

**[Unit 2: Agents]**  
**Artificial Intelligence (CSC 355)**

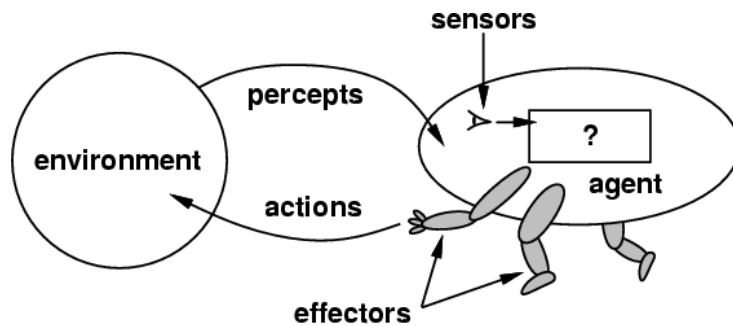
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**Intelligent Agents**

An Intelligent Agent perceives its environment via sensors and acts rationally upon that environment with its effectors (actuators). Hence, an agent gets percepts one at a time, and maps this percept sequence to actions.

**Properties of the agent**

- Autonomous
- Interacts with other agents plus the environment
- Reactive to the environment
- Pro-active (goal- directed)

**What do you mean, sensors/percepts and effectors/actions?****For Humans**

- **Sensors:** Eyes (vision), ears (hearing), skin (touch), tongue (gestation), nose (olfaction), neuromuscular system (proprioception)
- **Percepts:**
  - At the lowest level – electrical signals from these sensors
  - After preprocessing – objects in the visual field (location, textures, colors, ...), auditory streams (pitch, loudness, direction), ...
- **Effectors:** limbs, digits, eyes, tongue, .....
- **Actions:** lift a finger, turn left, walk, run, carry an object, ...

The Point: percepts and actions need to be carefully defined, possibly at different levels of abstraction

**A more specific example: Automated taxi driving system**

- **Percepts:** Video, sonar, speedometer, odometer, engine sensors, keyboard input, microphone, GPS, ...
- **Actions:** Steer, accelerate, brake, horn, speak/display, ...
- **Goals:** Maintain safety, reach destination, maximize profits (fuel, tire wear), obey laws, provide passenger comfort, ...
- **Environment:** Urban streets, freeways, traffic, pedestrians, weather, customers, ...

[ Different aspects of driving may require different types of agent programs!]

**Challenge!!**

Compare Software with an agent

Compare Human with an agent

**Percept:** The Agents perceptual inputs at any given instant.

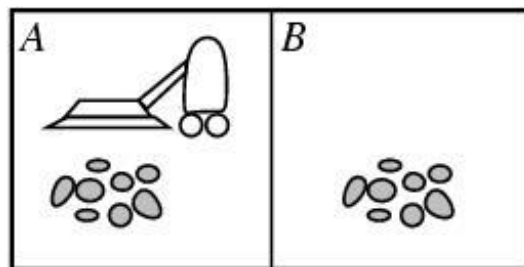
**Percept Sequence:** The complete history of everything the agent has ever perceived.

The *agent function* is mathematical concept that maps percept sequence to actions.

$$f : P^* \rightarrow A$$

The *agent function* will internally be represented by the *agent program*.

The agent program is concrete implementation of agent function it runs on the physical *architecture* to produce *f*.

**The vacuum-cleaner world: Example of Agent**

**Environment:** square A and B

**Percepts:** [location and content] *E.g. [A, Dirty]*

**Actions:** left, right, suck, and no-op

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

### The concept of rationality

A **rational agent** is one that does the right thing.

- Every entry in the table is filled out correctly.

What is the right thing?

- Right action is the one that will cause the agent to be most successful.

Therefore we need some way to measure success of an agent. Performance measures are the criterion for success of an agent 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, amount of noise generated, etc.

*It is better to design Performance measure according to what is wanted in the environment instead of how the agents should behave.*

It is not easy task to choose the performance measure of an agent. For example if the performance measure for automated vacuum cleaner is “The amount of dirt cleaned within a certain time” Then a rational agent can maximize this performance by cleaning up the dirt , then dumping it all on the floor, then cleaning it up again , and so on. Therefore “How clean the floor is” is better choice for performance measure of vacuum cleaner.

What is rational at a given time depends on four things:

- Performance measure,
- Prior environment knowledge,
- Actions,
- Percept sequence to date (sensors).
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**Definition:** *A rational agent chooses whichever action maximizes the expected value of the performance measure given the percept sequence to date and prior environment knowledge.*

## Environments

To design a rational agent we must specify its task environment. Task environment means: PEAS description of the environment:

- Performance
- Environment
- Actuators
- Sensors

### **Example: Fully automated taxi:**

- PEAS description of the environment:

**Performance:** Safety, destination, profits, legality, comfort

**Environment:** Streets/freeways, other traffic, pedestrians, weather,, ...

**Actuators:** Steering, accelerating, brake, horn, speaker/display,...

**Sensors:** Video, sonar, speedometer, engine sensors, keyboard, GPS, ...

## Agent Types:

**Refer Book: AI by Russel and Norvig**