

# Module: 01

## Introduction

### Motivation:

This module 1 : Introduction will brief about AI which is heart of any Intelligent System.

### Syllabus:

Lecture no	Content	Duration (Hr)	Self-Study (Hrs)
1	Introduction, History of Artificial Intelligence	1	1
2	Intelligent System Categorization	1	1
3	Components of AI, Foundations of AI	1	1
4	Applications of AI, Current trends in AI	1	1

### Learning Objective:

- Learner should know the overview of AI.

### Theoretical Background:

#### Introduction to AI

- In today's world, technology is growing very fast, and we are getting in touch with different new technologies day by day.
- Here, one of the booming technologies of computer science is Artificial Intelligence which is ready to create a new revolution in the world by making intelligent machines. The Artificial Intelligence is now all around us. It is currently working with a variety of subfields, ranging from general to specific, such as self-driving cars, playing chess, proving theorems, playing music, Painting, etc.
- AI is one of the fascinating and universal fields of Computer science which has a great scope in future. AI holds a tendency to cause a machine to work as a human.
- Artificial Intelligence is a branch of computer science dealing with the simulation of intelligent behavior in computers.
- The capability of a machine to imitate intelligent human behavior
- Artificial Intelligence is an approach to make a computer, a robot, or a product to think how smart human think.
- AI is a study of how human brain think, learn, decide and work, when it tries to solve problems. And finally this study outputs intelligent systems.
- The aim of AI is to improve computer functions which are related to human knowledge, for example, reasoning, learning, and problem-solving.
- Artificial Intelligence exists when a machine can have human based skills such as learning, reasoning, and solving problems

- With Artificial Intelligence you do not need to preprogram a machine to do some work, despite that you can create a machine with programmed algorithms which can work with own intelligence, and that is the greatness of AI.
- It is believed that AI is not a new technology, and some people says that as per Greek myth, there were Mechanical men in early days which can work and behave like humans.
- AI learns by creating machine learning models based on provided inputs and desired outputs.

## Key Definitions:

- Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think, learn, decide and solve problems intelligently like humans.

## Course Content:

### Lecture : 1

#### Introduction, History of Artificial Intelligence

- Artificial Intelligence is composed of two words **Artificial** and **Intelligence**, where Artificial defines "*man-made,*" and intelligence defines "*thinking power*", hence AI means "*a man-made thinking power.*"
- Artificial Intelligence is branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and able to make decisions.
- IBM Research defines Artificial Intelligence (AI) as Augmented Intelligence, helping experts scale their capabilities as machines do the time-consuming work.

AI can be defined follows by different people as follows:

		Measure of Success	
		In terms of human intelligence	In terms of rationality
Dimensions of Definition	Thought Process and Reasoning	<b>Thinking Humanly</b> "The exciting new effort to make computers think ... <i>machines with minds</i> , in the full and literal sense" (Haugeland, 1985) "The automation of activities that we associate with human thinking, activities such as decision-making, problem solving, learning ..." (Bellman, 1978)	<b>Thinking Rationally</b> "The study of mental faculties through the use of computational models" (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act" (Winston, 1992)
		<b>Acting Humanly</b> "The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better" (Rich and Knight, 1991)	<b>Acting Rationally</b> "A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes" (Schalkoff, 1990) "The branch of computer science that is concerned with the automation of intelligent behavior" (Luger and Stubblefield, 1993)
	Behavior		

## Acting humanly: The Turing Test approach

The **Turing Test**, proposed by Alan Turing (Turing, 1950), was designed to provide a satisfactory operational definition of intelligence. Turing defined intelligent behavior as the ability to achieve human-level performance in all cognitive tasks, sufficient to fool an interrogator. Roughly speaking, the test he proposed is that the computer should be interrogated by a human via a teletype, and passes the test if the interrogator cannot tell if there is a computer or a human at the other end. It tells whether or not a computer is really intelligent if it passes. For now, programming a computer to pass the test provides plenty to work on. The computer would need to possess the following capabilities:

- **natural language processing** to enable it to communicate successfully in English (or some other human language);
- **knowledge representation** to store information provided before or during the interrogation;
- **automated reasoning** to use the stored information to answer questions and to draw new conclusions;
- **machine learning** to adapt to new circumstances and to detect and extrapolate patterns.

Turing's test deliberately avoided direct physical interaction between the interrogator and the computer, because *physical* simulation of a person is unnecessary for intelligence. However, the so-called **total Turing Test** includes a video signal so that the interrogator can test the subject's perceptual abilities, as well as the opportunity for the interrogator to pass physical objects "through the hatch." To pass the total Turing Test, the computer will need

- **computer vision** to perceive objects, and
- **robotics** to move them about.

Within AI, there has not been a big effort to try to pass the Turing test. The issue of acting like a human comes up primarily when AI programs have to interact with people, as when an expert system explains how it came to its diagnosis, or a natural language processing system has a dialogue with a user. These programs must behave according to certain normal conventions of human interaction in order to make themselves understood. The underlying representation and reasoning in such a system may or may not be based on a human model.

## Thinking humanly: The cognitive modelling approach

If we are going to say that a given program thinks like a human, we must have some way of determining how humans think. We need to get *inside* the actual workings of human minds. There are two ways to do this: through introspection--trying to catch our own thoughts as they go by--or through psychological experiments. Once we have a sufficiently precise theory of the mind, it becomes possible to express the theory as a computer program. If the program's input/output and timing behavior matches human behavior, that is evidence that some of the program's mechanisms may also be operating in humans. For example, Newell and Simon, who developed GPS, the "General Problem Solver" (Newell and Simon, 1961), were not content to have their program correctly solve problems. They were more concerned with comparing the trace of its reasoning steps to traces of human subjects solving the same problems. This is in contrast to other researchers of the same time (such as Wang (1960)), who were concerned with getting the right answers regardless of how humans might do it. The interdisciplinary field of **cognitive science** brings together computer models from AI and experimental techniques from psychology to try to construct precise and testable theories of the workings of the human mind. Although cognitive science is a fascinating field in itself. We will occasionally comment on similarities or differences between AI techniques and human cognition. Real cognitive science, however, is necessarily based on experimental

investigation of actual humans or animals, and we assume that the reader only has access to a computer for experimentation. We will simply note that AI and cognitive science continue to fertilize each other, especially in the areas of vision, natural language, and learning.

### **Thinking rationally: The laws of thought approach**

The Greek philosopher Aristotle was one of the first to attempt to codify "right thinking," that is, irrefutable reasoning processes. His famous **syllogisms** provided patterns for argument structures that always gave correct conclusions given correct premises. For example, "Socrates is a man; all men are mortal; therefore Socrates is mortal." These laws of thought were supposed to govern the operation of the mind, and initiated the field of **logic**.

The development of formal logic in the late nineteenth and early twentieth centuries provided a precise notation for statements about all kinds of things in the world and the relations between them. (Contrast this with ordinary arithmetic notation, which provides mainly for equality and inequality statements about numbers.) By 1965, programs existed that could, given enough time and memory, take a description of a problem in logical notation and find the solution to the problem, if one exists. (If there is no solution, the program might never stop looking for it.) The so-called **logician** tradition within artificial intelligence hopes to build on such programs to create intelligent systems.

There are two main obstacles to this approach. First, it is not easy to take informal knowledge and state it in the formal terms required by logical notation, particularly when the knowledge is less than 100% certain. Second, there is a big difference between being able to solve a problem "in principle" and doing so in practice. Even problems with just a few dozen facts can exhaust the computational resources of any computer unless it has some guidance as to which reasoning steps to try first. Although both of these obstacles apply to *any* attempt to build computational reasoning systems, they appeared first in the logician tradition because the power of the representation and reasoning systems are well-defined and fairly well understood.

### **Acting rationally: The rational agent approach**

Acting rationally means acting so as to achieve one's goals, given one's beliefs. An **agent** is just something that perceives and acts. (This may be an unusual use of the word, but you will get used to it.) In this approach, AI is viewed as the study and construction of rational agents.

In the "laws of thought" approach to AI, the whole emphasis was on correct inferences. Making correct inferences is sometimes *part* of being a rational agent, because one way to act rationally is to reason logically to the conclusion that a given action will achieve one's goals, and then to act on that conclusion. On the other hand, correct inference is not *all* of rationality, because there are often situations where there is no provably correct thing to do, yet something must still be done. There are also ways of acting rationally that cannot be reasonably said to involve inference. For example, pulling one's hand off of a hot stove is a reflex action that is more successful than a slower action taken after careful deliberation.

All the "cognitive skills" needed for the Turing Test are there to allow rational actions. Thus, we need the ability to represent knowledge and reason with it because this enables us to reach good decisions in a wide variety of situations. We need to be able to generate comprehensible sentences in natural language because saying those sentences helps us get by in a complex society. We need learning not just for erudition, but because having a better idea of how the world works enables us to generate more effective strategies for dealing with it. We need visual perception not just because seeing is fun, but in order to get a better idea of what an action might achieve--for example, being able to see a tasty morsel helps one to move toward it.

## Why Artificial Intelligence?

Before Learning about Artificial Intelligence, we should know that what is the importance of AI and why should we learn it. Following are some main reasons to learn about AI:

- With the help of AI, you can create such software or devices which can solve real-world problems very easily and with accuracy such as health issues, marketing, traffic issues, etc.
- With the help of AI, you can create your personal virtual Assistant, such as Cortana, Google Assistant, Siri, etc.
- With the help of AI, you can build such Robots which can work in an environment where survival of humans can be at risk.
- AI opens a path for other new technologies, new devices, and new Opportunities.

## Goals of Artificial Intelligence

Following are the main goals of Artificial Intelligence:

1. Replicate human intelligence
2. Solve Knowledge-intensive tasks
3. An intelligent connection of perception and action
4. Building a machine which can perform tasks that requires human intelligence such as:
  - Proving a theorem
  - Playing chess
  - Plan some surgical operation
  - Driving a car in traffic
5. Creating some system which can exhibit intelligent behavior, learn new things by itself, demonstrate, explain, and can advise to its user.

## Advantages of Artificial Intelligence

Following are some main advantages of Artificial Intelligence:

- **High Accuracy with less errors:** AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.
- **High-Speed:** AI systems can be of very high-speed and fast-decision making, because of that AI systems can beat a chess champion in the Chess game.
- **High reliability:** AI machines are highly reliable and can perform the same action multiple times with high accuracy.
- **Useful for risky areas:** AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where to employ a human can be risky.
- **Digital Assistant:** AI can be very useful to provide digital assistant to the users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirement.

- **Useful as a public utility:** AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purpose, Natural language processing to communicate with the human in human-language, etc.

## Disadvantages of Artificial Intelligence

Every technology has some disadvantages, and the same goes for Artificial intelligence. Being so advantageous technology still, it has some disadvantages which we need to keep in our mind while creating an AI system. Following are the disadvantages of AI:

- **High Cost:** The hardware and software requirement of AI is very costly as it requires lots of maintenance to meet current world requirements.
- **Can't think out of the box:** Even we are making smarter machines with AI, but still they cannot work out of the box, as the robot will only do that work for which they are trained, or programmed.
- **No feelings and emotions:** AI machines can be an outstanding performer, but still it does not have the feeling so it cannot make any kind of emotional attachment with human, and may sometime be harmful for users if the proper care is not taken.
- **Increase dependency on machines:** With the increment of technology, people are getting more dependent on devices and hence they are losing their mental capabilities.
- **No Original Creativity:** As humans are so creative and can imagine some new ideas but still AI machines cannot beat this power of human intelligence and cannot be creative and imaginative.

## Prerequisite

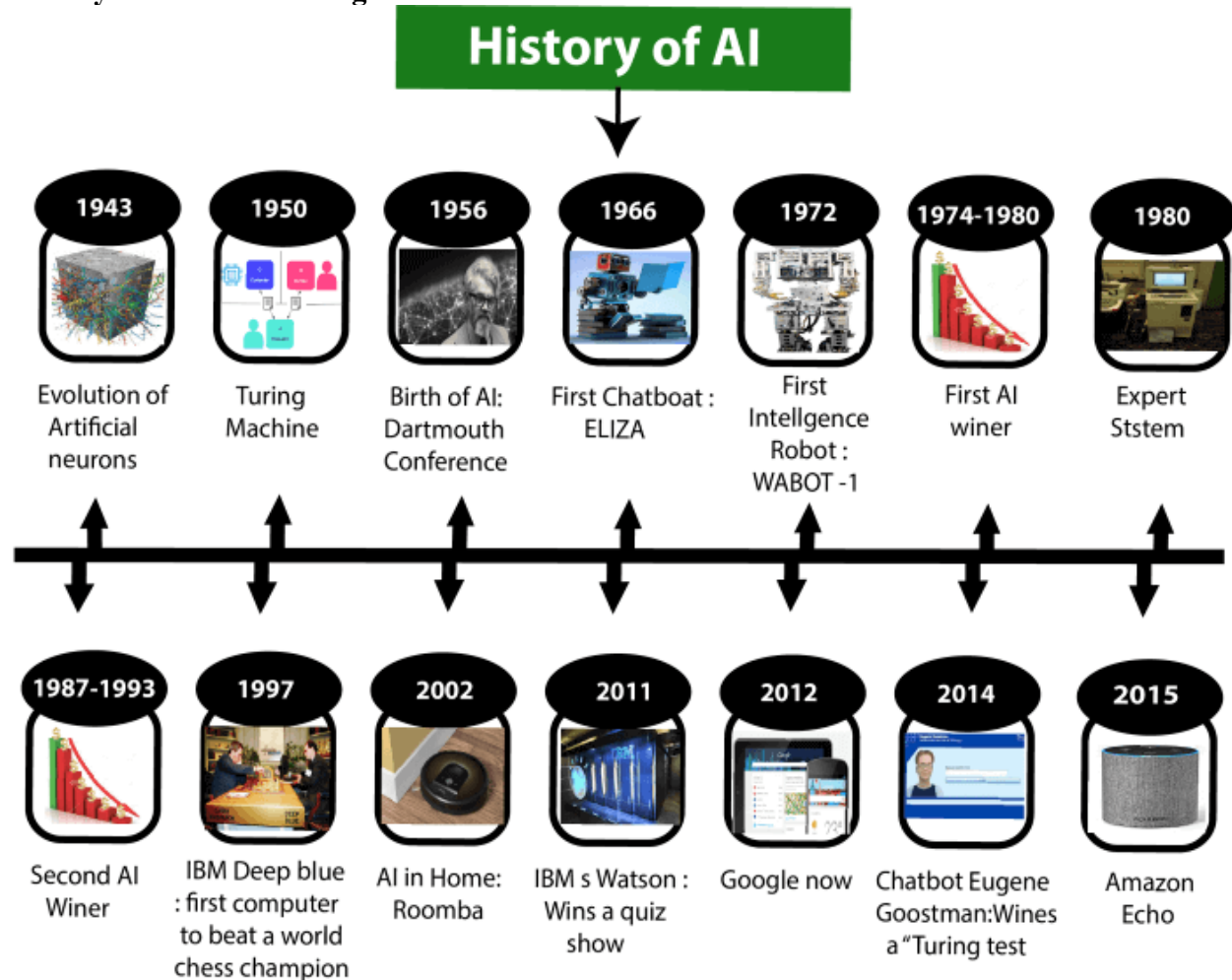
Before learning about Artificial Intelligence, you must have the fundamental knowledge of following so that you can understand the concepts easily:

- Any computer language such as C, C++, Java, Python, etc.(knowledge of Python will be an advantage)
- Knowledge of essential Mathematics such as derivatives, probability theory, etc.
- Basic knowledge of data structures and algorithms

## Technologies

- Special and fourth generation programming languages: R, Python, Java
- Expert systems shells: Prolog, LISP, SciLab, MATLAB
- TOP AI Tools: Microsoft Azure ML, TensorFlow, Google Cloud Prediction API, Meya, Infosys Nia, KAI, Receptiviti, Wipro HOLMES, API.AI, MindMeld, Premonition, Wit, Rainbird, Vital A.I, Ayasdi

## History of artificial intelligence



### Maturation of Artificial Intelligence (1943-1952)

- **Year 1943:** The first work which is now recognized as AI was done by Warren McCulloch and Walter Pitts in 1943. They proposed a model of **artificial neurons**.
- **Year 1949:** Donald Hebb demonstrated an updating rule for modifying the connection strength between neurons. His rule is now called **Hebbian learning**.
- **Year 1950:** The Alan Turing who was an English mathematician and pioneered Machine learning in 1950. Alan Turing publishes "**Computing Machinery and Intelligence**" in which he proposed a test. The test can check the machine's ability to exhibit intelligent behavior equivalent to human intelligence, called a **Turing test**.

### The birth of Artificial Intelligence (1952-1956)

- **Year 1955:** Allen Newell and Herbert A. Simon created the "first artificial intelligence program" which was named as "**Logic Theorist**". This program had proved 38 of 52 Mathematics theorems, and found new and more elegant proofs for some theorems.
- **Year 1956:** The word "Artificial Intelligence" first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. For the first time, AI coined as an academic field.

At that time high-level computer languages such as FORTRAN, LISP, or COBOL were invented. And the enthusiasm for AI was very high at that time.

#### The golden years-Early enthusiasm (1956-1974)

- **Year 1966:** The researchers emphasized developing algorithms which can solve mathematical problems. Joseph Weizenbaum created the first chatbot in 1966, which was named as ELIZA.
- **Year 1972:** The first intelligent humanoid robot was built in Japan which was named as WABOT-1.

#### The first AI winter (1974-1980)

- The duration between years 1974 to 1980 was the first AI winter duration. AI winter refers to the time period where computer scientist dealt with a severe shortage of funding from government for AI researches.
- During AI winters, an interest of publicity on artificial intelligence was decreased.

#### A boom of AI (1980-1987)

- **Year 1980:** After AI winter duration, AI came back with "Expert System". Expert systems were programmed that emulate the decision-making ability of a human expert.
- In the Year 1980, the first national conference of the American Association of Artificial Intelligence **was held at Stanford University**.

#### The second AI winter (1987-1993)

- The duration between the years 1987 to 1993 was the second AI Winter duration.
- Again Investors and government stopped in funding for AI research as due to high cost but not efficient result. The expert system such as XCON was very cost effective.

#### The emergence of intelligent agents (1993-2011)

- **Year 1997:** In the year 1997, IBM Deep Blue beats world chess champion, Gary Kasparov, and became the first computer to beat a world chess champion.
- **Year 2002:** for the first time, AI entered the home in the form of Roomba, a vacuum cleaner.
- **Year 2006:** AI came in the Business world till the year 2006. Companies like Facebook, Twitter, and Netflix also started using AI.

#### Deep learning, big data and artificial general intelligence (2011-present)

- **Year 2011:** In the year 2011, IBM's Watson won jeopardy, a quiz show, where it had to solve the complex questions as well as riddles. Watson had proved that it could understand natural language and can solve tricky questions quickly.
- **Year 2012:** Google has launched an Android app feature "Google now", which was able to provide information to the user as a prediction.



- **Year 2014:** In the year 2014, Chatbot "Eugene Goostman" won a competition in the infamous "Turing test."
- **Year 2018:** The "Project Debater" from IBM debated on complex topics with two master debaters and also performed extremely well.
- Google has demonstrated an AI program "Duplex" which was a virtual assistant and which had taken hairdresser appointment on call, and lady on other side didn't notice that she was talking with the machine.

Now AI has developed to a remarkable level. The concept of Deep learning, big data, and data science are now trending like a boom. Nowadays companies like Google, Facebook, IBM, and Amazon are working with AI and creating amazing devices. The future of Artificial Intelligence is inspiring and will come with high intelligence.

***Let's check the take away from this lecture***

### Exercise

Q.1 Which of the following is/are not an example of Artificial Intelligence? (U)

- Signature recognition
- Plagiarism detection in written text
- Spam email filters
- **Random number generator**

Q.2 Which of the following school of thought should be ideal for an agent aimed at Counseling a person suffering from depression? (U)

- **Thinking & acting Humanly**
- Thinking & acting Rationally

Q.3 Studying human brain as a means towards AI corresponds to which of the following definitions of AI? (U)

- Acting like humans
- Thinking rationally
- **Thinking like humans**

Q.4 Which powerful AI agent established computer domination in the world of chess? (R)

- DeepMind
- **DeepBlue**
- Watson
- AlphaGo

Q.5 Which was the first test proposed to evaluate artificial intelligence? (R)

- Theorem Proving
- IQ Test
- **Turing Test**

- Loebner Prize

Q.6 The early AI methods were heavily based upon which of the following (U)

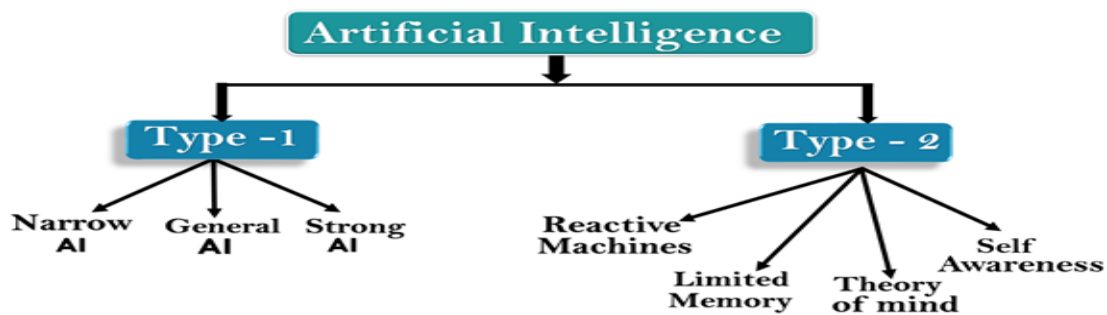
- **Logic**
- Probability
- Statistics
- Bayesian Networks

**Learning from this lecture:** Learners will be able to understand Introduction and Evolution of AI.

## Lecture : 2

### Categorization of IS

Artificial Intelligence can be divided in various types, there are mainly two types of main categorization which are based on capabilities and based on functionality of AI. Following is flow diagram which explains the types of AI.



### AI type-1: Based on Capabilities

#### 1. Weak AI or Narrow AI:

- Narrow AI is a type of AI which is able to perform a dedicated task with intelligence. The most common and currently available AI is Narrow AI in the world of Artificial Intelligence.
- Narrow AI cannot perform beyond its field or limitations, as it is only trained for one specific task. Hence it is also termed as weak AI. Narrow AI can fail in unpredictable ways if it goes beyond its limits.
- Apple Siris a good example of Narrow AI, but it operates with a limited pre-defined range of functions.
- IBM's Watson supercomputer also comes under Narrow AI, as it uses an Expert system approach combined with Machine learning and natural language processing.
- Some Examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition.

#### 2. General AI:

- General AI is a type of intelligence which could perform any intellectual task with efficiency like a human.

- The idea behind the general AI to make such a system which could be smarter and think like a human by its own.
- The worldwide researchers are now focused on developing machines with General AI.
- Some key characteristics of strong AI include capability include the ability to think, to reason, solve the puzzle, make judgments, plan, learn, and communicate by its own.

### 3. Super AI:

- Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than human with cognitive properties scientific creativity, General wisdom and social skills. It is an outcome of general AI.
- Super Intelligence ranges from machine just little smarter than human to a machine that is trillion times smarter.
- Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.



	Strong artificial intelligence	Weak artificial intelligence
Definition	<ul style="list-style-type: none"> <li>the form of artificial intelligence, which has the same intellectual abilities as human, or even surpasses him in it</li> </ul>	<ul style="list-style-type: none"> <li>Weak AI is generally developed or used for specific application domains.</li> <li>In a standard work on artificial intelligence, this is formulated as follows: "The assertion that machines could possibly act intelligently (called, weakness, act as if they are intelligent) is called the, weak AI 'hypothesis ..."</li> </ul>
Capabilities and Domains	<ul style="list-style-type: none"> <li>Logical thinking</li> <li>Making decisions in case of uncertainty</li> <li>To plan</li> <li>To learn</li> <li>Communication in natural language</li> <li>Use all these abilities to achieve a common goal</li> </ul>	<ul style="list-style-type: none"> <li>Expert systems</li> <li>Navigation systems</li> <li>Voice recognition</li> <li>Character recognition</li> <li>Suggestions for corrections in searches</li> </ul>

## Artificial Intelligence type-2: Based on functionality

### 1. Reactive Machines

- Purely reactive machines are the most basic types of Artificial Intelligence.

- Such AI systems do not store memories or past experiences for future actions.
- These machines only focus on current scenarios and react on it as per possible best action.
- IBM's Deep Blue system is an example of reactive machines.
- Google's AlphaGo is also an example of reactive machines.

## 2. Limited Memory

- Limited memory machines can store past experiences or some data for a short period of time.
- These machines can use stored data for a limited time period only.
- Self-driving cars are one of the best examples of Limited Memory systems. These cars can store recent speed of nearby cars, the distance of other cars, speed limit, and other information to navigate the road.

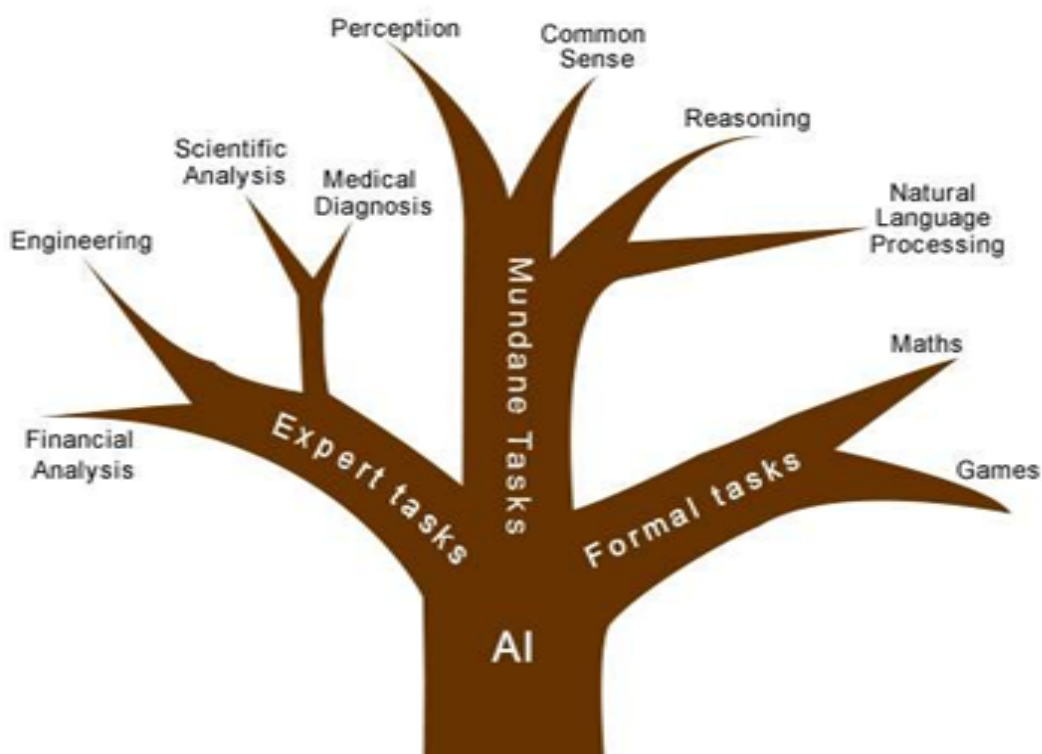
## 3. Theory of Mind

- Theory of Mind AI should understand the human emotions, people, beliefs, and be able to interact socially like humans.
- This type of AI machines are still not developed, but researchers are making lots of efforts and improvement for developing such AI machines.

## 4. Self-Awareness

- Self-awareness AI is the future of Artificial Intelligence. These machines will be super intelligent, and will have their own consciousness, sentiments, and self-awareness.
- These machines will be smarter than human mind.
- Self-Awareness AI does not exist in reality still and it is a hypothetical concept.

## Task Classification of AI



<b>Mundane (Ordinary) Tasks</b>	<b>Formal Tasks</b>	<b>Expert Tasks</b>
Perception <ul style="list-style-type: none"> <li>• Computer Vision</li> <li>• Speech, Voice</li> </ul>	<ul style="list-style-type: none"> <li>• Mathematics</li> <li>• Geometry</li> <li>• Logic</li> <li>• Integration and Differentiation</li> </ul>	<ul style="list-style-type: none"> <li>• Engineering</li> <li>• Fault Finding</li> <li>• Manufacturing</li> <li>• Monitoring</li> </ul>
Natural Language Processing <ul style="list-style-type: none"> <li>• Understanding,</li> <li>• Language Generation</li> <li>• Language Translation</li> </ul>	Games <ul style="list-style-type: none"> <li>• Go</li> <li>• Chess (Deep Blue)</li> <li>• Ckeckers</li> </ul>	Scientific Analysis
Common Sense	Verification	Financial Analysis
Reasoning	Theorem Proving	Medical Diagnosis
Planing		Creativity
Robotics <ul style="list-style-type: none"> <li>• Locomotive</li> </ul>		

***Let's check the take away from this lecture***

### Exercise

Q.1 Apple Siris is example of.....AI. (R)

- (a) **Narrow**
- (b) General
- (c ) Strong
- (d) None of above

Q.2 Theorem Proving is .....category of AI task. (U)

- (a) Mundane (Ordinary) Tasks
- (b) **Formal Tasks**
- ( c ) Expert Tasks
- (d) None of above

Q.3 Scientific Analysis is .....category of AI task. (U)

- (a) Mundane (Ordinary) Tasks
- (b) Formal Tasks
- ( c ) **Expert Tasks**
- (d) None of above

Q.4 ----- is a Mundane (Ordinary) Tasks. (U)

- (a) **Language Generation**

- (b) Logic
- (c ) Monitoring
- (d) None of above.

**Learning from this lecture:** Learners will be able to understand categorization of intelligent systems with real time examples.

## Lecture : 3

### Components of AI, Foundations of AI

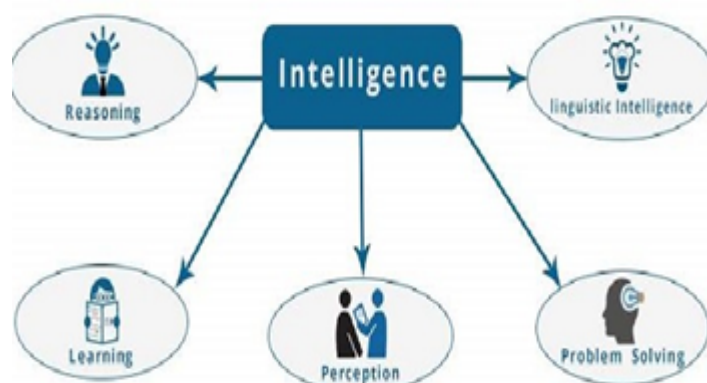
#### Components and Foundation of AI

- Intelligence is 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.
- Linguistic intelligence, Musical intelligence, Logical-mathematical intelligence, Spatial intelligence, Bodily-Kinesthetic intelligence, Intra-personal intelligence, Interpersonal intelligence
- 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.

AI is nothing but Intelligence.

Artificial Intelligence	Natural Intelligence
Non creative, Precise , Consistency, Multitasking	Creative, May contain error, Non consistent, Can't handle

#### Components of Intelligence



**Reasoning:** It is the set of processes that enables us to provide basis for judgment, 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.
Example – "Nita is a teacher. Nita is studious. Therefore, All teachers are	Example – "All women of age above 60 years are grandmothers. Shalini is 65 years. Therefore,

studious."	Shalini is a grandmother."
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**Learning** – It is the activity of gaining knowledge or skill by studying, practicing, being taught, or experiencing something.

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 parents.
- **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 ‘salt at the time of cooking came up salty last time, so next time we try to reduce.
- **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:** (1) It is the process in which one perceives and tries to arrive at a desired solution from a present situation by taking some path. (2) It 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(**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.

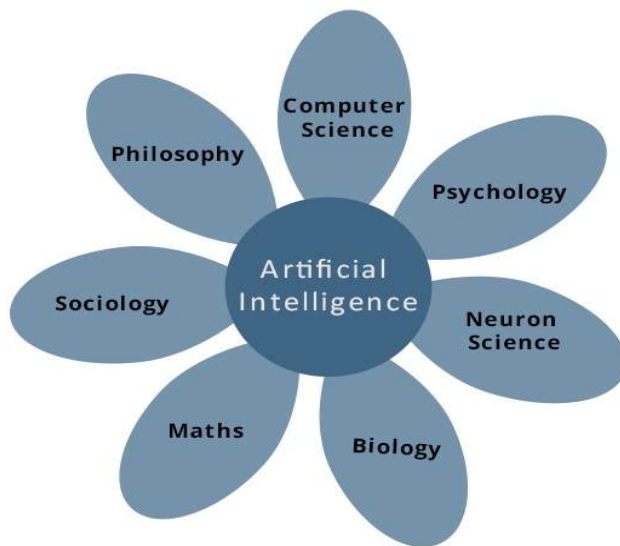
#### **Difference between Human and Machine Intelligence**

- 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.

#### **Foundation of AI**

To achieve the above factors for a machine or software Artificial Intelligence requires the following discipline:

- One or multiple areas can contribute to build an intelligent system.



## The Foundation of Artificial Intelligence Academic Disciplines of AI

- **Philosophy** Logic, methods of reasoning, mind as physical system, foundations of learning, language, rationality.
- **Mathematics** Formal representation and proof, algorithms, computation, (un)decidability, (in)tractability
- **Probability/Statistics** modeling uncertainty, learning from data
- **Economics** utility, decision theory, rational economic agents
- **Neuroscience** neurons as information processing units.
- **Psychology/** how do people behave, perceive, process cognitive
- **Cognitive Science** information, represent knowledge.
- **Computer engineering** building fast computers
- **Control theory** design systems that maximize an objective function over time
- **Linguistics** knowledge representation, grammars

***Let's check the take away from this lecture***

Exercise



Q.1 .....is not a component of AI. (U)

- (a) **Mathematics**
- (b) Learning
- (c) Reasoning
- (d) Problem Solving

Q.2 Psychology is .....for AI. (U)

- (a) Component
- (b) **Foundation**
- (c) Subarea
- (d) Non of above

Q.3..... conducts specific observations to makes broad general statements. (R)

- (a) Relational Reasoning
- (b) Deductive Reasoning
- (c ) Logical Reasoning
- (d) **Inductive Reasoning**

**Learning from this lecture:** Learners will be able to understand components of intelligence and prerequisite required for AI

## Lecture : 4

### Applications of AI, Current trends in AI

#### Applications of AI

##### 1. AI in Astronomy

- Artificial Intelligence can be very useful to solve complex universe problems. AI technology can be helpful for understanding the universe such as how it works, origin, etc.

##### 2. AI in Healthcare

- In the last, five to ten years, AI becoming more advantageous for the healthcare industry and going to have a significant impact on this industry.
- Healthcare Industries are applying AI to make a better and faster diagnosis than humans. AI can help doctors with diagnoses and can inform when patients are worsening so that medical help can reach to the patient before hospitalization.

##### 3. AI in Gaming

- AI can be used for gaming purpose. The AI machines can play strategic games like chess, where the machine needs to think of a large number of possible places.

##### 4. AI in Finance

- AI and finance industries are the best matches for each other. The finance industry is implementing automation, chatbot, adaptive intelligence, algorithm trading, and machine learning into financial processes.

## 5. AI in Data Security

- The security of data is crucial for every company and cyber-attacks are growing very rapidly in the digital world. AI can be used to make your data more safe and secure. Some examples such as AEG bot, AI2 Platform, are used to determine software bug and cyber-attacks in a better way.

## 6. AI in Social Media

- Social Media sites such as Facebook, Twitter, and Snapchat contain billions of user profiles, which need to be stored and managed in a very efficient way. AI can organize and manage massive amounts of data. AI can analyze lots of data to identify the latest trends, hashtag, and requirement of different users.

## 7. AI in Travel & Transport

- AI is becoming highly demanding for travel industries. AI is capable of doing various travel related works such as from making travel arrangement to suggesting the hotels, flights, and best routes to the customers. Travel industries are using AI-powered chatbots which can make human-like interaction with customers for better and fast response.

## 8. AI in Automotive Industry

- Some Automotive industries are using AI to provide virtual assistant to their user for better performance. Such as Tesla has introduced TeslaBot, an intelligent virtual assistant.
- Various Industries are currently working for developing self-driven cars which can make your journey more safe and secure.

## 9. AI in Robotics:

- Artificial Intelligence has a remarkable role in Robotics. Usually, general robots are programmed such that they can perform some repetitive task, but with the help of AI, we can create intelligent robots which can perform tasks with their own experiences without pre-programmed.
- Humanoid Robots are best examples for AI in robotics, recently the intelligent Humanoid robot named as Erica and Sophia has been developed which can talk and behave like humans.

## 10. AI in Entertainment

- We are currently using some AI based applications in our daily life with some entertainment services such as Netflix or Amazon. With the help of ML/AI algorithms, these services show the recommendations for programs or shows.

## 11. AI in Agriculture

- Agriculture is an area which requires various resources, labor, money, and time for best result. Now a day's agriculture is becoming digital, and AI is emerging in this field.

Agriculture is applying AI as agriculture robotics, solid and crop monitoring, predictive analysis. AI in agriculture can be very helpful for farmers.

## 12. AI in E-commerce

- AI is providing a competitive edge to the e-commerce industry, and it is becoming more demanding in the e-commerce business. AI is helping shoppers to discover associated products with recommended size, color, or even brand.

## 13. AI in education:

- AI can automate grading so that the tutor can have more time to teach. AI chatbot can communicate with students as a teaching assistant.
- AI in the future can be work as a personal virtual tutor for students, which will be accessible easily at any time and any place.

## Current trends in AI

### 1. AI will increasingly be monitoring and refining business processes

While the first robots in the workplace were mainly involved with automating manual tasks such as manufacturing and production lines, today's software-based robots will take on the repetitive but necessary work that we carry out on computers. Filling in forms, generating reports and diagrams and producing documentation and instructions are all tasks that can be automated by machines that watch what we do and learn to do it for us in a quicker and more streamlined manner. This automation – known as robotic process automation – will free us from the drudgery of time-consuming but essential administrative work, leaving us to spend more time on complex, strategic, creative and interpersonal tasks.

### 2. More and more personalization will take place in real-time

This trend is driven by the success of internet giants like Amazon, Alibaba, and Google, and their ability to deliver personalized experiences and recommendations. AI allows providers of goods and services to quickly and accurately project a 360-degree view of customers in real-time as they interact through online portals and mobile apps, quickly learning how their predictions can fit our wants and needs with ever-increasing accuracy. Just as pizza delivery companies like Dominos will learn when we are most likely to want pizza, and make sure the "Order Now" button is in front of us at the right time, every other industry will roll out solutions aimed at offering personalized customer experiences at scale.

### 3. AI becomes increasingly useful as data becomes more accurate and available

The quality of information available is often a barrier to businesses and organizations wanting to move towards AI-driven automated decision-making. But as technology and methods of simulating real-world processes and mechanisms in the digital domain have improved over recent years, accurate data has become increasingly available. Simulations have advanced to the stage where car manufacturers and others working on the development of autonomous vehicles can gain thousands of hours of driving data without vehicles even leaving the lab, leading to huge reductions in cost as well as increases in the quality of data that can be gathered. Why risk the expense and danger of testing AI systems in the real world when computers are now powerful enough, and trained on accurate-enough data, to simulate it all in the digital world? 2020 will see an increase in the accuracy and availability of real-world simulations, which in turn will lead to more powerful and accurate AI.

### 4. More devices will run AI-powered technology

As the hardware and expertise needed to deploy AI become cheaper and more available, we will start to see it used in an increasing number of tools, gadgets, and devices. In 2019 we're already used to

running apps that give us AI-powered predictions on our computers, phones, and watches. As the next decade approaches and the cost of hardware and software continues to fall, AI tools will increasingly be embedded into our vehicles, household appliances, and workplace tools. Augmented by technology such as virtual and augmented reality displays, and paradigms like the cloud and Internet of Things, the next year will see more and more devices of every shape and size starting to think and learn for themselves.

### **5. Human and AI cooperation increases**

More and more of us will get used to the idea of working alongside AI-powered tools and bots in our day-to-day working lives. Increasingly, tools will be built that allow us to make the most of our human skills – those which AI can't quite manage yet – such as imaginative, design, strategy, and communication skills. While augmenting them with super-fast analytics abilities fed by vast datasets that are updated in real-time.

For many of us, this will mean learning new skills, or at least new ways to use our skills alongside these new robotic and software-based tools. The IDC predicts that by 2025, 75% of organizations will be investing in employee retraining in order to fill skill gaps caused by the need to adopt AI. This trend will become increasingly apparent throughout 2020, to the point where if your employer isn't investing in AI tools and training, it might be worth considering how well placed they are to grow over the coming years.

### **6. AI increasingly at the “edge”**

Much of the AI we're used to interacting with now in our day-to-day lives takes place “in the cloud” – when we search on Google or flick through recommendations on Netflix, the complex, data-driven algorithms run on high-powered processors inside remote data centers, with the devices in our hands or on our desktops simply acting as conduits for information to pass through.

Increasingly, however, as these algorithms become more efficient and capable of running on low-power devices, AI is taking place at the “edge,” close to the point where data is gathered and used. This paradigm will continue to become more popular in 2020 and beyond, making AI-powered insights a reality outside of the times and places where super-fast fiber optic and mobile networks are available. Custom processors designed to carry out real-time analytics on-the-fly will increasingly become part of the technology we interact with day-to-day, and increasingly we will be able to do this even if we have patchy or non-existent internet connections.

### **7. AI increasingly used to create films, music, and games**

Some things, even in 2020, are probably still best left to humans. Anyone who has seen the current state-of-the-art in AI-generated music, poetry or storytelling is likely to agree that the most sophisticated machines still have some way to go until their output will be as enjoyable to us as the best that humans can produce. However, the influence of AI on entertainment media is likely to increase. This year we saw Robert De Niro de-aged in front of our eyes with the assistance of AI, in Martin Scorsese's epic *The Irishman*, and the use of AI in creating brand new visual effects and trickery is likely to become increasingly common.

In videogames, AI will continue to be used to create challenging, human-like opponents for players to compete against, as well as to dynamically adjust gameplay and difficulty so that games can continue to offer a compelling challenge for gamers of all skill levels. And while completely AI-generated music may not be everyone's cup of tea, where AI does excel is in creating dynamic soundscapes – think of smart playlists on services like Spotify or Google Music that match tunes and tempo to the mood and pace of our everyday lives.

### **8. AI will become ever more present in cybersecurity**

As hacking, phishing and social engineering attacks become ever-more sophisticated, and themselves powered by AI and advanced prediction algorithms, smart technology will play an increasingly important role in protecting us from these attempted intrusions into our lives. AI can be used to spot giveaway signs that digital activity or transactions follow patterns that are likely to be indicators of nefarious activity, and raise alarms before defenses can be breached and sensitive data compromised. The rollout of 5G and other super-fast wireless communications technology will bring huge opportunities for businesses to provide services in new and innovative ways, but they will also

potentially open us up to more sophisticated cyber-attacks. Spending on cybersecurity will continue to increase, and those with relevant skills will be highly sought-after.

#### **9. More of us will interact with AI, maybe without even knowing it**

Let's face it, despite the huge investment in recent years in natural-language powered chatbots in customer service, most of us can recognize whether we're dealing with a robot or a human. However, as the datasets used to train natural language processing algorithms continue to grow, the line between humans and machines will become harder and harder to distinguish. With the advent of deep learning and semi-supervised models of machine learning such as reinforcement learning, the algorithms that attempt to match our speech patterns and infer meaning from our own human language will become more and more able to fool us into thinking there is a human on the other end of the conversation. And while many of us may think we would rather deal with a human when looking for information or assistance, if robots fill their promise of becoming more efficient and accurate at interpreting our questions, that could change. Given the ongoing investment and maturation of the technology powering customer service bots and portals, 2020 could be the first time many of us interact with a robot without even realizing it.

#### **10. But AI will recognize us, even if we don't recognize it**

Perhaps even more unsettlingly, the rollout of facial recognition technology is only likely to intensify as we move into the next decade. Not just in China (where the government is looking at ways of making facial recognition compulsory for accessing services like communication networks and public transport) but around the world. Corporations and governments are increasingly investing in these methods of telling who we are and interpreting our activity and behavior. There's some pushback against this – this year, San Francisco became the first major city to ban the use of facial recognition technology by the police and municipal agencies, and others are likely to follow in 2020. But the question of whether people will ultimately begin to accept this intrusion into their lives, in return for the increased security and convenience it will bring, is likely to be a hotly debated topic of the next 12 months.

#### **Real Time Applications of AI:**

- Virtual Personal Assistants: Apple's Siri, Google Assistant, Amazon Alexa
- Smart Home: Nest labs, iRobot Roomba, Amazon echo
- Smart Car: fortwo, forCar2Go, Tesla
- Intelligent Chatbot: SIA, ibm watson chatbot, Hello Fresh
- Plagiarism Checkers: Plagarism Checker X, Urkund, Turnitin
- Smart Email Categorization: Zoho, SMTP2GO, AgileCRM
- Recommenders: Amazon, netflix recommendation system
- Automatic Text Summarization: Text Compactor, TheReviewIndex
- Domestic and Industrial Robot: Industry, Service and Domestic Robots
- Driverless Self Driving Car: Googlecars
- Deep Learning: Online Advertisements
- Augmented reality : surgery, Games
- Search Engine Optimization: Google, Yahoo, MSN, Bing

***Let's check the take away from this lecture***

Exercise

**Q.1 Application of AI are..... (U)**

- AI in Automotive Industry
- AI in Robotics
- AI in Finance
- **All listed here**

**Q.2 .....is not a current trend in AI (U)**

- Smart Home
- Smart Car
- Intelligent Chatbot
- **Personal Computer**

Learning from this lecture: Learners will be able to understand Applications and Current trends in AI

### **Conclusion**

This chapter was introduction to intelligent systems which covered Definition, History, Categorization, Components, Foundation, , Applications and recent trends in IS (i.e AI).

### **Short Answer Questions:**

Q.1 Give 5 different definitions of AI. (R)

Q.2 Differentiate Thinking Humanly Vs. Thinking Rationally and Acting Humanly Vs. Acting Rationally. (U)

Q.3 Summarize an inductive and a deductive reasoning with examples. (U)

Q.4 List various prerequisites areas with short description for Intelligent System. (R)

Q.5 Compare between Human Intelligence and Artificial Intelligence. (U)

### Long Answer Questions:

Q.1 Explain various applications and recent trends in AI.(U)

Q.2 Tabulate detailed evolution of Intelligent System. (R)

Q.3 Discuss various foundation areas with AI in detail. (U)

Q.4 Give an overview for various component of Intelligent System with brief discussion. (R)

Q.5 Describe various categories of intelligent systems and tasks. (U)

### References:

#### Books:

	Title	Authors	Publisher	Edition	Year	Chapter No
1	Artificial Intelligence a Modern Approach	Stuart J. Russell and Peter Norvig	McGraw Hill	3rd Edition	2009	
2	A First Course in Artificial Intelligence	Deepak Khemani	McGraw Hill Education (India)	1 <sup>st</sup> Edition	2013	

### Online Resources:

- [https://onlinecourses.nptel.ac.in/noc20\\_cs81/preview](https://onlinecourses.nptel.ac.in/noc20_cs81/preview) (Week 0, Week 1)
- <https://nptel.ac.in/courses/106/102/106102220/> (Week 1)
- <https://www.coursera.org/learn/introduction-to-ai/> (Week 1 and Week2)
- <https://www.coursera.org/learn/ai-for-everyone?#syllabus>
- [https://www.tutorialspoint.com/artificial\\_intelligence/artificial\\_intelligent\\_systems.htm](https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligent_systems.htm)
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