AI in Computer Games

why, where and how

AI in Computer Games

- Goals
- Game categories
- History
- Common issues and methods
- Issues in various game categories

Goals

- Games are entertainment!
- Important that things behave naturally
  - not necessarily perfect
  - "things" are not always creatures
- Follow (the game's) natural laws
  - and avoid cheating
- Characters should be aware

Game A(I?)

- Academic AI is usually concerned with making rational decisions
  - Searching for the optimal solution
- Game AI is more often about
  - Artificial Life
  - Believable behaviour
    - including realistic physics
  - Game balancing
    - challenging, but not unbeatable opponents

Game categories

- Role Playing Games (RPG, MMORPG)
- First Person (Third Person) Shooters (FPS/TPS)
- Real Time Strategy (RTS) games
- Sports games
- Simulation games
- Adventure games
- Classic strategy games
- Fighting games
- ...

History -1980

- 1960's
  - First computer games
    - SpaceWar (for two human players) (1962)
    - Board games (e.g. chess) against the machine
- 1970's
  - Pong (first public computer game?) (1972)
  - First computer controlled opponent in arcade games
  - Space Invaders (1978)
  - Predefined patterns
  - "AI" takes 1-2% of CPU

- 1962
  - SpaceWar
- 1972
  - Pong
1980's
- Pac-Man (1980)
- Opponents with personality
- A computer beats a master chess player (1983)
- First fighting games
- Adventure games
  - Dungeon, Zork, ...
- First MORPG (MUD)

1990's
- FPS and RTS games
- Games about/with evolution and learning (Creatures, Black & White)
- Deep Blue beats Kasparov (1997)
- Graphic cards take the load off the CPU
- AI takes 10-35% of CPU

2000-
- Computer games is a big industry
  - Games sell for about 25 billion USD per year
  - Market grows with 16% per year
  - A game project: 2 years, 8-15 million USD
- Less cheating in AI
- Characters are more aware
- Characters collaborate better
- Focus shift from graphics towards AI

Typical Game AI topics
- Strategical/tactical decisions
  - Against or with you
  - Search for best counter action
  - Adaptivity
- Simulation
  - of natural behaviour
  - for animation (e.g. bird flocks)
- Shortest path problems

Some methods
- Minimax
  - Logic games, search for best counter action
- Finite State Machines (FSM)
  - Behaviour
- A*
  - For shortest path problems
- Particle methods
  - Simulation of flocks, smoke, water, grass...
- Smart terrain

Minimax (counter actions)

Variants: "α-β-pruning" and "expectimax"
Finite State Machines

Pacman ghost (red)

Reinforcement Learning

Best ≠ shortest

Smart terrain

- Stor knowledge in objects instead of in the characters
  - Easier to know what is relevant
  - Easier to add new objects later

- Drink me! ➔ not thirsty, warm

- Invented by Will Wright (Sims)

Thoughts on learning

- Game characters are short lived
- Learning requires many attempts

  Keep it simple!

- Probabilistic methods (Menace)
- Evolutionary methods
  - Genetic algorithms
- Neural networks
  - In game development, but not in the game
Thoughts on learning

AI in various game types
- Board games
- Role playing games
- Strategy games
- Platform and sports games
- Racing games

Board games
- Discrete time / turn based
- Often deterministic
- AI is in the opponent
- AI goal is non-typical (for games)
  - usually strives for optimality
- Tree search
- Library
- Reinforcement learning

Role Playing and Adventure
- AI in enemies, bosses, party members and other NPCs, ...
- Scripting, FSMs, Messaging
- Role Playing ≠ Combat
  - combat oriented games are simpler to make
- Conversations (grammar machines)
- Quest generators
- Towns

Town behaviour
- Need-based system
  - Needs (e.g. hunger, business, ...)
  - Actions (e.g. eating, trading, ...)
  - "Need pathfinding"
- Problems
  - Finding people
  - Unwanted interaction between NPCs
**Strategy games**

- AI heavy (on both sides)
- Shortest path problems
- Strategical decisions
- Tactical decisions
- Town building and resource management
  - planning
- Indigenous life
- Reconnaissance (fog-of-war)
- Diplomacy
- Know thy enemy (observe and adapt)

**Action games (FPS, TPS)**

- Enemies
- Weapons
- Cooperative agents
- Attention
  - requires perception
  - requires a good physics engine
- Pathfinding
- Spatial reasoning
- Anticipation

**Platforms and sports**

- Platform games
  - Since 1996 (Mario 64) in 3D
  - Camera problems
- Sports games
  - Camera problems (harder)
  - Cooperation
  - Game balance can be difficult
  - Learning
Racing games

- Track AI
- Traffic (including pedestrians)
- Physics
- Tuning NPCs and vehicle parameters
  - Genetic algorithms
  - Particle swarm optimization

Conclusion

- Making realistic games requires more than good graphics
- Computer controlled characters must behave
  - Naturally
  - Reasonably intelligent, without cheating!
- Graphics has dedicated hardware
  - More processing power available to AI
- In the future
  - Dedicated AI cards?
  - Multi core processors
  - Knowledge transfer from games to robotics

Robocup (Aibo league)