

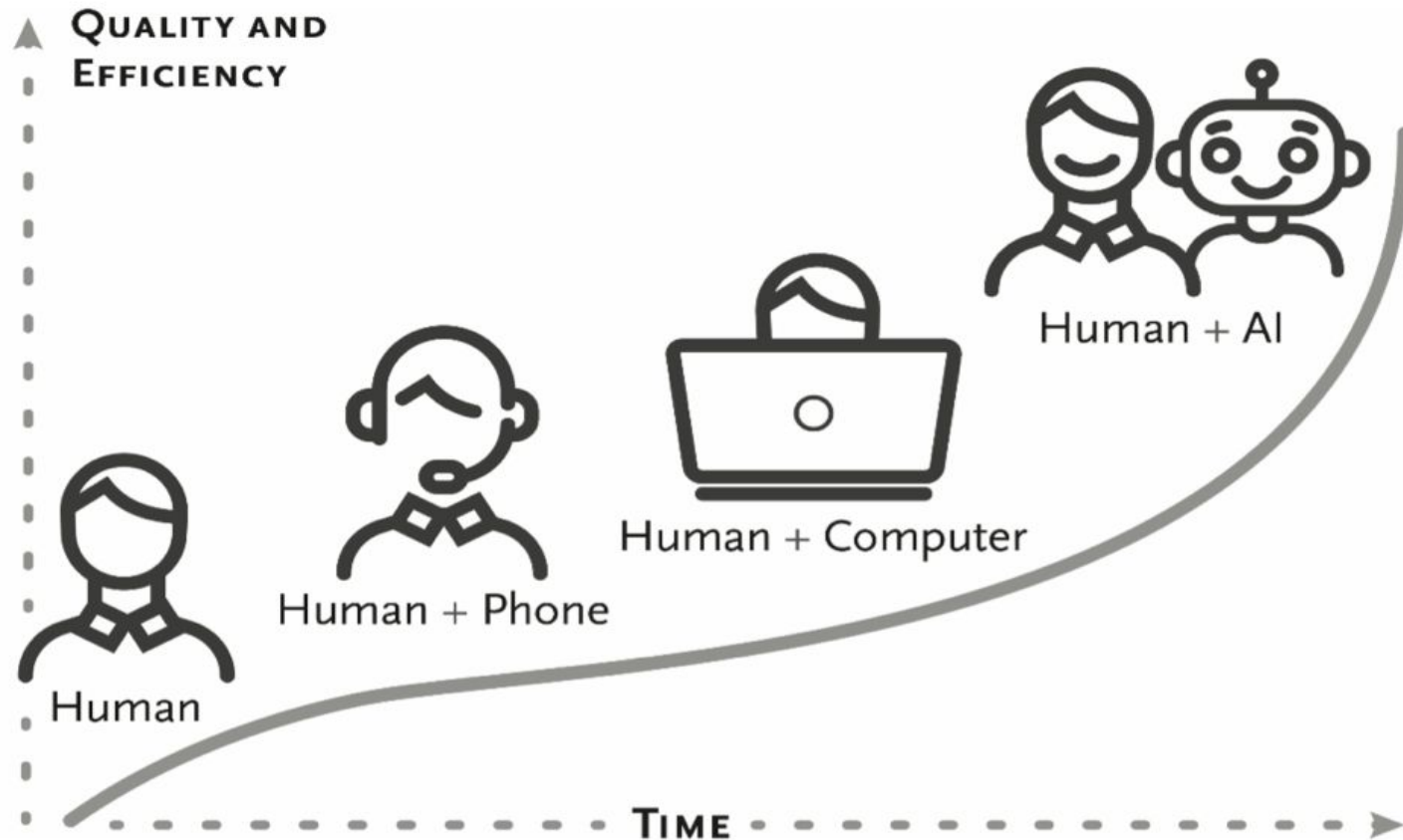


Artificial Intelligence

Lecture: Agent and Environment

Dr. Partha Pakray

1. Define intelligence.
2. What are the different approaches in defining artificial intelligence?
3. What is Turing test?
4. Suppose you design a machine to pass the Turing test. What are the capabilities such a machine must have?





2. What are the different approaches in defining artificial intelligence?

- Thinking rationally
- Acting rationally
- Thinking like a human
- Acting like a human



4. Suppose you design a machine to pass the Turing test. What are the capabilities such a machine must have?

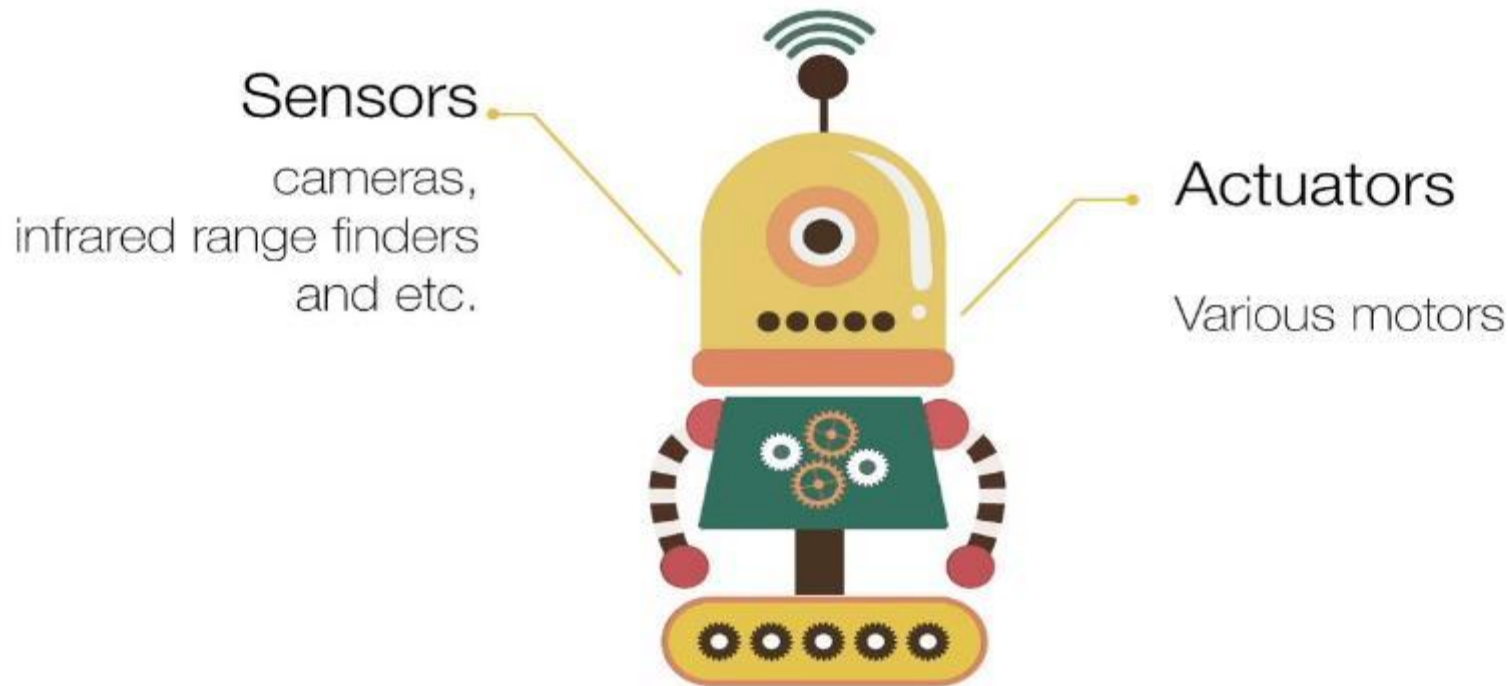
- Natural language processing
- Knowledge representation
- Automated reasoning
- Machine Learning
- Computer vision
- Robotics

- Define an Agent
- Define an Intelligent Agent
- Define an Rational Agent
- Explain Bounded Rationality
- Discuss different types of environmer
- Explain different agent architecture



Agents

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

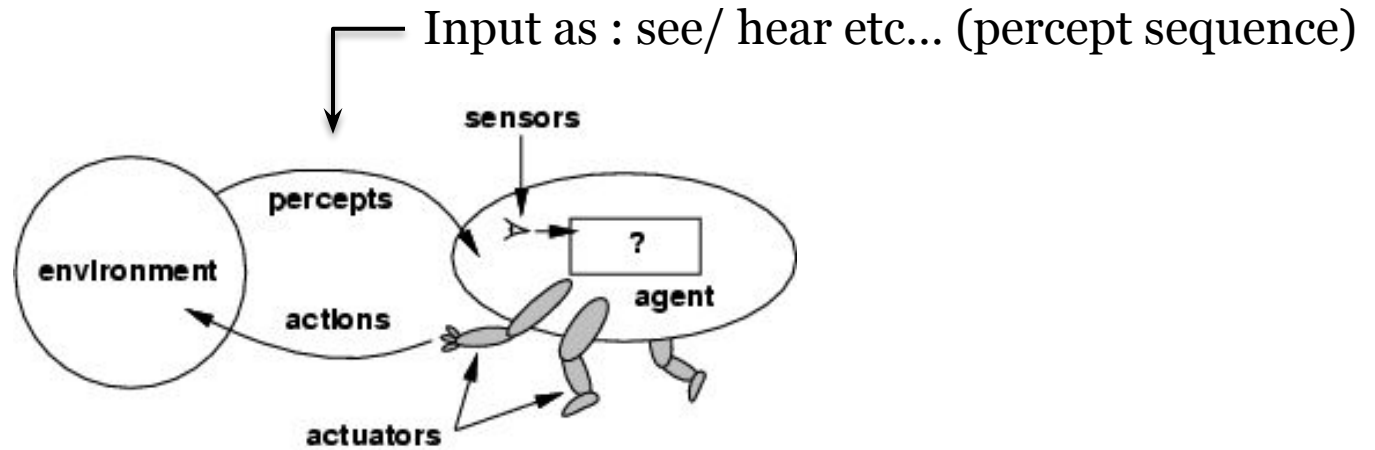


A robotic agent

Agents

- An **agent** is anything that can be viewed as **perceiving** its **environment** through **sensors** and **acting** upon that environment through **actuators**
- Human agent: eyes, ears, and other organs for **sensors**; hands, legs, mouth, and other body parts for **actuators**
- Robotic agent: cameras and infrared range finders for **sensors**; various motors for **actuators**

Agents & Environments

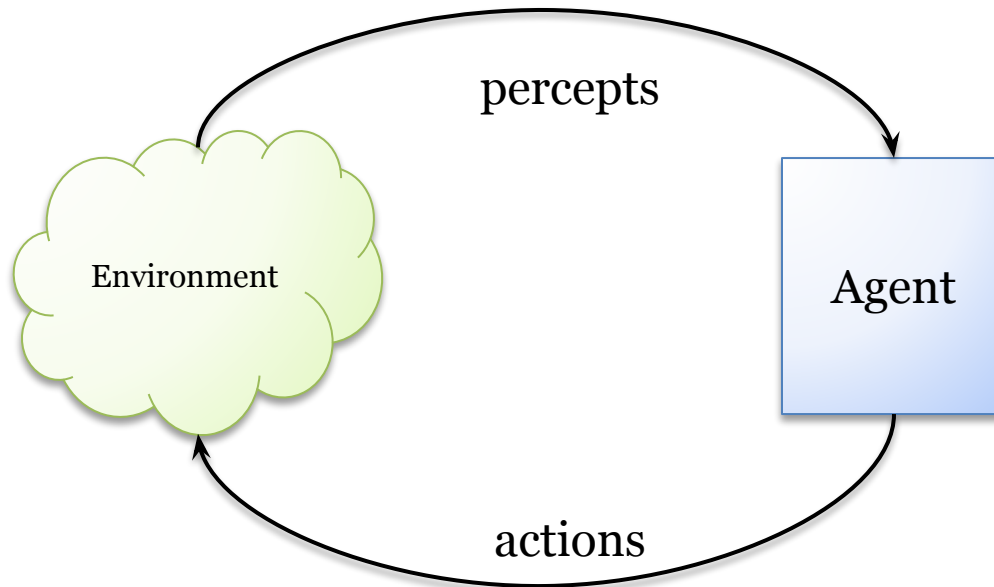


- ❖ Operate in an environment
- ❖ Perceives its environment through sensors
- ❖ Acts upon its environment through actuators / effectors
- ❖ Have Goals

Sensors & Effectors

- 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
- It can change the environment through actuators / effectors
 - An operation involving an actuator is called an **action**
 - Action can be grouped into action **Sequence**

Agents



- Implement mapping from percept sequence to actions
- Performance measure to evaluate agents
- Autonomous agent: decide autonomously which action to take in the current situation to maximize progress towards its goals.



Performance

- Behavior and performance of IAs in terms of agent function
 - Perception history (sequence) to Action Mapping
 - Ideal mapping: specifies which an agent should to take at any point in time.
- Performance measure: a subjective measure to characterize how successful an agent is (e.g., speed, power usage, accuracy, money, etc..)

Example of Agents

- Humans:
 - Eyes, ears, skin, taste buds, etc. for Sensors
 - Hand, fingers, legs, mouth for Effectors
- Robot:
 - Camera, infrared, etc. for Sensors
 - wheels, lights, speakers etc. for Actuators
- Software Agents (softbot)
 - Functions as sensors
 - Functions as actuators



Types of Agents


- Softbots
 - ask.com
- Expert System
 - Cardiologist
- Autonomous Spacecraft
- Intelligent buildings



Agent Faculties

The fundamental faculties of intelligence are

- Acting
- Sensing
- Understanding, reasoning, learning

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- In order to act intelligently, **one must sense**. Blind action is not a characterization of intelligence.
 - Understanding is essential to interpret the sensory percepts and decide on an action.
 - Many robotic agents stress sensing and acting, and do not have understanding.



Intelligent Agent

- Must Sense
- Must Act
- Must be autonomous (to some extent)
- Must be rational



Rationality

- AI is about building rational agents.
- An agent is something that perceives and acts.
- A rational agent always does the right thing.
 1. What are the functionalities (goals)?
 2. What are the components?
 3. How do we build them?



Perfect Rationality

- Perfect Rationality assumes that the rational agent knows all and will take the action that maximizes his utility.
- Human beings do not satisfy this definition of rationality.

Rational Action

- **Rational Action** is the action that maximizes the expected value of the performance measure given the percept sequence to date
- Is Rational Action means best action? **<Rational = Best>?**
 - Yes, to the best of its agent knowledge
- Does Rational means Optimal? **<Rational = Optimal>?**
 - Yes, to the best of its abilities
 - And its constraints
- In 1957, Simon proposed the notion of Bounded Rationality:



Bounded Rationality

“Because of the limitations of the human mind, humans must use approximate methods to handle many tasks.” Herbert Simon, 1972



Agent Environment


- Environments in **which agents operate can be defined in different ways**. It is helpful to view the following definitions as referring to the way the environment appears from the point of view of the agent itself.

Environment: Observability

- **Fully observable** environment
 - all of the environment relevant to the action being considered is observable.
 - In such environments, the agent does not need to keep track of the changes in the environment.
 - Example: A chess playing system is an example of a system that operates in a fully observable environment.
- **Partially observable** environment
 - the relevant features of the environment are only partially observable.
 - Example: A bridge playing program is an example of a system operating in a partially observable environment.

Environment: Determinism

- **Deterministic:** In *deterministic environments*, the next state of the environment is **completely described by the current state and the agent's action**. *Image analysis* systems are examples of this kind of situation. The processed image is determined completely by the current image and the processing operations.
- **Stochastic:** If an element of interference or uncertainty occurs then the environment is stochastic. Note that a deterministic yet **partially observable** environment will appear to be stochastic to the agent. Examples of this are the automatic vehicles that navigate a terrain, say, the Mars rovers robot. The new environment in which the vehicle is in is stochastic in nature.

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- **Strategic:** If the environment state is wholly **determined by the preceding state and the actions of multiple agents**, then the environment is said to be strategic. Example: Chess. There are two agents, the players and the next state of the board is strategically determined by the players' actions.



Environment: Episodicity

- An **episodic environment** means that subsequent episodes **do not depend on what actions occurred in previous episodes.**
- In a **sequential environment**, the agent **engages in a series of connected episodes.**

Environment: Dynamism

- **Static Environment:** **does not change from one state to the next** while the agent is considering its course of action. The only changes to the environment are those caused by the agent itself.
 - A static environment does not change while the agent is thinking.
 - The passage of time as an agent deliberates is irrelevant.
 - The **agent doesn't need to observe the world during deliberation.**
- **Dynamic Environment:** A Dynamic **Environment changes over time independent of the actions of the agent** -- and thus if an agent does not respond in a timely manner, this counts as a choice to do nothing.
 - Example: Interactive tutor



Environment: Continuity

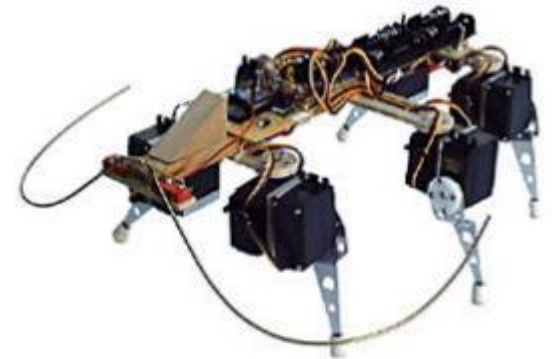
- **Discrete/Continuous**

- If the number of distinct percepts and actions is limited, the environment is discrete, otherwise it is continuous.

Examples of Agents



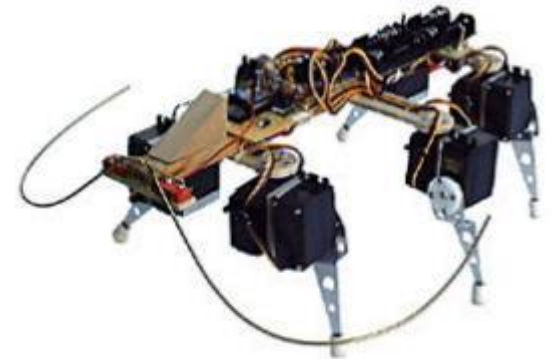
```
Else
  If (Len(Trim$(strL
    blnFileNext =
  Else
    ' Process data
    intColon = InStr
    If (intColon
      strName =
      strValue =
      strName = S
      Call xnNode
    End If
  End If
End If
End If
```



Examples of Agents



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Humans

Programs

Robots

senses

keyboard, mouse, dataset

cameras, pads

body parts

monitor, speakers, files

motors, limbs



What is Rational Agents?

Rational Agents

A rational agent is one that does the right thing

- Need to be able to assess agent's performance
 - Should be independent of internal measures
- Ask yourself: has the agent acted rationally?
 - Not just dependent on how well it does at a task
- First consideration: evaluation of rationality



Thank You!

Any Questions?