Artificial Intelligence Paper Presentation

Human-Level AI’s Killer Application
Interactive Computer Games
By John E. Laird and Michael van Lent (2001)

Fion Ching Fung Li (2010-81329)
Content

Introduction
Computer Games Genres
Roles
Resource and Development issues
Conclusion
Introduction
Interactive computer games

• Increasingly complex and realistic worlds
• with intelligent computer-controlled characters
  – continual evolution in the game industry toward more realistic gaming environments
• Provides the environments for research
• Human-level AI
  - creates enemies, partners and support characters acting like humans
  - expands types of experiences by introducing synthetic intelligent characters with their own goal, knowledge and capabilities
  - recreates experience of playing with and against humans without a network connection
  ➔ fun, challenging games
• Reasons for AI researchers working on this industry
  1. Increasingly important role of synthetic human-level characters
  2. Technology
  3. AI programmer
  4. Big industry with high revenue
  5. Cheap computer game hardware
  6. More realistic modelling of human characters
Computer Game Genres

Action Games
Role-playing Games
Adventure Games
Strategy Games
God Games
Team Sports
Individual Sports
Computer Game Genres

<table>
<thead>
<tr>
<th>Game Genres</th>
<th>AI Entity Roles</th>
<th>AI Research Problems</th>
<th>AI Research Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action</td>
<td>Tactical enemies</td>
<td>Interact with environment</td>
<td>High-level perception</td>
</tr>
<tr>
<td>Role playing</td>
<td>Partners</td>
<td>Fast response</td>
<td>Commonsense reasoning</td>
</tr>
<tr>
<td>Adventure</td>
<td>Support characters</td>
<td>Realistic sensing</td>
<td>Natural language</td>
</tr>
<tr>
<td>Strategy games</td>
<td>Story directors</td>
<td>Adapt to environment</td>
<td>Speech processing</td>
</tr>
<tr>
<td>God games</td>
<td>Strategic opponents</td>
<td>Adapt to environment</td>
<td>Gesture processing</td>
</tr>
<tr>
<td>Team sports</td>
<td>Units</td>
<td>Interact with humans</td>
<td>Planning &amp; counterplanning</td>
</tr>
<tr>
<td>Individual sports</td>
<td>Commentators</td>
<td>Adapt to human player</td>
<td>Cognitive modeling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficulty</td>
<td>Plan recognition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>adaptation</td>
<td>Soft real-time response</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategic adaptation</td>
<td>Reactive behavior</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interact with other AIs</td>
<td>Teamwork</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coordinate behavior</td>
<td>Scheduling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Navigation</td>
<td>Path planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use tactics and strategies</td>
<td>Spatial reasoning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allocate resources</td>
<td>Temporal reasoning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Understand game flow</td>
<td>Opponent modeling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Humanlike responses</td>
<td>Learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reaction times</td>
<td>Knowledge acquisition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Realistic movement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emotions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personalities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low computational overhead</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low development overhead</td>
<td></td>
</tr>
</tbody>
</table>
Action Games (1/2)

• Human player
  – Controls a character in virtual environment
  – Usually deadly forced to save the world from the forces of evil

• Different perspectives
  – First person: see what the character would see
  – Third person: looks over the shoulder of the character

• Usage of AI
  – control enemies
• Competition
  – Realism in graphics
  – Quality of AI

• Examples
  – Unreal (1998), Tomb Raider
    • Extended the genre
    • Human player can be part of a team which includes either human or AI partners
Role-Playing Games (1/2)

- Human player
  - Plays different types of character
  - Goes on quests, collects and sells items, fights monsters
  - Expands capabilities of the character
  - Example: Baldur’s Gate (1998), Diablo (1997), Ultima
Massively multiplayer role-playing games
- Thousands of people play and interact in the same game worlds

Roles of AI
- control enemies
- As partners who travel and adventure with the players
- As supporting characters
- For massively multiplayer games: expand and enhance the player-to-player social interactions
Adventure Games (1/2)

• Emphasize story, plot and puzzle solving
• Human player
  – Solves puzzles and interacts with other characters
  – adventure determined in part by their actions
• Roles of AI
  – Creates realistic supporting goal-driven characters
  – Player must interact with appropriately to further their progress in the game
• Computer director
  – Dynamically adjust story and plot based on actions of human player
Adventure Games (2/2)

• Majority of games
  – Have fixed scripts
  – Use many tricks to force the human player through essentially linear stories

• Few games
  – Example: Blade Runner
  – Have incorporated some autonomy and dynamic scripting into their characters and story line

• Examples
  – Text based: Adventure, Zork (1977)
  – 3D graphics: King’s Quest, Full Throttle (1995), Monkey Island (1990), Grim Fandango (1998), Rubu Tribe
Strategy Games (1/2)

• Human player
  – Controls many units (usually military units e.g. tanks)
  – battle from a god’s eye view against one or more opponents
  – Often faced with problems of allocating resources, scheduling production and organizing defenses and attacks

• Different types of battle
  – Historical: Close Combat, Age of Empires
  – Alternative reality e.g. Command and Conquer
  – Fictional future e.g. Starcraft
  – Mythical e.g. Warcraft, Myth
• Roles of AI

1. As a control for the detailed behavior of individual units that the human commands
   - Meant to be good soldiers who follows orders
     Not meant to be autonomous

2. As a strategic opponent that must play against the human
God Games (1/2)

• Human player
  – Has godlike control over a simulated world
  – Can modify the environment and, to some extent, its inhabitants
  – Result by observing the effects of player’s actions on individuals, society and the world

• Classic example: SimCity
  – Human player: acts as mayor
  – AI: controls individual units or citizens of the simulated world
• Intriguing example: The Sims
  – Human player
    • creates individual characters (units) that have significant autonomy, with their own drives, goals and strategies for satisfying these goals
    • comes in and stirs things up by managing both the individual characters and their environment
Team Sports

- **Human player**
  - Plays a combination of a coach and player in popular sports e.g. football, basketball, soccer, baseball, and hockey

- **Roles of AI**
  1. Unit-level control of all the individual players
     - While human controls one key players, computer controls all the other members of the team
  2. As strategic opponent or opposing coach
  3. Commentator: gives the play-by-play and color commentary of the game
Individual Sports

• Simulation of the sports from a first- or third-person perspective e.g. skiing, snowboarding

• Human player
  – Controls a participant in the game who competes against other human or computer players

• Roles of AI
  – Strategic opponent or unit
  – Commentator
Roles

Tactical Enemies
Partners
Support Characters
Strategic Opponents
Units
Commentators
Tactical Enemies

• Characteristic
  – Autonomous
    • Interact with complex dynamic environments
  – Models of high-level vision that have same strengths and weaknesses as humans
  – Responses need to be within range of humans in terms of reaction times and realistic movement
  – Model of emotions \(\rightarrow\) change their behavior as result
Partners

• Roles of AI partner
  – Must coordinate its behavior
  – Understand teamwork
  – Model the goals of human and adapt to his/her style

• AI research areas
  – Emphasize effortless cooperation and coordination between the human player and the AI partner
Supporting Characters

• Roles of supporting characters
  – Guide the player along various plot lines
  – Interact with and adapt to the environment, human player and other supporting characters
  – Provide humanlike responses, including natural language understanding and generation

• Require wide range of integrated AI capabilities
  – Natural language, path planning, teamwork, realistic movement
Strategic Opponents

• Most important aspects of strategy creation
  – Coordination of multiple types of a unit into a cohesive strategy

• Tasks of strategic opponent
  1. Allocating resources
  2. Issuing unit-control commands
     • Must enforce humanlike limitations: reaction times, realistic movement → make the battle fair
  3. Development of high-level strategy
Units

• given high-level commands from either human player or strategic opponent
• Need to carry out commands
• With semi-autonomous behavior
  – Coordination with other units
• Issues: computational and memory overhead
Commentators

• Roles of commentator
  – Observe the actions of AI and human
  – Generate natural language comments suitable to describe the action

• RoboCup
  – Separate competition for commentators agents

• Genres: Team sports, Individual sports, Action games

• Challenge
  – Create a natural language description of the ongoing action
  – Includes both the moment-to-moment action
  – As well as key tactical and strategy events
  – Requires complex plan recognition and deep understanding of the game
Resource and Development issues
Resource and Development issues

• Need to meet the limited computational power available in the average home computer or video game console

• AI systems must be developed at moderate cost
  – Reason: Game company will not be able to spend more than one-person year on development of AI for a game
  – Solution: develop techniques for quickly building and customizing human-level AI systems
• From a researcher’s perspective, Computer games ...
  – offer interesting and challenging environments for research problem in AI
  – Become more realistic worlds and require more complex behavior from characters
Thank you