Exploration

CS395 GAI
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Abstract Architecture strategy-game AI

- Decisions to be made
- Decision-Maker
- Decisions
- Model of current game state
- Model of Game World
- Perceptual System
- Motor System
Sensing the World

• Need hooks into the simulator to gather information about game state
  – First step in building world model

• Design issues
  – How much abstraction to introduce?
    • If you’re also the world designer, can align simulation and AI perception quite closely
  – How much to record, over what period?
    • What is needed to support decision-making, learning?
Modeling the world

• Perception tells you what is happening
• Must be assessed in terms of
  – What your goals and plans are
  – What your opponents/allies goals and plans are
• Assessment process identifies
  – Threats
  – Progress
  – Opportunities
• Assessment process provides *situational awareness*
Changing the World

• Need hooks into world simulator
• Design tradeoffs
  – Controlling continuous changes
    • Factored out in turn-based designs
    • Require tight, often autonomous, feedback control
  – Need to report consequences
    • Actions don’t always succeed
Making Decisions

• Some dimensions of decision-making
  – Deliberative versus Reactive
  – Centralized versus Local
  – Hierarchical versus Flat
  – Learned versus Hard-wired

• Mostly orthogonal

• Often used in mixtures

• Trade-offs can be subtle
Deliberative versus Reactive

• Deliberative ➔ Construct a plan, then execute it
  – Plans often involve multiple steps, including sensing, conditional branching
  – Enables optimization, but can be slow

• Reactive ➔ Just do something, based on sensors
  – Provides rapid, reflex action
  – Can lead to silly behaviors if unanticipated situations arise
Centralized versus Local

• Centralized ➔ AI structured as computer player
• Local ➔ AI structured as models for what units should do in the simulated world
• Local often easier to implement
  – Combinatorics of explicit coordination can become nasty
  – Gradient methods used to provide simulation of coordination
Hierarchical versus Flat

• Hierarchical ➔ Use structure of the problem for divide-and-conquer
  – Example: Echelon distinctions in military ➔ different levels of AIs
    • Company, Squad, individual AIs
  – Factors decision-making to make it more manageable
  – Imposes extra overhead of communication between layers
Learned versus Hard-wired

• Hard-wired
  – Fast runtime execution, guaranteed understanding of local behavior
  – Brittle, can be too predictable for player, non-local interactions hard to debug

• Learned
  – Can adapt to player, provide surprises
  – Slower runtime execution, higher memory load, can lead to unpredictable, degenerate behaviors
Strategies for making decisions

• Goals can be achieved in many ways
• Situations often allow many actions
• How to choose?
  – Generate a set of alternatives
  – Compute numerical evaluation of each of them
  – Pick the best
    • Or, for variability in play, pick randomly with bias proportional to perceived quality of choices
Exploration

• Goals of exploration:
  – Find territory to expand into
  – Find your neighbors
  – Find out how soon you need a navy
  – Find exploitable terrain for defense
How does the FAP do it?

• See Phil Houk’s technical report
How to explore the whole world?

- Need to build a navy
  - Find coastal sites for cities
  - Develop technology to build ships
    - Map-making, …
    - Optimize order of technological advances?
    - Strategies for ferrying units
- Build more explorers
  - Manage more explorers
    - Send off in different directions
    - Distribute across land masses
- Build infrastructure
  - Roads, to get explorers to embarkation points
- Get alliances to share maps