

CAP 6635 – Artificial Intelligence

Lecture 6: Foundations of AI (Part 1)



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College of Business



@ProfessorOge



ProfessorOgeMarques

What is artificial intelligence?

Defining artificial intelligence isn't just difficult; it's impossible, not the least because we don't really understand human intelligence.

Intelligence?

Artificial
intelligence is
hard to
define...

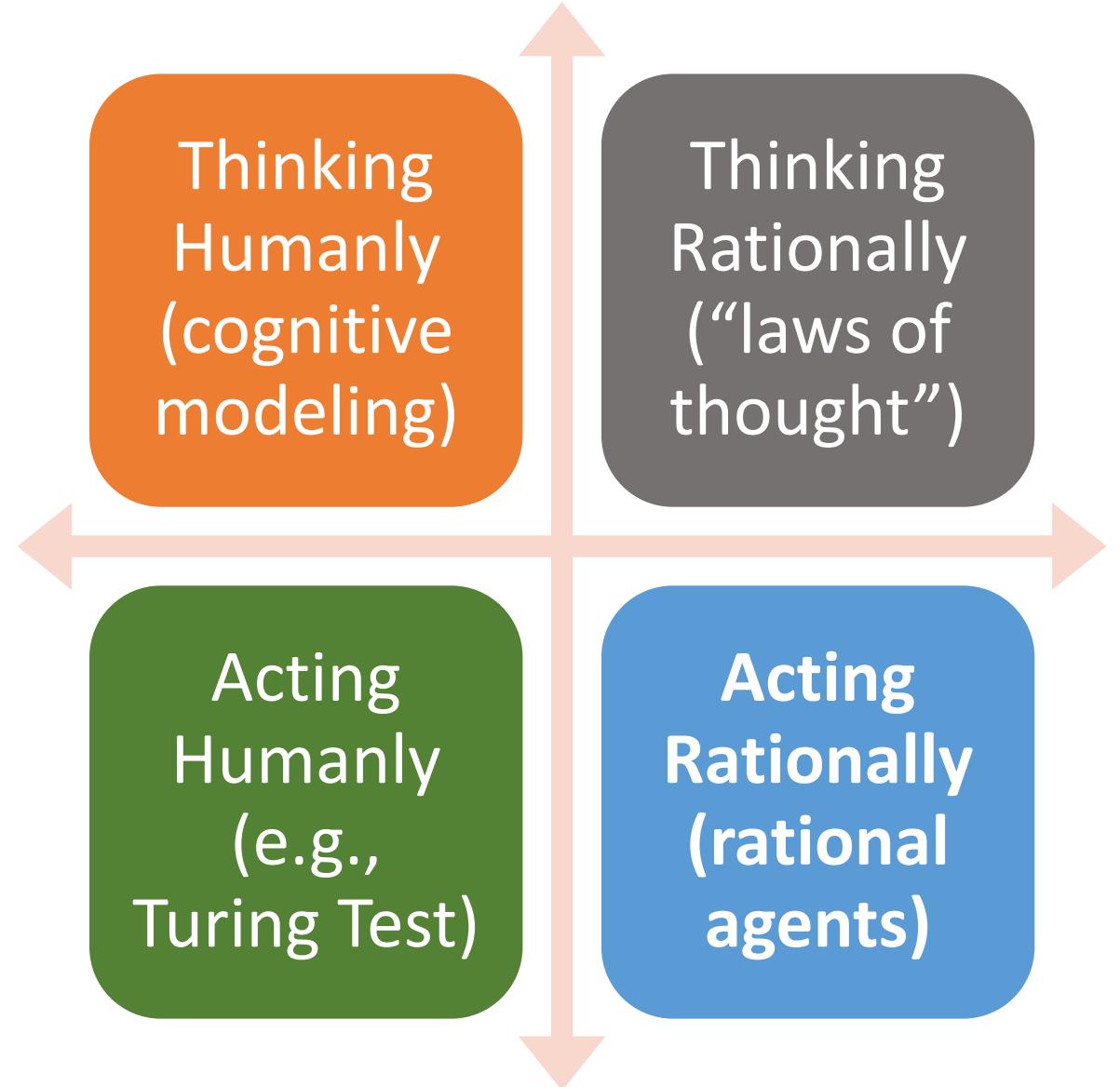
Merriam-Webster:

- a branch of computer science dealing with the simulation of intelligent behavior in computers
- the capability of a machine to imitate intelligent human behavior

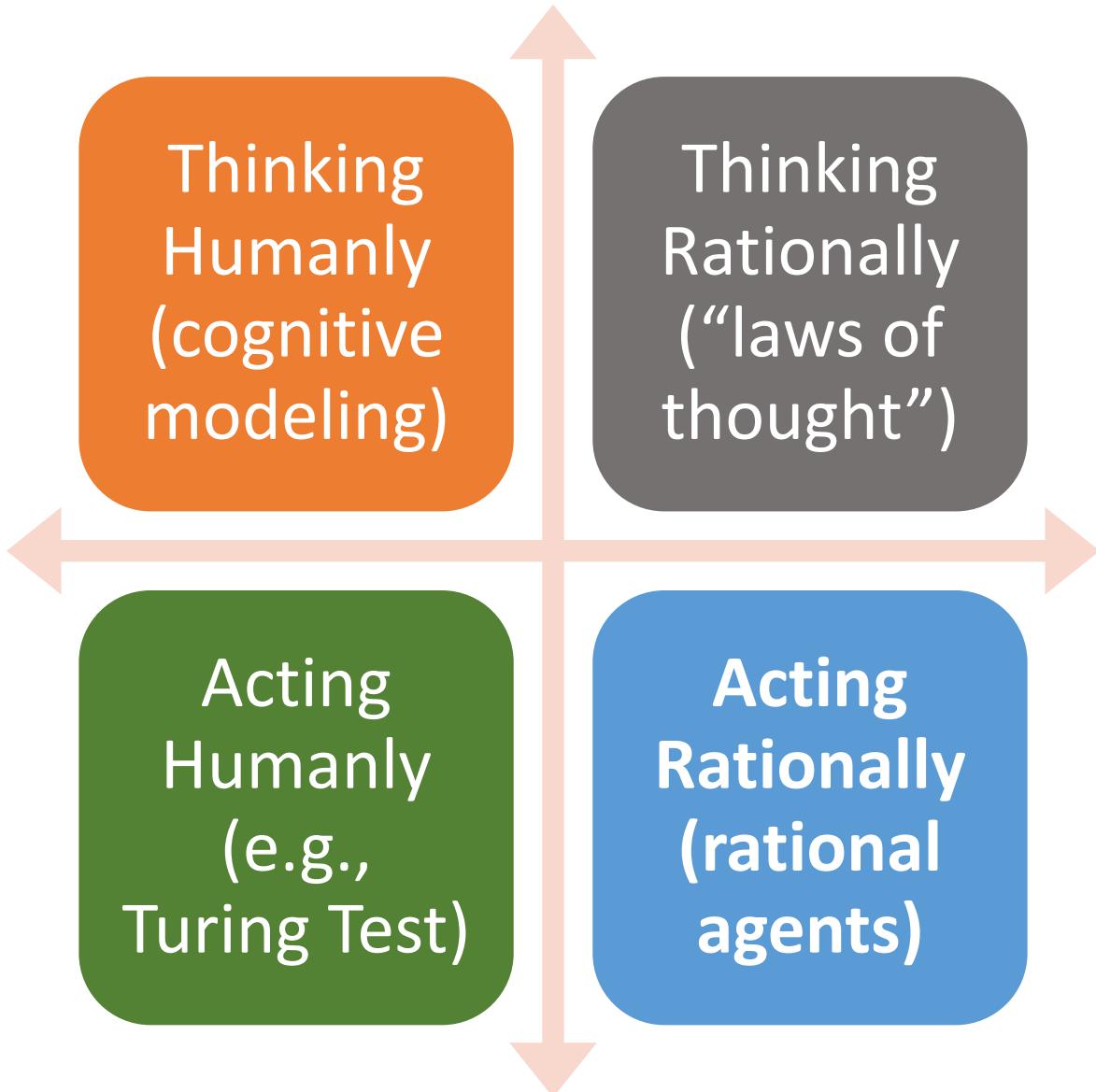
Encyclopedia Britannica:

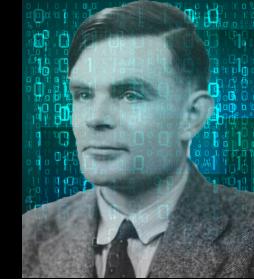
- the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings

Artificial Intelligence definitions: categories



The problems with some (groups of) definitions





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Computer AI passes Turing test in 'world first'

🕒 9 June 2014



THE ARENA FOR ACCOUNTABLE PREDICTIONS

The purpose of Long Bets is to improve long-term thinking. Long Bets is a public arena for enjoyably competitive predictions, of interest to society, with philanthropic money at stake. [The Long Now Foundation](#) furnishes the continuity to see even the longest bets through to public resolution. This website provides a forum for discussion about what may be learned from the bets and their eventual outcomes. [MORE »](#)

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BET 1

DURATION 27 years (02002-02029)

“By 2029 no computer - or "machine intelligence" - will have passed the Turing Test.” [DETAILED TERMS »](#)

PREDICTOR
[Mitchell Kapor](#)

STAKES \$20,000

will go to *The Electronic Frontier Foundation* if Kapor wins,
or *The Kurzweil Foundation* if Kurzweil wins.

CHALLENGER
[Ray Kurzweil](#)

Towards a Conversational Agent that Can Chat About... Anything

Tuesday, January 28, 2020

Towards a Human-like Open-Domain Chatbot

Daniel Adiwardana Minh-Thang Luong David R. So Jamie Hall
Noah Fiedel Romal Thoppilan Zi Yang Apoorv Kulshreshtha
Gaurav Nemade Yifeng Lu Quoc V. Le

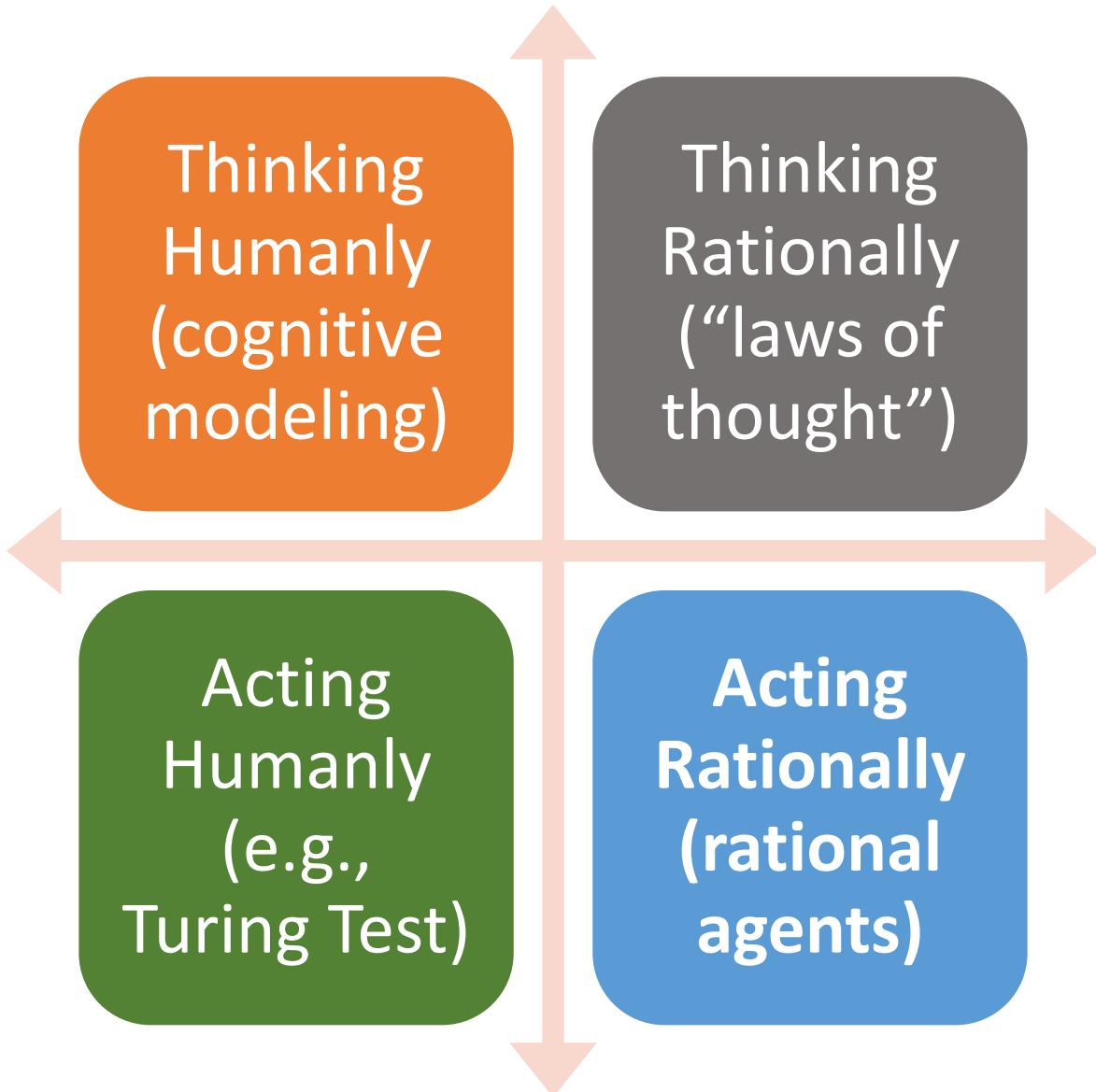
Google Research, Brain Team

{adiwardana,thangluong,davidso,jamiehall,nfiedel,romzee,ziy,
apoorvk,gnemade,yifenglu,qvl}@google.com

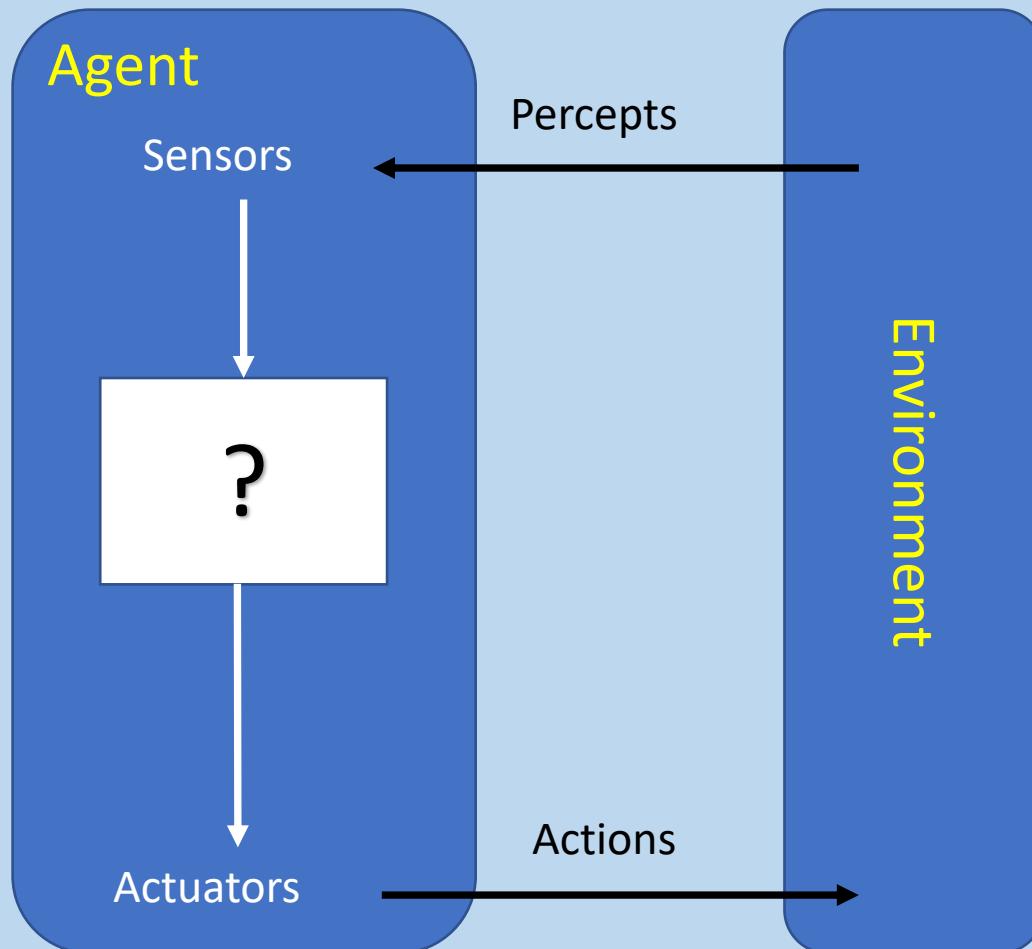
<https://www.youtube.com/watch?v=STrrILG15OY>



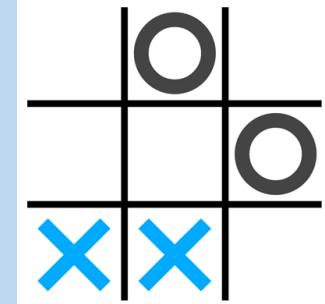
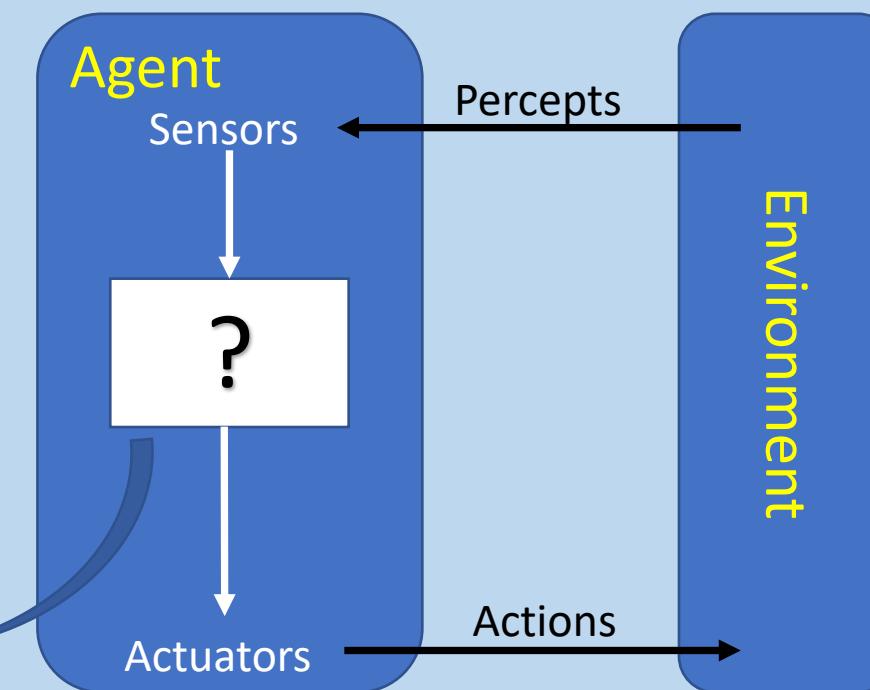
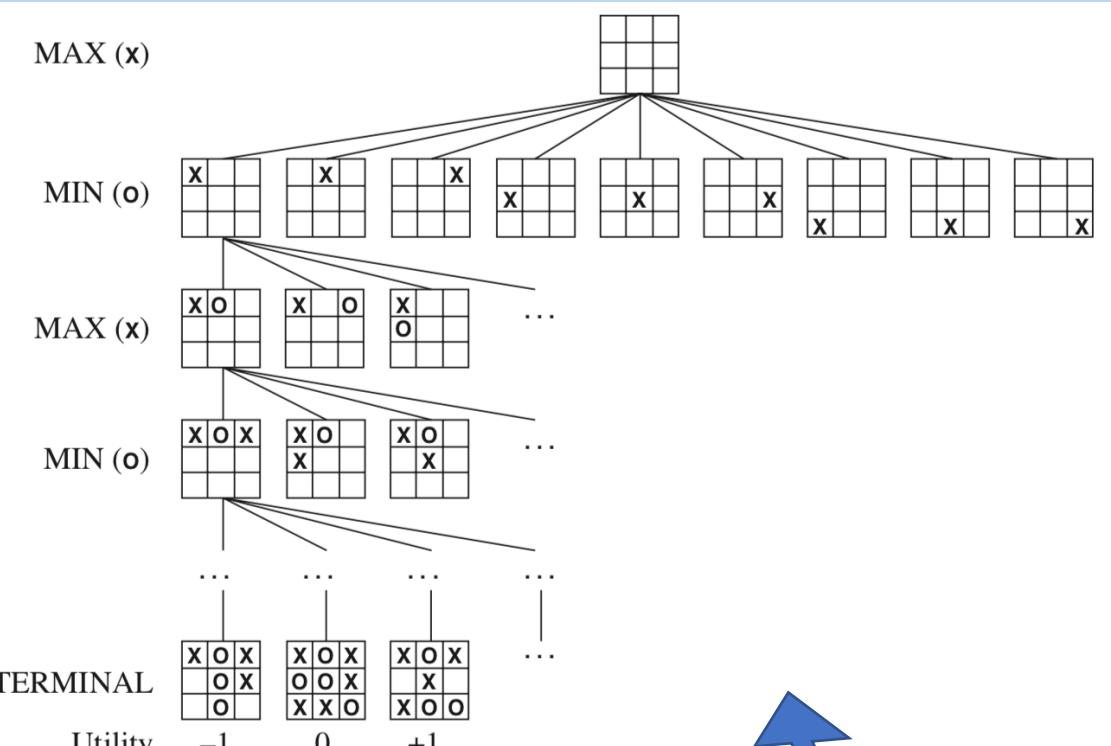
The problems with some (groups of) definitions



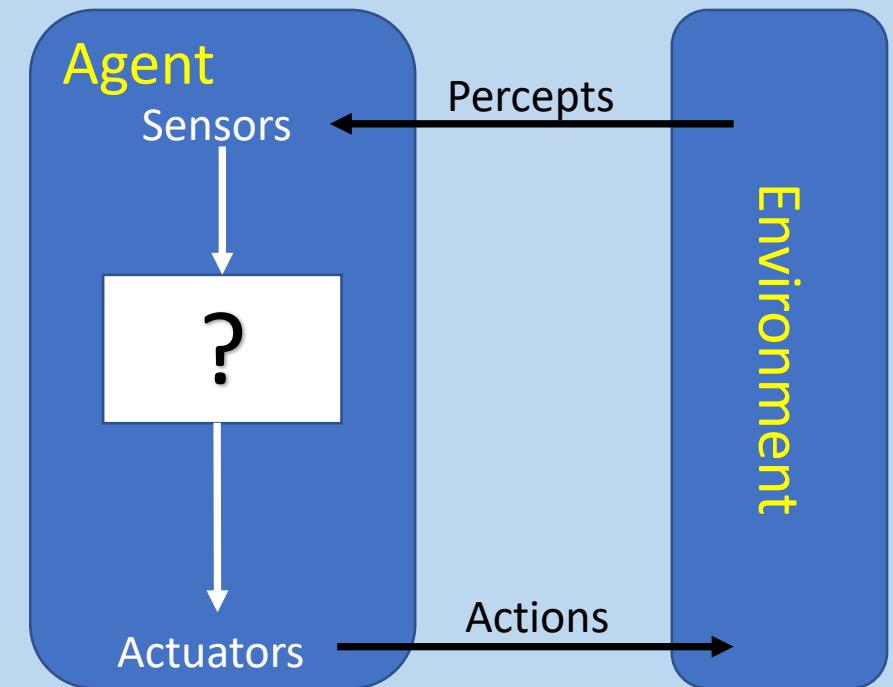
Agents and environment



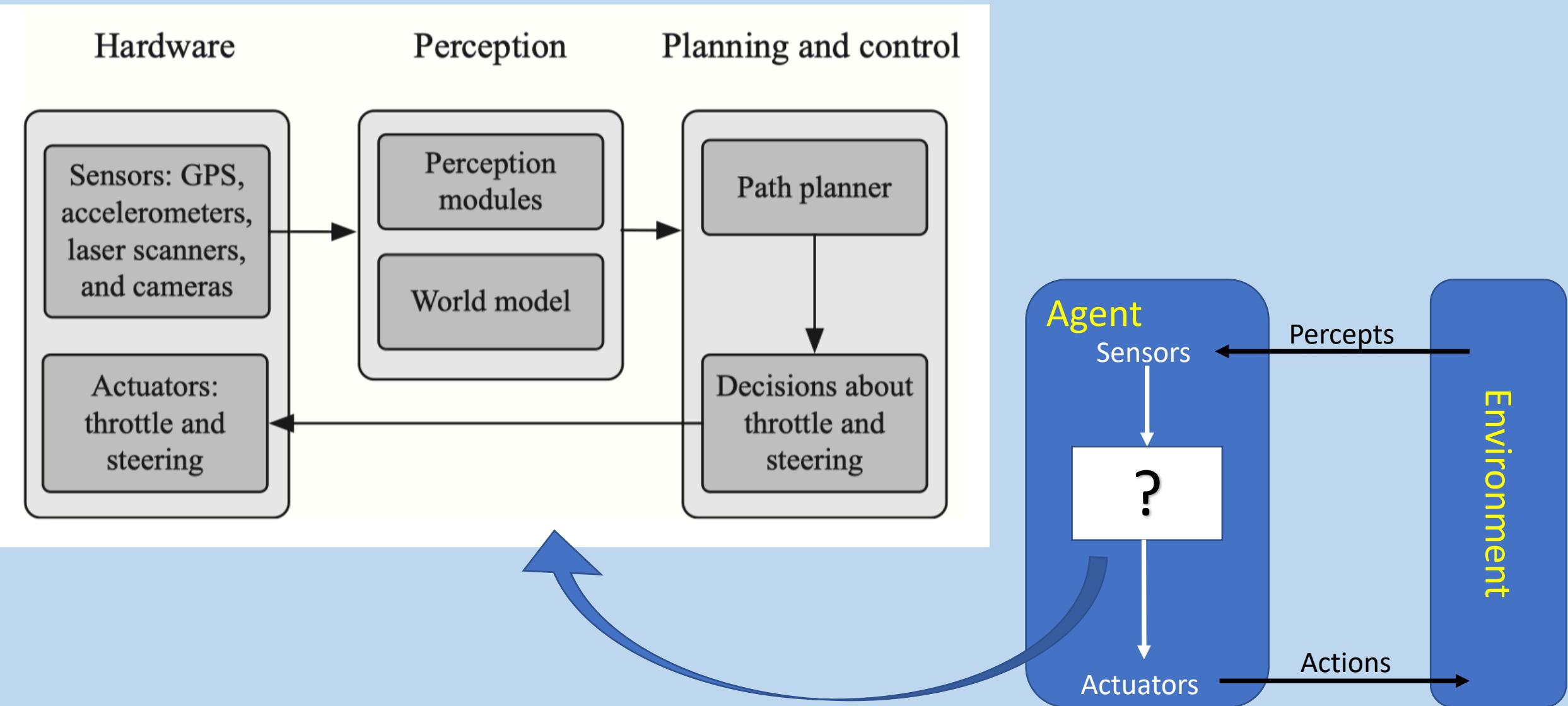
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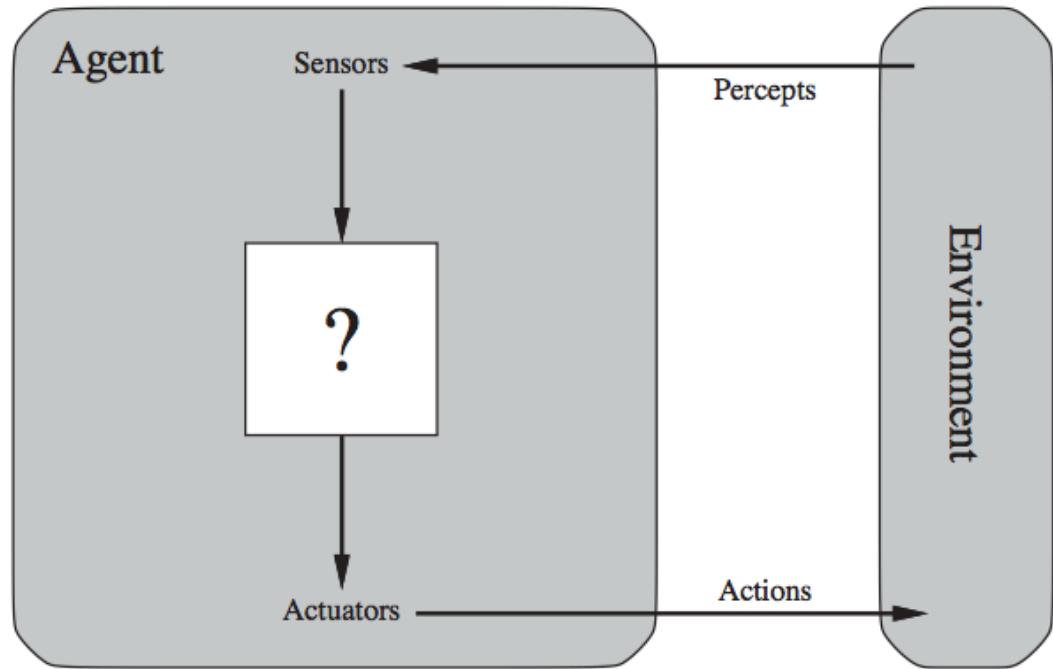
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Agents and environment



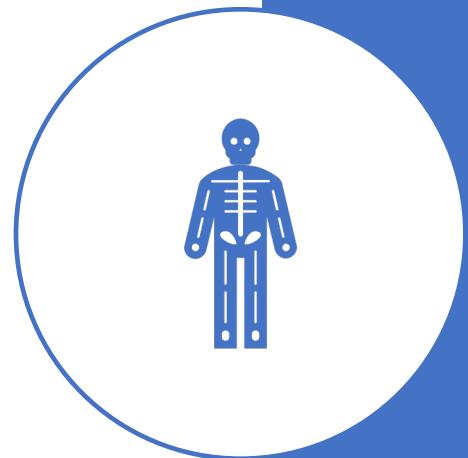
Agents



- An agent is *anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators*
- Human agent:
 - eyes, ears, and other organs for sensors;
 - hands, legs, mouth, and other body parts for actuators
- Robotic agent:
 - cameras and infrared range finders for sensors;
 - various motors for actuators

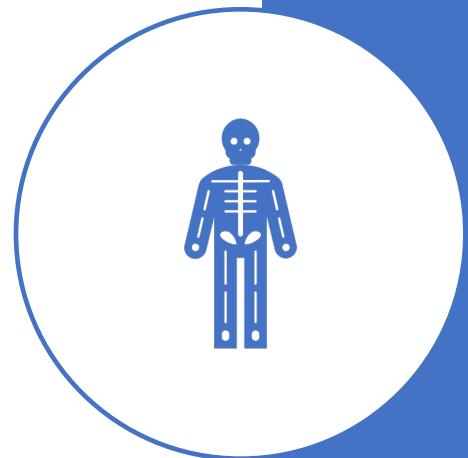
Rational agents

- For each possible percept sequence, a rational agent should:
 - select an action that is expected to maximize its performance measure,
 - based on the evidence provided by the percept sequence and
 - whatever built-in knowledge the agent has.



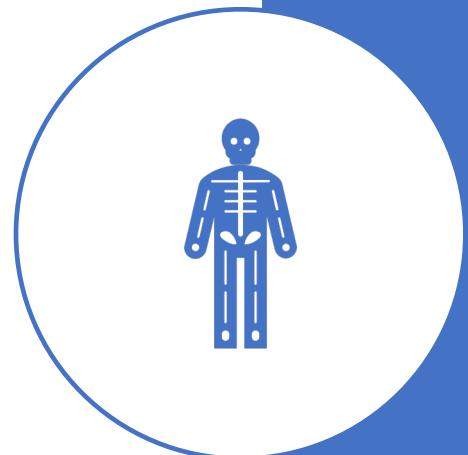
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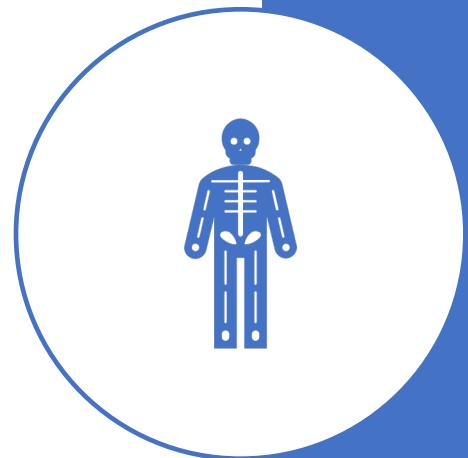
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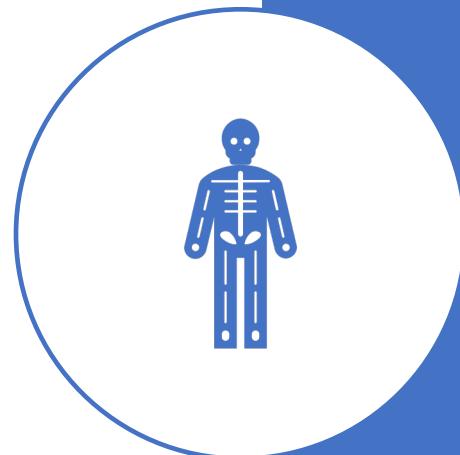
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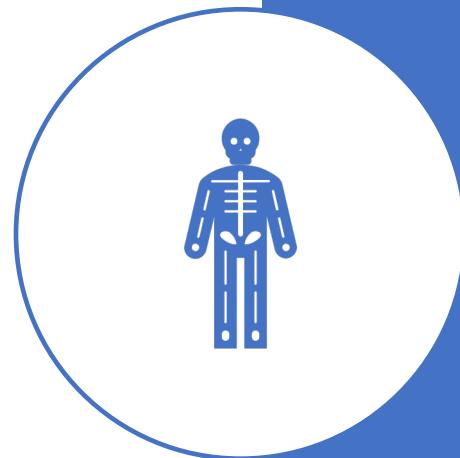
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PEAS:

Performance measure, Environment, Actuators, Sensors

Agent Type	Performance Measure	Environment	Actuators	Sensors
Robot soccer player	Winning game, goals for/against	Field, ball, own team, other team, own body	Devices (e.g., legs) for locomotion and kicking	Camera, touch sensors, accelerometers, orientation sensors, wheel/joint encoders
Internet book-shopping agent	Obtain requested/interesting books, minimize expenditure	Internet	Follow link, enter/submit data in fields, display to user	Web pages, user requests
Autonomous Mars rover	Terrain explored and reported, samples gathered and analyzed	Launch vehicle, lander, Mars	Wheels/legs, sample collection device, analysis devices, radio transmitter	Camera, touch sensors, accelerometers, orientation sensors, , wheel/joint encoders, radio receiver

Environment types

- **Fully observable** (vs. partially observable): An agent's sensors give it access to the complete state of the environment at each point in time.
- **Deterministic** (vs. stochastic): The next state of the environment is completely determined by the current state and the action executed by the agent.
- **Episodic** (vs. sequential): The agent's experience is divided into atomic "episodes" (each episode consists of the agent perceiving and then performing a single action), and the choice of action in each episode depends only on the episode itself.

Environment types

- **Static** (vs. dynamic): The environment is unchanged while an agent is deliberating. (The environment is semi-dynamic if the environment itself does not change with the passage of time, but the agent's performance score does)
- **Discrete** (vs. continuous): A limited number of distinct, clearly defined percepts and actions.
- **Single agent** (vs. multiagent): An agent operating by itself in an environment.

What are the environment types of...

- Tic-tac-toe
 - Chess
 - Go
 - DOTA 2
 - Self-driving vehicles
 - The real world
-
- Fully vs. **partially observable**
 - Deterministic vs. **stochastic**
 - Episodic vs. **sequential**
 - Static vs. **dynamic**
 - Discrete vs. **continuous**
 - Single agent vs. **multiagent**



Agent types
(in order of
increasing
generality)

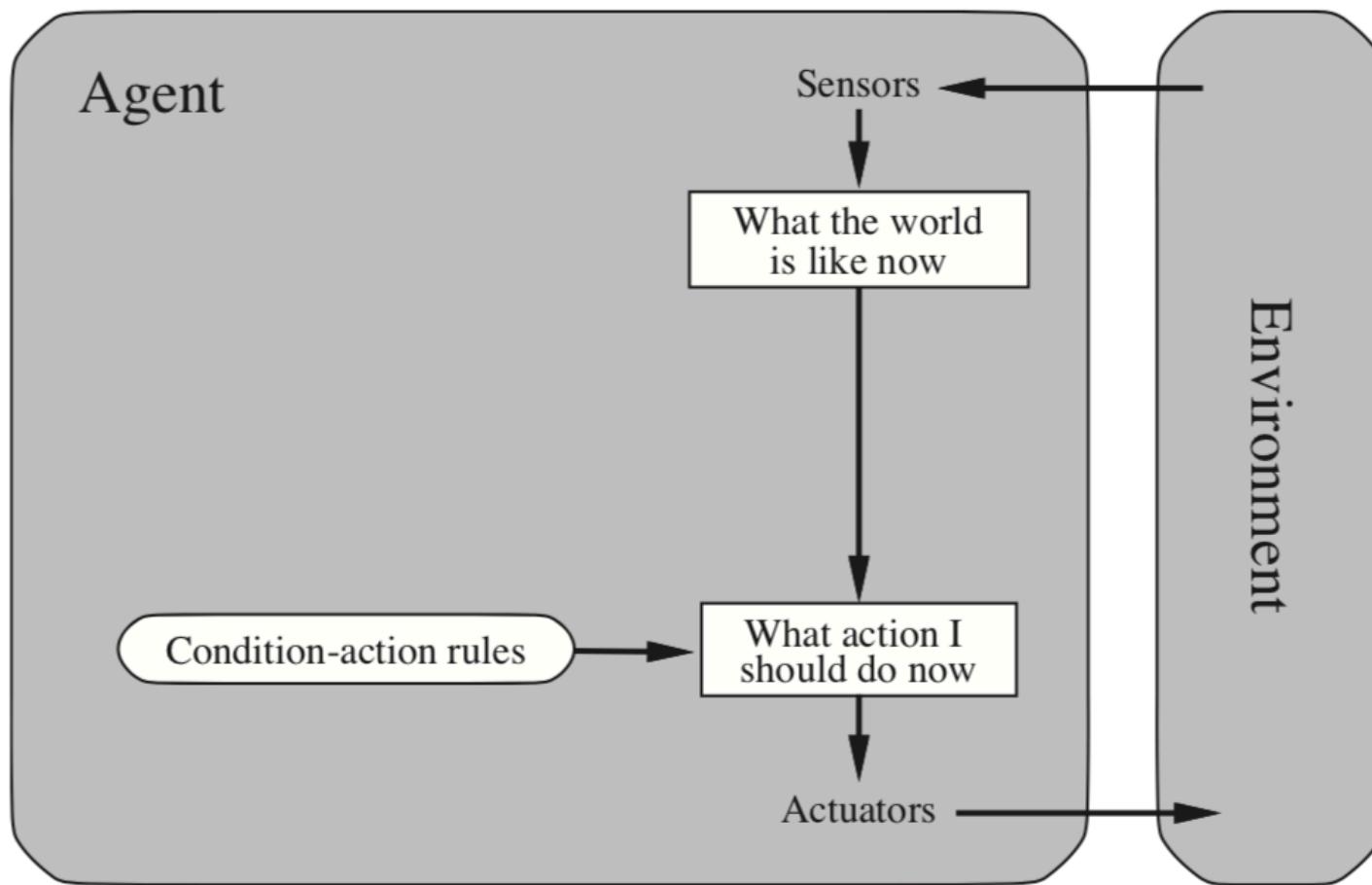
Simple reflex agents

Agents that keep track of the world

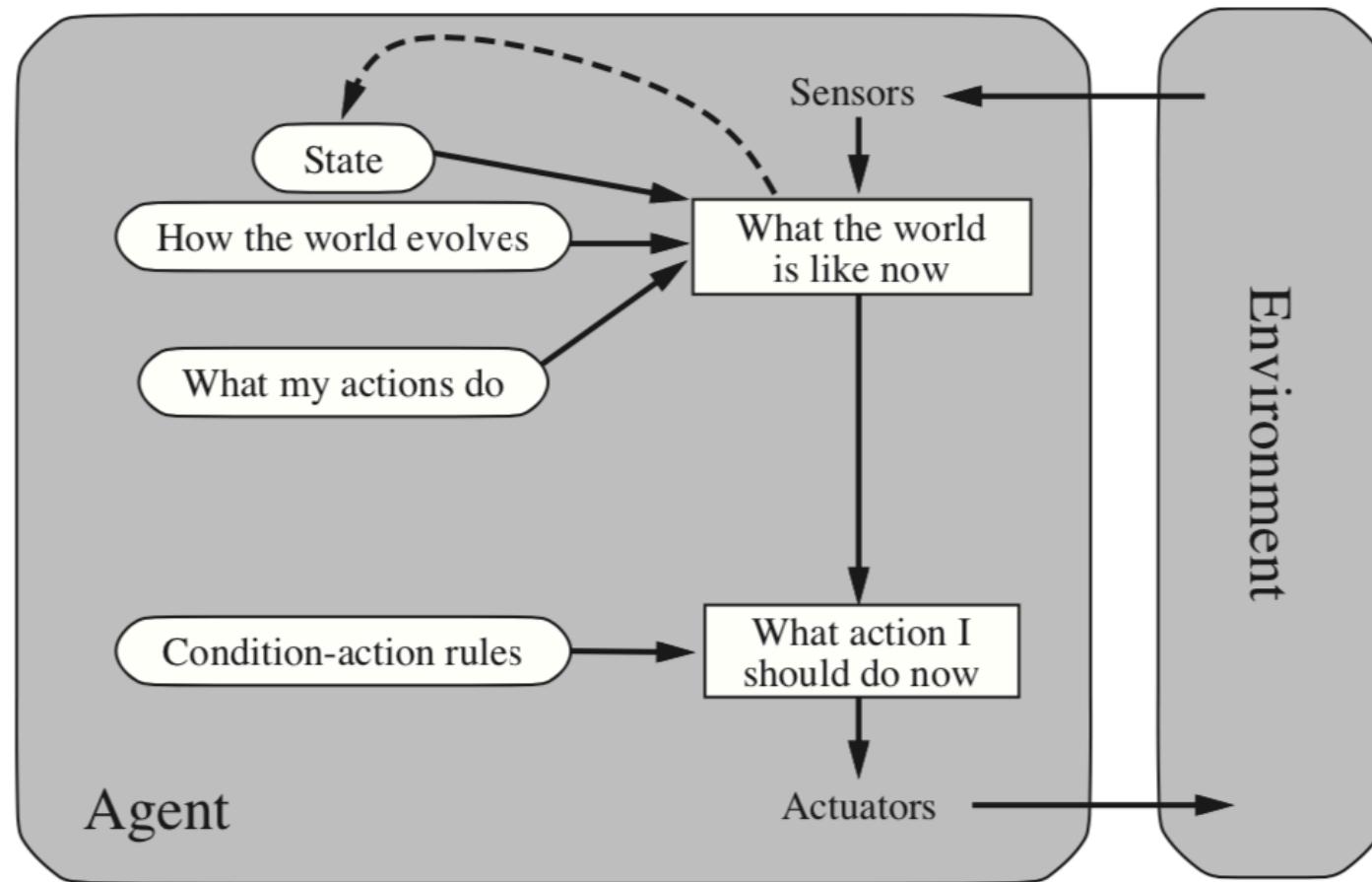
Goal-based agents

Utility-based agents

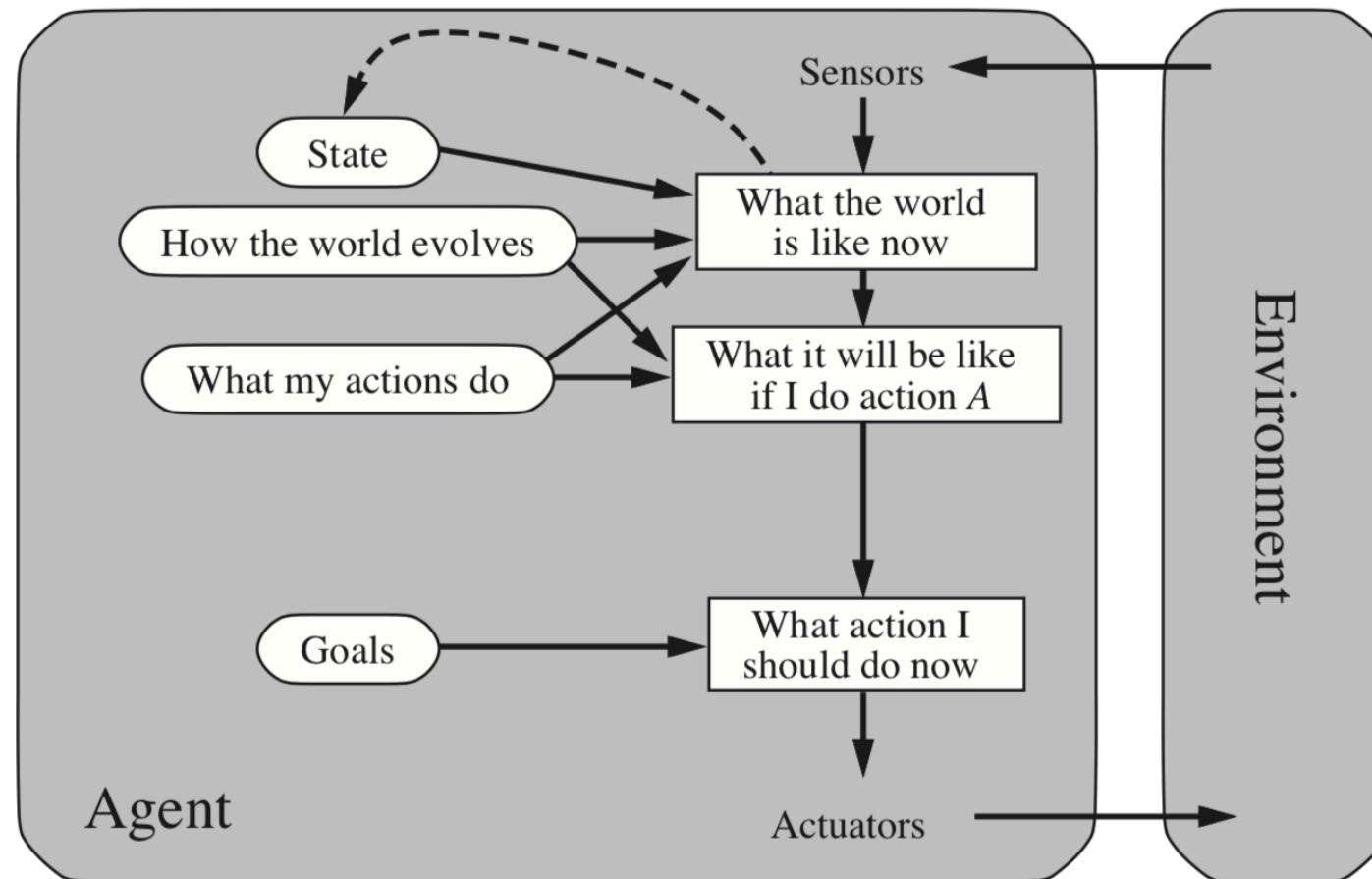
Simple reflex agents



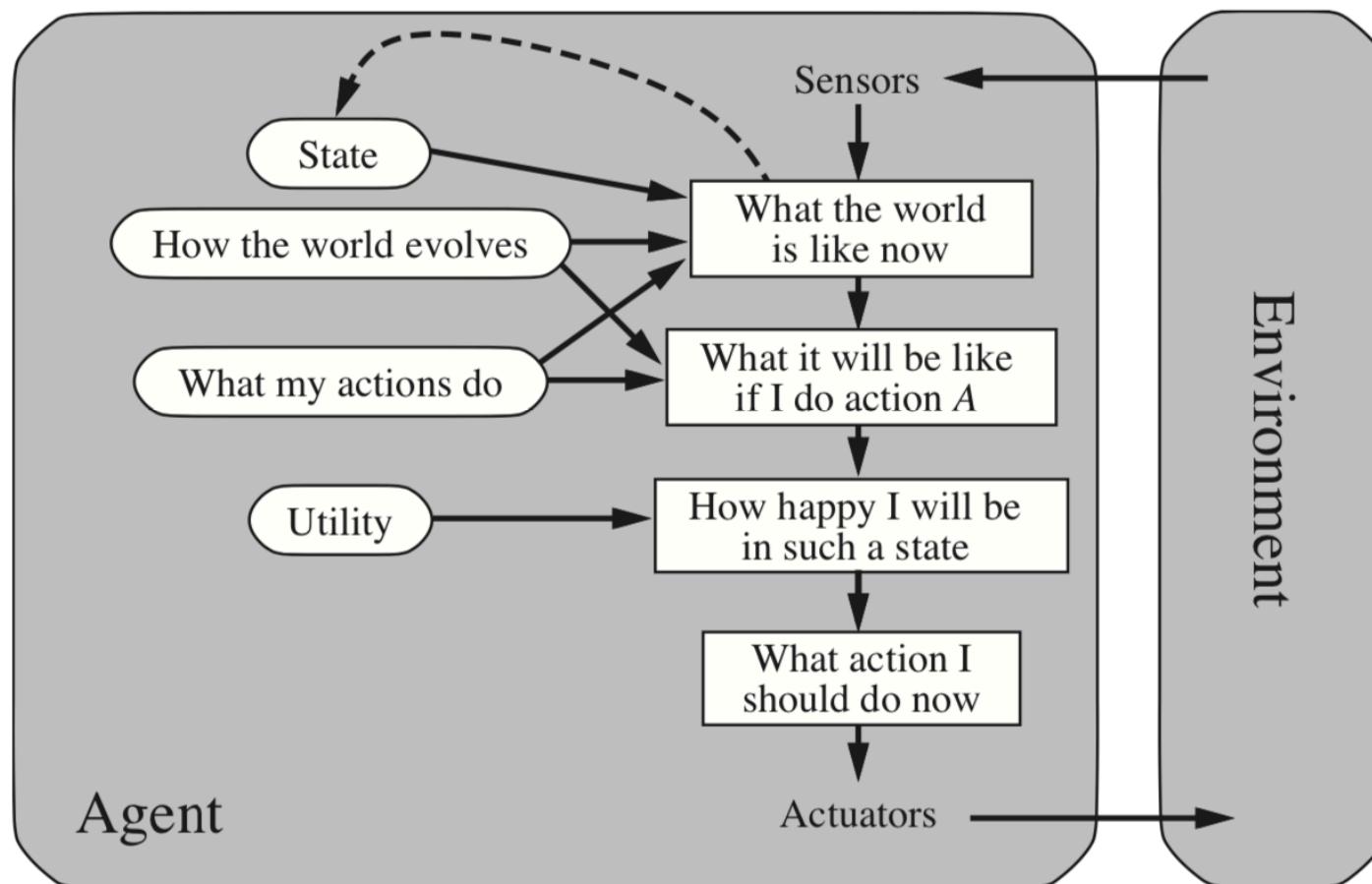
Agents that keep track of the world (Agents with internal states)



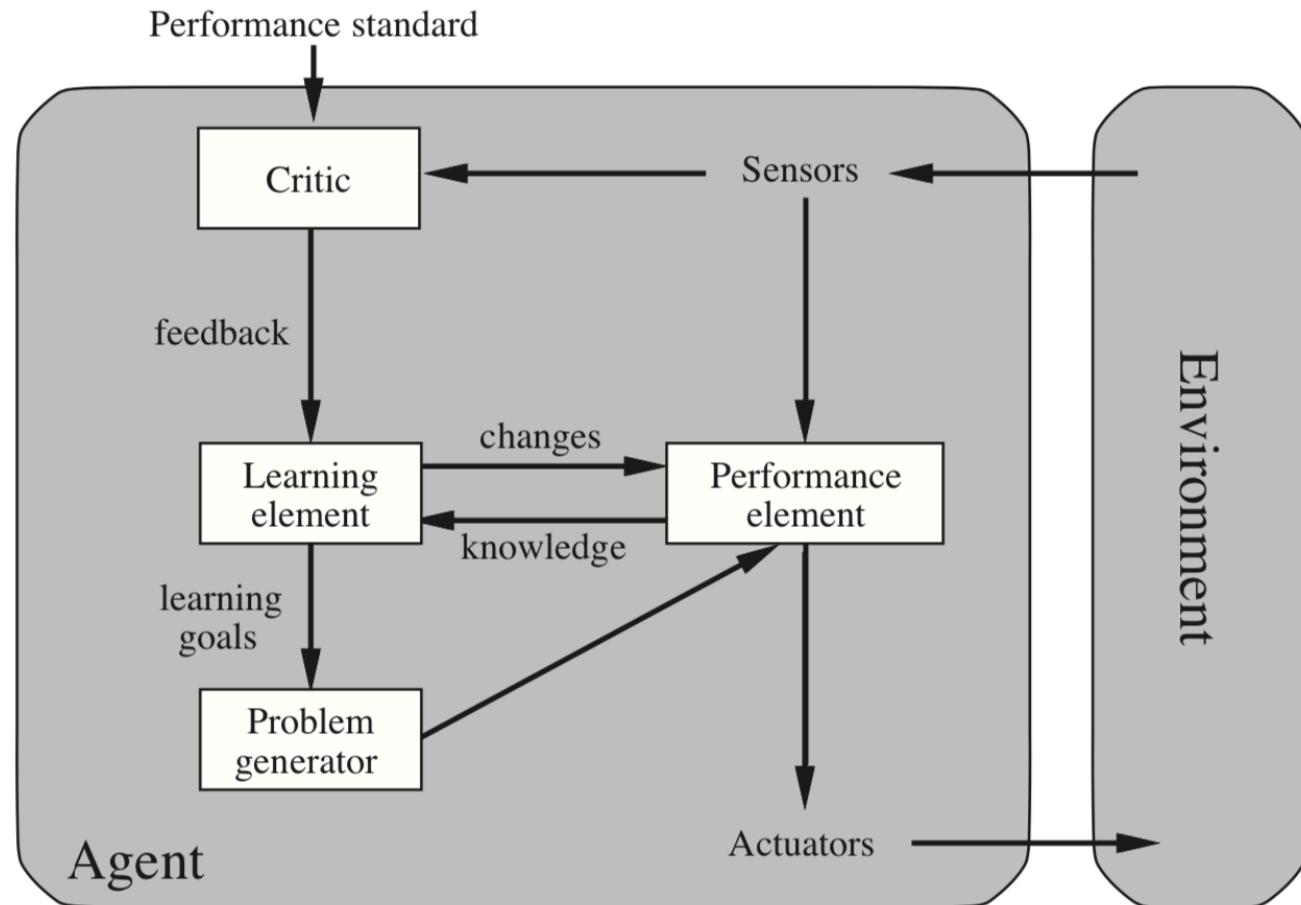
Model-based, goal-based agent



Model-based, utility-based agent



A general learning agent





Dimensions of AI

- **Strength** (how intelligent is it?)
- **Breadth** (does it solve a narrowly defined problem, or is it general?)
- **Training** (how does it learn?)
- **Capabilities** (what kinds of problems are we asking it to solve?)
- **Autonomy** (are AIs assistive technologies, or do they act on their own?)



Narrow vs. General AI

- What we have today is mostly **narrow AI**

“You can add narrow AIs ad infinitum, but a pile of narrow intelligences will never add up to a general intelligence.”