Cihan University of Sulaimani

Computer Science Department

Artificial Intelligence

First lecture

By

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Outline

- What is Intelligence?
- What is artificial intelligence?
- History of AI
- AI Branch
- What can AI systems do?
- What can’t AI systems do yet?
- What is intelligent Agent?
- Some Agent types

Lecture Martial

- A.Modern.Approach.4th.Edition.Peter.Norvig.Stuart.Russell.Pearson.
- https://dl.ebooksworld.ir/books/Artificial.Intelligence.A.Modern.Approach.4th.Edition.Peter.Norvig.%20Stuart.Russell.Pearson.9780134610993.EBooksWorld.ir.pdf
- The Beginners Guide to Artificial Intelligence AI:
- https://www.free-ebooks.net/artificial-intelligence/The-Beginners-Guide-to-Artificial-Intelligence-AI#gs.ej02mu
- https://www.free-ebooks.net/artificial-intelligence#gs.ej01vj
- **Exam (100 Marks)**

❖ Activity (20 P) (Quiz, Homework, Project)

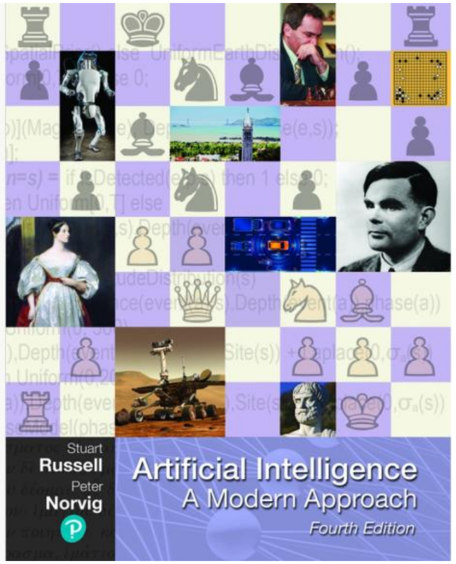
❖ Midterm Theory (20 P)

❖ Midterm Practice (10 P)

❖ Final (50 P)

❖ Theory (35 P)

❖ Practice (15 p)



What is Intelligence?

- What is Intelligence?

Intelligence is a property of mind that encompasses many related mental abilities, such as the capabilities to

❑reason

❑ plan

❑ solve problems

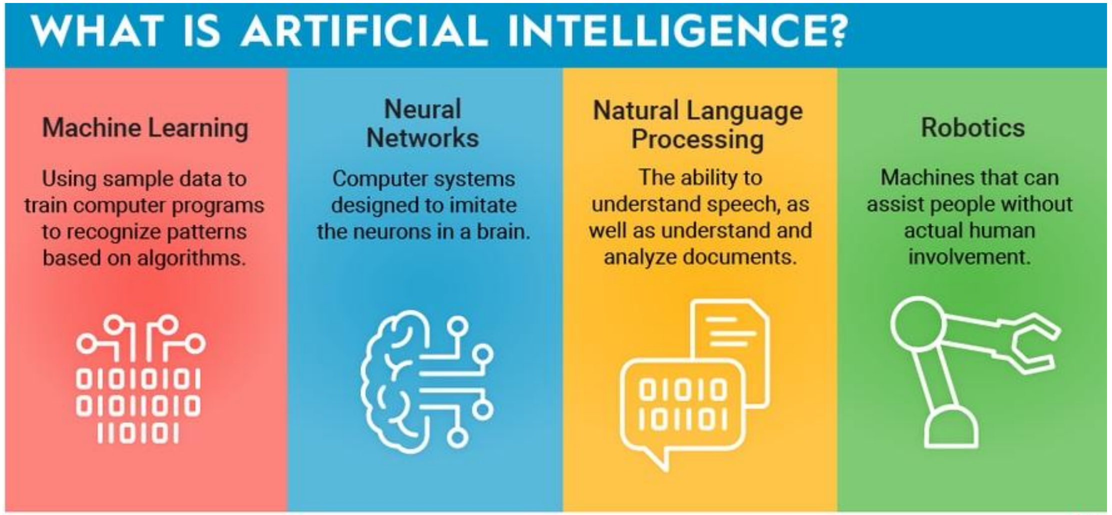
❑ think abstractly

❑ comprehend ideas and language

❑ learn

What is artificial intelligence?

- **Artificial intelligence (AI)** is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy.
- **Artificial intelligence (AI)** is the science of making machines that can think like humans.



WHAT IS ARTIFICIAL INTELLIGENCE?

Machine Learning

Using sample data to train computer programs to recognize patterns based on algorithms.

Neural Networks

Computer systems designed to imitate the neurons in a brain.

Natural Language Processing

The ability to understand speech, as well as understand and analyze documents.

Robotics

Machines that can assist people without actual human involvement.

History of AI

- John McCarthy (1927–2011), an American computer scientist and cognitive scientist, often hailed as the "father of artificial intelligence" (AI), made significant contributions to both AI and computer science.

- The birth of AI (1943 – 1956)
  - Pitts and McCulloch (1943): simplified mathematical model of neurons (resting/firing states) can realize all propositional logic primitives (can compute all Turing computable functions)
  - Allen Turing: Turing machine and Turing test (1950)
  - Claude Shannon: information theory; early game theory, possibility of chess playing computers
  - Tracing back to Boole, Aristotle, Euclid (logics, syllogisms, algebra of symbols)
- Early enthusiasm (1952 – 1969)
- AI became an industry (1980 – 1989)
  - wide applications in various domains
  - commercially available tools
- Current trends (1990 – present)
  - more realistic goals
  - more practical (application oriented)
  - resurgence of neural networks and emergence of genetic algorithms
  - distributed AI, intelligent agents, and semantic web

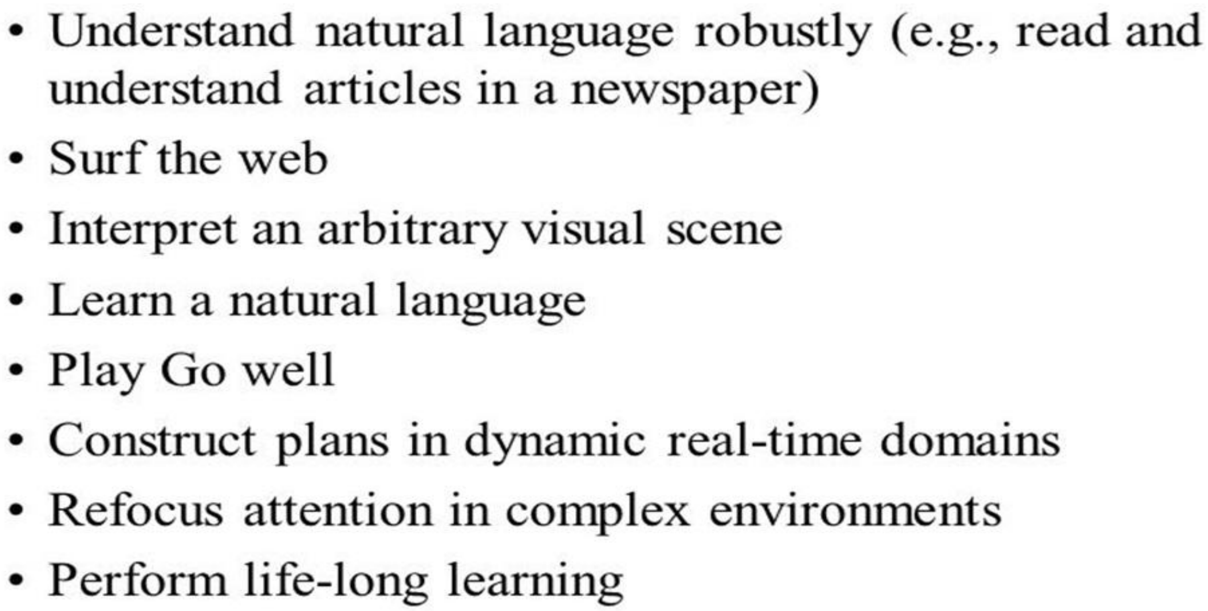
What can AI systems do?

Here are some example applications

- **Computer vision:** face recognition from a large set
- **Robotics:** autonomous (mostly) automobile
- **Natural language processing:** simple machine translation
- **Expert systems:** medical diagnosis in a narrow domain
- **Spoken language systems:** ~1000 word continuous speech
- **Planning and scheduling:** Hubble Telescope experiments
- **Learning:** text categorization into ~1000 topics
- **User modeling:** Bayesian reasoning in Windows help (the infamous paper clip…)
- **Games:** Grand Master level in chess (world champion), checkers, etc.

What can’t AI systems do yet?

What are AI systems not capable of?
One of the key limitations of AI is inability to generate new ideas or solutions.

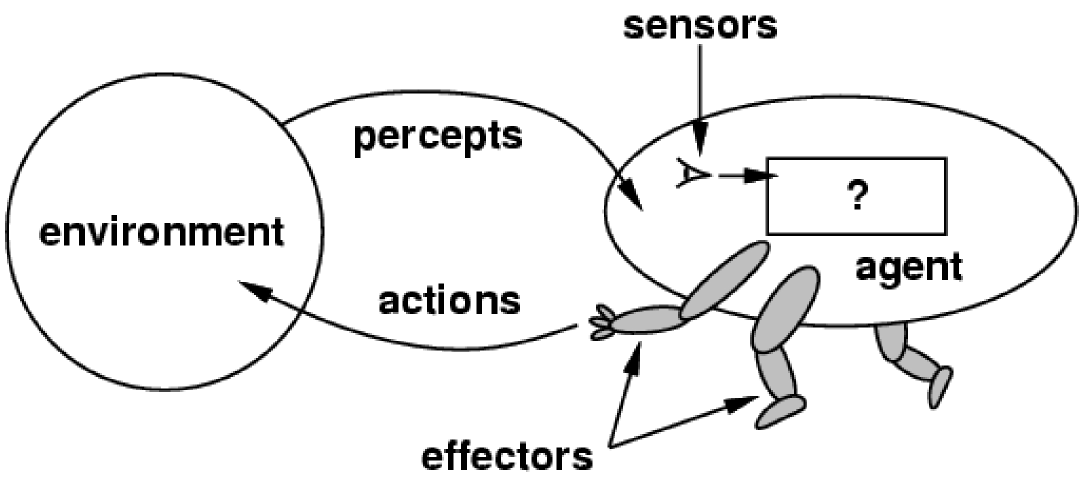


- Understand natural language robustly (e.g., read and understand articles in a newspaper)
- Surf the web
- Interpret an arbitrary visual scene
- Learn a natural language
- Play Go well
- Construct plans in dynamic real-time domains
- Refocus attention in complex environments
- Perform life-long learning

What is intelligent Agent?

- Intelligent agent is an agent that perceives its environment, takes actions autonomously in order to achieve goals, and may improve its performance with learning or acquiring knowledge.

- Properties
  - •Autonomous
  - •Reactive to the environment
  - •Pro-active (goal-directed)
  - •Interacts with other agents directly or via the environment



Some agent types

(0) Table-driven agents

- use a percept sequence/action table in memory to find the next action. They are implemented by a (large) **lookup table**. For example (cleaner robot).

(1) Simple reflex agents

- are based on **condition-action rules**, implemented with an appropriate production system. They are stateless devices which do not have memory of past world states. For example (Automated Room Light System)

(2) Agents with memory

- have **internal state**, which is used to keep track of past states of the world. For example(Smart Home Thermostat)

(3) Agents with goals

- are agents that, in addition to state information, have **goal information** that describes desirable situations. Agents of this kind take future events into consideration. For example (A Delivery Robot)

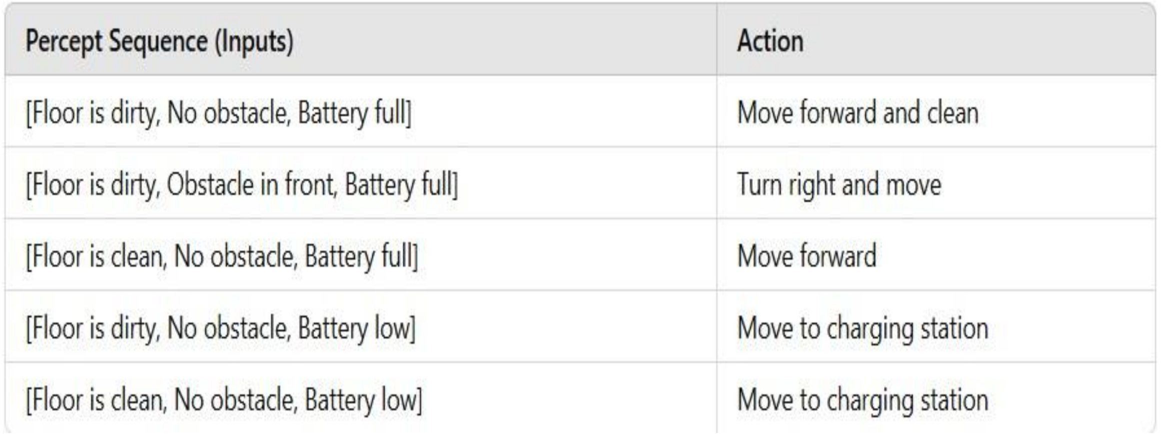
(4) Utility-based agents

- base their decisions on **classic axiomatic utility theory** in order to act rationally. For example (Self-driving car)

(0) Table-driven agents

- **Table lookup** of percept-action pairs mapping from every possible perceived state to the optimal action for that state

The robot uses these percepts to decide what action to take, and it has a **predefined percept sequence/action table** stored in its memory. Here’s a simplified example of how this table might look:

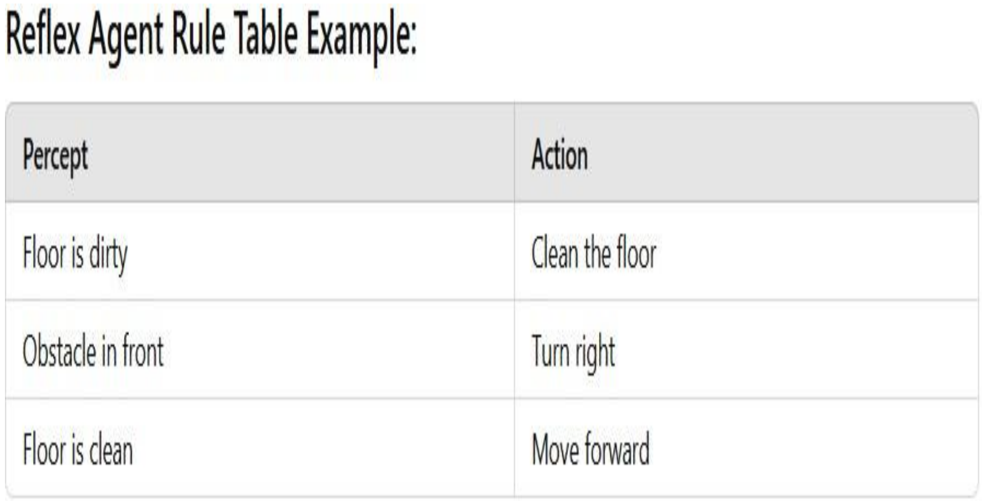


Percept Sequence (Inputs)	Action
[Floor is dirty, No obstacle, Battery full]	Move forward and clean
[Floor is dirty, Obstacle in front, Battery full]	Turn right and move
[Floor is clean, No obstacle, Battery full]	Move forward
[Floor is dirty, No obstacle, Battery low]	Move to charging station
[Floor is clean, No obstacle, Battery low]	Move to charging station

Avoids obstacles and plans in advance.
LiDAR navigation and 3D mapping combine to plot the optimum route.

(1) Simple reflex agents

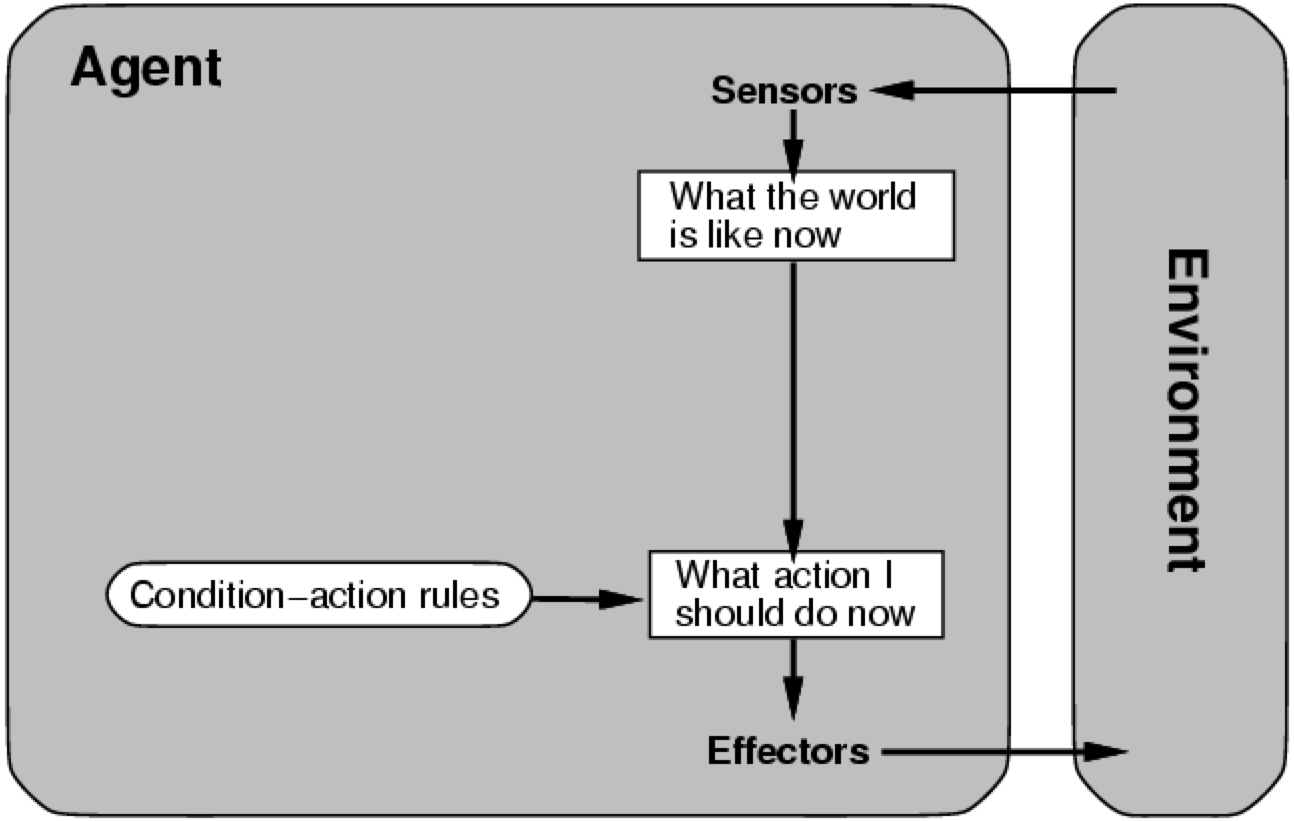
- A **simple reflex agent** acts solely based on the current percept, without considering the history of past percepts. It operates using a set of predefined rules that map specific conditions (percepts) directly to actions.
- Let's say the robot encounters the following percepts:
- Floor is dirty, No obstacle in front:
- Action: Clean the floor (according to the first rule).
- Floor is dirty, Obstacle in front:
- Action: Turn right (according to the second rule).



Reflex Agent Rule Table Example:

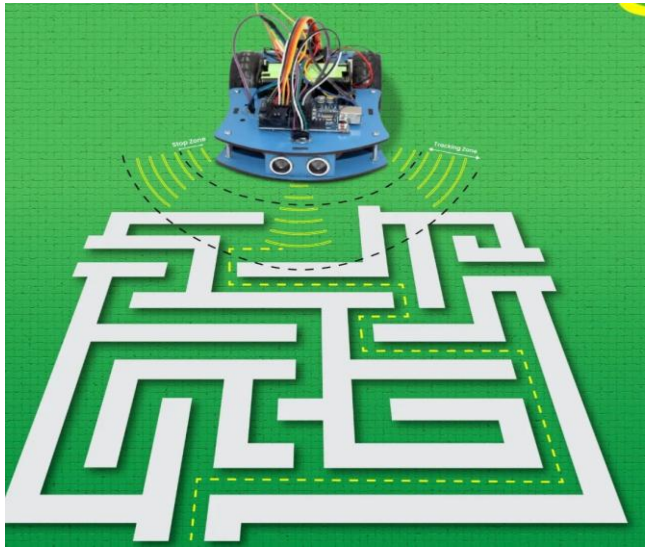
Percept	Action
Floor is dirty	Clean the floor
Obstacle in front	Turn right
Floor is clean	Move forward

(0/1) Table-driven/reflex agent architecture

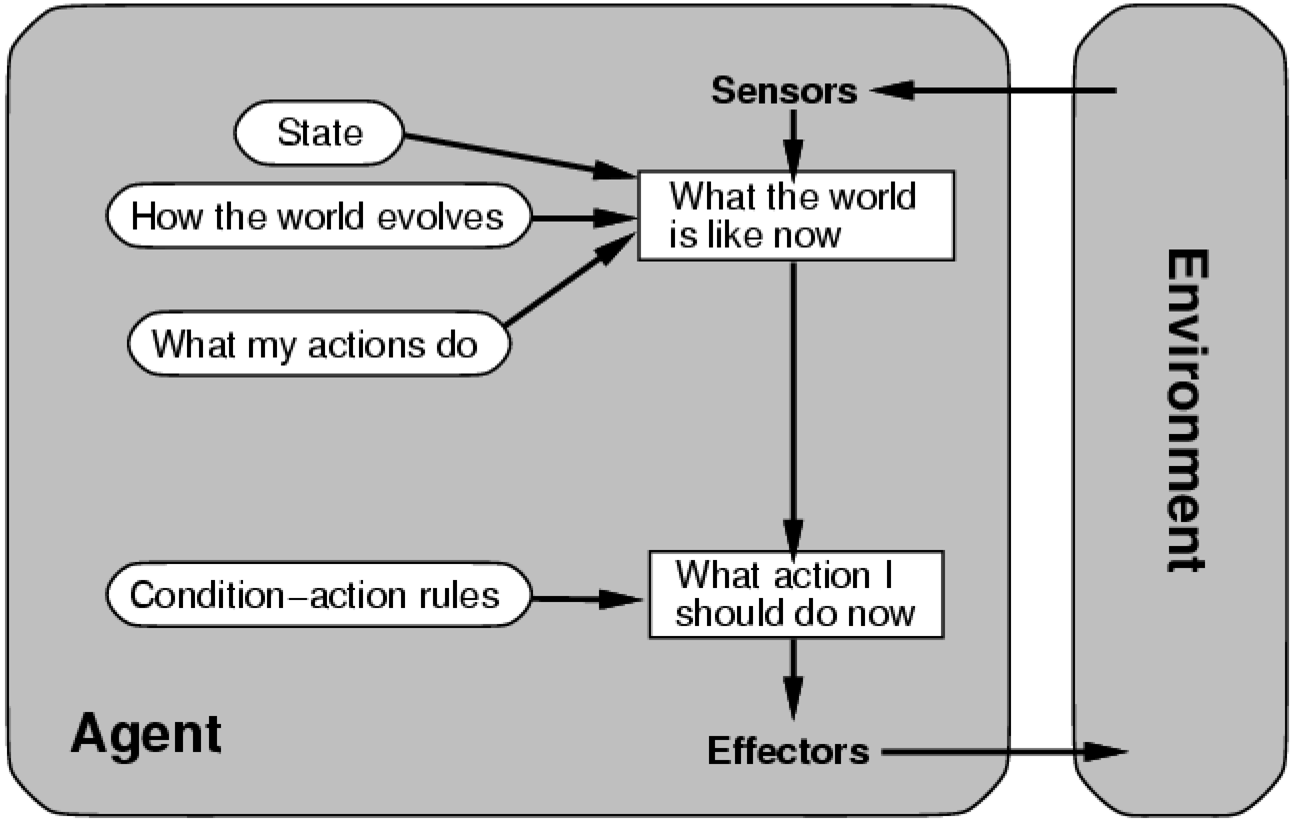


(2) Agents with memory

- An **agent with memory** stores information about past percepts or states to make more informed decisions. This memory allows the agent to consider the history of its environment and adjust its behavior accordingly.
- **Example: Maze-Solving Robot**
- Imagine a **maze-solving robot** that needs to find its way out of a maze. The robot uses its memory to remember the paths it has already taken to avoid getting stuck in loops.
- **Percepts (Inputs):**
- **Current location** (Percept 1)
- **Available paths (e.g., left, right, forward, backward)** (Percept 2)
- **Visited locations** (Percept 3, stored in memory)



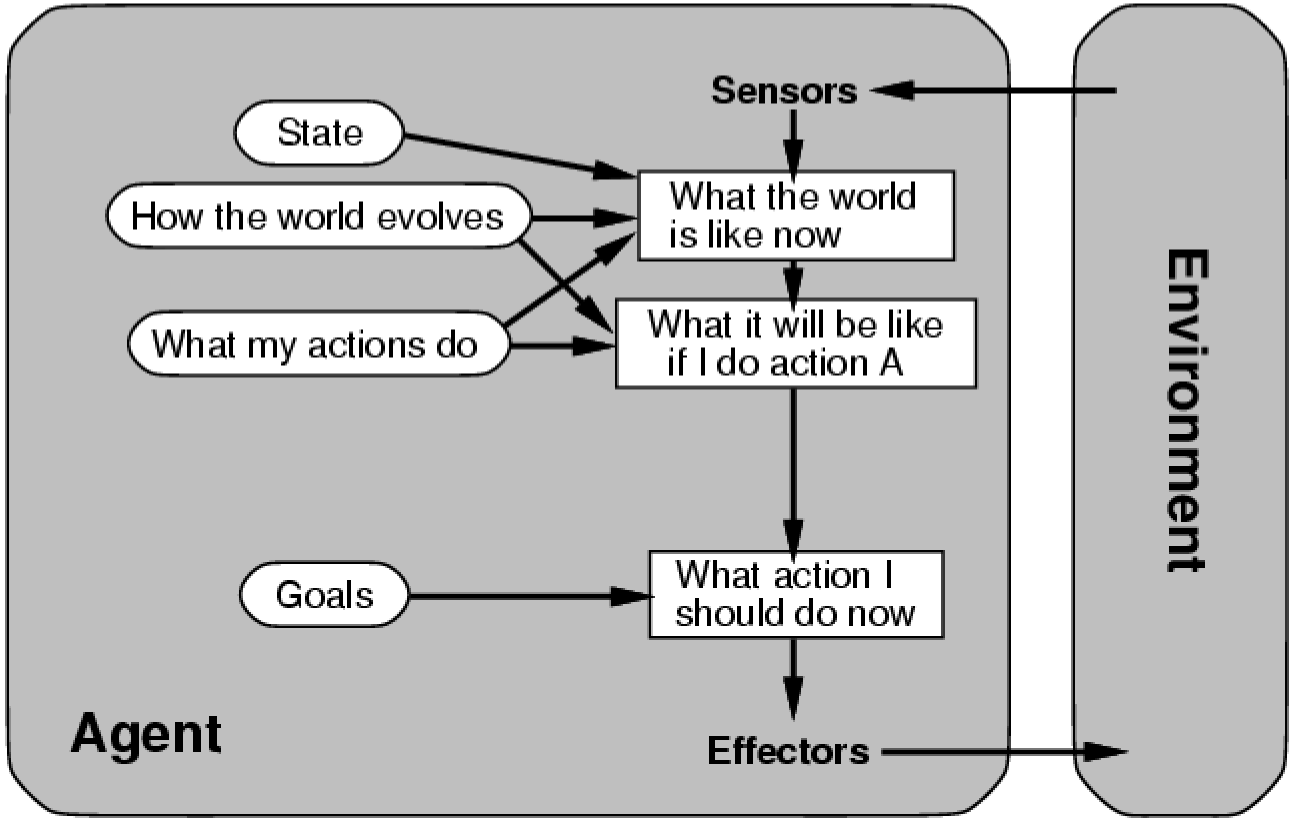
(2) Architecture for an agent with memory



(3) Goal-based agents

- An **agent with goals** chooses actions that help it achieve specific goals. Unlike simple reflex agents, goal-based agents take future consequences into account and act to bring about the desired goal state.
- **Example: A Delivery Robot**
- Let’s imagine a **delivery robot** that operates in a warehouse. The robot has a goal of delivering packages to specific locations. It uses its perception of the environment and its goal to choose actions.
- **Percepts (Inputs):**
- **Package location** (Percept 1)
- **Current robot location** (Percept 2)
- **Path obstacles** (Percept 3)
- **Target delivery location** (Percept 4)

(3) Architecture for goal-based agent


Sensors
State
How the world evolves
What my actions do
What the world is like now
What it will be like if I do action A
Goals
What action I should do now
Effectors
Agent
Environment

(4) Utility-based agents

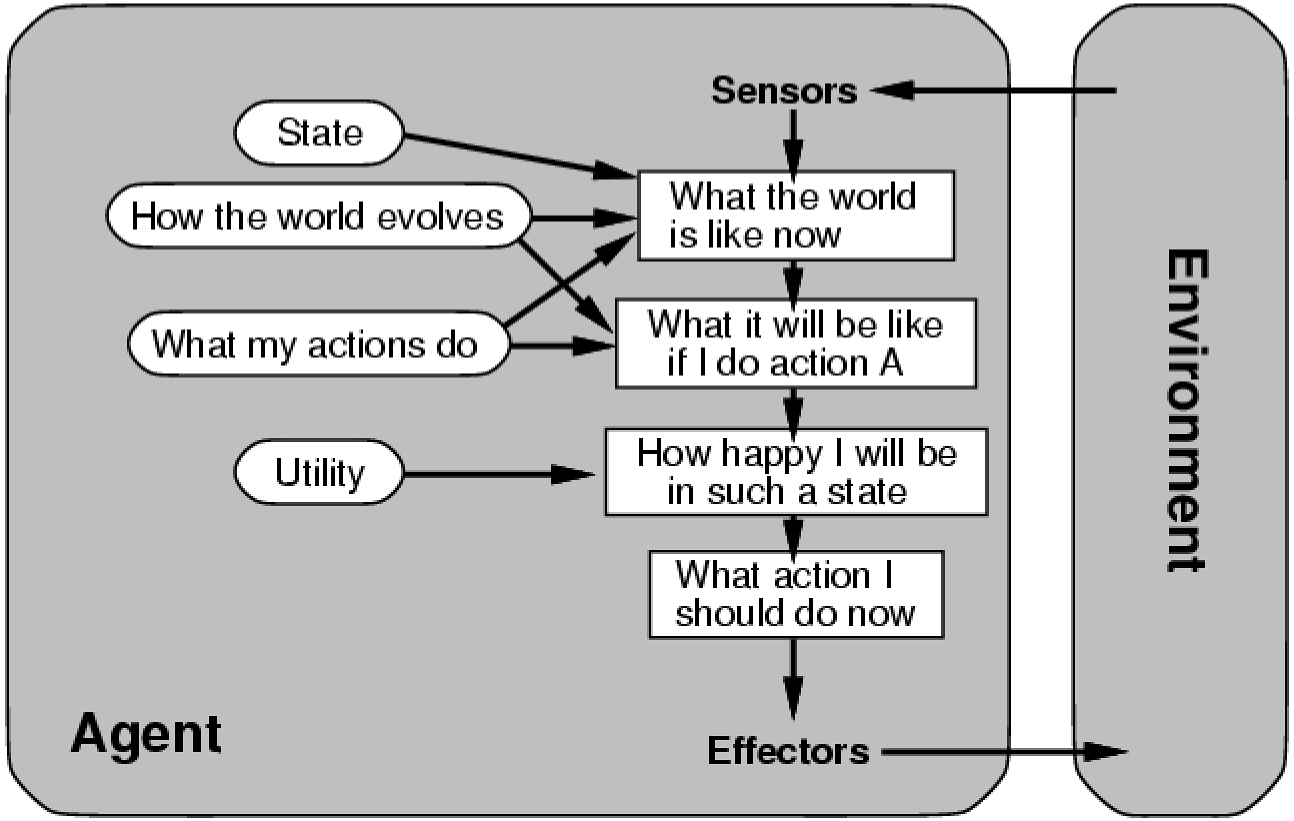
- A **utility-based agent** chooses its actions by considering multiple possible outcomes and selecting the one that maximizes its utility (a measure of how "good" a particular state or outcome is). Unlike simple reflex agents, utility-based agents use a performance metric to evaluate the desirability of outcomes, often in uncertain environments.

Example: Self-driving car

- Let’s imagine a **self-driving car** as a utility-based agent. The car has a variety of goals, such as reaching its destination safely, minimizing travel time, and ensuring passenger comfort. Each possible action the car can take is evaluated based on how well it achieves these goals.

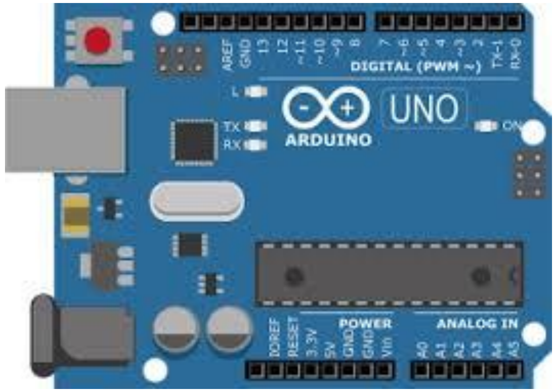
- **Percepts (Inputs):**
- **Current speed** (Percept 1)
- **Traffic conditions** (Percept 2)
- **Distance to destination** (Percept 3)
- **Obstacle on road** (Percept 4)
- **Weather conditions** (Percept 5)

(4) Architecture for a complete utility-based agent


Sensors
State
How the world evolves
What my actions do
Utility
What the world is like now
What it will be like if I do action A
How happy I will be in such a state
What action I should do now
Effectors
Agent
Environment

ARDUINO

- WHAT IS ARDUINO?
- Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects.
- https://www.arduino.cc/



Any Question!