CS378
Autonomous Multiagent Systems
Spring 2004

Prof: Peter Stone
TA: Mazda Ahmadi

Department of Computer Sciences
The University of Texas at Austin

Week 7b: Thursday, March 4th

Good Afternoon, Colleagues

Are there any questions?

Good Afternoon, Colleagues

Are there any questions?

- Applications using swarms/flocks?
- How can you prevent undesired emergent behavior?
- Can trail-laying scale to the real world?

Logistics

- Surveys

Class Discussion

Murat Deligonul on being ants again

Continue ML crash course

- Genetic algorithms/programming
- **Neural networks**
- Reinforcement learning

Go to the Ant

- Complex system behavior from many simple agents

Go to the Ant

- Complex system behavior from many simple agents
- Complexity comes from interactions, the environment

Agent Definition

Agents tied to environment

- *Agent = <State, Input, Output, Process>*

Agent Definition

Agents tied to environment

- *Agent = <State, Input, Output, Process>*
- *Environment = <State, Process>*

Agent Definition

Agents tied to environment

- *Agent = <State, Input, Output, Process>*
- *Environment = <State, Process>*

Note: supports hierarchical agents

Examples from Nature

- Ants: path planning
- Ants: brood sorting
- Termites: nest building
- Wasps: task differentiation
- Birds and Fish: flocking
- Wolves: surrounding prey

Principles

- Try to avoid functional decomposition

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)
- Decentralized control

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)
- Decentralized control
- System performance from interactions of many

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)
- Decentralized control
- System performance from interactions of many
- Diversity important: randomness, repulsion

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)
- Decentralized control
- System performance from interactions of many
- Diversity important: randomness, repulsion
- Embrace risk (expendability) and redundancy

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)
- Decentralized control
- System performance from interactions of many
- Diversity important: randomness, repulsion
- Embrace risk (expendability) and redundancy
- Agents should be able to share information

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)
- Decentralized control
- System performance from interactions of many
- Diversity important: randomness, repulsion
- Embrace risk (expendability) and redundancy
- Agents should be able to share information
- Mix planning with execution

Principles

- Try to avoid functional decomposition
- Simple agents (small, forgetful, local)
- Decentralized control
- System performance from interactions of many
- Diversity important: randomness, repulsion
- Embrace risk (expendability) and redundancy
- Agents should be able to share information
- Mix planning with execution
- Provide an "entropy leak"

Trail-Laying Robots

- An application to **real robots**
- Also use simulations

Trail-Laying Robots

- An application to **real robots**
- Also use simulations
- Can it scale to the real world?

Propose an ant-based algorithm to...

- ...Sort a dynamic set of items
  - Each item has a key and a rank
  - Goal: keep the ranks in ascending order of the keys

Propose an ant-based algorithm to...

- ...Sort a dynamic set of items
  - Each item has a key and a rank
  - Goal: keep the ranks in ascending order of the keys
- ...Create ant cemeteries
  - Goal: dead ants should all be piled in the same place
  - (it doesn't matter where)

Propose an ant-based algorithm to...

- ...Sort a dynamic set of items
  - Each item has a key and a rank
  - Goal: keep the ranks in ascending order of the keys
- ...Create ant cemeteries
  - Goal: dead ants should all be piled in the same place
  - (it doesn't matter where)
- ...Do network routing
  - build routing table mapping destinations to links at each node
  - Goal: minimal transit time for packets

Other ant-based research

- AntNet – Network routing solution
  - Randomized algorithm (packets sent probabilistically)

Other ant-based research

- AntNet – Network routing solution
  - Randomized algorithm (packets sent probabilistically)
- Holland – picking up pucks
  - Goal: robot putting pucks in a pile
  - Rules: move randomly, drop if you have 3
  - Analogy: ant burial

Other ant-based research

- AntNet – Network routing solution
  - Randomized algorithm (packets sent probabilistically)
- Holland – picking up pucks
  - Goal: robot putting pucks in a pile
  - Rules: move randomly, drop if you have 3
  - Analogy: ant burial
- Balch – ant tracking
  - Computer vision success

Other ant-based research

- AntNet – Network routing solution
  - Randomized algorithm (packets sent probabilistically)
- Holland – picking up pucks
  - Goal: robot putting pucks in a pile
  - Rules: move randomly, drop if you have 3
  - Analogy: ant burial
- Balch – ant tracking
  - Computer vision success
- Missionaries and Cannibals – An optimization problem