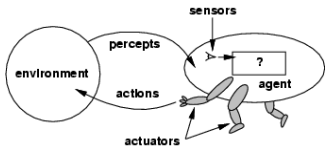
Agents and Environments

CIS*3700 (Winter 2007)

Generic Agent

- Agent function: [$f : P^* \rightarrow A$]



- Examples: human, robot, software agent (softbot).

Simple Vacuum-Cleaner Agent

- Environment: how many rooms are available and whether they need to be cleaned?
- Sensors: location of a room and whether there is dirt.
- Actuators: move around, vacuum dirt, or do nothing.
- Performance measures:
  - Average amount of dirt vacuumed
  - Average amount of dirt vacuumed, and electricity consumed and noise generated.

Rational Agent

- A rational agent does the right thing.
- PEAS specifies the setting of an intelligent agent:
  - P: The performance measure defines degree of success.
  - E: What the agent knows about the environment?
  - A: The actions that the agent can perform.
  - S: Everything that an agent has perceived so far.

Automated Taxi Driver

- Performance measure: Safe, fast, legal, comfortable trip, maximize profits
- Environment: Roads, other traffic, pedestrians, customers
- Actuators: Steering wheel, accelerator, brake, signal, horn
- Sensors: Cameras, sonar, speedometer, GPS, odometer, engine sensors, keyboard

Medical Diagnosis System

- Performance measure: Healthy patient, minimize costs, lawsuits
- Environment: Patient, hospital, staff
- Actuators: Screen display (questions, tests, diagnoses, treatments, referrals)
- Sensors: Keyboard (entry of symptoms, findings, patient's answers)

Rational Agent

- Ideal agent: always take the action that is expected to maximize its performance measure given the percept sequence it has perceived so far and the knoweldge it has about the environment.
- Autonomous agent: capable of determining its behavior by its own experience.

Rationality ¹ Omniscience

- Omniscience: knowing actual outcome of actions and acting accordingly.
- Rationality: concerning expected success given what has been perceived.
  - Can't take into account something that could not be perceived
  - Can't take an action that is incapable of taking.

Properties of Environment

- 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.
  - Strategic: the environment is deterministic except for the actions of other agents.

Properties of Environment

- 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.
- Static (vs. dynamic): The environment is unchanged while an agent is deliberating.
  - Semidynamic: the environment itself does not change with the passage of time but the agent's performance score does.

Properties of Environment

- 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.
- Difficulty of agent design :
  - Simplest: fully observable, deterministic, episodic, static, discrete, and single agent.
  - Hardest: partially observable, stochastic, sequential, dynamic, continuous, and multiagent.

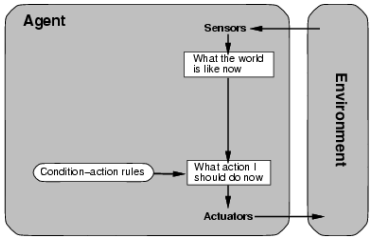
Environment Types

	Chess w/ clock	Chess w/o 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

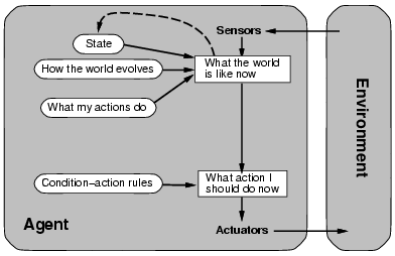
Table Look-up Agent

- Keep all percept sequences in memory and associate them with the appropriate actions.
- Drawbacks:
  - Huge table (e.g., 35^{100} entries for chess)
  - Take a long time to build the table
  - No autonomy
  - Even with learning, need a long time to learn the table entries

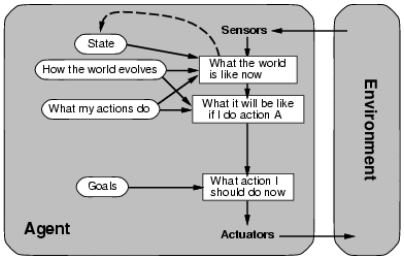
Simple Reflex Agent



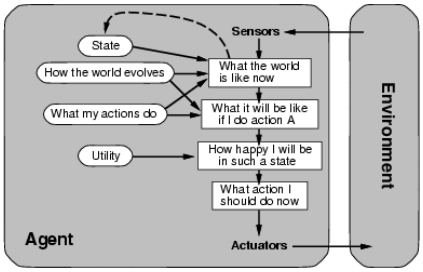
Model-based Reflex Agent



Goal-based Agent



Utility-based Agent



Learning Agent