Good Afternoon, Colleagues

Are there any questions?
Some Definitions

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- **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
Issues and Challenges

• How to break down and resynthesize the problem among agents

• Communication/interaction protocols

• Maintain coherence, stability: guarantees?
  – Coherence is a global property

• Representation by agents of each other and interactions

• Reconciling different points of view

• Engineering
Dimensions and issues

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

Convoy example
Individual Agents

What did Sycara say about reactive vs. deliberative agents?
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

- Hard to evaluate agent architecture against one another
Conflicts, Resources

- Omniscience for one agent creates bottleneck
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  - Will that be good for global performance? (invisible hand)
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  - Pitfall: no stability
  - Pitfall: lying
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- Negotiation, game theory
Multiagent Planning

- Complex individual agents
- Teamwork modeling
  - Modeling of teammates and opponents
- Recent: emphasis on flexibility in dynamic environments
Communication

• Middle agents (brokers)

• Standard languages

• Ontologies

More next week
Mataric: Adaptive Group Behavior

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- More complex behaviors than in Brooks’ article
  - Multiagent
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- More complex behaviors than in Brooks’ article
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- Hit a complexity limit?
  - (Subsumption or 3T more prevalent?)
Basis Behaviors

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  - Combinations: complementary, contradictory
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  - What 2 multiagent architectures does she compare?
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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?
Discussion

Basis behaviors for other tasks
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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?
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Basis behaviors for other tasks

- 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?
Negotiation

- Example: Split the dollar
  - One person makes an offer
  - Other accepts or rejects
  - If rejects, both get nothing
Negotiation

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- Another version
  - One person makes an offer
  - Other accepts, rejects, or counters
  - If counters, $.05 lost
  - Game ends with an accept or reject