Unit 1

What is Artificial Intelligence?

According to the father of Artificial Intelligence, John McCarthy, it is *"The science and engineering of making intelligent machines, especially intelligent computer programs"*.

Artificial Intelligence is a way of **making a computer, a computer-controlled robot, or a software think intelligently**, in the similar manner the intelligent humans think.

AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

Philosophy of AI

While exploiting the power of the computer systems, the curiosity of human, lead him to wonder, *"Can a machine think and behave like humans do?"*

Thus, the development of AI started with the intention of creating similar intelligence in machines that we find and regard high in humans.

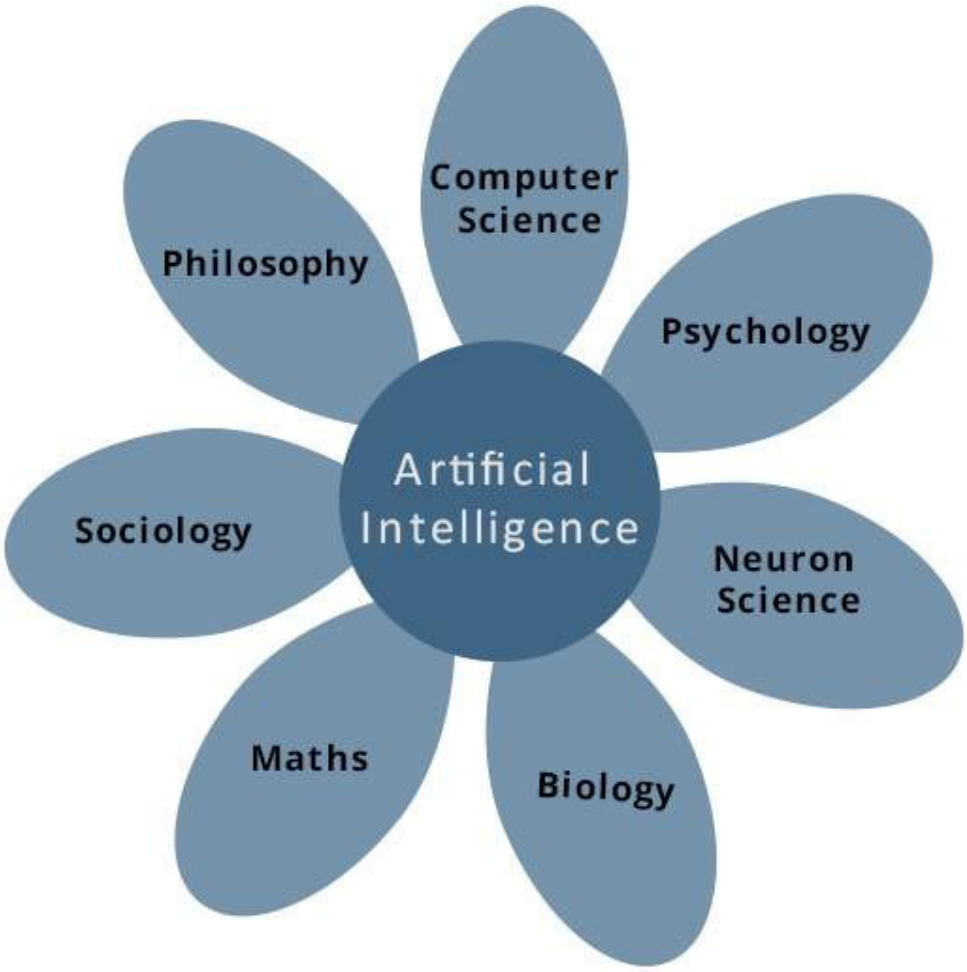
Goals of AI

- **To Create Expert Systems –** The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.
- **To Implement Human Intelligence in Machines –** Creating systems that understand, think, learn, and behave like humans.

What Contributes to AI?

Artificial intelligence is a science and technology based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering. A major thrust of AI is in the development of computer functions associated with human intelligence, such as reasoning, learning, and problem solving.

Out of the following areas, one or multiple areas can contribute to build an intelligent system.



Typical problems to which AI methods are applied

- Optical character recognition
- Handwriting recognition
- Speech recognition
- Face recognition
- Artificial creativity
- Computer vision
- Virtual reality
- Image processing
- Motion interpolation[89]
- Pixel-art scaling algorithms[90]
- Image scaling[91]
- Image restoration[92][93]
- Photo colorization[94]

- Photo and video manipulation
- Diagnosis (artificial intelligence)
- Game theory and strategic planning
- Game artificial intelligence and computer game bot
- Natural language processing, translation and chatterbots
- Nonlinear control and robotics

Intelligent Agents

Intelligent Agents can be any entity or object like human beings, software, machines. These agents are capable of making decisions based on the inputs it receives from the environment using its sensors and acts on the environment using actuators. AI-Enabled agents collect input from the environment by making use of sensors like cameras, microphone or other sensing devices. The agents perform some real-time computation on the input and deliver output using actuators like screen or speaker. These agents have abilities like Real-Time problem solving, Error or Success rate analysis and information retrieval.

The Structure of Intelligent Agents

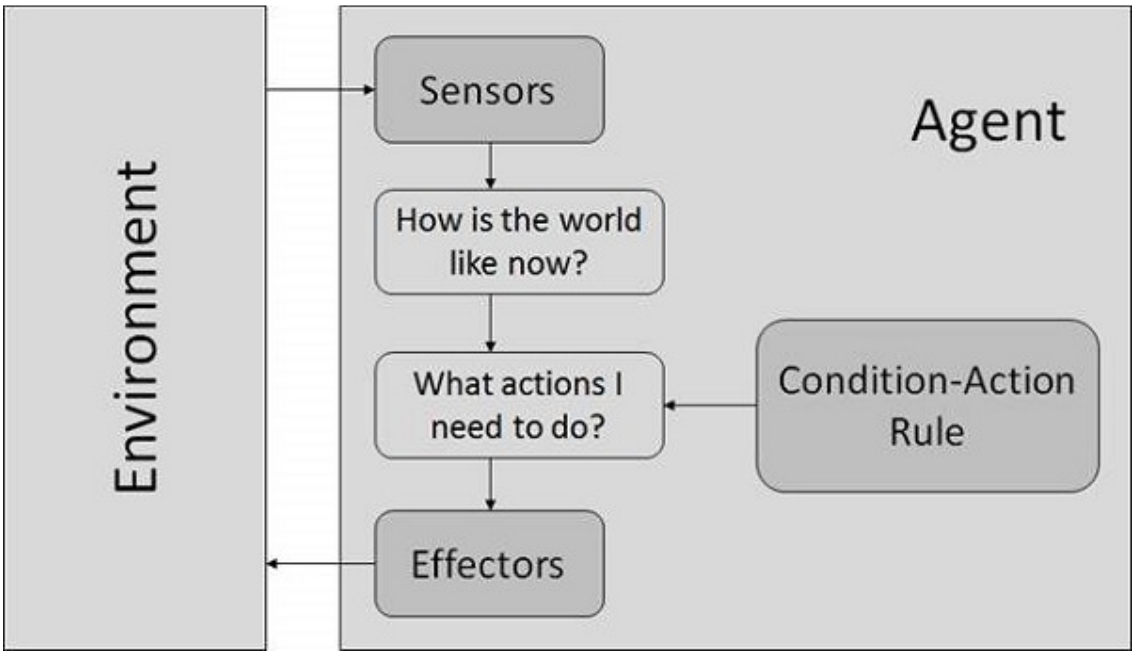
Agent's structure can be viewed as –

- Agent = Architecture + Agent Program
- Architecture = the machinery that an agent executes on.
- Agent Program = an implementation of an agent function.

Simple Reflex Agents

- They choose actions only based on the current percept.
- They are rational only if a correct decision is made only on the basis of current precept.
- Their environment is completely observable.

Condition-Action Rule – It is a rule that maps a state (condition) to an action.



Model Based Reflex Agents

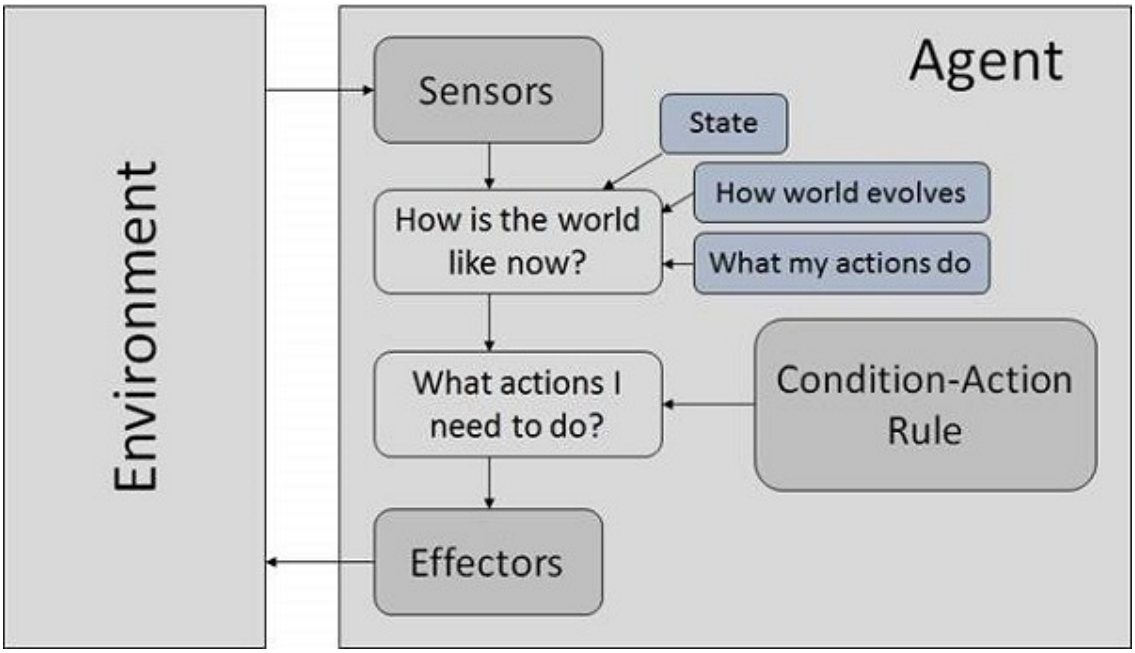
They use a model of the world to choose their actions. They maintain an internal state.

Model – knowledge about "how the things happen in the world".

Internal State – It is a representation of unobserved aspects of current state depending on percept history.

Updating the state requires the information about –

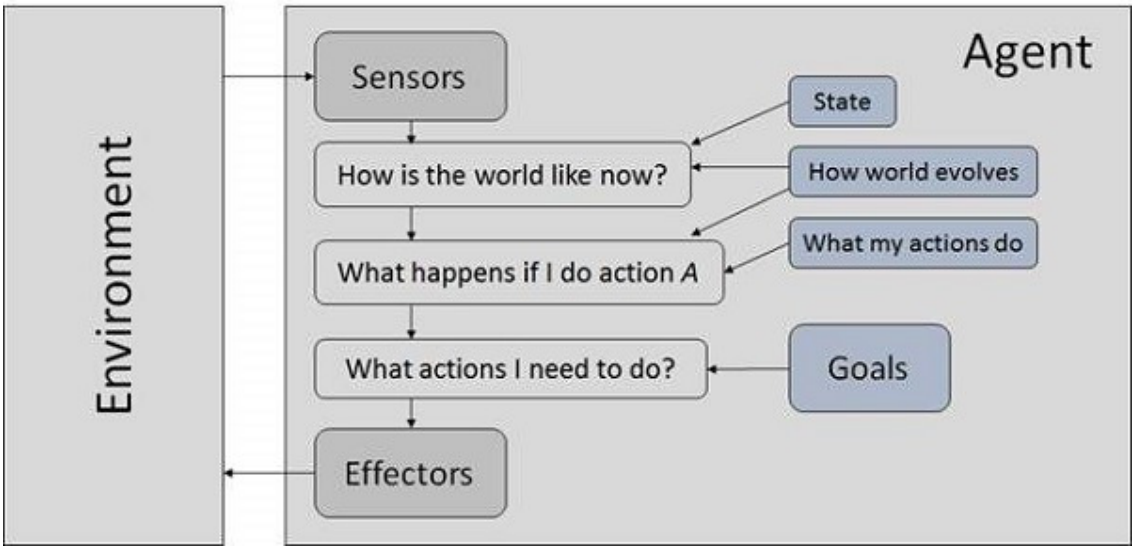
- How the world evolves.
- How the agent's actions affect the world.



Goal Based Agents

They choose their actions in order to achieve goals. Goal-based approach is more flexible than reflex agent since the knowledge supporting a decision is explicitly modeled, thereby allowing for modifications.

Goal – It is the description of desirable situations.



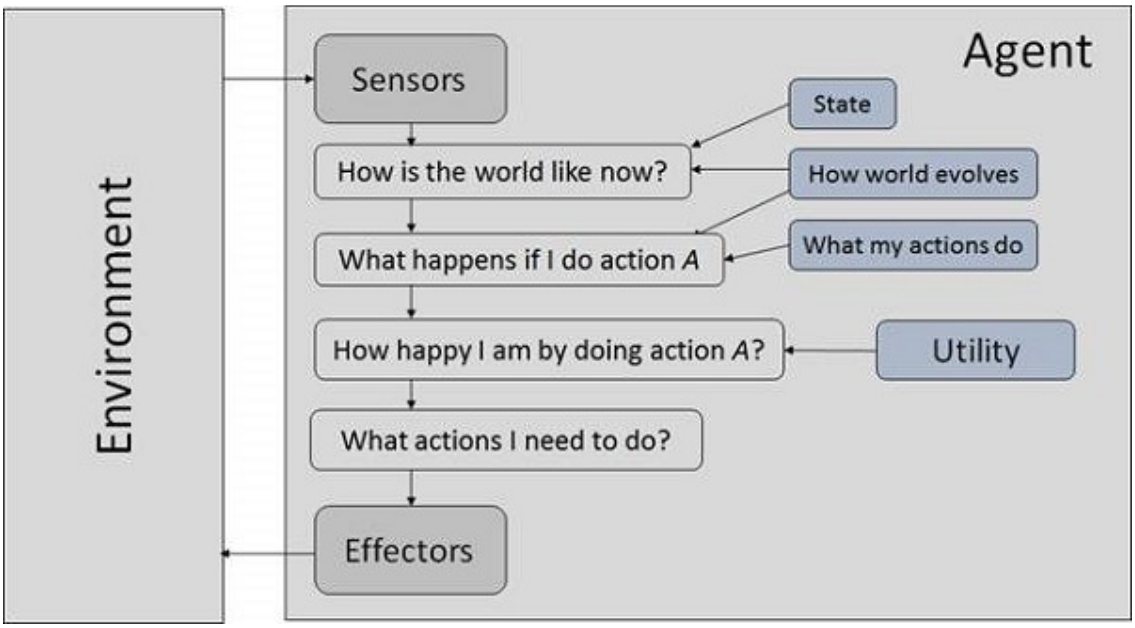
Utility Based Agents

They choose actions based on a preference (utility) for each state.

Goals are inadequate when –

- There are conflicting goals, out of which only few can be achieved.

- Goals have some uncertainty of being achieved and you need to weigh likelihood of success against the importance of a goal.



Natural Language Processing (NLP)

NLP refers to AI method of communicating with an intelligent systems using a natural language such as English.

Processing of Natural Language is required when you want an intelligent system like robot to perform as per your instructions, when you want to hear decision from a dialogue based clinical expert system, etc.

The field of NLP involves making computers to perform useful tasks with the natural languages humans use. The input and output of an NLP system can be –

- Speech
- Written Text

Components of NLP

There are two components of NLP as given –

Natural Language Understanding (NLU)

Understanding involves the following tasks –

- Mapping the given input in natural language into useful representations.
- Analyzing different aspects of the language.

Natural Language Generation (NLG)

It is the process of producing meaningful phrases and sentences in the form of natural language from some internal representation.

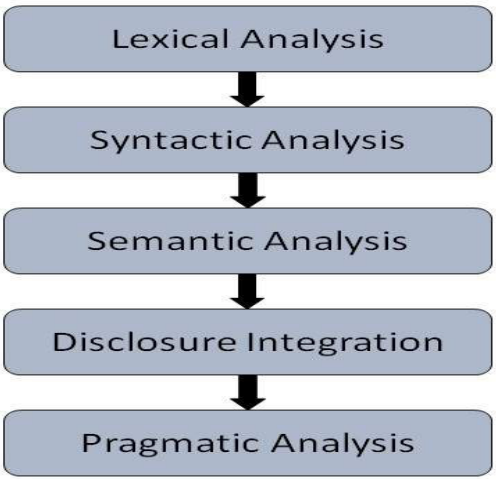
It involves –

- **Text planning –** It includes retrieving the relevant content from knowledge base.
- **Sentence planning –** It includes choosing required words, forming meaningful phrases, setting tone of the sentence.
- **Text Realization –** It is mapping sentence plan into sentence structure.

The NLU is harder than NLG.

There are general five steps –

- **Lexical Analysis –** It involves identifying and analyzing the structure of words. Lexicon of a language means the collection of words and phrases in a language. Lexical analysis is dividing the whole chunk of txt into paragraphs, sentences, and words.
- **Syntactic Analysis (Parsing) –** It involves analysis of words in the sentence for grammar and arranging words in a manner that shows the relationship among the words. The sentence such as "The school goes to boy" is rejected by English syntactic analyzer.



- **Semantic Analysis –** It draws the exact meaning or the dictionary meaning from the text. The text is checked for meaningfulness. It is done by mapping syntactic structures and objects in the task domain. The semantic analyzer disregards sentence such as "hot ice-cream".

- **Discourse Integration –** The meaning of any sentence depends upon the meaning of the sentence just before it. In addition, it also brings about the meaning of immediately succeeding sentence.
- **Pragmatic Analysis –** During this, what was said is re-interpreted on what it actually meant. It involves deriving those aspects of language which require real world knowledge.

COMPUTER VISION

Computer vision is an interdisciplinary field that deals with how computers can be made to gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do.Computer vision is concerned with the automatic extraction, analysis and understanding of useful information from a single image or a sequence of images. It involves the development of a theoretical and algorithmic basis to achieve automatic visual understanding.As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models for the construction of computer vision systems.

References

1. Wikipedia
2. Tutorialspoint