Autonomous Multiagent Systems

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Week 9, Tuesday (10/22)

Any Questions?

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Readings Overview

- OASIS for airtraffic control
- RL for elevator control
- Electric elves for office support

Readings Overview – OASIS

- Concretization of BDI
  - Decision nodes, chance nodes $\Rightarrow$ beliefs, desires, intentions trees
- Real time: *assume significant changes to state can be determined instantaneously*
  - No blind execution
  - No constant reevaluation

Implemented in an airport!

General Domain Characteristics

- Non-deterministic ($\Rightarrow$ beliefs)
- Action choices ($\Rightarrow$ intentions)
- Multiple objectives, possibly incompatible ($\Rightarrow$ desires)
- Environment determines best actions ($\Rightarrow$ desires)
- Incomplete information ($\Rightarrow$ beliefs)
- Dynamic world ($\Rightarrow$ intentions)

Can't just use decision theory

Decision Theory

- Choice nodes: system gets to choose
- Chance nodes: environment selects randomly

Deliberation Functions

- Maximin: aim for a best, worst case
- Expected utility: aim for a best expected case

Air-traffic Management

70–80 agents at a time

- One agent per aircraft
- Sequencer
- Wind modeller
- Coordinator
- Trajectory checker

Keep schedule until complete or impossible

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BDI

Beliefs: All possible wind velocities and trajectories

Desires: Pruned to only keep the right ETA

Intentions: Pruned further to keep only the best in terms of fuel consumption, etc.

RL for elevator control

- Modeling elevator traffic during lunch

- Huge state space
  - Which call buttons are pressed
  - Which car buttons are pressed
  - Times since buttons pressed

- Small action space
  - Move up/down (when at a floor)
  - Stop/continue (when moving)
  - Some action constraints

Function approximation

- Neural network to approximate Q
- 47 inputs: ("after considerable experimentation")
  - call buttons (18)
  - car location (16)
  - other car locations (10)
  - domain info: at highest-needed floor or longest-waiting passenger (2)
  - bias unit (1)

Two architectures

- Parallel: all elevators share the same network (homogeneous)

- Decentralized: each elevator has its own network (heterogeneous)

Results

- Both outperform many other standard algorithms

- Why not use it?

Electric Elves: Human Organization Support

- Proxy agents for meeting scheduling
- Activities within an individual research project
- Meeting planning with participants outside the organization

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Challenges

- Adjustable autonomy
- Reliable information access
- Capability matching
- Agent coordination
- Scaling up to continual, reliable usability

Technologies

- Adjustable autonomy motivated by CAP
- MDPs to choose to delay risky decisions
- Capability characterization language
- Adaptive wrappers for info sources
- Data mining from publication records
- STEAM to coordinate agents

Used continuously for several months

Next Week's Readings – Distributed Rational Decision Making

- Chapter 6 or a web article
- Don't be confused with week 11
- Start early on week 11