Artificial Intelligence in video games

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Summary

- History of AI in video games
  - Why videogames are so appropriate for AI
  - Why AI fits so well in videogames
- Learning methods / Types of AI
  - Finite State Machines
  - Tree Search
 - Utility-based AI
- Examples

History of AI in video games

- First software that mastered a game by Alexander Douglas (1952).
- Later, chess as "standard".
- First superhuman chess capability the IBM's Deep Blue.
- Other uses of AI very important as well (procedural generation)
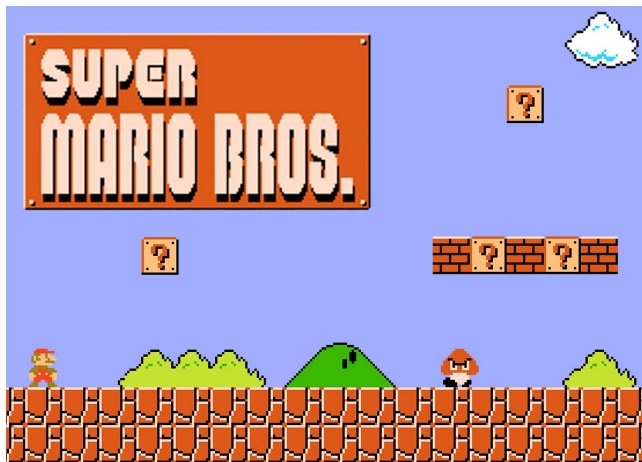
Why videogames are so appropriate for AI

- **Difficulty and interesting problems of games**
  - People usually like games being hard
  - High difficulty encourages to use AI in games.
  - Checkers, Chess, Go...
  - Go: >10^170 states.
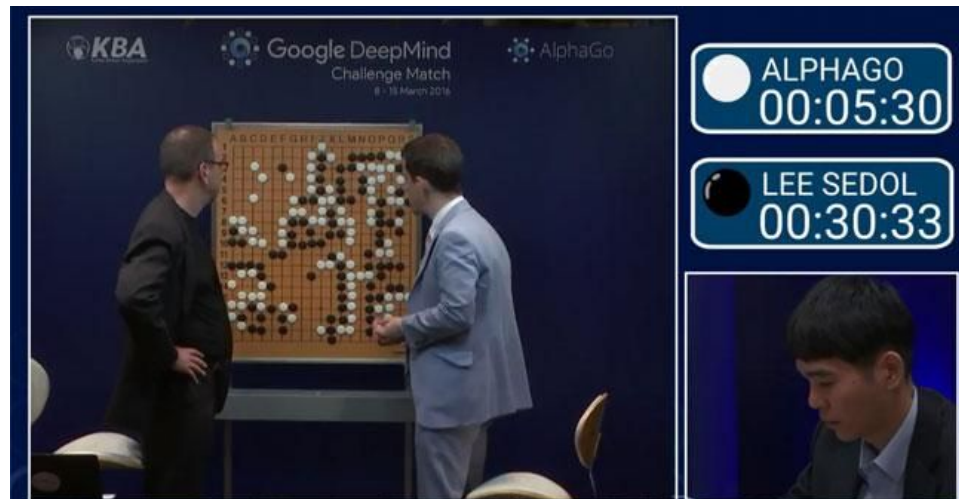
Why videogames are so appropriate for AI

- **Human-Computer Interaction**
  - Games are one of the better examples of human-computer interaction.
  - The range of action that can be done vary depending on the game

Why videogames are so appropriate for AI

- **Popularity of games**
  - First introduced as arcades in some few locals
  - Nowadays multi-billionaire industry
  - Now we can play anywhere and anytime
  - More people play
    - More innovative content
  - More creative games developed
    - AI will be more creative

Why videogames are so appropriate for AI

- **Cover of any AI field by many challenges**
  - Many genres → Many types of problems to be solved
  - Go and Arcade games: ML
  - Checkers and Chess: Tree Search
  - Jeopardy!: Knowledge representation, reasoning, Natural Language Processing…

Why AI fits so well in videogames

3 most important reasons:

- **AI plays and improves the game**
  - Any level of AI improves a videogame
  - 2 main goals: play well and play human-like
  - AI is capable of controlling player and non-playable characters

Why AI fits so well in videogames

- **More content, better content**
  - AI helps game designers:
    - Memory usage: Calculating every state is a very heavy task.
    - Content creation: A good AI creates content with diversity, quality and quantity.


Elite (1984)

No Man's Sky (2016)

Why AI fits so well in videogames

- **Player experience and behavioral data analysis**
  - Analyse the data from the player and game
    - Tailor the experience to each player
    - Speed up game design → whole game production
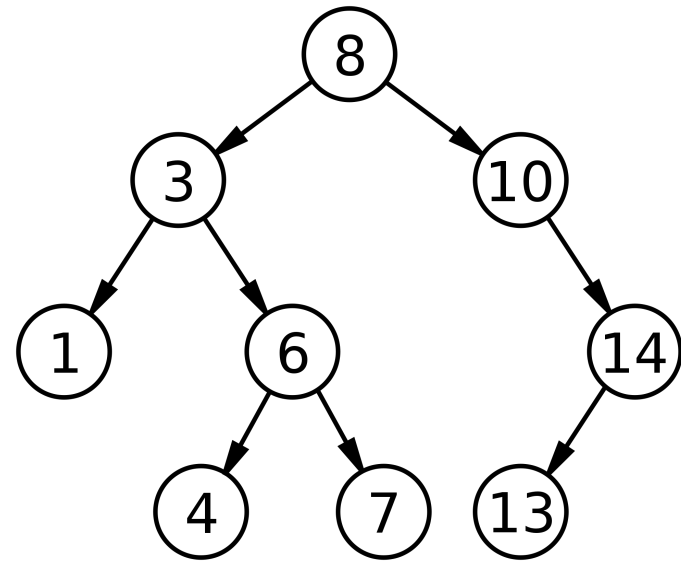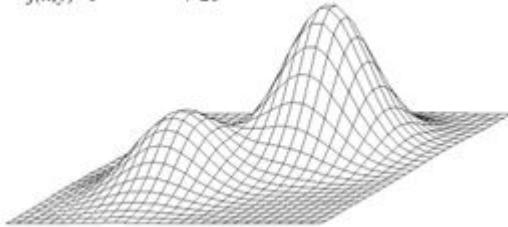 - Game designed with AI → Good game

Learning methods / Types of AI

- 3 popular class of AI methods for game development. Finite state machines, behavior trees and utility-based AI
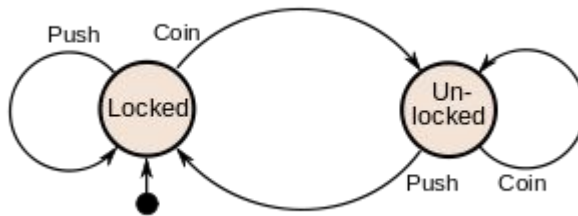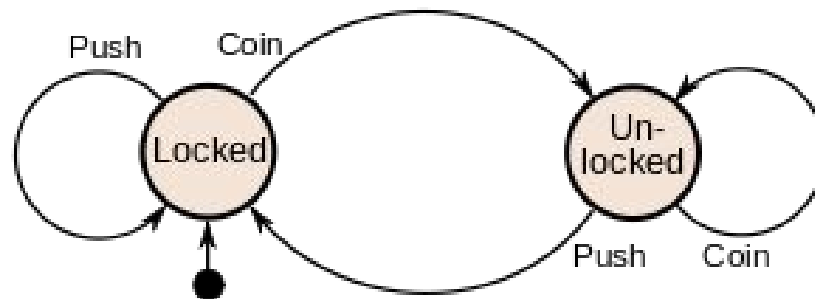

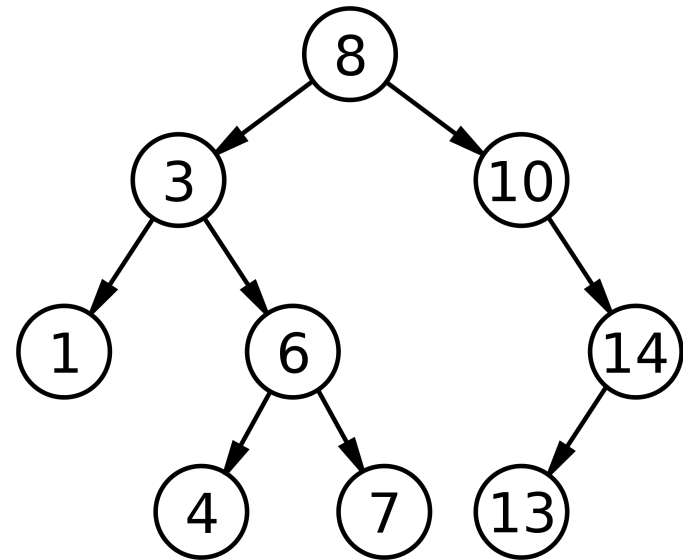$f(x,y)=e^{-(x^2+y^2)} + 2e^{-((x-1.7)^2+(y-1.7)^2)}$

Finite State Machines

- Dominated processes of AI in games until the mid-2000s.
- Very simple to design, implement and visualize.
- After their design there is limited room for adaptivity and evolution.

Tree Search

- The strength compared to FSM is their modularity. However, they have same problems
- From root to children.
- Trees are composed of three node types.
  - Sequence.
  - Selector.
  - Decorator.

Utility-based AI

- Utility is a measure of the "goodness" of a choice.
- Can be viewed as a function to decide which path to take.
- Heuristics.
- Three most known types.
  - Hill climbing.
  - Beam search.
  - Best first.

$$f(x,y)=e^{-(x^2+y^2)} + 2e^{-((x-1.7)^2+(y-1.7)^2)}$$
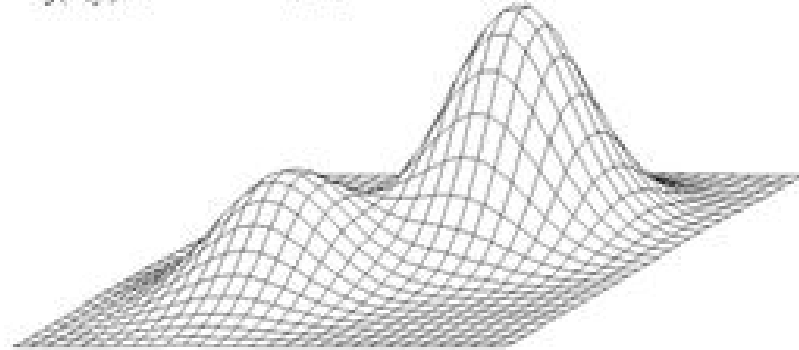
Examples

- MarI/O: A program that learns to play Super Mario World. (0:00 - 2:00)

  https://www.youtube.com/watch?v=qv6UVOQ0F44

- TensorKart: A program that learns to drive in Mario Kart. (0:00 - 1:20)

  https://www.youtube.com/watch?v=vrccd3yeXnc