CHAPTER – 1

INTRODUCTION

Artificial Intelligence (AI):

Artificial Intelligence is the part of computer science concerned with designing intelligent computer system that means systems that exhibit the characteristics we associate with intelligence in human behavior. An AI device should have the following abilities:

- ➢ To learn from experience.
- ➢ To reason that is the reasoning.
- ➢ The ability to understand and communicate in a natural language.
- ➢ The ability to plan and execute complex task.

The intelligent behavior of any AI device can be characterized in the following four points:

1. *Acting Humanly (The Turing Test Approach):*

Acting humanly means designing or developing mechanic device that can act as human being. Alan Turing in 1950 purpose the Turing test to convince the people that a particular machine can think or not. To pass a Turing test a computer or machine must have the following points:

- ➢ Natural language processing that means the machine must be able to communicate successfully in natural languages like English.
- ➢ Knowledge representation that means the ability to store different types of knowledge perceived from surrounding environment.
- ➢ Automated reasoning that means to answer the questions and drawing conclusions on the basis of stored knowledge.
- ➢ Machine learning that means the ability to adapt in new circumstances and learn new facts and rules.

2. *Thinking Humanly (Cognitive Modeling Approach):*

An AI device should think like a human being. For this we need to study about the actual working of human mind. This can be done by:

- ➢ Through introspection
- ➢ Through psychological experiments.

Once, we have a precise theory of mind, it is possible to express the theory as a computer program.

The field of cognitive science brings together computer models from AI and experiments technique from psychology to try to construct precise and testable theories about the working of human mind.

3. *Acting Rationally (The Rational Agent Approach):*

Agent is something that acts. Computer agent is expected to have the following attributes:

- ➢ Perceiving their environment.

- ➢ Autonomous control
- ➢ Adapting to change
- ➢ Persisting over a long period of time
- ➢ Capable of taking goals

Rational behavior of any agent means doing the things in a right manner so that the agent can achieve its goal. In AI system every artificial agent must act rationally by justifying its behavior.

4. *Thinking Rationally:*

Rational thinking means justifying the thinking process of any agent. All the conclusion and decisions made by agent must be rational or justifiable. In AI, we can use logical programming to support rational thinking however, it is very much complex as it requires a huge knowledge base containing different type of knowledge about the surrounding environment and various suitable knowledge representations technique.

History of Artificial Intelligence:

The history of Artificial Intelligence is quite interesting and started around 100 years ago.

Rossum's Universal Robots (R.U.R.):

In 1920 the Czech writer Karel Čapek published a science fiction play named Rossumovi Univerzální Roboti (Rossum's Universal Robots), also better known as R.U.R. The play introduced the word robot. R.U.R. deals about a factory, which creates artificial people named as robots. They differentiate from today's term of robot. In R.U.R. robots are living creatures, who are more similar to the term of clones. The robots in R.U.R. first worked for the humans, but then there comes are robot rebellion which leads to the extinction of the human race.

Alan Turing:

Alan Turing was born on 23th June 1912 in London. He is widely known, because the encrypted the code of the enigma, which were used from Nazi Germany to communicate. Alan Turing's study also led to his theory of computation, which deals about how efficient problems can be solved. His presented his idea in the model of the Turing machine, which is today still a popular term in Computer Science. The Turing machine is an abstract machine, which can, despite the model's simplicity, construct any algorithm's logic. Because of discoveries in neurology, information theory and cybernetics in the same time researches and with them Alan Turing created the idea that it is possible to build an electronic brain.

Some years after the end of World War 2, Turing introduced his widely known Turing Test, which was an attempt to define machines intelligent. The idea behind the test was that are machine (e.g. a computer) is then called intelligent, if a machine (A) and a person (B) communicate through natural language and a second person (C), a so-called elevator, cannot detect which of the communicators (A or B) is the machine.

The Dartmouth Conference:

In 1956 there was probably the first workshop of Artificial Intelligence and with it the field of AI research was born. Researcher from Carnegie Mellon University (CMU), Massachusetts Institute of Technology (MIT) and employee from IBM met together and founded the AI research. In the following years they made huge process. Nearly everybody was very optimistic. That was in the

1960s. The progress slowed down in the following years. Because of the failing recognizing of the difficulty of the tasks promises were broken.

The First AI Winter:

Because of the over optimistic settings and the not occurred breakthroughs U.S. and British government cut of exploratory research in AI. The following years were called (first) AI Winter. The enthusiasm was lost, nobody wanted to fund AI research. The interest of publicity on Artificial Intelligence decreased. This was around 1974.

Expert Systems:

After the first AI Winter, Artificial Intelligence came back in a form of so-called "expert systems". Expert systems are programs that answer question and solve problems in a specific domain. They emulate an expert in a specific branch and solve problems by rules. There are two types of engines in expert systems: First, there is the knowledge engine, which represents facts and rules about a specific topic. Second, there is the inference engine, which applies the rules and facts from the knowledge engine to new facts.

Synthesis of Integral Design:

In 1981 an expert system named SID (Synthesis of Integral Design) designed 93% of the VAX 9000 CPU logic gates. The SID system was existing out of 1,000 hand-written-rules. The final design of the CPU took 3 hours to calculate and outperformed in many ways the human experts. As an example, the SID produced a faster 64-bit adder than the manually designed one. Also the bug per gate rate, which where around 1 bug per 200 gates from human experts, was much lower at around 1 bug per 20,000 gates at the final result of the SID system.

The Second AI Winter:

The second AI Winter came in the later 80s and early 90s after a series of financial setbacks. The fall of expert systems and hardware companies who suffered through desktop computers built by Apple and IBM led again to decreasing AI interest, on the one hand side from publicity and on the other side from investors.

Deep Blue:

After many ups and downs Deep Blue became the first chess computer to beat a world chess champions, Garry Kasparov. On 11 May 1997 IBM's chess computer defeated Garry Kasparov after six games with 3½–2½.

Deep Blue used tree search to calculate up to a maximum of 20 possible moves. It evaluated positions by a value function mainly written by hand, which was later optimized by analyzing thousands of games. Deep Blue also contained an opening and endgame library of many grandmaster games.

In 1997 Deep Blue was the 259th most powerful supercomputer with 11.38 GFLOPS. In comprising: The most powerful supercomputer in 1997 had 1,068 GFLOPS and in December 2017 the most powerful supercomputer has 93,015 GFLOPS. FLOPS stand for floating-point operations per second and the 'G' in GFLOPS stands for Giga. So the equivalent of 1 GFLOPS are 10^9 FLOPS.

21st Century: Deep Learning, Big Data and Artificial General Intelligence:

In the last two decades, Artificial intelligence grow heavily. The AI market (hardware and software) has reached $8 billion in 2017 and the research firm IDC (International Data Corporation) predicts that the market will be $47 billion by 2020.

This all is possible through Big data, faster computers and advancements in machine learning techniques in the last years. With the usage of Neural Networks complicated tasks like video processing, text analysis and speech recognition can be tackled now and the solutions which are already existing will become better in the next years.

Atari Games:

In 2013 DeepMind, one of the world's foremost AI research, introduced an AI which could play a couple of Atari games on top of a level of human players. This first seems not very expressive, but they just used reinforcement learning and neural networks to let the AI self-learn these games. Also they just used the pixels as an input to the agent, so there was no direct reward score given to the agent depending on the moves he did.

In 2015 they further introduced a smarter agent, who successfully played 49 classic Atari games by itself.

Next to classic games from old retro consoles DeepMind is developing an AI for more complex game, like e.g. Starcraft 2. Starcraft 2 is a Real Time Strategy (RTS) game, which is the most popular 1 v/s 1 E-Sport title. Starcraft 2 is very popular in South Korea and the best Starcraft 2 pro player come from South Korea. Nevertheless there are many European and North American pro player who play for living. Starcraft 2 is a much more complex game than classic video games: There are much more possible actions we can do, we do not know everything about our opponent and we have to scout him to explore what he is doing. In Starcraft 2 there are also dozens of strategy decision to choose from every minute and in general much more to care about comparing to classic video games.

AlphaGo:

Next to classic Atari games, DeepMind also managed to defeat the world best human Go player with his AI AlphaGo. In October 2015 they first defeated the European Go champion Fan Hui five to zero. After the match there was a lot of skeptics in the Go scene about AlphaGo, because Fan Hui is 'only' an 2-dan (out of 9-dan, which is best) European Champion. Therefore the DeepMind team flew to South Korean to face Lee Sedol, a 9-dan Go Player. Lee Sedol is known as one of the best Go players in the world. After DeepMind managed to win the first 3 matches Lee Sedol seemed very desperate. But in the fourth game AlphaGo lost after it made an obvious mistake. In the last match AlphaGo could win again. In the end AlphaGo managed to win with 4-1 against Lee Sedol.

In 2017 DeepMind published the next generation of AlphaGo. AlphaGo Zero is build up on reduced hardware and just learned Go to play against itself. After three days of training AlphaGo Zero was stronger than the version of AlphaGo who defeated Lee Sedol and won against his younger version with 100-0. After 40 days of training it also defeated his former version of AlphaGo Zero.

Advantages of Artificial Intelligence:

Artificial intelligence is complex in nature. It uses very complicated mixture of computer science, mathematics and other complex sciences. Complex programming helps these machines replicate the cognitive abilities of human beings.

1. Error Reduction:

Artificial intelligence helps us in reducing the error and the chance of reaching accuracy with a greater degree of precision is a possibility. It is applied in various studies such as exploration of space.

Intelligent robots are fed with information and are sent to explore space. Since they are machines with metal bodies, they are more resistant and have greater ability to endure the space and hostile atmosphere.

They are created and acclimatized in such a way that they cannot be modified or get disfigured or breakdown in the hostile environment.

2. Difficult Exploration:

Artificial intelligence and the science of robotics can be put to use in mining and other fuel exploration processes. Not only that, these complex machines can be used for exploring the ocean floor and hence overcoming the human limitations.

Due to the programming of the robots, they can perform more laborious and hard work with greater responsibility. Moreover, they do not wear out easily.

3. Daily Application:

Computed methods for automated reasoning, learning and perception have become a common phenomenon in our everyday lives. We have our lady Siri or Cortana to help us out.

We are also hitting the road for long drives and trips with the help of GPS. Smartphone in an apt and every day is an example of the how we use artificial intelligence. In utilities, we find that they can predict what we are going to type and correct the human errors in spelling. That is machine intelligence at work.

When we take a picture, the artificial intelligence algorithm identifies and detects the person's face and tags the individuals when we are posting our photographs on the social media sites.

Artificial Intelligence is widely employed by financial institutions and banking institutions to organize and manage data. Detection of fraud uses artificial intelligence in a smart card based system.

4. Digital Assistants:

Highly advanced organizations use 'avatars' which are replicas or digital assistants who can actually interact with the users, thus saving the need of human resources.

For artificial thinkers, emotions come in the way of rational thinking and are not a distraction at all. The complete absence of the emotional side, makes the robots think logically and take the right program decisions.

Emotions are associated with moods that can cloud judgment and affect human efficiency. This is completely ruled out for machine intelligence.

5. Repetitive Jobs:

Repetitive jobs which are monotonous in nature can be carried out with the help of machine intelligence. Machines think faster than humans and can be put to multi-tasking. Machine intelligence can be employed to carry out dangerous tasks. Their parameters, unlike humans, can be adjusted. Their speed and time are calculation based parameters only.

When humans play a computer game or run a computer-controlled robot, we are actually interacting with artificial intelligence. In the game we are playing, the computer is our opponent. The machine intelligence plans the game movement in response to our movements. We can consider gaming to be the most common use of the benefits of artificial intelligence.

6. Medical Applications:

In the medical field also, we will find the wide application of AI. Doctors assess the patients and their health risks with the help of artificial machine intelligence. It educates them about the side effects of various medicines.

Medical professionals are often trained with the artificial surgery simulators. It finds a huge application in detecting and monitoring neurological disorders as it can simulate the brain functions.

Robotics is used often in helping mental health patients to come out of depression and remain active. A popular application of artificial intelligence is radiosurgery. Radiosurgery is used in operating tumors and this can actually help in the operation without damaging the surrounding tissues.

7. No Breaks:

Machines, unlike humans, do not require frequent breaks and refreshments. They are programmed for long hours and can continuously perform without getting bored or distracted or even tired.

Disadvantages of Artificial Intelligence:

1. High Cost:

Creation of artificial intelligence requires huge costs as they are very complex machines. Their repair and maintenance require huge costs.

They have software programs which need frequent up gradation to cater to the needs of the changing environment and the need for the machines to be smarter by the day.

In the case of severe breakdowns, the procedure to recover lost codes and re-instating the system might require huge time and cost.

2. No Replicating Humans:

Intelligence is believed to be a gift of nature. An ethical argument continues, whether human intelligence is to be replicated or not.

Machines do not have any emotions and moral values. They perform what is programmed and cannot make the judgment of right or wrong. Even cannot take decisions if they encounter a situation unfamiliar to them. They either perform incorrectly or breakdown in such situations.

3. No Improvement with Experience:

Unlike humans, artificial intelligence cannot be improved with experience. With time, it can lead to wear and tear. It stores a lot of data but the way it can be accessed and used is very different from human intelligence.

Machines are unable to alter their responses to changing environments. We are constantly bombarded by the question whether it is really exciting to replace humans with machines.

In the world of artificial intelligence, there is nothing like working with a whole heart or passionately. Care or concerns are not present in the machine intelligence dictionary. There is no sense of belonging or togetherness or a human touch. They fail to distinguish between a hardworking individual and an inefficient individual.

4. No Original Creativity:

Do you want creativity or imagination?

These are not the forte of artificial intelligence. While they can help you design and create, they are no match for the power of thinking that the human brain has or even the originality of a creative mind.

Human beings are highly sensitive and emotional intellectuals. They see, hear, think and feel. Their thoughts are guided by the feelings which completely lacks in machines. The inherent intuitive abilities of the human brain cannot be replicated.

5. Unemployment:

Replacement of humans with machines can lead to large scale unemployment.

Unemployment is a socially undesirable phenomenon. People with nothing to do can lead to the destructive use of their creative minds.

Humans can unnecessarily be highly dependent on the machines if the use of artificial intelligence becomes rampant. They will lose their creative power and will become lazy. Also, if humans start thinking in a destructive way, they can create havoc with these machines.

Artificial intelligence in wrong hands is a serious threat to mankind in general. It may lead to mass destruction. Also, there is a constant fear of machines taking over or superseding the humans.

Everything that has been created in this world and in our individual societies is the continuous result of intelligence. Artificial intelligence augments and empowers human intelligence. So as long we are successful in keeping technology beneficial, we will be able to help this human civilization.