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1. Learning Outcomes

After studying this module, you shall be able to:

- Define what 'artificial intelligence' is
- Know the history behind it and how it emerged
- Know the basics of computerized intelligence
- Understand the goals of artificial intelligence

2. Introduction

We people clearly have different conceptions of what it means to be smart. In western cultures, being smart is typically thought of as having good mental skills that are instrumental to succeeding in school and in higher- level jobs and occupations. In some other culture, it might be being equipped with the ability and the skill to hunt. Or, to know archery! But, in a broader perspective, it is the ability to acquire knowledge, to think and reason effectively and to deal adaptively with the environment. Too complex? In layman language, when we are able to figure out what should our next move be in the game of chess, that's intelligence. If we are careful enough to carry an umbrella when the weather outside requires us to, that too is intelligence! Did I mention this is what Human Intelligence is? Is there anything apart from Human Intelligence that can keep things going? Can machines think? Can we make machines think that they can think? The answer to these inquisitive questions lie in the concept of *Artificial Intelligence* .

To begin with, Artificial Intelligence is making a computer that thinks like a human.

3. Define

Artificial intelligence (AI) refers to the idea of making machines intelligent as humans. It is the ability of the machines to carry on intelligent activities like problem solving and decision making etc. It entails successful transactions with the environment and thus making effective contributions to it. The term was propounded by John McCarthy (1955) and referered to scientific engineering of creating intelligent machines. No matter how much ironical, human intelligence is used to simulate intelligence in machines.

Investigation on AI requires superspeciality and is divided into various subfields that generally lack coordination with each other. The work that the individual subfields do, the research that is done, is often not integrated as a whole. This can be attributed to various social and cultural factors where the machine my be incepted in a particular culture, gain social approval from there and perform for organizations around. Supplementary are technical issues also where focus of every subfield is different. One subfield may emphasize upon problem solving while other may focus on servicing of the machines. Therefore the research in this area has to rely on requirements. Nevertheless, all the subfields have to merge at the epicentre and exhibit holistic functioning. Efforts directed in development of the machine have to be coordinated. For example, one field may specialize in creating intelligence, the other may focus on weaving it in psychosocial fabric and the end user may benefit with coordinated use of all features.

Some of the major AI targets includes inculcating cognitive processes of attention, perception decision making, logical analyses in machines. General intelligence emerges as a tough goal to be

accomplished. AI incorporates use of various tools such as statistics, economics, mathematical symbols etc. The area of AI uses interdisciplinary approach where it incorporates use of multiple fields such as science, linguistics, psychology, mathematics etc.

The field relies on the principle that it is the precision of human intelligence which eases its simulation in machines. This however brings up ethical challenges of simulating human intelligence in machines and extracting human like activity from them. The field poses extreme positivity but is set to serious challenges. At present, it occupies an important place in technological world executing important functioning.

3. History

The concept of thinking machines and including artificial beings was introduced by Greek myths. Simulation of human intelligence developed as a feature in majority of the cultures and also assumed an important place in fiction such as Mary Shelly's Frankenstein. Replication of emotional intelligence was also an integral part of the story.

The aspect of formal or mathematical analysis has been in existence since long. Depending on the work of renound mathematician Alan Turning, mathematical principles led to the development of computer programmes which on shifting (Till here changes are done).

The methods of Mechanical or even referred as "formal" reasoning was developed and explained by many philosophers and mathematicians since the ancient times. The study of logic have an important role to play as it led to the invention of digital electronic computer that are programmed and further based on the work of mathematician like Alan Turning and others. Turing's theory of computation recommended that a machine can just by simply shuffling the symbols for example as simple as "0" and "1", could suggest any probable act of mathematical deduction. For example **we present some trouble to the computer it will further process it in the combination of 0 and 1 but eventually convert its result in such a manner that we are be able to see the solution in the same language in which we have presented the problem.** The work in the areas of information technology, neurology and also inm the fields of cybernetics have further stimulated other researchers yo build an electronuic device for the brain also.

The field of Artificial intelligence came into exsistence just immediately after a conference in Dartmouth college 1956. John McCarthy had basically coined the term called artificial intelligence, there were others also you were known as the learders of AI, namely Marvin Minsky, Allen Newell and Herbert Simon. The researchers with their students formulated programs for computers by which it could solve all word problems with theorems and also used algebra. People were amazed to see computer speal inm English and even communicate just luke Humans. The researches in the area was majorly funded by U.S agencies as they were optimistic about this new field in focus. Herbert Simon wasthe one who predicted that "machines will be capable, in another twenty years, of doing any kind of work which a man can also do".

This field was very much critized for some of the problems and difficulties which they were not able to resolve, by Sir James Lighthill. Which led the funding agencies to withdraw themselves from the projects of AI, thus they were few funds avalaible for this field to vary on with their research work further. After 1974 funds were difficult to arrange for and this period is also termed as "AI winter".

Early 1980s was a period of revival for the field of AI, as commercial success of expert system starting place. It is a kind of a programme that could stimulate the analytical skills and even the knowledge for human experts.

It was somewhere in 1990s and also at early 21st century that AI had achieved great successes. It was being used for so many purposes such as data mining, logistics, in medical diagnosis and many more areas where technology was being applied. It was an emerging field with many new researches to its credit, therefore a need further arisis to expand the horizon of our minds. The successes of AI can be explained with many factors such as, the incresase use of computers, also with bigger importance in resolving specific subproblems, and it also forms new ties between AI and other fields that were working on similar thoughts aor problems. It was also referred as a new commitment by researchers to pure mathematical methods which includes rigorous scientific standards.

5. Computerized Intelligence

The important GOALS are:

The common problem of creating intelligence has been broken down into a numerous specific sub-problems. The reason being addressing all the problems at one go would have been an unfruitful effort. It would consist of certain traits, abilities and even the capabilities that researchers would rather prefer to have any intelligent system to display. The traits discussed in the following sections have received the most attention.

Deduction, reasoning, problem solving

The most appreciated concern/ effort in the field of AI research has been creating an intelligent machine which can address problems and assess the reasoning as well.

The early Artificial intelligence researchers have constructed certain algorithms that imitated the step-by-step processes involved in the process of reasoning that are commonly used by humans to solve puzzles or make logical deductions. By end of 1980s and also1990s, Artificial intelligence research had started developing extremely well flourishing methods for dealing with doubtful and also those informations that were not complete.certain concepts were employed to understand them like probability and economics. So, as mentioned earlier, AI research is multidisciplinary and not just confined to mechanical engineering. It involves and appreciates inputs from various disciplines.

Human beings have the capabilities to resolve most of their issues or problems by applying fast, intuitive judegements, instead of using conscious, step by step assumption that the early AI researchers were using with their previous models. Consider this example - suppose you are traveling by car and unfortunately you get a flat tire. The step by step deduction would demand you to call a mechanic and search for a solution. Whereas, working according to the intuitive judgement would enable you to change the tire yourself. AI has made a lot of progress at replicating "sub-symbolic" problem solving: that are basically the personalised approaches which emphasizes the importance of sensorimotor skills to higher order reasoning. The neural net that is involved attempts to simulate the structures inside the brain whivh further give rise to specialised skills such as statistical approaches being used in AI. The main goal is to look exactly just like humans.

The diagram of Knowledge representation
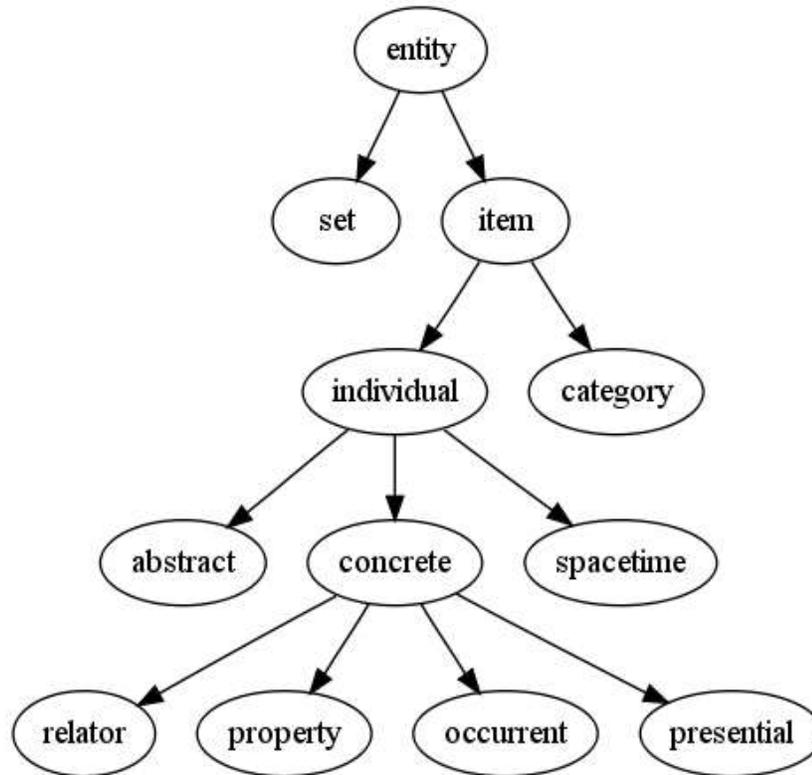
In the above flowchart an ontology represents knowledge as a set of concepts within a domain and the relationships between those concepts.

Knowledge Representation and also the concept of knowledge engineering are key to Artificial intelligence research. Most of the problems that machines are estimated to solve will eventually require broad and detailed knowledge about the world. How would you change the tire if you are unaware of the skill required to do it? The things that AI needs to signify are: some objects, cateogories, properties, and also the relations between those objects that includes situations, different events, time frames, causes and effects of certain events; knowledge about knowledge (what we know about what other people know); and more of these kinds. Even those events can also be included which might not have in depth research.

To mention a few difficulties of in knowledge representation would be:

Default Reasoning with that of qualification problems

A lot of of the things agents might know take the form of "working assumptions. Let us understand it by an example , suppose if a name of some animal say tiger comes up in conversation between two people,they will typically picture an animal that is fist according to its size, dangerous and in relayion to its quickness. We cannot make the same assumptions about all the Tigers, some might not mathch. John McCarthy had identified the same problem in the year 1969 as a term called qualification problem. Almost nothing is absolutely refered as true or false in the way it has been presented in abstract logic. Artificial intelligence research is exploring a number of solutions to above problems.

The extensiveness of commonsense knowledge

We can understanad this concept by simply knowing the fact that whaterver is known about the number of atomic facts by an individual is all through astronomical. Therefore all the Research projects that attempt to build a complete knowledge base of any commonsense knowledgebasically requires an enormous amounts of complex ontological engineering. That must be built, by hand, or by focusing on them one by one. The important aspect is to have the computer understand enough concepts that can be learned by reading from different sources like the internet, and thus be able to add to its own ontology. Basically, apart from its own storehouse of the knowledge it has acquired, a computer should have enough commonsense to add on the information that it comes across through any article or something.
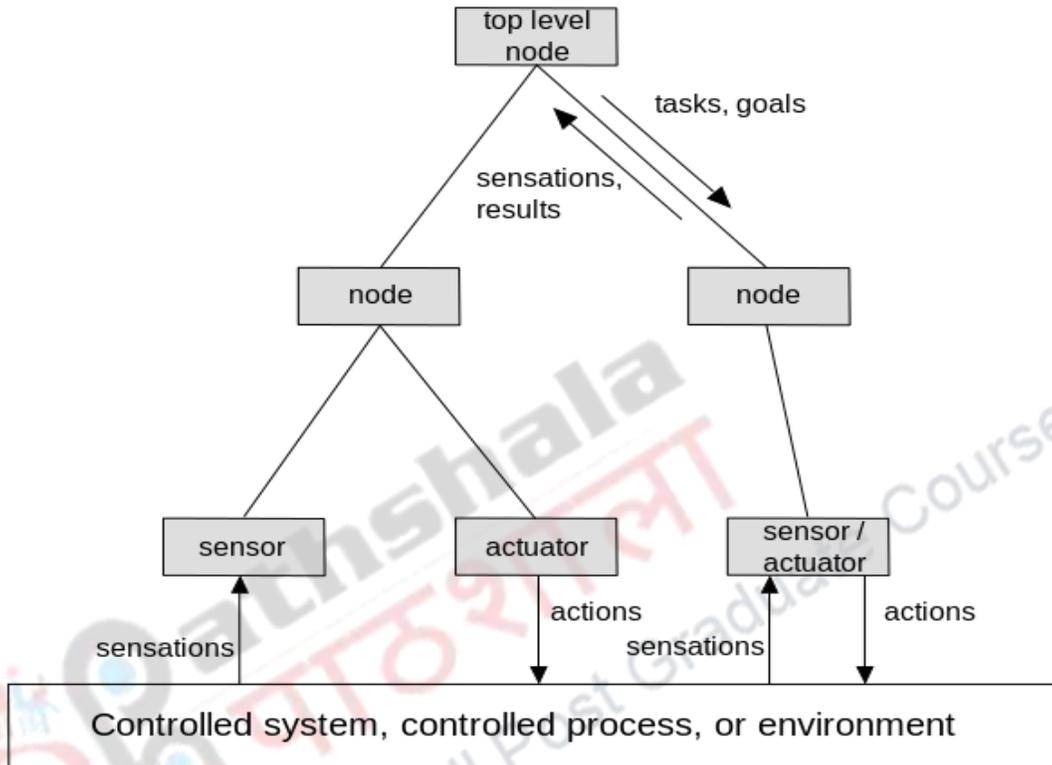
The sub-symbolic form of some commonsense knowledge

Most of the concepts known by individuals are not always represented ina form of some"facts" or "statements" that cold be easily expressed in a verbal manner.
Let us understand it with the help of an example, an art critic if he looks even once at a statue, then he can instantly realize that it is a fake one. Intuition, the ability to acquire knowledge without inference or the use of reason comes naturally with intelligence. While traveling by public transport if someone is constantly staring at your back, you get an intuition. This is included in Intelligence. These are basically some tendencies which are represented in the brain unconsciously or even sub-symbolically. Knowledge gained through this helps in providing information, supporting and providing a context for symbolic, conscious knowledge. Once you are aware of that person staring at you, you can consciously take an action. The problems that are associated with sub-symbolic reasoning, that might be present in AI, computational intelligence and even the statistical AI will provide different ways to represent this very kind of knowledge.

Planning

Hierarchical Control System

A heirarchial control system refers to be a control system in which a specified set of devices and governing software are arranged in a hierarchy.

Intelligent agents are those agents that can be able of seting goals and further helping us to achieve them. Thus it requires an approach that can help them to look into the future so that appropriate choices can be made by the researchers.

In traditional planning problems, the representative can presume that it is the only thing that is acting on the world , therefore it can be certain about what might be the consequences of its actions. However, if the representative is not the only actor, then it must be periodically ascertained that whether the world matches with its predictions and it must change its plan as it might become necessary. In the same manner we switch of Plan B if Plan A fails.
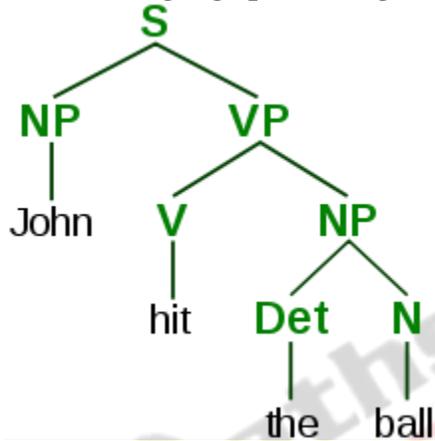
Learning

Learning which is involved for machines involves the learning of computer algorithms that can improve automaticallythrough experience. This has been an important aspect in AI research since 1956.

Unsupervised Learning can be defined as the ability to find patterns in a stream of inputs. Thus on the other hand Supervised Learning includes both classifications and numerical regression. Where

categorization or classification is used to determine what category something belongs in, after seeing a number of examples of things from several categories. For example, "A", "B", "AB" are classified into different blood types. Regression on the other hand is the attempt to create a function that describes the relationship between inputs and outputs and further helps in prediction of how these outputs received can be changed according to the inputs received. In case of reinforcement learning, the representative is rewarded for good responses and punished for any bad ones. These can be analyzed in terms of decision theory that deals with the concepts of utility. Computer learning is defined as any mathematical analysis that involves algorithms.

Natural language processing (communication)

The diagram represents the parse tree that exaplains about the syntactic structure of a sentence according to some formal grammar.

The method where natural learning is involved gives machine the capacity to read and comprehend the languages that humans communicate with each other.

A powerful natural language processing system would permit the natural language user to use interfaces. The knowledge can be acquired through many written sources, such as newswire texts. The natural language processing also include information retrieval and machine translation. Just Imagine if blind people could have a machine capable of reading for them, how useful it will turn for them.

The most common method used in processing and further extracting meaning from natural language is through semantic indexing. This can lead to Increase in processing speed and also drop in the cost of data storage.

Perception

Now let us understand machine perceptions. They are the ability to use input from our sensors (such as cameras, microphones, to deduce aspects of the world. Computer Vision is the ability to analyze visual input.

Motion and impact of manipulation

AI is known for its work in the area of Robots. As Intelligence is required for robots to be able to handle difficult tasks such as object manipulation and navigation, with problems of localization which explains about knowing where we are, or finding our own things. It also includes mapping which is learning about what is around us and also helps in building a map of the environment. The third aspect which is also included is motion planning , that is figuring out how to get at some place. The fourth is path planning that explains about going from one point in space to another point, which may involve compliant motion - where the robot moves while maintaining physical contact with an object). In layman language, a robot serving water to the guests at home!

Long-term goals

The most important long-term goals that are used in research , pertaining to artificial intelligence are: (1) Social intelligence, (2) Creativity, and (3) General intelligence.

Social intelligence

Kismet, a robot with rudimentary social skills

When we refer toAffective computing it means the study and development of systems and devices that can help in recognizing, interpreting, processing, and simulating human affects. It includes creating certain intelligent agents which are capable of maintaining social order. It is an interdisciplinary field comprising different fields such as computer sciences, psychology and cognitive science. the modern branch of computer science originated with Rosalind Picard's 1995 paper on affective computing. A motivation behind this research was the ability to simulate empathy. The machine should be capable enough to interpret the emotional state of humans and help in adaptation of their behavior. This can further help them in giving an appropriate response for those emotions.

Emotion and social skills are seen to play two roles for an intelligent representative. First, it must have the capacity to help the representative in predicting the actions of others, by understanding their motives and emotional states. For eg - if you're fighting with an intelligent agent, it should be able to predict at what stage of the argument you are gonna get violent and run to destroy it! Therefore computers shoulf provide human computer interaction, so that they are aslos able to display emotions as humans do. It does not mean that they should not mean actually experience them itself—in order to appear sensitive to the emotional dynamics of human interaction. How would you feel if an empathetic robot counsels you? Where a personal touch is an absolute necessity, can technology ever replace it?

Creativity

Artificial intelligence studies creativity in two ways, first theoretically and second through practically. The former one is taken from all philosophical and psychological viewpoint.whereas the latter one deals with specific implementations of certain systems that hjave the capacity to produce outputs that are considered to be creative. Other related fields of computational research are Artificial Intuition and Artificial Thinking.

General intelligence

According to most of the researchers they view that their work will ultimately be incorporated into a machine with the help of *general* intelligence . it is the ability to combine all the skills that are required by humans and that exceeds their abilities. A few researchers believe in the notion that anthropomorphic features such as artificial consciousness or an artificial brain may be required for such a project.

the problems mentioned above may require general intelligence to solve problems. For example, even a straightforward, specific task like machine translation requires that the machine read and write in both languages. A problem like machine translation is considered "AI Complete". In order to solve this particular problem, you must solve all the problems.

6. Summary

- *Artificial Intelligence* is termed as the intelligence that is exhibited by machines or software. The term was coined by John McCarthy in 1955 who defined it as "the science and engineering of making intelligent machines".

- AI research was established at a conference which took place in the campus of Dartmouth College in 1956.

- Some of the goals of artificial intelligence include :

- Deduction, reasoning, problem solving : The most appreciated concern/ effort in the field of AI research has been creating an intelligent machine which can address problems and assess the reasoning as well.

  - Knowledge Representation that knowledge is a set of concepts within a domain and also has a relationships between those concepts.

  - Planning refers to Intelligent representatives that must be able to set goals for themselves and also achieve them

  - Learning : Intelligent agents should be able to learn the new information they come across.

  - Natural Language Processing method basically gives machines the ability to understand, read and comprehend the languages that humans speak and coomunicate with ea.chother