CSE 604 Artificial Intelligence

Chapter 2: Intelligent Agents

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

Dr. Ahmedul Kabir

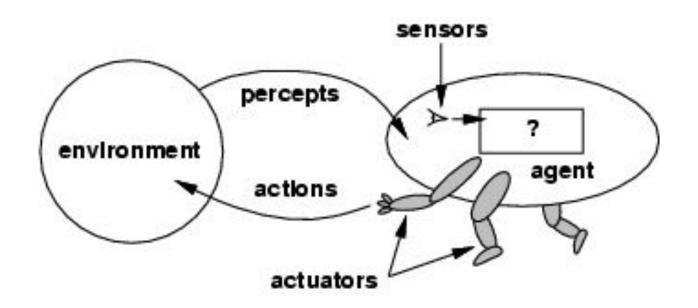


Outline

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

Agents

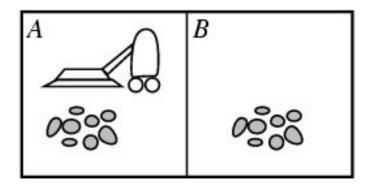
• An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators



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
 - percepts may not supply all relevant information
- Rational ≠ clairvoyant
 - 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:
 - Performance measure
 - Environment
 - Actuators
 - Sensors

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

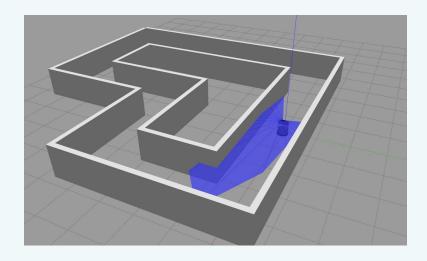
Fully Observable

Partially Observable

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

Agent can observe only partial information from the environment





Single Agent

Multiagent

Our agent is the only intelligent agent in the environment

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





Deterministic

Stochastic

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

Agent is uncertain of the outcome of it's action





Episodic

Sequential

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

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



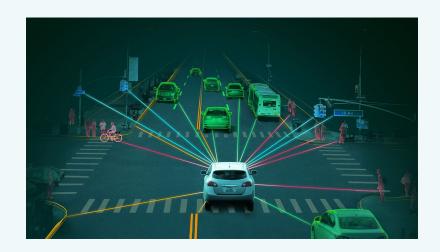


Static Dynamic

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

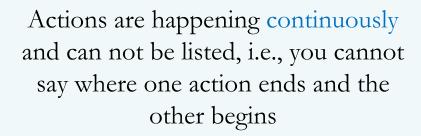
The environment is constantly changing even when the agent is taking an action





Discrete Continuous

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







Environment types

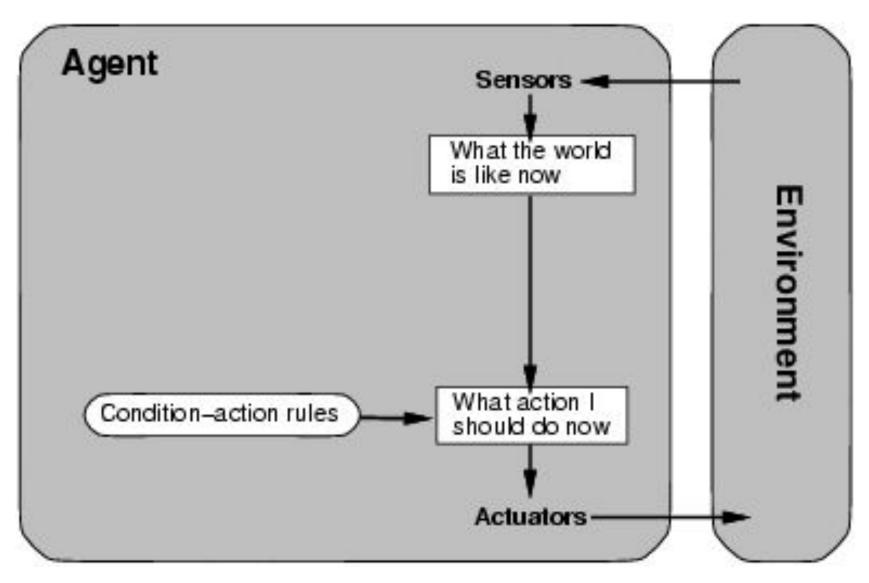
•	Chess with	Chess without		ıt	Taxi driving
4	a clock		a clock		
Fully observab	ole Ye	s Y	es	No	
Deterministic	Strategi	c S_1	trategic		No
Episodic	No		Jo	No	
Static	Semi	Y	es	No	
Discrete	Yes	Yes	No		
Single agent	No	No	No		

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

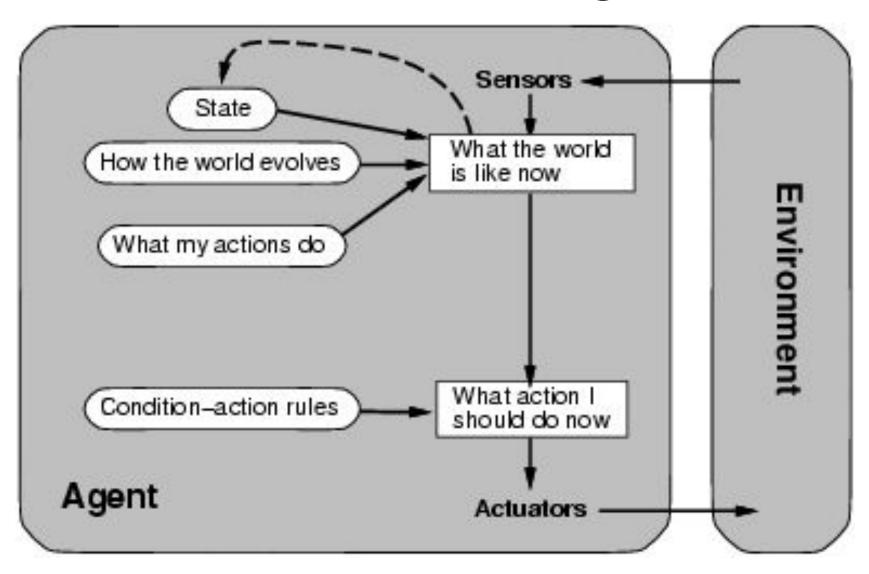
Agent types

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

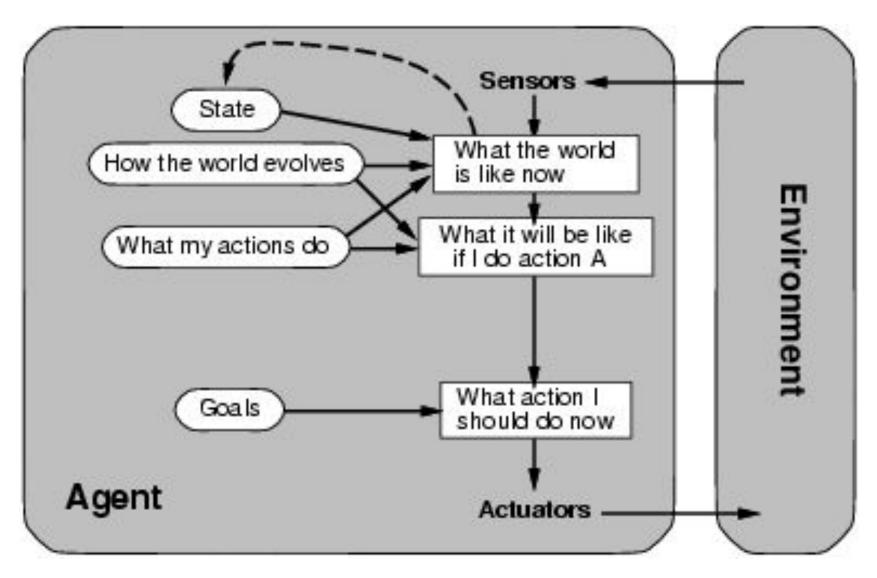
Simple reflex agents



Model-based reflex agents



Goal-based agents



Utility-based agents

