Artificial Intelligence (CSC261)

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Recap...!

▶ Our approach to artificial intelligence centers around rational agents, as outlined in Unit 1.

▶ Along with this we studied about:
  ▶ Definition of AI
  ▶ AI Perspectives
  ▶ History of AI
  ▶ Foundations and Applications of AI

▶ This chapter aims to provide a more concrete understanding of the notion of rationality, by demonstrating its applicability to various types of agents functioning in any possible environment.

Introduction of agents

▶ The environment serves as the context within which an agent performs its actions.

▶ Anything that is capable of perceiving its surroundings through sensors and taking actions in response using actuators can be considered an agent.
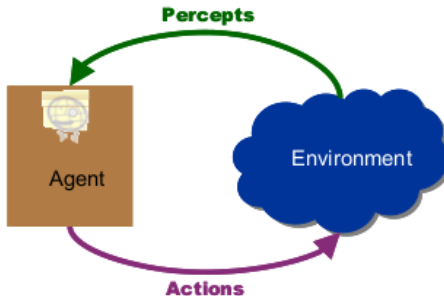

Figure 1: A high level view of agent and environment

Introduction of agents

- ► What do you mean, sensors/percepts and effectors/actions for human?
    - ► Sensors: Eyes (vision), ears (hearing), skin (touch), tongue (gestation), and so on.
    - ► Percepts:
        - ► At the lowest level: electrical signals from these sensors
        - ► After pre-processing: objects in the visual field (location, textures, colors, ...), auditory streams (pitch, loudness, direction), and so on.
    - ► Effectors: limbs, digits, eyes, tongue, and so on.
    - ► Actions: lift a finger, turn left, walk, run, carry an object, and so on.
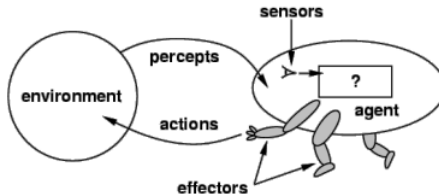
Introduction of agents

▶ An agent perceives its environment through sensors.
▶ The complete set of inputs at a given time is called a percept.
▶ The current percept, or a sequence of percepts can influence the actions of an agent.
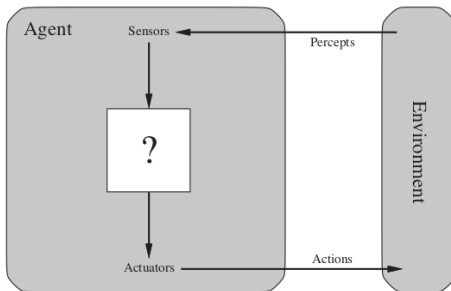▶ The agent can change the environment through actuators or effectors.

Figure 3: Agents interact with environments through sensors and actuators

Introduction of agents

▶ An operation involving an effector is called an action.
▶ Actions can be grouped into action sequences.
▶ The agent can have goals which it tries to achieve.
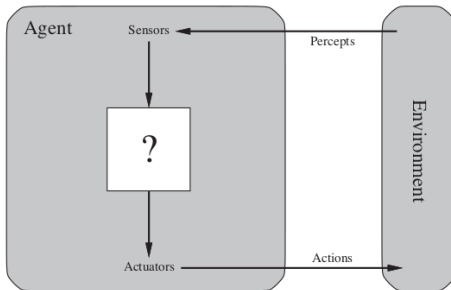▶ Thus, an agent can be looked upon as a system that implements a mapping from percept sequences to actions.

Figure 4: Agents interact with environments through sensors and actuators

Introduction of agents

▶ A performance measure has to be used in order to evaluate an agent.

▶ An autonomous agent decides autonomously which action to take in the current situation to maximize progress towards its goals.
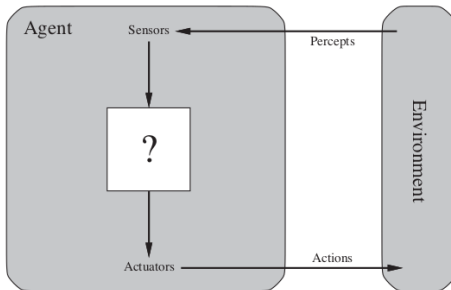

Figure 5: Agents interact with environments through sensors and actuators

Introduction of agents

- For example: Automated driving system
    - Percepts: Video, sonar, speedometer, odometer, engine sensors, keyboard input,microphone, GPS, and so on.
    - Actions: Steer, accelerate, brake, horn, speak/display, and so on.
    - Goals: Maintain safety, reach destination, maximize profits (fuel, tire wear), obey laws, provide passenger comfort, and so on.
    - Environment: Urban streets, freeways, traffic, weather, customer and so on,
- Different aspects of driving may require different types of agent programs.
- Challenge:
    - Compare Software with an agent
    - Compare Human with an agent

Structure and Configuration of Intelligent agent

▶ We are talking about agents by describing behavior —the action that is performed after any given sequence of percepts.

▶ The job of AI is to design an agent program that implements the agent function —the mapping from percepts to actions.

▶ We assume this program will run on some sort of computing device with physical sensors and actuators —we call this the architecture:

  ▶ em agent = architecture + program

▶ Generally, the program we choose has to be one that is appropriate for the architecture.

▶ If the program is going to recommend actions like Walk, the architecture had better have legs.

▶ The architecture might be just an ordinary PC, or it might be a robotic car with several onboard computers, cameras, and other sensors etc.

Structure and Configuration of Intelligent agent

▶ **Architecture**: This refers to machinery or devices that consists of actuators and sensors. The intelligent agent executes on this machinery. Examples include a personal computer, a car, or a camera.

▶ **Agent function**: This is a function in which actions are mapped from a certain percept sequence. Percept sequence refers to a history of what the intelligent agent has perceived.

▶ **Agent program**: This is an implementation or execution of the agent function. The agent function is produced through the agent program's execution on the physical architecture.

Structure and Configuration of Intelligent agent

▶ Agent program take the current percept as input from the sensors and return an action to the actuators.

▶ 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. $f : P* \to A$

▶ 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.

Properties of Intelligent Agents

- ▶ They have some level of autonomy that allows them to perform certain tasks on their own.
- ▶ They have a learning ability that enables them to learn even as tasks are carried out.
- ▶ They can interact with other entities such as agents, humans, and systems.
- ▶ New rules can be accommodated by intelligent agents incrementally.
- ▶ They exhibit goal-oriented habits (pro-active).
- ▶ They are knowledge-based. They use knowledge regarding communications, processes, and entities.

PEAS description of Agents

- ▶ To design a rational agent we must specify its task environment.
- ▶ Task environment means PEAS description of the environment:
    - ▶ Performance
        - ▶ Performance measure is the unit to define the success of an agent. Performance varies with agents based on their different precepts.
    - ▶ Environment
        - ▶ Environment is the surrounding of an agent at every instant. It keeps changing with time if the agent is set in motion.
    - ▶ Actuators
        - ▶ An actuator is a part of the agent that delivers the output of action to the environment.
    - ▶ Sensors
        - ▶ Sensors are the receptive parts of an agent that takes in the input for the agent.

PEAS description of Agents

- Example: PEAS description of the environment for fully automated taxi:
  - Performance: Safety, destination, profits, legality, comfort
  - Environment: Streets/freeways, other traffic, pedestrians, weather
  - Actuators: Steering, accelerating, brake, horn, speaker/display
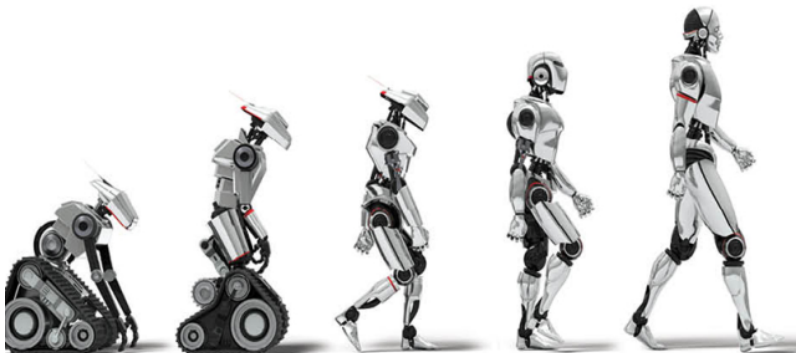 - Sensors: Video, sonar, speedometer, engine sensors, keyboard, GPS

📄 S. J. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd ed. Pearson, 2010.

mple Reflexive - **Model Based** - **Goal Based** - **Utility Based** - **Learning Agent**