UMaine COS 470/570: Introduction to AI

Admin What is Al? Overview Applications Agents Agent structure Agent types

Where are we going?

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Admin stuff

- Syllabus
- Slack
- Lisp "review"

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What is AI?

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What is AI?

What do you think AI is?

Where are we

Agent types going?

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1. Getting computers to do intelligent things

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- 1. Getting computers to do intelligent things
- 2. Doing the *right* thing: being rational



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- 1. Getting computers to do *intelligent* things
- 2. Doing the *right* thing: being rational
- 3. Doing things that are easy for animals/humans, but hard for computers



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- 1. Getting computers to do *intelligent* things
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- Doing things that are easy for animals/humans, but hard for computers
- 4. Doing computationally-hard things quickly

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- 5. Creating truly intelligent artifacts (but what is intelligence?)

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- 1. Getting computers to do *intelligent* things
- 2. Doing the *right* thing: being rational
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- 4. Doing computationally-hard things quickly
- 5. Creating truly intelligent artifacts (but what is intelligence?)

So which of these is correct?

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A quick history

17 th century	Automata
19 th century	Analytical engine & Ada Lovelace (late 19 th century)
1940s	Turing, von Neumann, Shannon, Post, McCul- loch & Pitts + Rosenblatt (1940s)
1956	Dartmouth Conference: McCarthy, Minsky,
	Shannon (org.); Newell, Simon,
1960s	General problem solving ("weak") methods
1970s (early)	AI winter
1970s (late)	Expert systems, knowledge-based systems ("strong" methods)
1980s	PDP, multilayer NNets
	Machine learning, case-based reasoning
	Partial-order planning, planning + acting
	Bayesian networks
	Multiagent systems (MAS)

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> Artificial Intelligence

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A quick history

1989	LeCun's "deep" NNet (MNIST, 8 layers, 3 days to train)
1990	DARPA's DART
	Deep Blue beats Kasparov
	Data mining
	Fast planning (forward planning)
	Empirical AI
	LSMM nets
2000s	Big data
	"Deep Learning"
2010s	Explosion of DL: image recog, drug disc, NLP, self-
	driving cars,
2011	Watson on <i>Jeopardy</i>
2016	Google/DeepMind's AlphaGo
2018	AlphaZero

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Spin-offs/Contributions of AI

Expert systems Robotics Spam filters GUIs Linked-lists Symbolic programming Functional programming Computer vision Speech recognition Interpreters Rapid development env. Garbage collection Symbolic mathematics OOP Admin What is AI? Overview Applications Agents Agent structure Agent types Where are we going?



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Related to

CS Linguistics Genetics Ecology Psychology Philosophy Org. behavior Physics Neuroscience Economics Complex systems Admin

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Al landscape



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Applications

- Financial: loan applications, check recognition, trading
- Medicine: diagnosis; drug discovery (Atomwise: Ebola, Pfizer+Watson: immuno-oncology); Watson for cancer pt. Q&A, screening; remote patient monitoring; robotic surgery (2006)
- Scheduling: Factory, DART, Hubble, shuttle, Mars rovers
- Control: AUVs, UAVs (drones), space vehicles, autonomous cars, Roombas
- GPS/directions
- Images: recognition, handwriting, image labeling/search, face recognition,

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Applications

- Interaction: NLP, machine translation, chatbots, Twitterbots (e.g., @DeepDrumpf), assistants (Siri, Alexa, Google)
- Data mining/search: Google, Bing, ...
- Games: Chess, checkers, Go, NPC in video games, Aibo (etc.)
- Security: Dark Trace, ARMOR @ LAX, Sift (online fraud)
- Arts: poetry, art, novels, DeepDream, GANs for paintings
- Misc: Forkable (predicts what you want to eat, delivers), Nova (sales letters), clickbait generator

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Examples: Poetry

there is no one else in the world. there is no one else in sight. they were the only ones who mattered. they were the only ones left. he had to be with me. she had to be with him. i had to do this. i wanted to kill him. i started to cry. i turned to him.



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Portrait of Edmond Belamy. 2018, created by GAN (Generative Adversarial Network). Sold for \$432,500 on 25 October at Christie's in New York. Image @ Obvious

Examples: Novel writing

 Novel writing: pass first round of judging in Japanese short-form novel competition



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Examples: Movies

- Characters (e.g., LoTR)
- Watson created the Morgan trailer needed some cleanup, but 24 hrs rather than 10–30 days

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Examples: Deep Drumpf





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AGENTS

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Agents

- Helpful way to think about AI systems
- Agent: receives *percept*, makes decision, takes action
- Encapsulates *behavior*, not just methods (cf. OOP)

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Agent properties

- Responsive
- Proactive
- Rational
 - Utility maximizer
 - Expected utility
 - Ideal vs. bounded rationality
- Autonomous
- Social

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Agent structure

- Input = percepts
- Outputs via effectors
- Agent program

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Issues

- What are the percepts?
- What effectors are available?
- What are agent's goals?
- What environment will it be in?
- What's the best architecture



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Issues

- What are the percepts?
- What effectors are available?
- What are agent's goals?
- What environment will it be in?
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Generic agent

function SKELETON-AGENT(percept) returns action
 static: memory, the agent's memory of the world

 $memory \leftarrow$ UPDATE-MEMORY(memory, percept) $action \leftarrow$ CHOOSE-BEST-ACTION(memory) $memory \leftarrow$ UPDATE-MEMORY(memory, action) **return** action Admin

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Reflex agent



function SIMPLE-REFLEX-AGENT(percept) returns action static: rules, a set of condition-action rules

```
state \leftarrow INTERPRET-INPUT( percept)

rule \leftarrow RULE-MATCH(state, rules)

action \leftarrow RULE-ACTION[rule]

return action
```

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Model-based agents



 $action \leftarrow \text{Rule-Action}(rule)$

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Intelligence

Goal-based/goal-directed agents





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Utility-based agents





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Learning agents





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Where are we going?

Al techniques organized around questions from standpoint of agent:

- How can I achieve my goals?
- How can I "think"?
- How can I learn to understand input?
- How can I use knowledge about the world?
- How can I deal with uncertainty?
- How can I understand complex, realistic input?
- How do I take action?
- Can I be creative?
- How can I work effectively in a group?

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