AI in Computer Games

why and how

Computer Games

Game types
- Board, card and dice games
- Strategy games
  - Real Time (RTS) or turn based
  - Helicopter view
- Role Playing Games (RPG)
  - MMORPG (Massive Multiplayer Online ...)
- Action games
  - First person shooter (FPS)

What is AI in games?

- A game must ‘feel’ natural
- Game ‘bookkeeping’, scoring
- Obey laws of nature/the game
- Characters are aware of environment
- Path finding
- Decision making
- Planning

AI Goals

1. Natural behaviour
2. Reasonable challenge
   - Optimality is usually not wanted!
3. Predictable
   - If you want to delegate tasks to AI
4. Without cheating!
   - Used to be very common in Game AI

History -1980

- 1960’s
  - First computer games (SpaceWar, for two players)
  - Board games (e.g. chess) against the computer
- 1970’s
  - Pong (first public computer game?)
  - First computer controlled arcade game opponents
  - Space Invaders
  - Preset patterns
  - 1-2% of CPU time spent on AI

History 1980-

- 1980’s
  - Pac-Man – opponents have personality
  - First fighting game
- 1990’s
  - First FPS and RTS games
  - Games that involve learning and/or evolution
  - Graphic cards – allows more CPU time for AI
  - 10-35% of CPU time spent on AI
Board games
- Discrete time
- Usually deterministic
- AI is in the opponent
- Goal is to play well – difficulty levels
- Minimax tree search
- Library
- Or: reinforcement learning

Reinforcement learning
- Learns to play by trial-and-error
- Must play many games, but can do so against itself (unsupervised)
- No roof, may discover previously unknown strategies
- If trained against a particular opponent, will learn to exploit weaknesses

Card and dice games
- Discrete time
- Probabilistic
- AI is in the other players
- Goal is to play well
- Expectimax tree search
  - Chance nodes – expected value
- Deduction and abduction

Strategy games
- AI on all sides
- Shortest path problems (all)
- Tactical decisions (all)
  - Low-level decisions: shoot, hide, run
- Strategical decisions (opponent)
  - High-level decisions: conquer, negotiate, resupply

Role Playing Games and Action games
- AI is in the opponent, in you party members, and in extra characters
- More important to behave naturally than to behave optimally
- Limited conversations
  - Cannot handle full natural language
  - Player needs some direction
- Strategical/tactical decisions (fights)
Realistic reactions
- Inputs – perception by characters
  - What can it see/know
  - Communication, orders
- Reaction
  - Time
  - Variation
  - Avoid floundering – use thresholds
- Success rate – game balancing

Techniques
- Finite state machines (FSM)
  - Multi-level FSM
  - Probabilistic FSM
- Message passing
- Planning
- Smart terrain
- Swarm behaviour
- Learning

Finite state machines

Planning
- An action has
  - Prerequisites (qualifications)
  - Effects
  - Side-effects (ramifications)
- Frame problem: what does not change?
  - Frame axioms: this does not change!
  - Add/delete list: only this changes!
  - Russian roulette problem: load-spin-?

Planning (cont.)
- Planning as state space search
  - Search backwards from goals
  - Complex state descriptions
  - Loops!
  
  Goal: stack X on Y

Smart terrain
- Move NPC knowledge into objects
  - Easier to identify relevant knowledge
  - Easier to add new objects
- Pathfinding
  - Static: precomputed paths
  - Dynamic: e.g. danger areas
Thoughts on learning

- AI characters are short lived
- Most learning technique require many attempts
- Keep it simple!

The future

- It is becoming harder to impress players with graphics
- Next step is to impress with natural behaviour
  - no matter how perfect a character is rendered and animated, it still won’t look good if it behaves strangely

The far future

- When we have good looking, naturally behaving characters, we might want to build them
  - Experience from AI in virtual worlds will transfer to the real world