

CSE 604

Artificial Intelligence

Chapter 2: Intelligent Agents

Adapted from slides available in Russell & Norvig's textbook webpage

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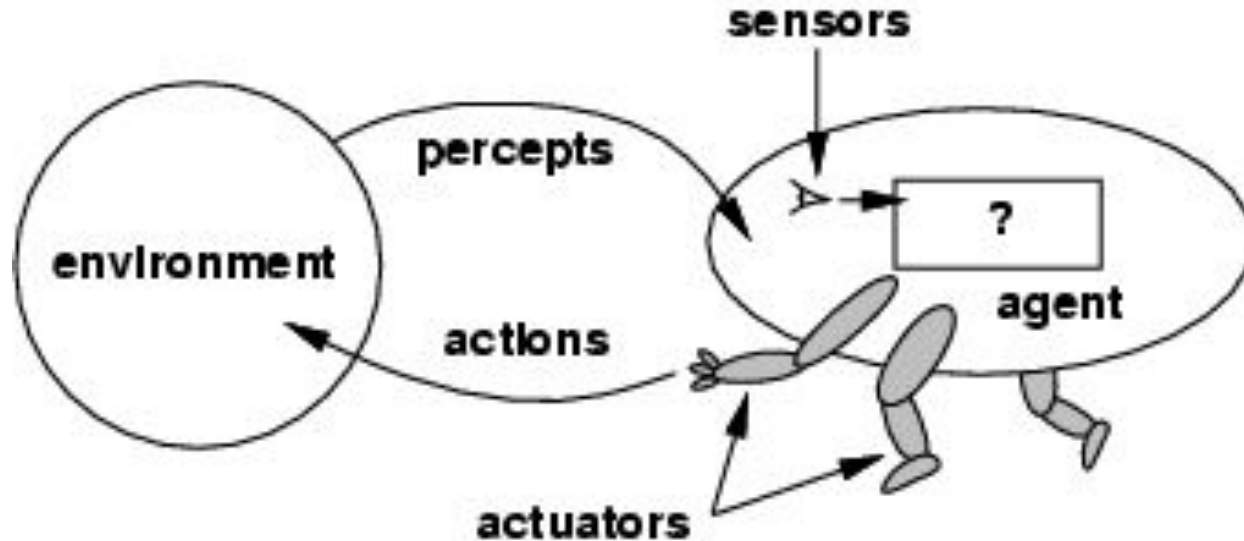


Outline

- Agents and environments
- Rationality
- PEAS (Performance measure, Environment, Actuators, Sensors)
- Environment types
- Agent types

Agents

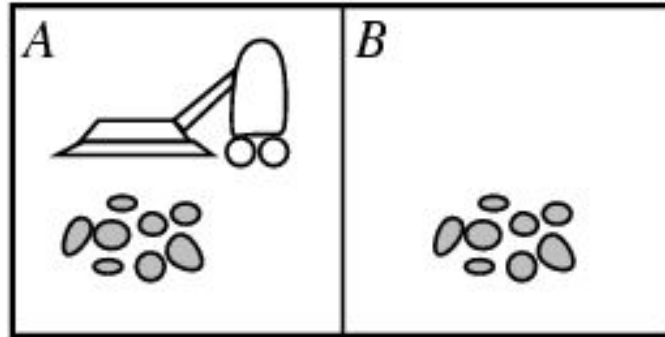
- An **agent** is anything that can be viewed as **perceiving** its environment through sensors and **acting** upon that environment through actuators



Examples of Agents

- **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
- **Software agent:** receives keystrokes, file contents, network packets as sensory inputs; acts by displaying on screen, writing files etc.

Vacuum-cleaner world



- **Percepts:** location and contents, e.g., [A, Dirty]
- **Actions:** *Left, Right, Suck, NoOp*

Rational Agent

- A rational agent chooses whichever action maximizes the expected value of the performance measure given the percept sequence to date
- Rational \neq omniscient Omniscient (all-knowing)
 - percepts may not supply all relevant information
- Rational \neq clairvoyant Clairvoyant (can't see the future)
 - action outcomes may not be as expected
- Hence, rational \neq successful
- Rational \Rightarrow exploration, learning, autonomy

Rational agents

- An agent should strive to "do the right thing", based on what it can perceive and the actions it can perform.
- **Performance measure:** An objective criterion for success of an agent's behavior
- E.g., performance measure of a vacuum-cleaner agent could be :
 - amount of dirt cleaned up
 - amount of time taken
 - amount of electricity consumed

PEAS

- Specifying the task environment:
 - **P**erformance measure
 - **E**nvironment
 - **A**ctuators
 - **S**ensors

PEAS

- Agent: **Part-picking robot**
 - **Performance measure:** % of parts in correct bins
 - **Environment:** Conveyor belt, parts, bins
 - **Actuators:** Jointed arm and hand
 - **Sensors:** Camera, joint angle sensors



PEAS

- Agent: **Automated car**
 - **Performance measure:** Safe, fast, legal, comfortable trip
 - **Environment:** Roads, other traffic, pedestrians
 - **Actuators:** Steering wheel, accelerator, brake
 - **Sensors:** Camera, GPS, Speedometer, engine sensor

Environment types

- Fully observable vs. partially observable
- Single agent vs. multiagent
- Deterministic vs. stochastic
- Episodic vs. sequential
- Static vs dynamic
- Discrete vs continuous

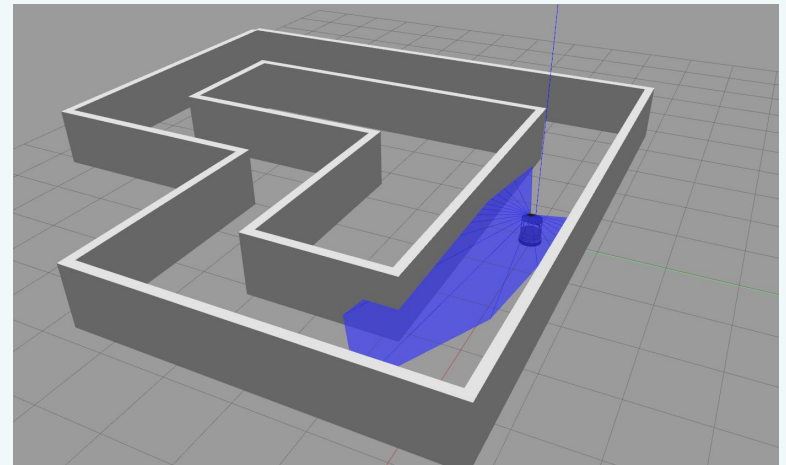
Fully Observable

Agent can observe (see/hear/perceive)
all relevant information from the
environment



Partially Observable

Agent can observe only **partial**
information from the environment



Single Agent

Our agent is the only intelligent agent in the environment



Multiagent

There are multiple intelligent agents which can be either **cooperative** or **competitive**



Deterministic

Agent can **fully determine** the outcome of it's action (next step, not necessarily the full task)



Stochastic

Agent is **uncertain** of the outcome of it's action



Episodic

Agent's actions are completely **independent** of each other, not linked to past or future actions



Sequential

Agent's actions are **dependent** on its past/future actions. The actions form a **sequence**.



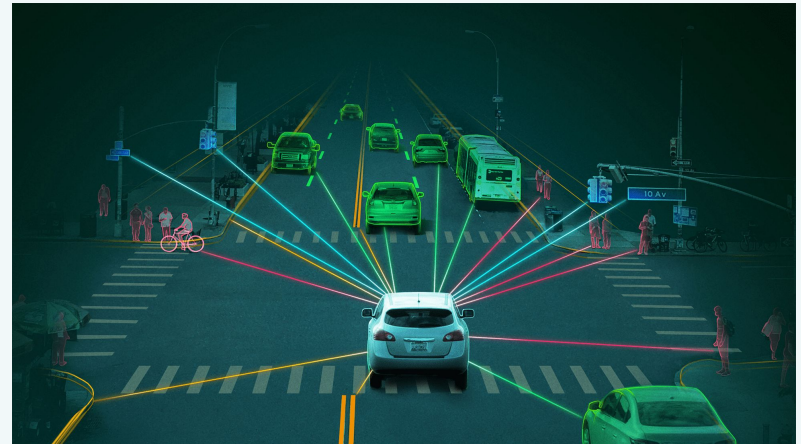
Static

While the agent is in the process of taking it's action, the environment **doesn't change**



Dynamic

The environment is **constantly changing** even when the agent is taking an action



Discrete

Agent's task can be broken down into **discrete set of actions** (you can make a list of agent's actions A_1, A_2, \dots, A_n)



Continuous

Actions are happening **continuously** and can not be listed, i.e., you cannot say where one action ends and the other begins



Environment types

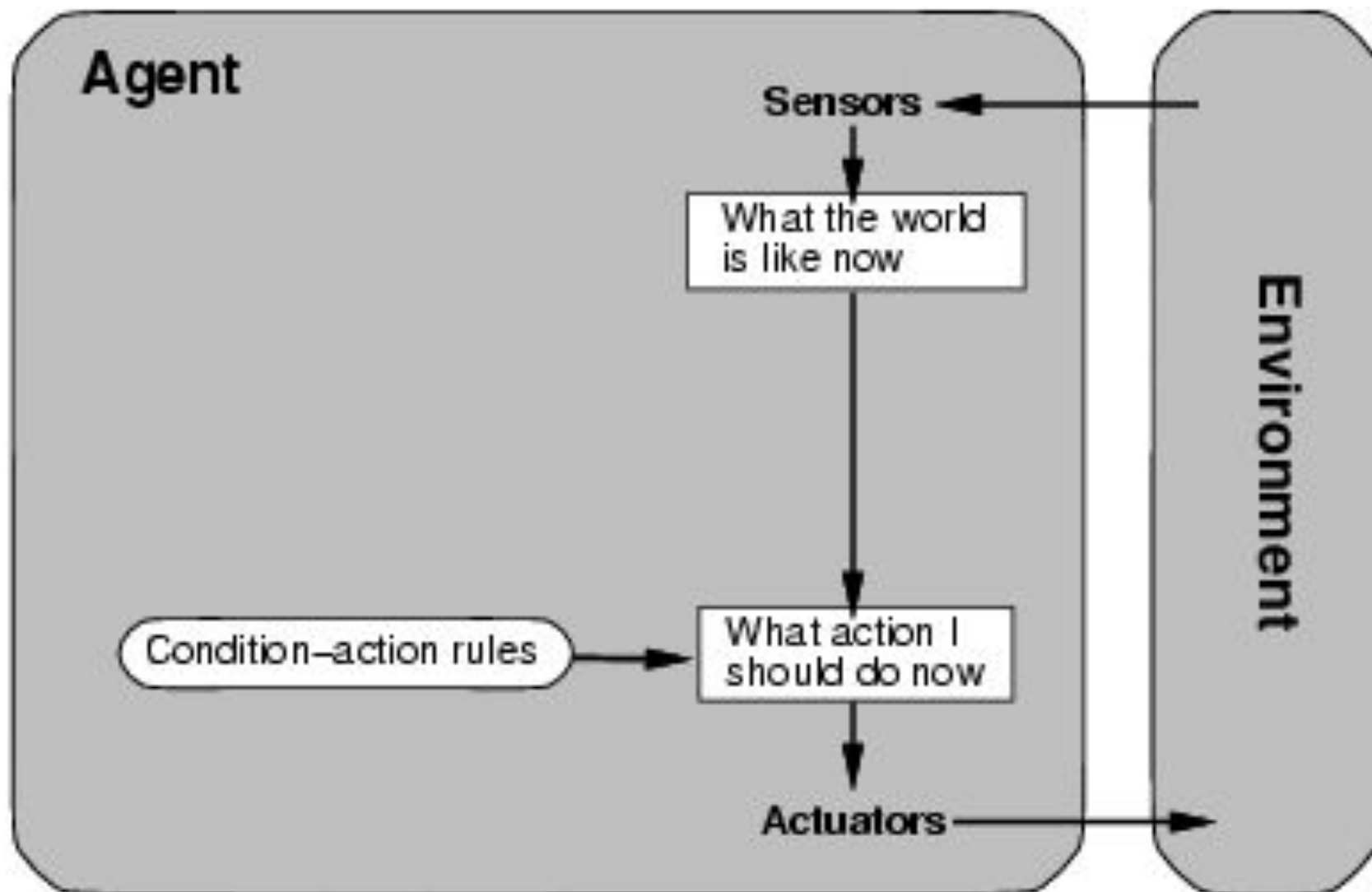
	Chess with a clock	Chess without a clock	Taxi driving
Fully observable	Yes	Yes	No
Deterministic	Strategic	Strategic	No
Episodic	No	No	No
Static	Semi	Yes	No
Discrete	Yes	Yes	No
Single agent	No	No	No

- The environment type largely determines the agent design
- The real world is (of course) partially observable, stochastic, sequential, dynamic, continuous, multi-agent

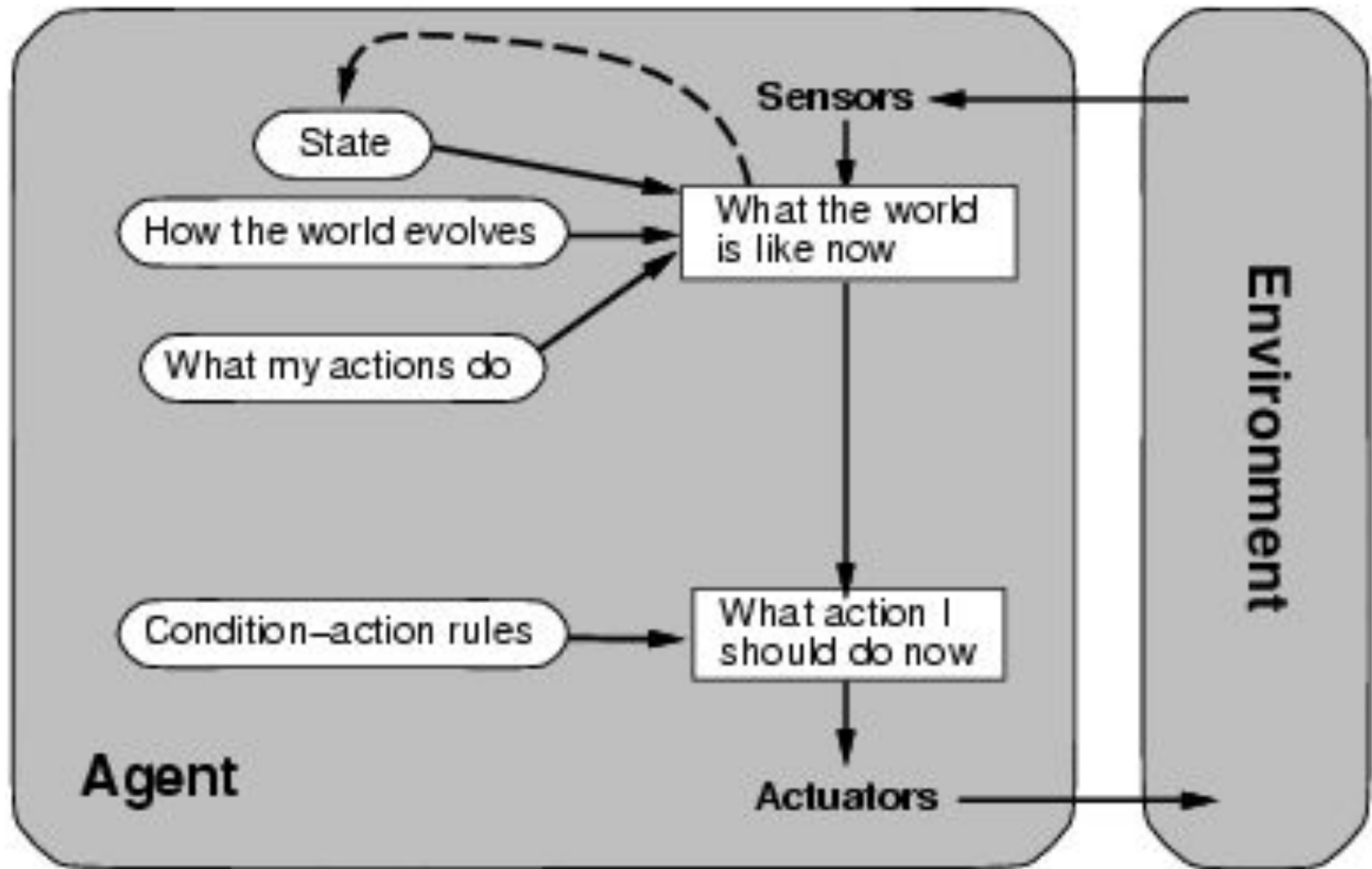
Agent types

- Four basic types in order of increasing generality:
 - Simple reflex agents
 - Model-based reflex agents
 - Goal-based agents
 - Utility-based agents

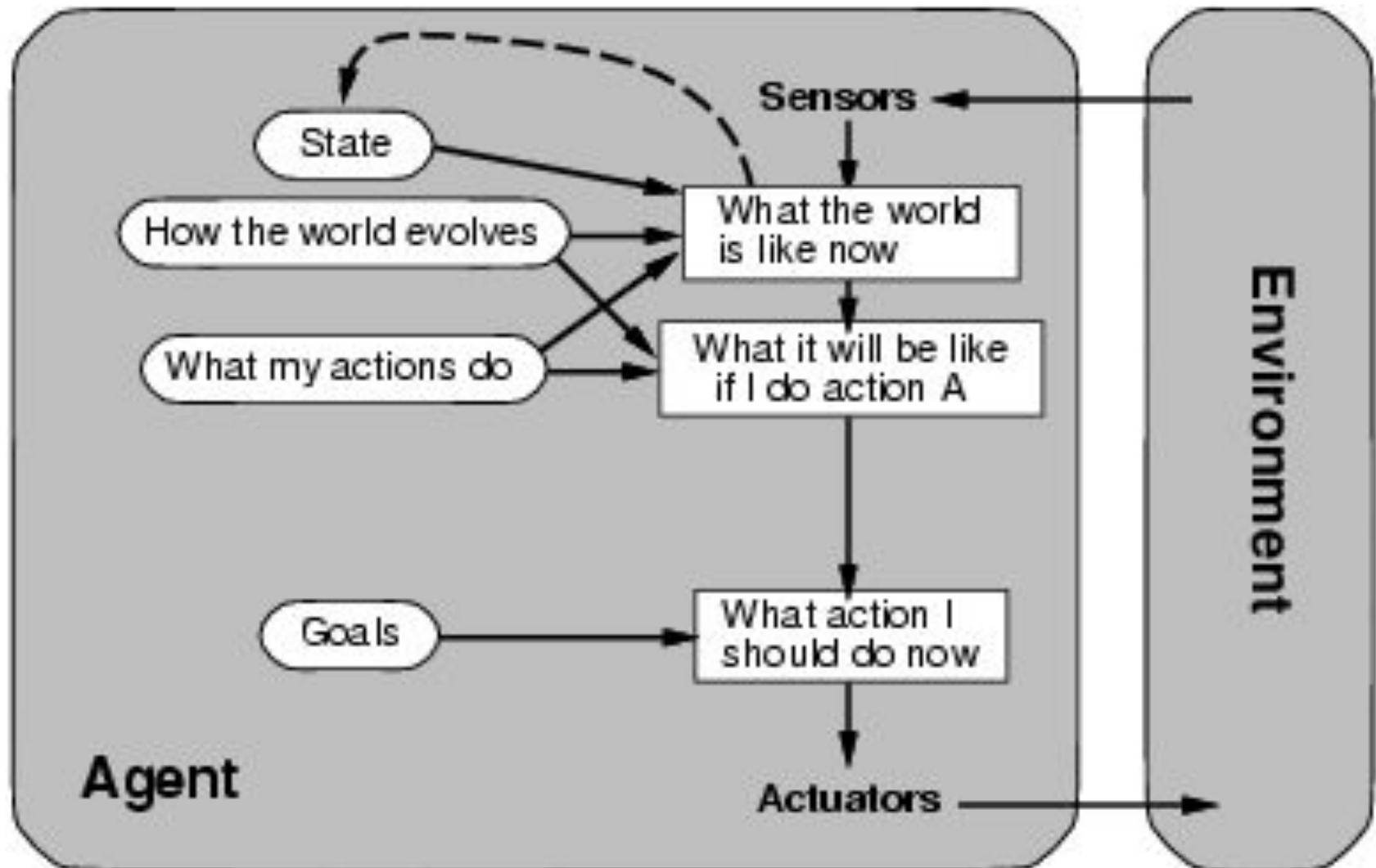
Simple reflex agents



Model-based reflex agents



Goal-based agents



Utility-based agents

