CS344M
Autonomous Multiagent Systems

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Good Afternoon, Colleagues

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- Subsumption vs. deliberative today
- RoboCup strategies now vs. CMU-98

Logistics

- Programming assignment 3 — how was it?

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- Programming assignment 4 assigned
- Week 4 and 5 readings are up
- Warren Powell talk - Friday 11 am (PAI 3.14)

Some Definitions

- **Distributed Computing :** Processors share data, but not control. Focus on low-level parallelization, synchronization.
- **Distributed AI :** Control as well as data is distributed. Focus on problem solving, communication, and coordination.
- **Distributed Problem Solving :** Task decomposition and/or solution synthesis.
- **Multiagent Systems :** Behavior coordination or behavior management.
  - No necessary guarantees about other agents.
  - Individual behaviors typically simple relative to interaction issues.

Multiagent Systems

- Study, behavior, construction of **possibly preexisting** autonomous agents that interact with each other.
  - incomplete information for agents
  - no global control
  - decentralized data
  - asynchronous computation

Why Multiagent Systems?

(7)

- Some domains require it. (Hospital scheduling)
- Interoperation of legacy systems
- Parallelism.
- Robustness.
- Scalability
- Simpler programming.
- "Intelligence is deeply and inevitably coupled with interaction." – *Gerhard Weiss*

Organizations

- **Hierarchy:** authority from above
- **Community of Experts:** specialists, mutual adjustment
- **Market:** bid for tasks and resources; contracts
- **Scientific community:** full solutions (perhaps with varying information) combined

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- Engineering

Dimensions and issues

- cooperative vs. competitive
- communication
- trust
- recursive modeling
- coalititions
- game theory

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Convoy example

Individual Agents

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"Sophisticated individual agent reasoning can increase MAS coherence because each individual agent can reason about nonlocal effects of local actions, form expectations of the behavior of others, or explain and possibly repair conflicts and harmful interactions."

"Reactive agents do not have representations of their environment and act using a stimulus-response type of behavior; they respond to the present state of the environment in which they are situated."

Individual Agents

- Purely reactive agents have disadvantages
  - Can't react to nonlocal info or predict effects on global behavior
  - hard to engineer
- Hybrid approach better (three layers)
- Hard to evaluate agent architecture against one another

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- Negotiation, game theory

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- (pursuit slides)

Communication

- Middle agents (brokers)
- Standard languages
- Ontologies

More next week

Mataric: Adaptive Group Behavior

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- Hit a complexity limit?
  - (Subsumption or 3T more prevalent?)

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- Example: locomotion
  - Safe-wandering, following, dispersion, aggregation, homing
  - What 2 multiagent architectures does she compare?
  - Anything special about this domain? Or could it apply just as well to others?

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- Can human behavior be thought of as arising from a set of basis behaviors?
- What kinds of basis behaviors would they be?
- Would they be the same as the ones Mataric listed?
- Are there others?

Pursuit Activity

Group 1: homogeneous, non-communicating
Group 2: homogeneous, communicating
Group 3: heterogeneous, non-communicating
Group 4: heterogeneous, communicating