

Principles of Computer Game Design and Implementation

Lecture 29

Putting It All Together

- Games are unimaginable without AI
 - (Except for puzzles, casual games,...)
 - No AI – no computer adversary/companion
- Good AI makes a game interesting
 - No “silver bullet” solution
 - What is more important, smooth paths or smart decisions?
- We looked at *some* AI techniques

Virtual Player V Smart Agents:

Smart virtual player, simple agents



Civilisation IV

Virtual Player V Smart Agents: Smart Agents



Doom 3



Serious Sam

Virtual Player V Smart Agents: Groups of Smart Agents



F.E.A.R.

Virtual Player V Smart Agents: Smart Virtual Player, Smart Agents



Lord of The Rings:
The Battle for Middle Earth



Perfect Dark Zero

Virtual Player V Smart Agents: Techniques

- Smart Virtual Player
 - Turn-based game search (board games)
 - Rule based system (RTS: C&C, Age of Empires,...)
- Smart Agents
 - Planning (F.E.A.R)
 - Behaviour Trees (Halo)
- Smart VP, smart agents
 - Agent coalition
 - Hierarchical models (FSMs, BTs)

Game AI Design

- Decide what AI should and **should not** do
 - Include *everything*
 - E.g. *Empire earth* project took a month, 30 pages
- Brainstorm different techniques
- Identify components
- Identify interfaces

Game AI: Requirements

- Be intelligent but **purposely** flawed
- Have no **unintended** weaknesses
- Perform within CPU and memory constraints
 - Cheat!
 - **Precompute!!**
- Be configurable by game designers /player
- Be **visible**

Artificial Stupidity

- AI researchers / developers want strongest possible AI
- Gamers want *believable* AI
- Player is supposed to win!
 - Winning because AI gives up is not as rewarding

Loosing Gracefully Techniques (1)

- Warn the player about an attack / be visible
(Especially in action-adventure games)
 - Shout “Take that!” before attacking
 - Great camouflage makes for bad gameplay
 - Move before firing
 - Player enters room, the monster looks sideways
- Have horrible aim
 - Being killed is not pleasant for the player
- Miss the first time – aim at a close destructible object

Loosing Gracefully Techniques (2)

- “Kung-Fu” style attack
 - Only one team member attacks the player
 - Half-life:
 - One attack slot
 - When out of ammo, AI player shouts “Cover me”
 - Another player starts attacking
 - Illusion of agent communication

Loosing Gracefully Techniques (3)

- Pull back at the last minutes
 - A “boss” becomes vulnerable when players health and ammo are low
- Intended Vulnerabilities
 - Stand on mines
 - Gun misfires
 - ...

Cover Up Weakness with Design: Halo

- Rushing levels with the assault rifle isn't fun
 - levels end too quickly.
 - **AI is more accurate** the longer the player is out of cover.
- AI isn't very good at dealing with close quick targets
 - **Powerful melee attacks.**
- One can **refine** the design to fix flaws in AI

Cover Up Weakness with Design: Half-Life

- Player throws grenades
 - Pathfinder tries to find an escape route
 - Fails to do that for all agents
 - Standing helplessly is stupid
 - **Play animation of crouching down and covering head**

Explicit and Implicit AI Designs

- **Explicit**
 - Characters' behaviour is predefined (Doom 3, Unreal 2,...)
- **Implicit**
 - Characters **work together** to create an emergent storyline (Pizza Tycoon)
- Modern games with implicit AI still have a storyline
 - GTA series
 - Bioshock Infinite

AI Techniques

- We only had a look at **simulation-based** behaviour in this module
 - Specify rules / states / actions / perceptions
 - Let the system figure out what to do next
- Alternative: **scripted behaviour**
 - Agents follow some predefined behaviour

Scripted Behaviour

- Game designers decides what computer characters do
 - Fixed trigger regions
 - When player approaches, character starts talking
 - Scripts send units to attack at some time

Scripts

- Technique of specifying a game's logic outside the game's source language
 - Scripting languages
- These two notions are closely interlinked
 - If the behaviour is specified by designers, they need a way to access it

Scripting 101

```
If (PlayerArmed == TRUE)
    BEGIN
        DoFlee();
    END
ELSE
    BEGIN
        DoAttack();
    END
```



AI for Game Developers. David M. Bourg, Glenn Seaman
O'Reilly, 2004

Verbal Interaction

If (PlayerArmed == Dagger)

 Say("What a cute little knife.");

If (PlayerArmed == Bow)

 Say("Drop the bow now and I'll let you live.");

If (PlayerArmed == Sword)

 Say("That sword will fit nicely in my collection.");

If (PlayerArmed == BattleAxe)

 Say("You're too weak to wield that battle axe.");

Scripting Events

```
If (PlayerLocation(120,76))  
    Trigger(kExposionTrap);
```

```
if (PlayerLocation(56,16))  
    Trigger(kPoisonTrap);
```

```
If (PlayerLocation(kDoorway))  
    PlaySound(kCreakingDoorSnd);
```

Advantages of Scripted Behaviour

- Faster / parallel game code development
- Easier to write and modify
- Much easier to execute
 - No search, no simulation
 - No pathfinding?
 - Simple execution of the script
- Possibility to create mods (PC)
 - Selling point long past the release date

Disadvantages

- Limits player's choices
- Allows to exploit AI flaws
 - Players will learn the limits of the script
- Non-programmers are required to program
- To be interesting, games need LOTS of scripts

Best of Both Worlds(?)

- Combining smart agents with scripted behaviour
- FSMs as scripts
 - Game design & AI design done by the same people
 - Enforced transitions based on the storyline
- Override the default behaviour of characters
- *Bind* agents and objects

In Place of a Conclusion: Game AI Techniques (1)

- Agents and multiagent systems
- A* pathfinding
- Behaviour trees
- Blackboard architectures
 - Coordination method
- Command hierarchy
 - Taking decisions on different levels

In Place of a Conclusion: Game AI Techniques (2)

- Dead reckoning
 - Predicting a player's future position
- Decision trees
- Emergent behaviour
 - Behaviour that was not explicitly programmed
- Flocking
- Formations
 - Group movements

In Place of a Conclusion: Game AI Techniques (3)

- Fuzzy logic
 - Yes / no → degree of (un)certainty
- Goal oriented behaviour
- Influence mapping
 - RTS games: how valuable a tile is
- Learning
- Level of detail AI

In Place of a Conclusion: Game AI Techniques (4)

- Markov systems
 - Uncertainty as probability. Markov FSM & Markov processes
- Minimax
- Rule-based systems
- Scripting
- State Machines (FSM, HFSM, Stack FSM)
- Steering

In Place of a Conclusion: Game AI Techniques (5)

- Subsumption architecture
 - Several layers of FSM, highest layer has priority
- Tactical and strategic AI
 - Global plans on top of short-sited goals
- Terrain analysis
 - Identify strategic locations
- Trigger system