AI notes

Artificial Intelligence : The Future Of Programming

Since the invention of computers or machines, their capability to perform various tasks went on growing exponentially. 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.

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?"*

Philosophical AI is AI, not philosophy; but it's AI rooted in and flowing from, philosophy.

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

The philosophy of artificial intelligence is a branch of the philosophy of technology that explores artificial intelligence and its implications for knowledge and understanding of intelligence, ethics, consciousness, epistemology, and free will. Furthermore, the technology is concerned with the creation of artificial animals or artificial people (or, at least, artificial creatures; see artificial life) so the discipline is of considerable interest to philosophers. These factors contributed to the emergence of the philosophy of artificial intelligence. Some scholars argue that the AI community's dismissal of philosophy is detrimental.

The philosophy of artificial intelligence attempts to answer such questions as follows:

- Can a machine act intelligently? Can it solve *any* problem that a person would solve by thinking?
- Are human intelligence and machine intelligence the same? Is the human brain essentially a computer?
- Can a machine have a mind, mental states, and consciousness in the same sense that a human being can? Can it *feel how things are*?

Questions like these reflect the divergent interests of AI researchers, cognitive scientists and philosophers respectively. The scientific answers to these questions depend on the definition of "intelligence" and "consciousness" and exactly which "machines" are under discussion.

Goals of AI

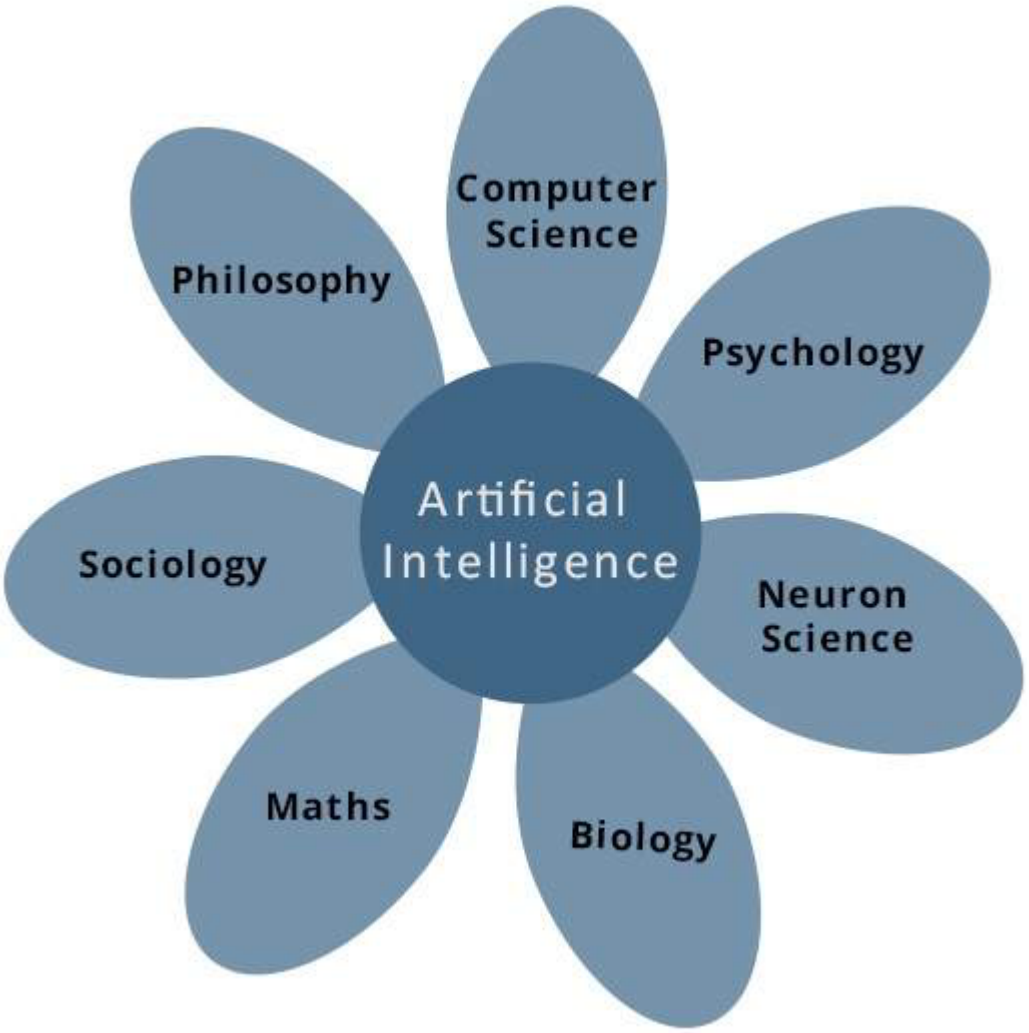
- **To Create Expert Systems** − The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.
- **To Implement Human Intelligence in Machines** − Creating systems that understand, think, learn, and behave like humans.

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.

AI is unique, sharing borders with Mathematics, Computer Science, Philosophy, Psychology, Biology, Cognitive Science and many others

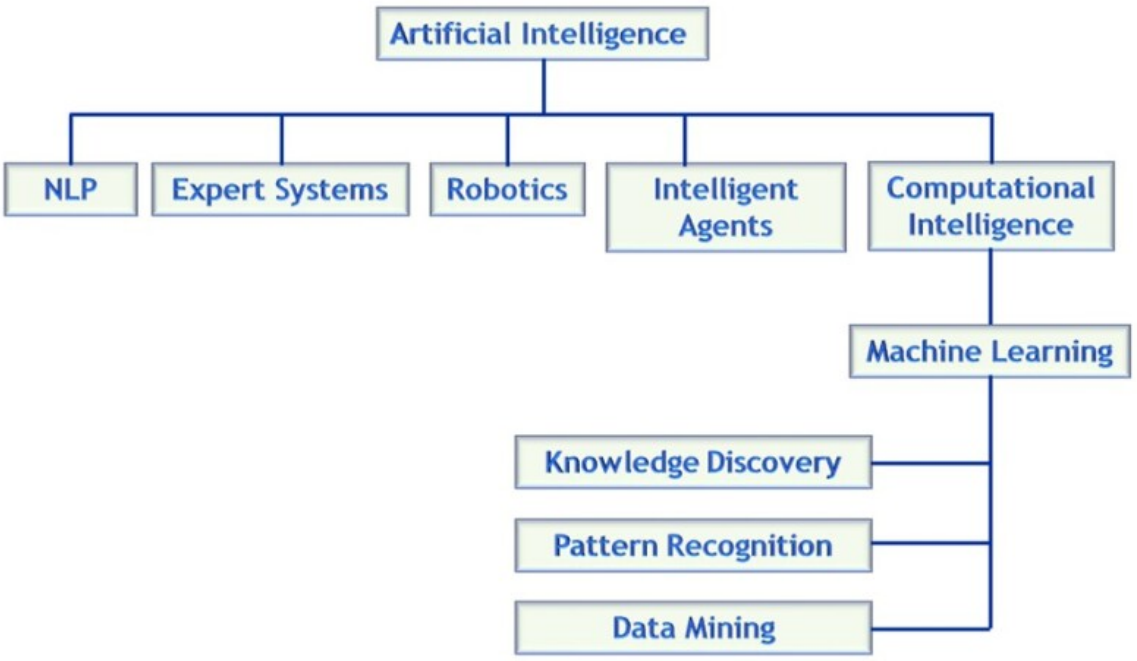


The Elements of AI

One of the simplest and most straightforward definitions of AI was presented by John McCarthy, a professor of computer science at Stanford University, as “the science and engineering of making intelligent systems.” The intelligent systems could be in the form of software, hardware, or a combination of both

The key elements of AI include:

- Natural language processing (NLP)
- Expert systems
- Robotics
- Intelligent agents
- Computational intelligence



Programming Without and With AI

The programming without and with AI is different in following ways −

Programming Without AI	Programming With AI
A computer program without AI can answer the **specific** questions it is meant to solve.	A computer program with AI can answer the **generic** questions it is meant to solve.
Modification in the program leads to change in its structure.	AI programs can absorb new modifications by putting highly independent pieces of information together. Hence you can modify even a minute piece of information of program without affecting its structure.
Modification is not quick and easy. It may lead to affecting the program adversely.	Quick and Easy program modification.

What is AI Technique?

In the real world, the knowledge has some unwelcomed properties −

- Its volume is huge, next to unimaginable.
- It is not well-organized or well-formatted.
- It keeps changing constantly.

AI Technique is a manner to organize and use the knowledge efficiently in such a way that −

- It should be perceivable by the people who provide it.
- It should be easily modifiable to correct errors.
- It should be useful in many situations though it is incomplete or inaccurate.

AI techniques elevate the speed of execution of the complex program it is equipped with.

Machine Learning (ML)
Machine learning focuses on applications that learn from experience and improve their decision-making or predictive accuracy over time.
Natural Language Processing (NLP)
Natural language processing strives to build machines that understand and respond to text

or voice data — and respond with text or speech of their own — in much the same way humans do.
Automation and Robotics
Expert systems or applications that are able to perform tasks given by a human. They have sensors to detect real-world data such as temperature, movement, sound, heat, pressure, light that is processed to exhibit intelligence with the capability to adapt in accordance to its inputs and learn from it's mistakes.
AutoPilot | Some Industrial Production…
Machine Vision (MV)
Is the technology and methods used to provide imaging-based automatic inspection and analysis for such applications as automatic inspection, process control, and robot guidance, usually in industry
Data Mining
Learn about data mining, which combines statistics and artificial intelligence to analyze large data sets to discover useful information

Applications of AI

AI has been dominant in various fields such as −

- **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.

History of AI

Here is the history of AI during 20th century −

Year	Milestone / Innovation
1923	Karel Čapek play named “Rossum's Universal Robots” (RUR) opens in London, first use of the word "robot" in English.
1943	Foundations for neural networks laid.
1945	Isaac Asimov, a Columbia University alumni, coined the term *Robotics*.
1950	Alan Turing introduced Turing Test for evaluation of intelligence and published *Computing Machinery and Intelligence.* Claude Shannon published *Detailed Analysis of Chess Playing* as a search.
1956	John McCarthy coined the term *Artificial Intelligence*. Demonstration of the first running AI program at Carnegie Mellon University.
1958	John McCarthy invents LISP programming language for AI.
1964	Danny Bobrow's dissertation at MIT showed that computers can understand natural language well enough to solve algebra word problems correctly.
1965	Joseph Weizenbaum at MIT built *ELIZA*, an interactive problem that carries on a dialogue in English.
1969	Scientists at Stanford Research Institute Developed *Shakey*, a robot, equipped with locomotion, perception, and problem solving.
1973	The Assembly Robotics group at Edinburgh University built *Freddy*, the Famous Scottish Robot, capable of using vision to locate and assemble models.
1979	The first computer-controlled autonomous vehicle, Stanford Cart, was

	built.
1985	Harold Cohen created and demonstrated the drawing program, *Aaron*.
1990	Major advances in all areas of AI − • Significant demonstrations in machine learning • Case-based reasoning • Multi-agent planning • Scheduling • Data mining, Web Crawler • natural language understanding and translation • Vision, Virtual Reality • Games
1997	The Deep Blue Chess Program beats the then world chess champion, Garry Kasparov.
2000	Interactive robot pets become commercially available. MIT displays *Kismet*, a robot with a face that expresses emotions. The robot *Nomad* explores remote regions of Antarctica and locates meteorites.

• 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, the Intelligence comes in multifold −

Intelligence	Description	Example
Linguistic intelligence	The ability to speak, recognize, and use mechanisms of	Narrators, Orators

	phonology (speech sounds), syntax (grammar), and semantics (meaning).	
Musical intelligence	The ability to create, communicate with, and understand meanings made of sound, understanding of pitch, rhythm.	Musicians, Singers, Composers
Logical-mathematical intelligence	The ability of use and understand relationships in the absence of action or objects. Understanding complex and abstract ideas.	Mathematicians, Scientists
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
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
Intra-personal intelligence	The ability to distinguish among one's own feelings, intentions, and motivations.	Gautam Buddhha
Interpersonal intelligence	The ability to recognize and make distinctions among other people's feelings, beliefs, and intentions.	Mass Communicators, Interviewers

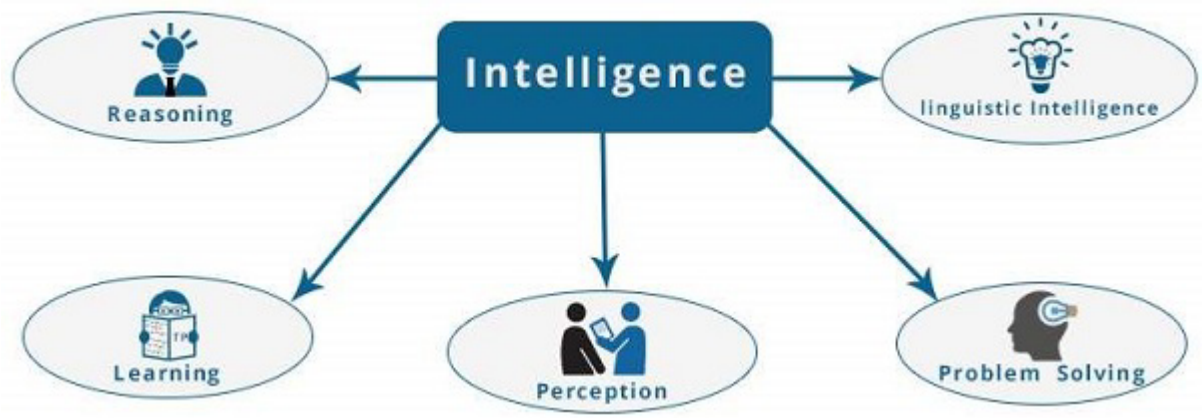
You can say a machine or a system is **artificially intelligent** when it is equipped with at least one and at most all intelligences in it.

- ## 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 enables 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** − It is the activity of gaining knowledge or skill by studying, practising, being taught, or experiencing something. Learning enhances the awareness of the subjects of the study.
  The ability of learning is possessed by humans, some animals, and AI-enabled systems. Learning is categorized as −

    - **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 are available.
- **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.

Difference between Human and Machine Intelligence

- Humans perceive by patterns whereas the machines perceive by set of rules and data.
- Humans store and recall information by patterns, machines do it by searching algorithms. For example, the number 40404040 is easy to remember, store, and recall as its pattern is simple.
- Humans can figure out the complete object even if some part of it is missing or distorted; whereas the machines cannot do it correctly.

S. No.	Feature	Artificial Intelligence	Human Intelligence
1.	Emergence	AI is an advancement made by human insights; its early improvement is credited to Norbert Weiner who theorized on criticism mechanisms.	On the other hand, human creatures are made with the intrinsic capacity to think, reason, review, etc.
2.	Nature	Artificial intelligence (AI) strives to build machines that can mimic human behavior and carry out human-like tasks.	Human intelligence seeks to adapt to new situations by combining a variety of cognitive processes.
3.	State	Machines are digital.	The human brain is analogous.
4.	Function	AI-powered machines rely on input of data and instructions.	Humans use their brains' memory, processing power, and cognitive abilities.

5.	Pace/Rate of AI and human	As compared to people, computers can handle more data at a speedier rate. For occurrence, in the event that the human intellect can solve a math problem in 5 minutes, AI can solve 10 problems in a minute.	In terms of speed, humans cannot beat the speed of AI or machines.
6.	Learning ability	As machines are unable to reason abstractly or draw conclusions from the past. They can only acquire knowledge through information and frequent training, but they will never develop a human-specific thinking process.	Learning from various events and prior experiences is the foundation of human intelligence.
7.	Decision Making	AI is profoundly objective in choice making because it analyzes based on absolutely accumulated data.	Human choices may be affected by subjective components which are not based on figures alone.
8.	Perfection	AI frequently produces precise comes about because its capacities are based on a set of modified rules.	For human insights, there’s more often than not room for “human error” as certain subtle elements may be missed at one point or the other.

9.	Energy Consumption	The modern computer generally uses 2 watts of energy.	On the other hand, human brains uses about 25 watts
10.	Modification of AI and Human	AI takes much more time to adjust to unused changes.	Human insights can be adaptable in reaction to the changes in their environment. This makes individuals able to memorize and ace different skills.
11.	Versatility	AI can as it were perform fewer assignments at the same time as a framework can as it were learn duties one at a time.	The human judgment skills underpin multitasking as proven by differing and concurrent roles.
12.	Social Networking	AI has not aced the capacity to choose up on related social and enthusiastic cues.	On the other hand, as social creatures, people are much way better at social interaction since they can prepare theoretical data, have self-awareness, and are delicate to others' feelings.
13.	Task	It does optimization of the system. It cannot be creative or innovative as	It is innovative or creative.

humans can only think and
machines cannot.

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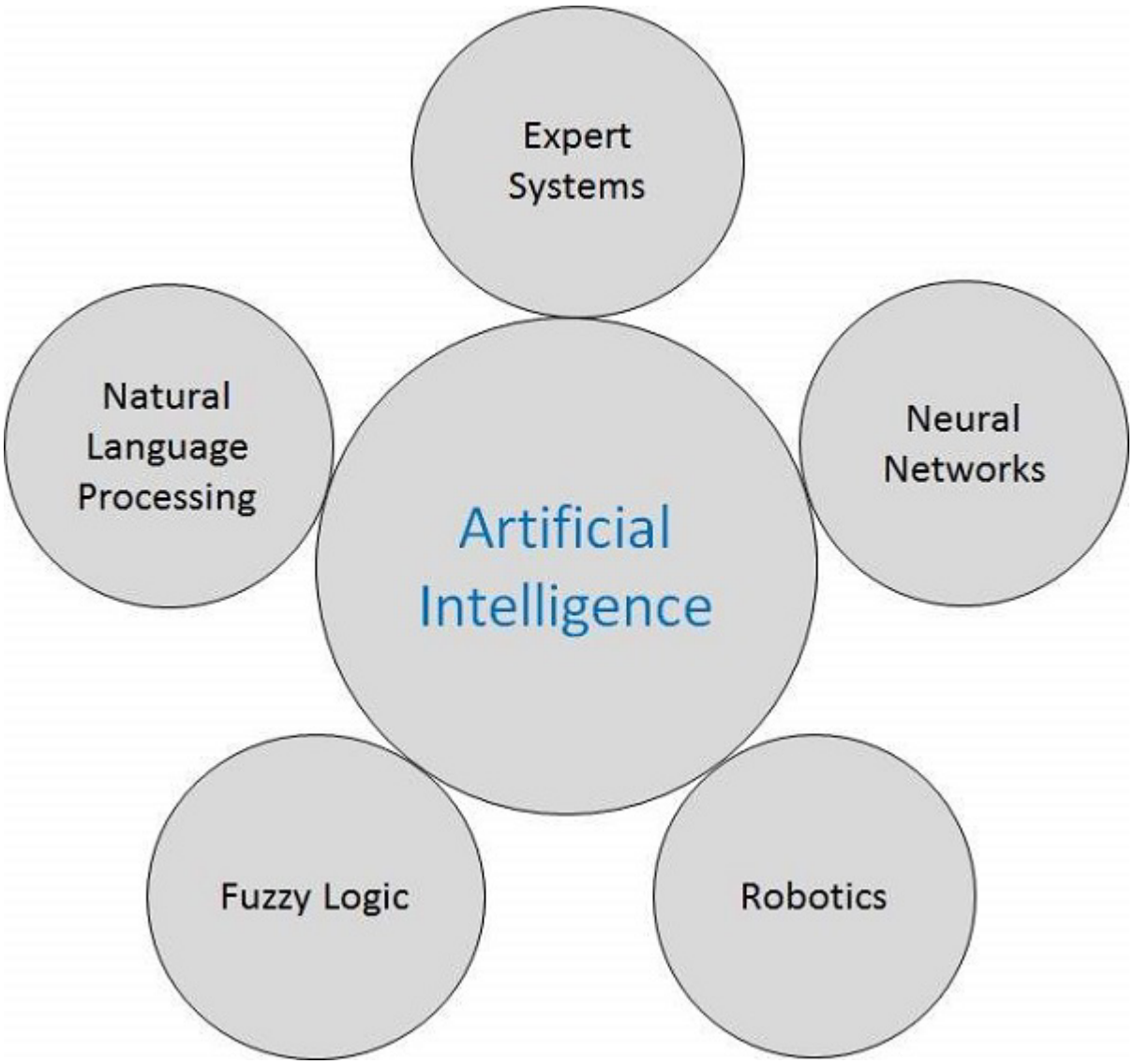
The domain of artificial intelligence is huge in breadth and width. While proceeding, we consider the broadly common and prospering research areas in the domain of AI −



- Speech and Voice Recognition

These both terms are common in robotics, expert systems and natural language processing. Though these terms are used interchangeably, their objectives are different.

Speech Recognition	Voice Recognition
The speech recognition aims at understanding and comprehending **WHAT** was spoken.	The objective of voice recognition is to recognize **WHO** is speaking.
It is used in hand-free computing, map, or menu navigation.	It is used to identify a person by analysing its

	tone, voice pitch, and accent, etc.
Machine does not need training for Speech Recognition as it is not speaker dependent.	This recognition system needs training as it is person oriented.
Speaker independent Speech Recognition systems are difficult to develop.	Speaker dependent Speech Recognition systems are comparatively easy to develop.

Working of Speech and Voice Recognition Systems

The user input spoken at a microphone goes to sound card of the system. The converter turns the analog signal into equivalent digital signal for the speech processing. The database is used to compare the sound patterns to recognize the words. Finally, a reverse feedback is given to the database.

This source-language text becomes input to the Translation Engine, which converts it to the target language text. They are supported with interactive GUI, large database of vocabulary, etc.

- # Real Life Applications of Research Areas

There is a large array of applications where AI is serving common people in their day-to-day lives −

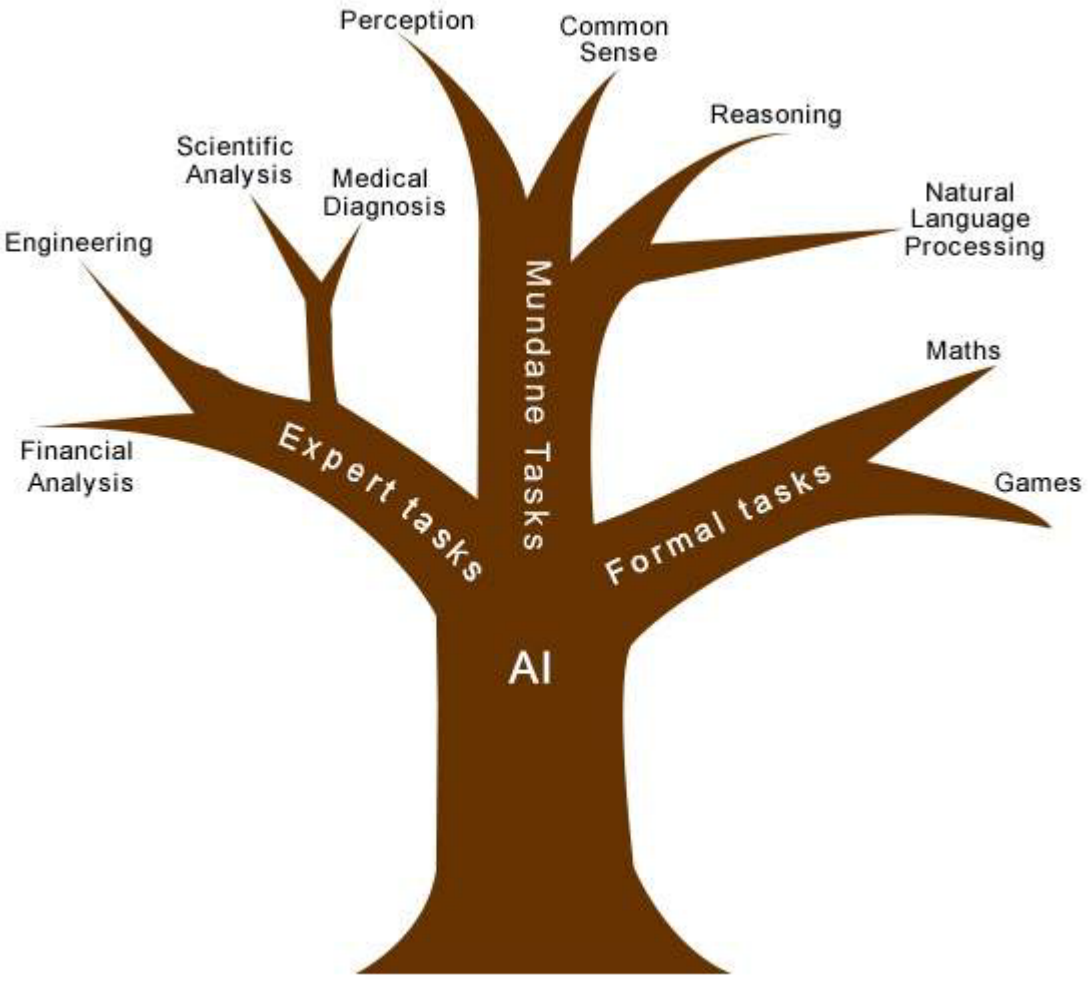
Sr.No.	Research Areas	Real Life Application
1	**Expert Systems** Examples − Flight-tracking systems, Clinical systems.	

2	**Natural Language Processing** Examples: Google Now feature, speech recognition, Automatic voice output.	
3	**Neural Networks** Examples − Pattern recognition systems such as face recognition, character recognition, handwriting recognition.	
4	**Robotics** Examples − Industrial robots for moving, spraying, painting, precision checking, drilling, cleaning, coating, carving, etc.	

5	**Fuzzy Logic Systems** Examples – Consumer electronics, automobiles, etc.	

- Task Classification of AI

The domain of AI is classified into **Formal tasks, Mundane tasks,** and **Expert tasks.**



Task Domains of Artificial Intelligence		
Mundane (Ordinary) Tasks	**Formal Tasks**	**Expert Tasks**
Perception	• Mathematics	• Engineering

• Computer Vision • Speech, Voice	• Geometry • Logic • Integration and Differentiation	• Fault Finding • Manufacturing • Monitoring
Natural Language Processing • Understanding • Language Generation • Language Translation	Games • Go • Chess (Deep Blue) • Ckeckers	Scientific Analysis
Common Sense	Verification	Financial Analysis
Reasoning	Theorem Proving	Medical Diagnosis
Planing		Creativity
Robotics • Locomotive	•	

Humans learn **mundane (ordinary) tasks** since their birth. They learn by perception, speaking, using language, and locomotives. They learn Formal Tasks and Expert Tasks later, in that order.

For humans, the mundane tasks are easiest to learn. The same was considered true before trying to implement mundane tasks in machines. Earlier, all work of AI was concentrated in the mundane task domain.

Later, it turned out that the machine requires more knowledge, complex knowledge representation, and complicated algorithms for handling mundane tasks. This is the reason **why AI work is more prospering in the Expert Tasks domain** now, as the expert task domain needs expert knowledge without common sense, which can be easier to represent and handle.

• Robotics and Artificial Intelligence

Robotics is a separate entity in Artificial Intelligence that helps study the creation of intelligent robots or machines. Robotics combines electrical engineering, mechanical engineering and computer science & engineering as they have mechanical construction, electrical component and programmed with programming language. Although, Robotics and Artificial Intelligence both have different objectives and applications, but most people treat robotics as a subset of Artificial Intelligence (AI). Robot machines look very similar to humans, and also, they can perform like humans, if enabled with AI.

In earlier days, robotic applications were very limited, but now they have become smarter and more efficient by combining with Artificial Intelligence. AI has played a crucial role in the industrial sector by replacing humans in terms of productivity and quality. In this article, '***Robotics and Artificial Intelligence***, we will discuss Robots & Artificial Intelligence and their various applications, advantages, differences, etc. Let's start with the definition of Artificial Intelligence (AI) and Robots.

- ## What is Artificial Intelligence?

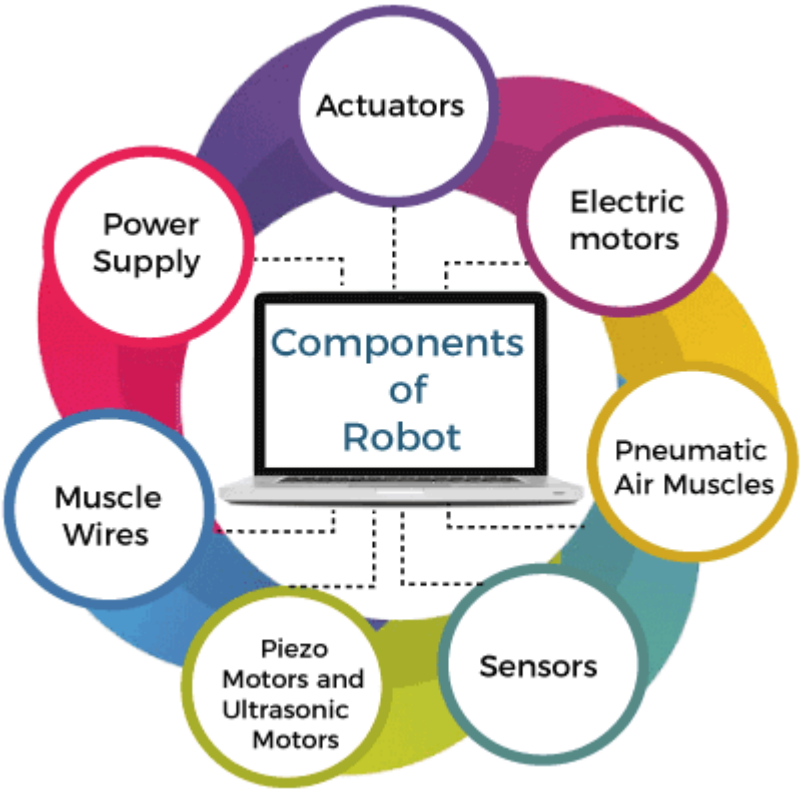
Artificial Intelligence is defined as the branch of Computer Science & Engineering, which deals with creating intelligent machines that perform like humans. Artificial Intelligence helps to enable machines to sense, comprehend, act and learn human like activities. There are mainly 4 types of Artificial Intelligence: **reactive machines, limited memory, theory of mind, and self-awareness.**

- ## What is a robot?

A robot is a machine that looks like a human, and is capable of performing out of box actions and replicating certain human movements automatically by means of commands given to it using programming. Examples: Drug Compounding Robot, Automotive Industry Robots, Order Picking Robots, Industrial Floor Scrubbers and Sage Automation Gantry Robots, etc.

Components of Robot

Several components construct a robot, these components are as follows:



- **Actuators:** Actuators are the devices that are responsible for moving and controlling a system or machine. It helps to achieve physical movements by converting energy like electrical, hydraulic and air, etc. Actuators can create linear as well as rotary motion.
- **Power Supply:** It is an electrical device that supplies electrical power to an electrical load. The primary function of the power supply is to convert electrical current to power the load.
- **Electric Motors:** These are the devices that convert electrical energy into mechanical energy and are required for the rotational motion of the machines.
- **Pneumatic Air Muscles:** Air Muscles are soft pneumatic devices that are ideally best fitted for robotics. They can contract and extend and operate by pressurized air filling a pneumatic bladder. Whenever air is introduced, it can contract up to 40%.

- **Muscles wire:** These are made up of nickel-titanium alloy called Nitinol and are very thin in shape. It can also extend and contract when a specific amount of heat and electric current is supplied into it. Also, it can be formed and bent into different shapes when it is in its martensitic form. They can contract by 5% when electrical current passes through them.
- **Piezo Motors and Ultrasonic Motors:** Piezoelectric motors or Piezo motors are the electrical devices that receive an electric signal and apply a directional force to an opposing ceramic plate. It helps a robot to move in the desired direction. These are the best suited electrical motors for industrial robots.
- **Sensor:** They provide the ability like see, hear, touch and movement like humans. *Sensors are the devices or machines which help to detect the events or changes in the environment and send data to the computer processor. These devices are usually equipped with other electronic devices*. Similar to human organs, the electrical sensor also plays a crucial role in Artificial Intelligence & robotics. AI algorithms control robots by sensing the environment, and it provides real-time information to computer processors.

Applications of Robotics

Robotics have different application areas. Some of the important applications domains of robotics are as follows:

- **Robotics in defence sectors:** The defence sector is undoubtedly the one of the main parts of any country. Each country wants their defence system to be strong. Robots help to approach inaccessible and dangerous zone during war. DRDO has developed a robot named ***Daksh*** to destroy life-threatening objects safely. They help soldiers to remain safe and deployed by the military in combat scenarios. Besides combat support, robots are also deployed in ***anti-submarine operations, fire support, battle damage management, strike missions, and laying machines.***
- **Robotics in Medical sectors:** Robots also help in various medical fields such as laparoscopy, neurosurgery, orthopaedic surgery, disinfecting rooms, dispensing medication, and various other medical domains.
- **Robotics in Industrial Sector:** Robots are used in various industrial manufacturing industries such as cutting, welding, assembly, disassembly, pick and place for printed circuit boards, packaging & labelling, palletizing, product inspection & testing, colour coating, drilling, polishing and handling the materials.
  Moreover, Robotics technology increases productivity and

profitability and reduces human efforts, resulting from lower physical strain and injury. The industrial robot has some important advantages, which are as follows:

- Accuracy
- Flexibility
- Reduced labour charge
- Low noise operation
- Fewer production damages
- Increased productivity rate.

- **Robotics in Entertainment:** Over the last decade, use of robots is continuously getting increased in entertainment areas. Robots are being employed in entertainment sector, such as movies, animation, games and cartoons. Robots are very helpful where repetitive actions are required. A camera-wielding robot helps shoot a movie scene as many times as needed without getting tired and frustrated. A big-name **Disney** has launched hundreds of robots for the film industry.
- **Robots in the mining industry:** Robotics is very helpful for various mining applications such as robotic dozing, excavation and haulage, robotic mapping & surveying, robotic drilling and explosive handling, etc. A mining robot can solely navigate flooded passages and use cameras and other sensors to detect valuable minerals. Further, robots also help in excavation to detect gases and other materials and keep humans safe from harm and injuries. The robot rock climbers are used for space exploration, and underwater drones are used for ocean exploration.

AI technology used in Robotics

Computer Vision

Robots can also see, and this is possible by one of the popular Artificial Intelligence technologies named Computer vision. ***Computer Vision*** plays a crucial role in all industries like health, entertainment, medical, military, mining, etc.

Computer Vision is an important domain of Artificial Intelligence that helps in extracting meaningful information from images, videos and visual inputs and take action accordingly.

Natural Language Processing

NLP (Natural Languages Processing) can be used to give voice commands to AI robots. It creates a strong human-robot interaction. NLP is a specific area of Artificial Intelligence that enables the communication between humans and robots. Through the NLP technique, the robot can understand and reproduce human language. Some robots are equipped with NLP so that we can't differentiate between humans and robots.

Similarly, in the health care sector, robots powered by Natural Language Processing may help physicians to observe the decease details and automatically fill in EHR. Besides recognizing human language, it can learn common uses, such as learn the accent, and predict how humans speak.

Edge Computing

Edge computing in robots is defined as a service provider of robot integration, testing, design and simulation. Edge computing in robotics provides better data management, lower connectivity cost, better security practices, more reliable and uninterrupted connection.

Complex Event Process

Complex event processing (CEP) is a concept that helps us to understand the processing of multiple events in real time. An event is described as a Change of State, and one or more events combine to define a Complex event. The complex event process is most widely used term in various industries such as healthcare, finance, security, marketing, etc. It is primarily used in credit card fraud detection and also in stock marketing field.

For example, the deployment of an airbag in a car is a complex event based on the data from multiple sensors in real-time. This idea is used in Robotics, for example, Event-Processing in Autonomous Robot Programming.

Transfer Learning and AI

This is the technique used to solve a problem with the help of another problem that is already solved. In Transfer learning technique, knowledge gained from solving one problem can be implement to solve related

problem. We can understand it with an example such as the model used for identifying a circle shape can also be used to identify a square shape.

Transfer learning reuses the pre-trained model for a related problem, and only the last layer of the model is trained, which is relatively less time consuming and cheaper. In robotics, transfer learning can be used to train one machine with the help of other machines.

Reinforcement Learning

Reinforcement learning is a feedback-based learning method in machine learning that enables an AI agent to learn and explore the environment, perform actions and learn automatically from experience or feedback for each action. Further, it is also having feature of autonomously learn to behave optimally through hit-and-trail action while interacting with the environment. It is primarily used to develop the sequence of decisions and achieve the goals in uncertain and potentially complex environment. In robotics, robots explore the environment and learn about it through hit and trial. For each action, he gets rewarded (positive or negative). Reinforcement learning provides Robotics with a framework to design and simulate sophisticated and hard-to-engineer behaviours.

Affective computing

Affective computing is a field of study that deals with developing systems that can identify, interpret, process, and simulate human emotions. Affective computing aims to endow robots with emotional intelligence to hope that robots can be endowed with human-like capabilities of observation, interpretation, and emotion expression.

Mixed Reality

Mixed Reality is also an emerging domain. It is mainly used in the field of programming by demonstration (PbD). PbD creates a prototyping mechanism for algorithms using a combination of physical and virtual objects.

• What are Artificially Intelligent Robots?

Artificial intelligent robots connect AI with robotics. AI robots are controlled by AI programs and use different AI technologies, such as Machine learning, computer vision, RL learning, etc. Usually, most robots are not AI robots, these robots are programmed to perform repetitive

series of movements, and they don't need any AI to perform their task. However, these robots are limited in functionality.

AI algorithms are necessary when you want to allow the robot to perform more complex tasks.

A warehousing robot might use a path-finding algorithm to navigate around the warehouse. A drone might use autonomous navigation to return home when it is about to run out of battery. A self-driving car might use a combination of AI algorithms to detect and avoid potential hazards on the road. All these are the examples of artificially intelligent robots.

What are the advantages of integrating Artificial Intelligence into robotics?

- The major advantages of artificially intelligent robots are social care. They can guide people, especially come to aid for older people, with chatbot like social skills and advanced processors.
- Robotics also helps in Agricultural industry with the help of developing AI based robots. These robots reduce the farmer's workload.
- In Military industry, Military bots can spy through speech and vision detectors, along with saving lives by replacing infantry
- Robotics also employed in volcanoes, deep oceans, extremely cold places, or even in space where normally humans can't survive.
- Robotics is also used in medical and healthcare industry as it can also perform complex surgeries that have a higher risk of a mistake by humans, but with a pre-set of instructions and added Intelligence. AI integrated robotics could reduce the number of casualties greatly.

Difference in Robot System and AI Programs

Here is the difference between Artificial Intelligence and Robots:

1. AI Programs

Usually, we use to operate them in computer-simulated worlds.

Generally, input is given in the form of symbols and rules.

To operate this, we need general-purpose/Special-purpose computers.

2. Robots

Generally, we use robots to operate in the real physical world.

Inputs are given in the form of the analogue signal or in the form of the speech waveform.

Also, to operate this, special hardware with sensors and effectors are needed.