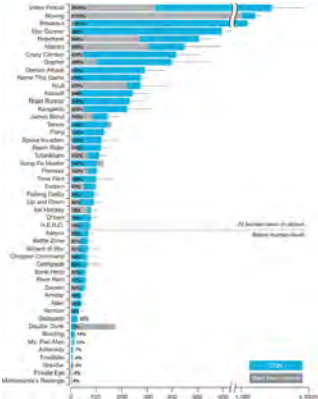# Chinook (Schaeffer et al, 2007)

Left 4 Dead (Valve, 2008)

Watson (IBM, 2011)

Deep learning for Atari games
(DeepMind, 2013)

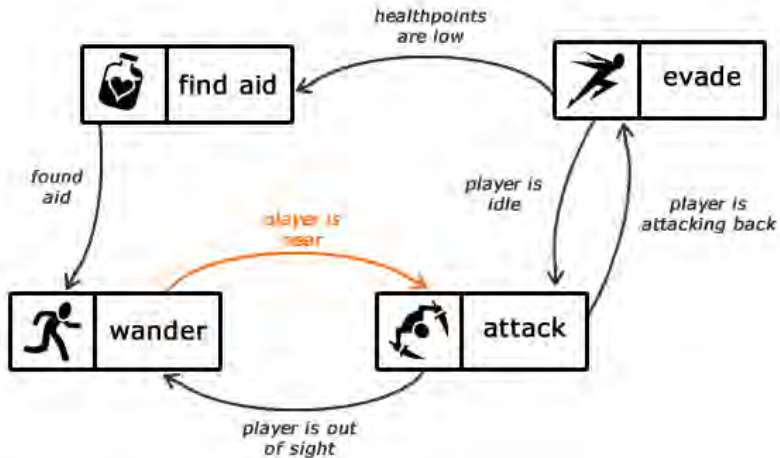# AlphaGo (Google DeepMind, 2016)
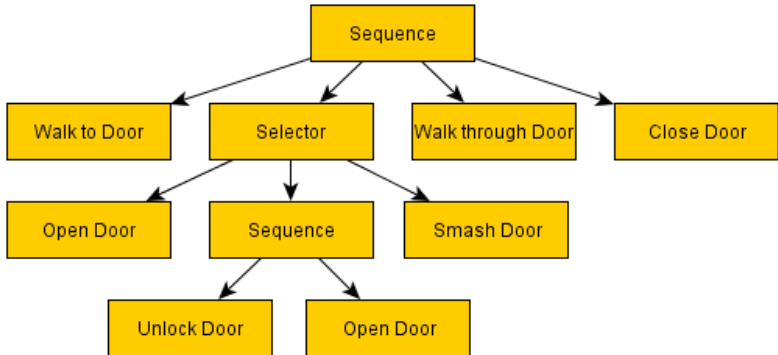
AI architectures

Rule-based AI

- ► Generally implemented as `if` statements or event-based triggers
- ► Triggers can be complicated e.g. based on raycasts
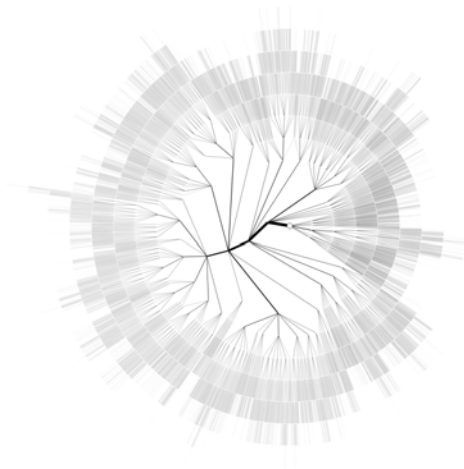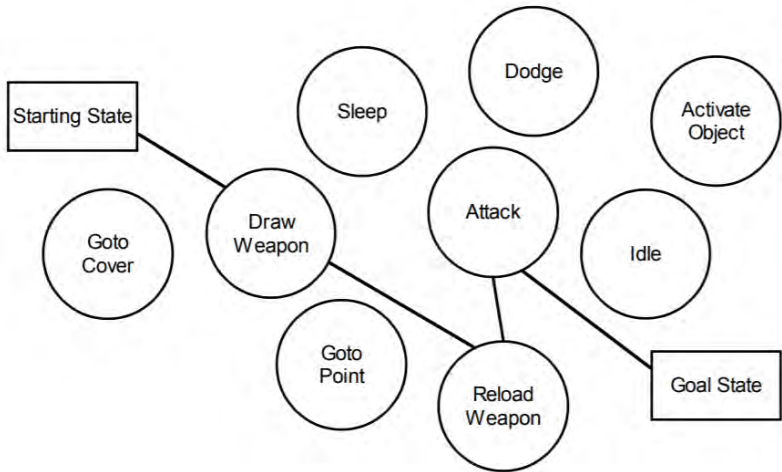
Finite state machines
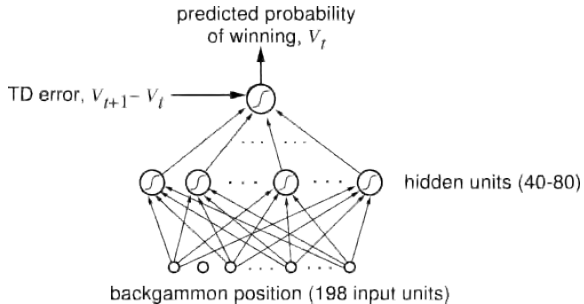
Behaviour trees

Multi-agent approaches (e.g. flocking)

Game tree search

Planning

Machine learning

predicted probability of winning, V_t

TD error, $V_{t+1} - V_t$ →

hidden units (40-80)

backgammon position (198 input units)

AI architectures

- ► Can roughly be divided into **hand-authored**...
  - ► Rule-based, FSM, behaviour trees
- ► ... and **computational intelligence**
  - ► Search, planning, machine learning
- ► Do you want to **design** the AI behaviours yourself, or do you want them to **emerge** from the system?
- ► Predictability and authorial control versus adaptability and novelty
- ► Can also combine the two, e.g. use a rule-based system to constrain a CI system