

CS344M

Autonomous Multiagent Systems

Prof: Peter Stone

Department of Computer Science
The University of Texas at Austin

Good Afternoon, Colleagues

Good Afternoon, Colleagues

Are there any questions?

Logistics

- Questions about the syllabus?

Logistics

- Questions about the syllabus?
- Class registration

Logistics

- Questions about the syllabus?
- Class registration
 - Too many for student-led discussions

Logistics

- Questions about the syllabus?
- Class registration
 - Too many for student-led discussions
- Problems with the assignment?

Logistics

- Questions about the syllabus?
- Class registration
 - Too many for student-led discussions
- Problems with the assignment?
- Mailing list — announcements yesterday

Logistics

- Questions about the syllabus?
- Class registration
 - Too many for student-led discussions
- Problems with the assignment?
- Mailing list — announcements yesterday
 - CC Katie, Patrick, and me on everything

Logistics

- Questions about the syllabus?
- Class registration
 - Too many for student-led discussions
- Problems with the assignment?
- Mailing list — announcements yesterday
 - CC Katie, Patrick, and me on everything
- Last week's slides are up

Logistics

- Questions about the syllabus?
- Class registration
 - Too many for student-led discussions
- Problems with the assignment?
- Mailing list — announcements yesterday
 - CC Katie, Patrick, and me on everything
- Last week's slides are up
- Next week's readings are up:
 - Brooks' reactive robots
 - A more deliberative architecture
 - RoboCup challenge paper

Logistics

- Questions about the syllabus?
- Class registration
 - Too many for student-led discussions
- Problems with the assignment?
- Mailing list — announcements yesterday
 - CC Katie, Patrick, and me on everything
- Last week's slides are up
- Next week's readings are up:
 - Brooks' reactive robots
 - A more deliberative architecture
 - RoboCup challenge paper
- Change rooms?

Words without (accepted) definitions

- Intelligence
- Agent

Words without (accepted) definitions

- Intelligence
- Agent

All proposed definitions include too much or leave gaps.

Words without (accepted) definitions

- Intelligence
- Agent

All proposed definitions include too much or leave gaps.

But there are examples. . .

Thermostats

- Are they agents or not?
- How does Wooldridge resolve this?

Intelligent (autonomous) Agents

- Autonomous robot

Intelligent (autonomous) Agents

- Autonomous robot
- Information gathering agent
 - Find me the cheapest?

Intelligent (autonomous) Agents

- Autonomous robot
- Information gathering agent
 - Find me the cheapest?
- E-commerce agents
 - Decides what to buy/sell and does it

Intelligent (autonomous) Agents

- Autonomous robot
- Information gathering agent
 - Find me the cheapest?
- E-commerce agents
 - Decides what to buy/sell and does it
- Air-traffic controller

Intelligent (autonomous) Agents

- Autonomous robot
- Information gathering agent
 - Find me the cheapest?
- E-commerce agents
 - Decides what to buy/sell and does it
- Air-traffic controller
- Meeting scheduler

Intelligent (autonomous) Agents

- Autonomous robot
- Information gathering agent
 - Find me the cheapest?
- E-commerce agents
 - Decides what to buy/sell and does it
- Air-traffic controller
- Meeting scheduler
- Computer-game-playing agent

Not Intelligent Agents

- Thermostat
- Telephone
- Answering machine
- Pencil
- Java object

Your Agent Examples

Your Agent Examples

Automotive: cruise control, parallel parker, traffic detecting agent

Physical Control: Elevators, oil spill robots, DARPA mule, Roomba

Simple: water boiler, smoke detector

Software: antivirus software, MS Windows

Telecom: portable GPS device, cell phone, computer monitors

Game/entertainment: MMO gold farming agent, NPC in video game, pacman player, backgammon player

Service: Stock trading agent, “carebot”

An Example

An Example

- You, as a class, act as a learning agent

An Example

- You, as a class, act as a learning agent
- **Actions:** Wave, Stand, Clap

An Example

- You, as a class, act as a learning agent
- **Actions:** Wave, Stand, Clap
- **Observations:** colors, reward

An Example

- You, as a class, act as a learning agent
- **Actions:** Wave, Stand, Clap
- **Observations:** colors, reward
- **Goal:** Find an optimal *policy*

An Example

- You, as a class, act as a learning agent
- **Actions:** Wave, Stand, Clap
- **Observations:** colors, reward
- **Goal:** Find an optimal *policy*
 - Way of selecting actions that gets you the most reward

How did you do it?

How did you do it?

- What is your policy?
- What does the world look like?

Formalizing My Example

Knowns:

Formalizing My Example

Knowns:

- $\mathcal{O} = \{\text{Blue, Red, Green, Black, } \dots\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{Wave, Clap, Stand\}$

$o_0, a_0, r_0, o_1, a_1, r_1, o_2, \dots$

Formalizing My Example

Knowns:

- $\mathcal{O} = \{\text{Blue, Red, Green, Black, } \dots\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{Wave, Clap, Stand\}$

$$o_0, a_0, r_0, o_1, a_1, r_1, o_2, \dots$$

Unknowns:

Formalizing My Example

Knowns:

- $\mathcal{O} = \{\text{Blue, Red, Green, Black, } \dots\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{\text{Wave, Clap, Stand}\}$

$o_0, a_0, r_0, o_1, a_1, r_1, o_2, \dots$

Unknowns:

- $\mathcal{S} = 4 \times 3$ grid
- $\mathcal{R} : \mathcal{S} \times \mathcal{A} \mapsto \mathbb{R}$
- $\mathcal{P} = \mathcal{S} \mapsto \mathcal{O}$
- $\mathcal{T} : \mathcal{S} \times \mathcal{A} \mapsto \mathcal{S}$

Formalizing My Example

Knowns:

- $\mathcal{O} = \{\text{Blue, Red, Green, Black, } \dots\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{\text{Wave, Clap, Stand}\}$

$$o_0, a_0, r_0, o_1, a_1, r_1, o_2, \dots$$

Unknowns:

- $\mathcal{S} = 4 \times 3$ grid
- $\mathcal{R} : \mathcal{S} \times \mathcal{A} \mapsto \mathbb{R}$
- $\mathcal{P} = \mathcal{S} \mapsto \mathcal{O}$
- $\mathcal{T} : \mathcal{S} \times \mathcal{A} \mapsto \mathcal{S}$

$$o_i = \mathcal{P}(s_i)$$

Formalizing My Example

Knowns:

- $\mathcal{O} = \{\text{Blue, Red, Green, Black, } \dots\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{\text{Wave, Clap, Stand}\}$

$$o_0, a_0, r_0, o_1, a_1, r_1, o_2, \dots$$

Unknowns:

- $\mathcal{S} = 4 \times 3$ grid
- $\mathcal{R} : \mathcal{S} \times \mathcal{A} \mapsto \mathbb{R}$
- $\mathcal{P} = \mathcal{S} \mapsto \mathcal{O}$
- $\mathcal{T} : \mathcal{S} \times \mathcal{A} \mapsto \mathcal{S}$

$$o_i = \mathcal{P}(s_i)$$

$$r_i = \mathcal{R}(s_i, a_i)$$

Formalizing My Example

Knowns:

- $\mathcal{O} = \{\text{Blue, Red, Green, Black, } \dots\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{\text{Wave, Clap, Stand}\}$

$$o_0, a_0, r_0, o_1, a_1, r_1, o_2, \dots$$

Unknowns:

- $\mathcal{S} = 4 \times 3$ grid
- $\mathcal{R} : \mathcal{S} \times \mathcal{A} \mapsto \mathbb{R}$
- $\mathcal{P} = \mathcal{S} \mapsto \mathcal{O}$
- $\mathcal{T} : \mathcal{S} \times \mathcal{A} \mapsto \mathcal{S}$

$$o_i = \mathcal{P}(s_i)$$

$$r_i = \mathcal{R}(s_i, a_i)$$

$$s_{i+1} = \mathcal{T}(s_i, a_i)$$