

2. Intelligent Agents

2.1 AGENTS AND ENVIRONMENTS

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

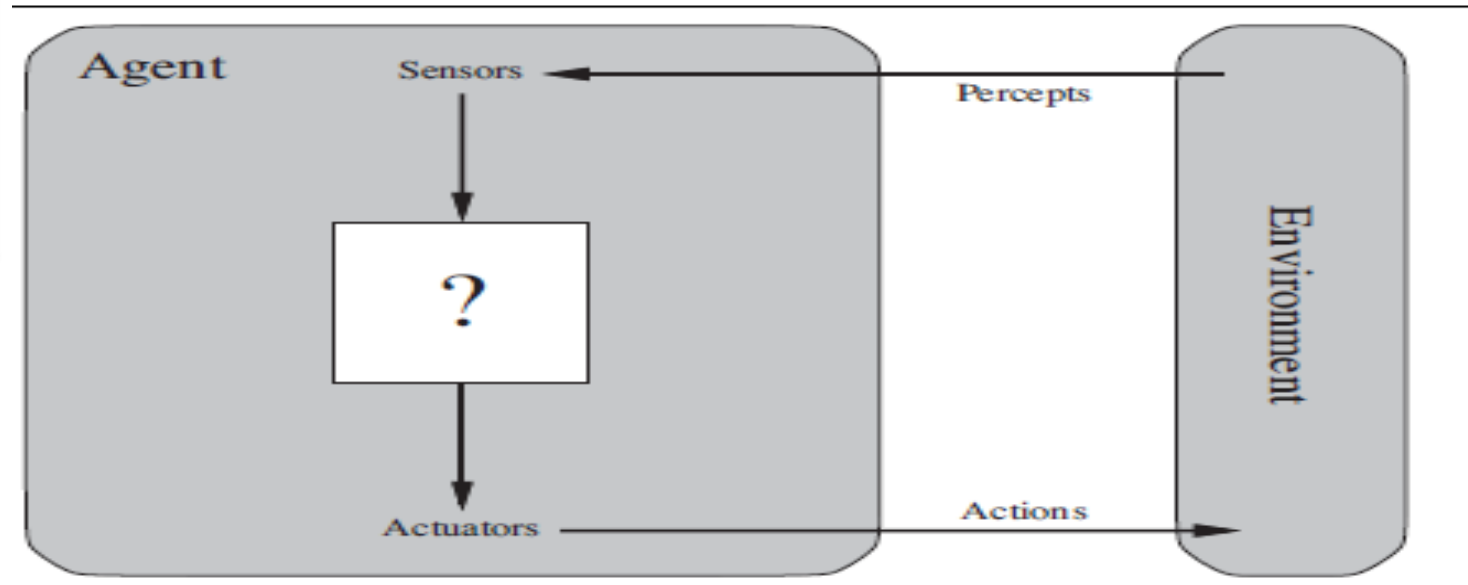
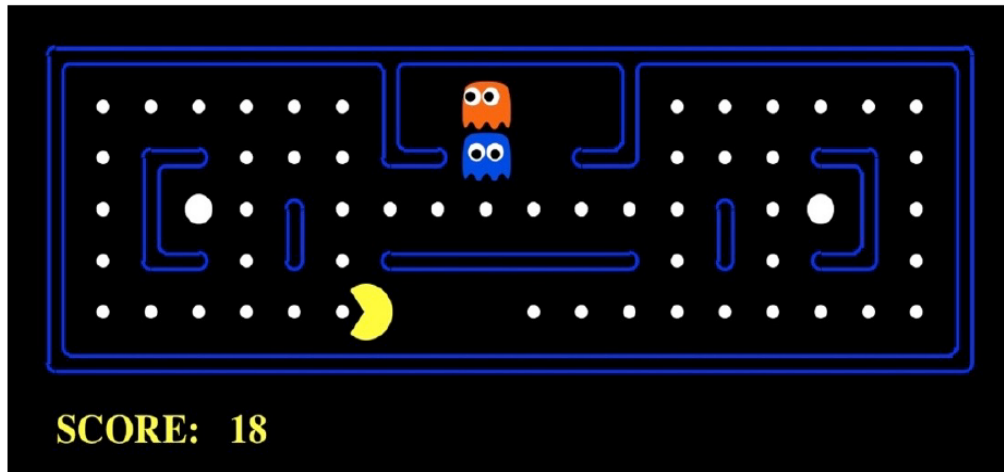


Figure 2.1 Agents interact with environments through sensors and actuators.

Sensors? & Actuators?

- A human agent ---sensors ?
 - has eyes, ears ; actuators.: hands, legs, vocal tract, and so on
- robotic agent --?
 - cameras and infrared range finders; actuators :various motors
- A software agent -- sensory inputs
 - receives keystrokes, file contents, and network packets; acts on the environment by displaying on the screen, writing files, and sending network packets.

Defs

- **percept** : the agent's perceptual inputs at any given instant.
- **percept sequence** : complete history of everything the agent has ever perceived.
- **agent function** : describes an agent's behavior that maps any given percept sequence to an action.

Experimenting agent

- construct table by trying out all possible percept sequences and recording which actions the agent does in response.
- table *-external* characterization of the agent.
- *Internally*, the **agent function** for an artificial agent will be implemented by an **agent program**.
- The agent function is an **abstract mathematical description**; the agent program is a **concrete implementation**, running within some physical system.

Example

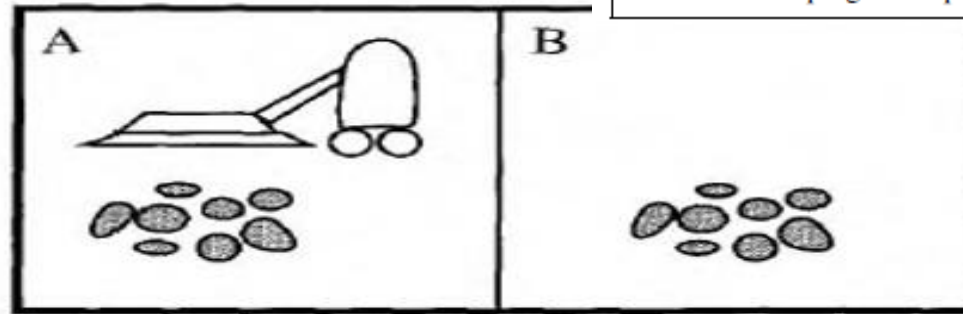


Figure 2.2 A vacuum-cleaner world with just two locations.

function REFLEX-VACUUM-AGENT(*[location,status]*) **returns** an action

if status = Dirty then return Suck
else if location = A then return Right
else if location = B then return Left

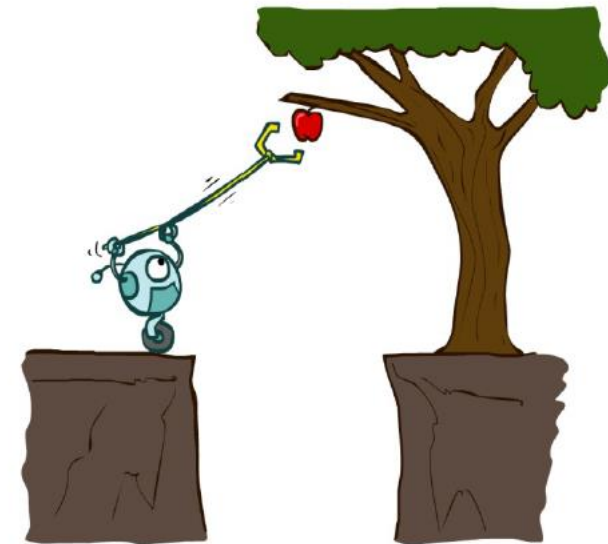
Figure 2.8 The agent program for a simple reflex agent in the two-state vacuum environment. This program implements the agent function tabulated in Figure 2.3.

Percept sequence	Action
[A,Clean]	Right
[A,Dirty]	Clear
[B,Clean]	Left
[B,Dirty]	Clear
[A,Clean],[A,Clean]	Right
[A,Clean],[A,Dirty]	Clear
[A,Clean],[A,Clean],[A,Clean]	Right
[A,Clean],[A,Clean],[A,Dirty]	Clear

Figure 2.3 Partial tabulation of a simple agent function for the vacuum-cleaner world shown in Figure 2.2.

2.2 Good Behavior: The Concept Of Rationality

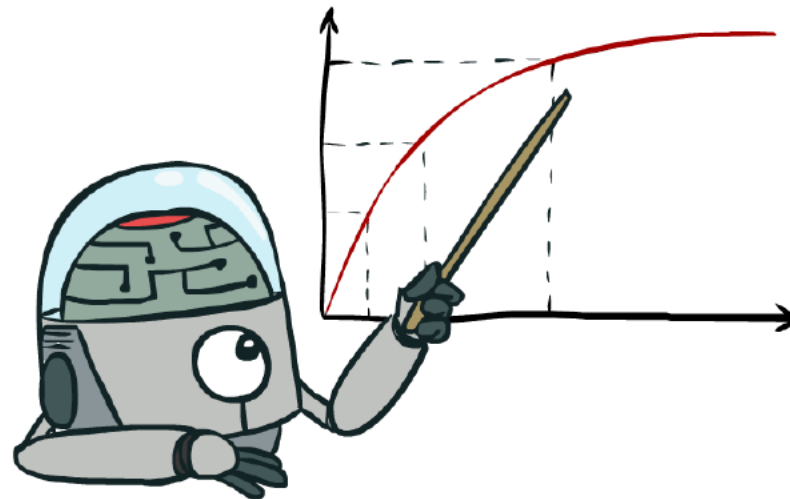
- A **rational agent** is one that does the right thing—conceptually speaking, every entry in the table for the agent function is filled out correctly.
- No fixed performance measure for all tasks and agents-
 - who decides? Easy?
- A rational agent can maximize this performance measure – example: how much dirt / how many times?
- suitable performance measure ?
- Penalties?



- *As a general rule, it is better to design performance measures according to what one actually wants in the environment, rather than according to how one thinks the agent should behave*

We'll use the term **rational** in a very specific, technical way:

- Rational: *maximally achieving pre-defined goals*
- Goals are expressed in terms of the **utility** of outcomes
- World is uncertain, so we'll use **expected** utility
- Being rational means acting to **maximize your expected utility**



2.2.1 Rationality

- What is rational at any given time depends on four things:
 - The performance measure that defines the criterion of success.
 - The agent's prior knowledge of the environment.
 - The actions that the agent can perform.
 - The agent's percept sequence to date.
- This leads to a **definition of a rational agent**:
- *For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has*

2.2.2 Omniscience, learning, and autonomy

- Rationality? Omniscience?
- An omniscient agent knows the *actual* outcome of its actions and can act accordingly; but omniscience is impossible in reality.
- Example -crossing road
- This example shows that rationality is not the same as perfection. Rationality maximizes *expected* performance, while perfection maximizes *actual* performance.
- Our definition requires a rational agent not only to gather information but also to **learn** as much as possible from what it perceives.
 - Initial knowledge- then augment
 - Complete priori- no need to learn- act correctly- fragile- lacks autonomy
- A rational agent should be autonomous—it should learn what it can to compensate for partial or incorrect prior knowledge.

2.3 THE NATURE OF ENVIRONMENTS

2.3.1 Specifying the task environment

- **task environment.** Includes the performance measure, the environment, and the agent's actuators and sensors.
- **PEAS** (**P**erformance, **E**nvironment, **A**ctuators, **S**ensors) description.

Agent Type	Performance Measure	Environment	Actuators	Sensors
Taxi driver	Safe, fast, legal, comfortable trip, maximize profits	Roads, other traffic, pedestrians, customers	Steering, accelerator, brake, signal, horn, display	Cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors, keyboard

Figure 2.4 PEAS description of the task environment for an automated taxi.

Agent Type	Performance Measure	Environment	Actuators	Sensors
Medical diagnosis system	Healthy patient, reduced costs	Patient, hospital, staff	Display of questions, tests, diagnoses, treatments, referrals	Keyboard entry of symptoms, findings, patient's answers
Satellite image analysis system	Correct image categorization	Downlink from orbiting satellite	Display of scene categorization	Color pixel arrays
Part-picking robot	Percentage of parts in correct	Conveyor belt with parts; bins	Jointed arm and hand	Camera, joint angle sensors
Refinery controller	Purity, yield, safety	Refinery, operators	Valves, pumps, heaters, displays	Temperature, pressure, chemical sensors
Interactive English tutor	Student's score on test	Set of students, testing agency	Display of exercises, suggestions, corrections	Keyboard entry

Figure 2.5 Examples of agent types and their PEAS descriptions.