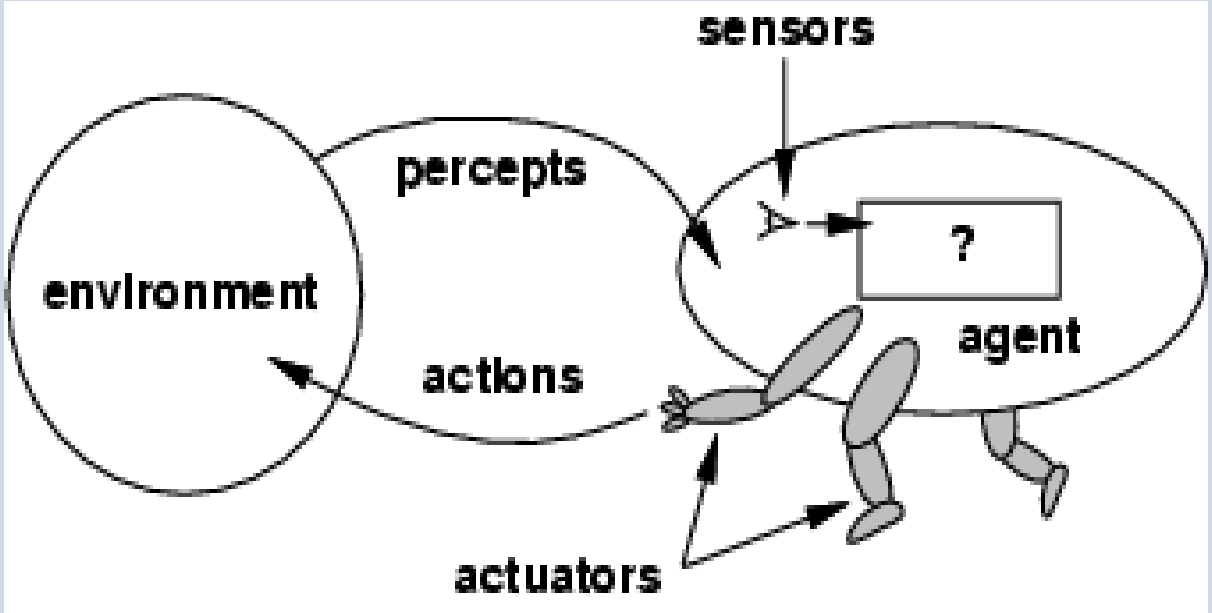
CHAPTER 1

AGENTS

Section: Environment types

AGENTS

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators
- We can view any AI program as an agent.



AGENTS

- **Percept:** refers to the agent's perceptual inputs at any given instant.
- **Percept sequence:** refers to the complete history of every thing the agent has ever perceived.
- **Sensors**: is the method by which we input the data to the agent.
- **Environment:** is the world around the agent that it can view. (the other things around it is not of intrest to it)

AGENTS

- **Actuator:** The method it gives the response to the environment.
- **Action:** is what this agent is cabable of doinh (or programmed to do)
- **Any agent's choice of action at any given instant can depend on the entire percept sequence observed to that date.**
- **Agent function:** describes the agent's behavior by mapping any given percept sequence to an action. (abstract mathematical description)

- **Agent program:** It is the program that implements the agent function for an artificial agent. (concrete implementation)

AGENTS

- **Example of agents**
- **Identify: agent function, percepts, environment, sensors, actions,…**
- Voice Recognition
- Medical Diagnosis
- Automated Traffic Control
- Image annotation
- **Moving Robot**

RATIONAL OR HUMAN

Human or rational?

- Several definitions are available in the literature.

Thinking *VS* *Behavior*

Model humans *VS* *Work from an ideal standard*

➢ Two points of views:

1. Thinking/Acting humanly: success is measured in term of fidelity to human performance.

2. Thinking/Acting rationally: success is measured using an ideal concept of intelligence called Rationality.

RATIONAL AGENTS

- **Rational agents:** one that does the right thing.

But what do we mean by right thing?

- Every entry for the agent function is filled out correctly, conceptually speaking.
- Right action is the one that will cause the agent to be most successful.

Answer: We need to define a **Peformance Measure** to evaluate the behavior of the agent in an environment.

- There is not one fixed performance measure for all agents.

RATIONAL AGENTS

- **Rationality** depends on four things:
  - The performance measure that defines the criterion of success.
  - The agent's prior knoweledge of the environment.
  - The actions that the agent can perform.
  - The agent's percept sequence to date.
- **Performance measure:** A performance measure is designed according to what one actually wants in the environment rather than according to how one thinks the agent should behave.

RATIONAL AGENTS

- **For example,** we can measure the behaviour of face recognition by the accuracy of identifying the person of that face whatever the its pose, light or other conditions.
- We seek to make extra programming effort to increase its accuracy by adding image preprocessing functions to the face image to overcome these problems.
- **However, we donot expect it to identify a person whose face was not stored in the database? Or to do an action it is not programmed to do**

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 knoweledge the agent has**.

ENVIRONMENT TYPES

- We need to know the type (i.e characteristics of the environment) to understand its complexity and to make our AI agent program efficient (i.e has high performance)
- The environment is viewed from different procespects not one to fully understand it.
- **Accessible vs non-accessible (fully observable vs partially observable)**
- **Deterministic vs stochastic**
- **Episodic vs sequential** **Static vs dynamic**
- **Discrete vs continuous** **Single agent vs multi-agent**

1- ACCESSIBLE VS NON-ACCESSIBLE

- **Accessibility** (observability):
- If an agent **has access to the complete state of the environment at each point of time** thanks to its sensors, the environment is fully observable.
- The sensors detect all aspects that are ***relevant*** to the choice of action; (of course the data it needs from the environment, not the one it does not benefit from)
- **Fully observable** environments are convenient because the agent need not maintain any internal state to keep track of the world.

1- ACCESSIBLE VS NON-ACCESSIBLE

- Otherwise, it is **partially observable**.
- An environment might be partially observable because of noisy and inaccurate sensors or because parts of the state are simply missing from the sensor data.
- If the agent has no sensors at all then the environment is **unobservable**.
- Accessible environment is **easy** to program, gives better results and performance

1- ACCESSIBLE VS NON-ACCESSIBLE

- **Example:**
- In face recognition, the full face is captured using the camera, or the camera is working well --→ accessible environment
- Non accessible environment when
- part of the face is not shown or the camera is damaged or produce low quality pictures now.

1- ACCESSIBLE VS NON-ACCESSIBLE

- **Example:**
- **Chess –** the board is fully observable, and so are the opponent's moves.
- **Driving –** the environment is partially observable because what's around the corner is not known. We also canot easily know what is the next move of each driver.
- Example: Controlling traffic light???

2- STATIC VS DYNAMIC

- **Staticity**:
- If the environment can change while an agent is deliberating (i.e. making the decsion using the current input), then we say the environment is **dynamic** for this agent, otherwise it is static.
- The problem is that we take the décision based on the current inputs that descibes the state of the environment.

2- STATIC VS DYNAMIC

- If the environment changes dynamically while we are thinking about the décision, the inputs is not describing the environment now, and our response will be either wrong, or will not apply.
- Static environments are easy to deal with because the agent need not keep looking at the world while it is deciding on an action, nor need it worry about the passage of time.
- Static environment is **easy** to program, gives better results and performance

2- STATIC VS DYNAMIC

- If the environment itself does not change with the time but the agent's performance score does, then we say the environment is **semidynamic**. (as in game, you lose if you are late to finish the game at time)
- **Example**:
- In face recognition, if the person moves fast and another person enters in front on the camers while we are still identifying the first one, then our response will be wrong adn this is not the one who is currently standing in front of the camera.

2- STATIC VS DYNAMIC

- Response time is very important in dynamic environments.
- Crossword puzzles are static
- Robot arm manipulation of a thing??

3- EPISODIC VS SEQUENTIAL

- In an environment, the agent's experience is divided into **atomic episodes (i.e independent on each other)**.
- In each episode, the agent receives a percept and then performs a single action.
- Importantly, the next episode does not depend on the actions taken in previous episodes.
- Many classification tasks are episodic.

3- EPISODIC VS SEQUENTIAL

- **Example**
- Face recognition is **episodic**.
- A robot that has to spot defective parts on an assembly line bases each decision on the current part, regardless of previous decisions.
- Moreover, the current decision doesn't affect whether the next part is defective.
- In **sequential** environments, the current decision could affect all future decisions.

3- EPISODIC VS SEQUENTIAL

- **Example**:
- Chess and taxi driving are sequential: in both cases, short-term actions can have long-term consequences.
- **Episodic environments are much simpler than sequential environments because the agent does not need to think ahead.**

4- DETERMINISTIC VS. STOCHASTIC

- If the **next state** of the environment is completely determined by the **current state and the action executed by the agent**, then we say the environment is **deterministic**.
- Otherwise, it is **stochastic**.
- **Example:**
- **Taxi driving** is clearly stochastic in this sense, because one can never predict the behavior of traffic exactly; moreover, one's tires blow out and one's engine seizes up without warning.

4- DETERMINISTIC VS. STOCHASTIC

- The use of the word “stochastic” generally implies that uncertainty about outcomes is quantified in terms of probabilities
- **Deterministic environments are much simpler than stochastic environments because the agent is sure of the effect of its actions and no need to get sure of it by perceiving the environment and analyzing it to get sure it has been fulfilled.**

5- DISCRETE VS. CONTINUOUS

- If an environment consists of a **finite number of states** that can be deliberated in the environment to obtain the actions, it is said to be a **discrete** environment.
- The environment in which the states and therefore the actions are performed cannot be numbered i.e. is not discrete, is said to be continuous.
- **Example:**
- **Chess** is **discrete** as it has only a finite number of distinct states. The number of moves might vary with every game, but still, it's finite.

5- DISCRETE VS. CONTINUOUS

- Face recognition is **discrete.**
- **Self-driving cars** are an example of **continuous** environments as their states and actions are driving, parking, etc. which cannot be numbered.
- **Discrete environments are much simpler than continuous environments.**

6- SINGLE AGENT VS. MULTIAGENT

- An environment consisting of only one agent is said to be a **single-agent** environment.
- An environment involving more than one agent is a **multi-agent** environment.
- In multi-agent, are they cooperating or competing.
- **Example:**
- An agent trying to get out of a maze or the one solving the crossword puzzle is a single-agent.
- The game of football is multi-agent as it involves 11 players in each team.

6- SINGLE AGENT VS. MULTIAGENT

- In car driving, does an agent A (the taxi driver) have to treat an object B (another vehicle) as an agent, or can it be treated as an object behaving according to the laws of physics, analogous to waves at the beach or leaves blowing in the wind?
- The key distinction is whether B's behavior is best described as maximizing a performance measure whose value depends on agent A's behavior.

6- SINGLE AGENT VS. MULTIAGENT

- **Chess** is a **competitive** multi-agent environment.
- In the **taxi-driving** environment, avoiding collisions maximizes the performance measure of all agents, so it is a partially **cooperative** multi-agent environment.
- However, in another situation drivers sometimes be competitive because, for example, only one car can occupy a parking space

6- SINGLE AGENT VS. MULTI-AGENT

- The agent-design problems in multi-agent environments are often quite different from those in single-agent environments.
- **Communication** is very important in multiagent
- environments; in some competitive environments, **randomized behavior** is rational because it avoids the pitfalls of predictability.

AGENTS

- **PEAS description:**

- We can get complete specification of the task facing an agent by:

1. Defining the **P**erformance measure.
2. Describing the external **E**nvironment.
3. Describing **A**ctuators.
4. Describing **S**ensors

QUIZ

IN THE PROJECT YOU WILL WORK ON, DETERMINE YOUR PROJECT ENVIRONMENT TYPE