Good Afternoon, Colleagues

Are there any questions?
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Logistics

- First assignment: how did it go?
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- Next soccer assignment: score a goal and passing
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  - Help each other with C issues – parsing strings
Logistics

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  - Evaluating mostly on the logic – does the agent “do the right thing?”
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• Next soccer assignment: score a goal and passing
  – Help each other with C issues – parsing strings
  – Evaluating mostly on the logic – does the agent “do the right thing?”

• 2D or 3D?
Self-Introductions

• Speak loudly
Self-Introductions

- Speak loudly
- Name, year, major
Self-Introductions

- Speak loudly
- Name, year, major
- At least one other thing about yourself
Discussion

An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to affect what it senses in the future.

• Is this a good definition?

• The authors claim is is a “formal” definition of agents. Is it?
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• Can you do better?
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• Is this a good definition?

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• Can you do better?

• Do they need to be social? persistent?

• Can they cease to be agents in a different environment?

• Autonomy
Varieties of Autonomy

• Do we have complete freedom over our beliefs, goals, and actions?
Varieties of Autonomy

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- Software service has no autonomy — does what it’s told.
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  - Decide how to act so as to accomplish delegated goals
Varieties of Autonomy

- Do we have complete freedom over our beliefs, goals, and actions?
- Software service has no autonomy — does what it’s told.
- What’s Wooldridge’s take on where autonomous agents lie on the spectrum?
  - Decide how to act so as to accomplish delegated goals
- Also mentions adjustable autonomy
My Requirements of Agents

• They must **sense** their environment.

• They must **decide** what action to take (“think”).

• They must **act** in their environment.
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**Complete Agents**
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**Multiagent systems:** Interact with other agents
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**Multiagent systems:** Interact with other agents

**Learning agents:** Improve performance from experience
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**Complete Agents**

**Multiagent systems:** Interact with other agents

**Learning agents:** Improve performance from experience

Box:

- Autonomous Bidding
- Cognitive Systems
- Traffic management
- **Robot Soccer**
Environments

Environment $\rightarrow$ sensations, actions
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- fully observable vs. partially observable (accessible)
Environments

Environment $\rightarrow$ sensations, actions

- fully observable vs. partially observable (accessible)
- deterministic vs. non-deterministic
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- fully observable vs. partially observable (accessible)
- deterministic vs. non-deterministic
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Environment $\mapsto$ sensations, actions

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- deterministic vs. non-deterministic
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- discrete vs. continuous
- single-agent vs. multiagent
The Decision
The Decision

• reactive vs. deliberative
The Decision

- reactive vs. deliberative
- multiagent reasoning?
The Decision

- reactive vs. deliberative
- multiagent reasoning?
- learning?
Formalizing My Example

Knobs:

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

Unknowns:

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

\[ o_i = P(s_i) \quad r_i = R(s_i, a_i) \quad s_{i+1} = T(s_i, a_i) \]
Standard/Reactive/State-based Agents

- Observation $P$, Action $A$, Internal State $I$
Standard/Reactive/State-based Agents

- Observation $P$, Action $A$, Internal State $I$

- Standard agent:
Standard/Reactive/State-based Agents

- Observation $P$, Action $A$, Internal State $I$

- Standard agent: $\text{action} : P^* \mapsto A$
Standard/Reactive/State-based Agents

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- Standard agent: $action : P^* \mapsto A$

- Reactive agent:
Standard/Reactive/State-based Agents

- Observation $P$, Action $A$, Internal State $I$

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- Standard agent: $\text{action} : P^* \mapsto A$

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  - Decision based entirely on the present
Standard/Reactive/State-based Agents

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- Standard agent: \( \text{action} : \mathcal{P}^* \mapsto A \)

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- State-based agent:
Standard/Reactive/State-based Agents

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- State-based agent: $\text{action} : I \mapsto A$, $\text{next} : I \times P \mapsto I$
Standard/Reactive/State-based Agents

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- Standard agent: $action : P^* \mapsto A$

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It is worth observing that state-based agents as defined here are in fact no more powerful than the standard agents we introduced earlier. In fact, they are \textit{identical} in their expressive power.
Standard/Reactive/State-based Agents

- Observation $P$, Action $A$, Internal State $I$

- Standard agent: $\text{action} : \mathcal{P}^* \mapsto \mathcal{A}$

- Reactive agent: $\text{action} : \mathcal{P} \mapsto \mathcal{A}$
  - Decision based entirely on the present

- State-based agent: $\text{action} : \mathcal{I} \mapsto \mathcal{A}$, $\text{next} : \mathcal{I} \times \mathcal{P} \mapsto \mathcal{I}$

It is worth observing that state-based agents as defined here are in fact no more powerful than the standard agents we introduced earlier. In fact, they are identical in their expressive power.
Reactive agents for next Thursday’s assignment task?
Discussion

What are some tasks that are partially observable, non-deterministic, dynamic, continuous, and multi-agent?

Can we possibly expect an agent to perform well in such tasks?