AI with Python – Primer Concept

Since the invention of computers or machines, their capability to perform various tasks has experienced an exponential growth. Humans have developed the power of computer systems in terms of their diverse working domains, their increasing speed, and reducing size with respect to time.

A branch of Computer Science named Artificial Intelligence pursues creating the computers or machines as intelligent as human beings.

Basic Concept of Artificial Intelligence (AI)

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.

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.

The Necessity of Learning AI

As we know that AI pursues creating the machines as intelligent as human beings. There are numerous reasons for us to study AI. The reasons are as follows –

AI can learn through data

In our daily life, we deal with huge amount of data and human brain cannot keep track of so much data. That is why we need to automate the things. For doing automation, we need to study AI because it can learn from data and can do the repetitive tasks with accuracy and without tiredness.

AI can teach itself

It is very necessary that a system should teach itself because the data itself keeps changing and the knowledge which is derived from such data must be updated

constantly. We can use AI to fulfill this purpose because an AI enabled system can teach itself.

AI can respond in real time

Artificial intelligence with the help of neural networks can analyze the data more deeply. Due to this capability, AI can think and respond to the situations which are based on the conditions in real time.

AI achieves accuracy

With the help of deep neural networks, AI can achieve tremendous accuracy. AI helps in the field of medicine to diagnose diseases such as cancer from the MRIs of patients.

AI can organize data to get most out of it

The data is an intellectual property for the systems which are using self-learning algorithms. We need AI to index and organize the data in a way that it always gives the best results.

Understanding Intelligence

With AI, smart systems can be built. We need to understand the concept of intelligence so that our brain can construct another intelligence system like itself.

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What is Intelligence?

The ability of a system to calculate, reason, perceive relationships and analogies, learn from experience, store and retrieve information from memory, solve problems, comprehend complex ideas, use natural language fluently, classify, generalize, and adapt new situations.

Types of Intelligence

As described by Howard Gardner, an American developmental psychologist, Intelligence comes in multifold –

Sr.No	Intelligence & Description	Example

1	**Linguistic intelligence** The ability to speak, recognize, and use mechanisms of phonology (speech sounds), syntax (grammar), and semantics (meaning).	Narrators, Orators
2	**Musical intelligence** The ability to create, communicate with, and understand meanings made of sound, understanding of pitch, rhythm.	Musicians, Singers, Composers
3	**Logical-mathematical intelligence** The ability to use and understand relationships in the absence of action or objects. It is also the ability to understand complex and abstract ideas.	Mathematicians, Scientists
4	**Spatial intelligence** The ability to perceive visual or spatial information, change it, and re-create visual images without reference to the objects, construct 3D images, and to move and rotate them.	Map readers, Astronauts, Physicists
5	**Bodily-Kinesthetic intelligence** The ability to use complete or part of the body to solve problems or fashion products, control over fine and coarse motor skills, and manipulate the objects.	Players, Dancers
6	**Intra-personal intelligence** The ability to distinguish among one's own feelings, intentions, and motivations.	Gautam Buddhha
7	**Interpersonal intelligence** The ability to recognize and make distinctions among other people's feelings, beliefs, and intentions.	Mass Communicators, Interviewers

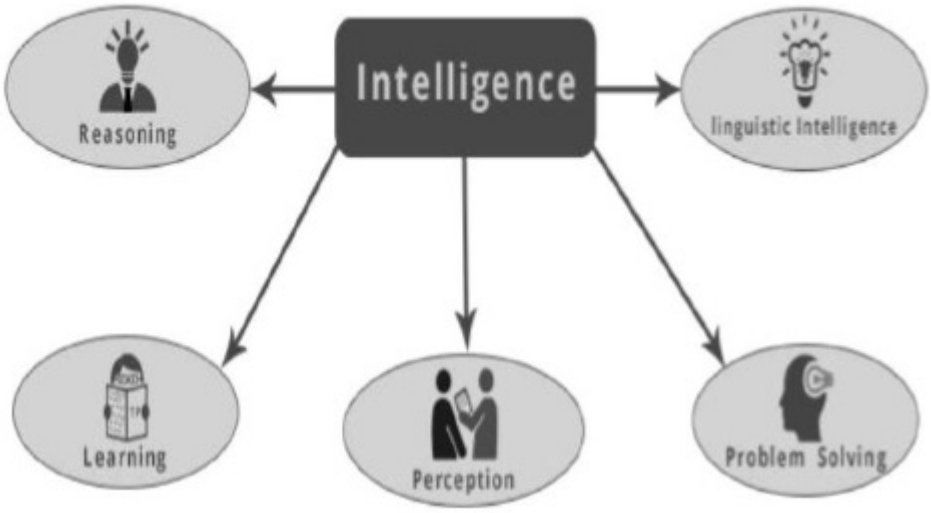
You can say a machine or a system is artificially intelligent when it is equipped with at least one or all intelligences in it.

What is Intelligence Composed Of?

The intelligence is intangible. It is composed of −

- Reasoning
- Learning
- Problem Solving
- Perception

- Linguistic Intelligence



Let us go through all the components briefly –

Reasoning

It is the set of processes that enable us to provide basis for judgement, making decisions, and prediction. There are broadly two types –

Inductive Reasoning	Deductive Reasoning
It conducts specific observations to makes broad general statements.	It starts with a general statement and examines the possibilities to reach a specific, logical conclusion.
Even if all of the premises are true in a statement, inductive reasoning allows for the conclusion to be false.	If something is true of a class of things in general, it is also true for all members of that class.
Example – "Nita is a teacher. Nita is studious. Therefore, All teachers are studious."	**Example** – "All women of age above 60 years are grandmothers. Shalini is 65 years. Therefore, Shalini is a grandmother."

Learning – l

The ability of learning is possessed by humans, particular species of animals, and AI-enabled systems. Learning is categorized as follows –

Auditory Learning

It is learning by listening and hearing. For example, students listening to recorded audio lectures.

Episodic Learning

To learn by remembering sequences of events that one has witnessed or experienced. This is linear and orderly.

Motor Learning

It is learning by precise movement of muscles. For example, picking objects, writing, etc.

Observational Learning

To learn by watching and imitating others. For example, child tries to learn by mimicking her parent.

Perceptual Learning

It is learning to recognize stimuli that one has seen before. For example, identifying and classifying objects and situations.

Relational Learning

It involves learning to differentiate among various stimuli on the basis of relational properties, rather than absolute properties. For Example, Adding 'little less' salt at the time of cooking potatoes that came up salty last time, when cooked with adding say a tablespoon of salt.

- **Spatial Learning** – It is learning through visual stimuli such as images, colors, maps, etc. For example, A person can create roadmap in mind before actually following the road.
- **Stimulus-Response Learning** – It is learning to perform a particular behavior when a certain stimulus is present. For example, a dog raises its ear on hearing doorbell.

Problem Solving

It is the process in which one perceives and tries to arrive at a desired solution from a present situation by taking some path, which is blocked by known or unknown hurdles.

Problem solving also includes **decision making**, which is the process of selecting the best suitable alternative out of multiple alternatives to reach the desired goal.

Perception

It is the process of acquiring, interpreting, selecting, and organizing sensory information.

Perception presumes **sensing**. In humans, perception is aided by sensory organs. In the domain of AI, perception mechanism puts the data acquired by the sensors together in a meaningful manner.

Linguistic Intelligence

It is one's ability to use, comprehend, speak, and write the verbal and written language. It is important in interpersonal communication.

What's Involved in AI

Artificial intelligence is a vast area of study. This field of study helps in finding solutions to real world problems.

Let us now see the different fields of study within AI –

Machine Learning

It is one of the most popular fields of AI. The basic concept of this filed is to make the machine learning from data as the human beings can learn from his/her experience. It contains learning models on the basis of which the predictions can be made on unknown data.

Logic

It is another important field of study in which mathematical logic is used to execute the computer programs. It contains rules and facts to perform pattern matching, semantic analysis, etc.

Searching

This field of study is basically used in games like chess, tic-tac-toe. Search algorithms give the optimal solution after searching the whole search space.

Artificial neural networks

This is a network of efficient computing systems the central theme of which is borrowed from the analogy of biological neural networks. ANN can be used in robotics, speech

recognition, speech processing, etc.

Genetic Algorithm

Genetic algorithms help in solving problems with the assistance of more than one program. The result would be based on selecting the fittest.

Knowledge Representation

It is the field of study with the help of which we can represent the facts in a way the machine that is understandable to the machine. The more efficiently knowledge is represented; the more system would be intelligent.

Application of AI

In this section, we will see the different fields supported by AI −

Gaming

AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge.

Natural Language Processing

It is possible to interact with the computer that understands natural language spoken by humans.

Expert Systems

There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.

Vision Systems

These systems understand, interpret, and comprehend visual input on the computer. For example,

- A spying aeroplane takes photographs, which are used to figure out spatial information or map of the areas.
- Doctors use clinical expert system to diagnose the patient.
- Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist.

Speech Recognition

Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human's noise due to cold, etc.

Handwriting Recognition

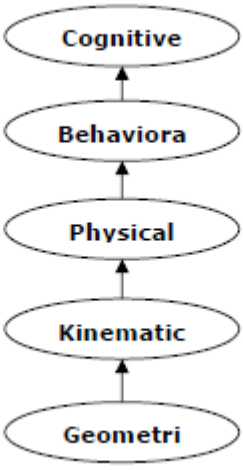
The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.

Intelligent Robots

Robots are able to perform the tasks given by a human. They have sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence. In addition, they are capable of learning from their mistakes and they can adapt to the new environment.

Cognitive Modeling: Simulating Human Thinking Procedure

Cognitive modeling is basically the field of study within computer science that deals with the study and simulating the thinking process of human beings. The main task of AI is to make machine think like human. The most important feature of human thinking process is problem solving. That is why more or less cognitive modeling tries to understand how humans can solve the problems. After that this model can be used for various AI applications such as machine learning, robotics, natural language processing, etc. Following is the diagram of different thinking levels of human brain –



Agent & Environment

In this section, we will focus on the agent and environment and how these help in Artificial Intelligence.

Agent

An agent is anything that can perceive its environment through sensors and acts upon that environment through effectors.

- A **human agent** has sensory organs such as eyes, ears, nose, tongue and skin parallel to the sensors, and other organs such as hands, legs, mouth, for effectors.
- A **robotic agent** replaces cameras and infrared range finders for the sensors, and various motors and actuators for effectors.
- A **software agent** has encoded bit strings as its programs and actions.

Environment

Some programs operate in an entirely **artificial environment** confined to keyboard input, database, computer file systems and character output on a screen.

In contrast, some software agents (software robots or softbots) exist in rich, unlimited softbots domains. The simulator has a **very detailed, complex environment**. The software agent needs to choose from a long array of actions in real time. A softbot is designed to scan the online preferences of the customer and shows interesting items to the customer works in the **real** as well as an **artificial** environment.