**Lecture-01**

**Introduction to Artificial Intelligence**

Artificial intelligence (AI) is a branch of computer science focused on creating intelligent machines capable of mimicking human cognitive functions like learning and problem-solving. Artificial Intelligence (AI) operates on a core set of concepts and technologies that enable machines to perform tasks that typically require human intelligence.

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 your own intelligence, and that is the awesomeness of AI.

It is believed that AI is not a new technology, and some people say that as per Greek myth, there were Mechanical men in the early days who can work and behave like humans.

**Why Artificial Intelligence**

* With the help of AI, you can **create 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 assistants**, such as Cortana, Google Assistant, Siri, etc.
* With the help of AI, you can **build such Robots** which can work in an environment where the survival of humans can be at risk.
* AI opens a path for other new technologies, new devices, and new opportunities.

*Here are some foundational concepts required to develop an AI system:*

1. *Machine Learning (ML): This is the backbone of AI, where algorithms learn from data without being explicitly programmed. It involves training an algorithm on a data set, allowing it to improve over time and make predictions or decisions based on new data.*
2. *Neural Networks: A* ***neuron*** *in the context of artificial intelligence is a mathematical function that mimics the behavior of a biological neuron in the human brain. It receives input signals, processes them through weights and biases, applies an activation function, and produces an output. Neurons are the fundamental units in a neural network, and they are responsible for transforming input data into meaningful outputs by learning from examples. A* ***neural network*** *is a series of interconnected neurons organized into layers, including an input layer, hidden layers, and an output layer. Each node connects to others, and has its own associated weight and threshold. If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network. Otherwise, no data is passed along to the next layer of the network. A neural network that only has two or three layers is just a basic neural network.*
3. *Deep Learning is a subset of machine learning that involves neural networks with many layers (hence "deep"). A neural network that consists of more than three layers—which would be inclusive of the inputs and the output - can be considered a deep learning algorithm. These deep neural networks can automatically learn to represent data in multiple layers of abstraction, making them powerful for complex tasks like image and speech recognition, natural language processing, and even game playing. Unlike traditional machine learning methods, deep learning models can learn features directly from raw data, eliminating the need for manual feature extraction.*
4. *Natural Language Processing (NLP): NLP involves programming computers to process and analyze large amounts of natural language data, enabling interactions between computers and humans using natural language.*
5. *Robotics: While often associated with AI, robotics merges AI concepts with physical components to create machines capable of performing a variety of tasks, from assembly lines to complex surgeries.*
6. *Cognitive Computing: This AI approach mimics human brain processes to solve complex problems, often using pattern recognition, NLP, and data mining.*
7. *Expert Systems: These are AI systems that emulate the decision-making ability of a human expert, applying reasoning capabilities to reach conclusions.*

Each of these concepts helps to build systems that can automate, enhance, and sometimes outperform human capabilities in specific tasks.

**Core Goal of Artificial Intelligence (AI)**

Emulate human intelligence in machines. This can involve tasks like:

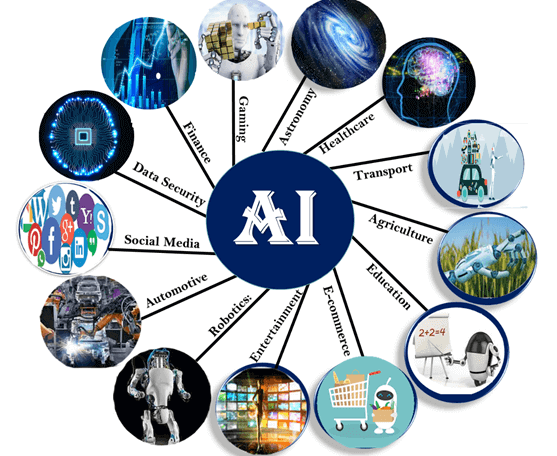
* Reasoning: Analyze information and draw logical conclusions.
* Learning: Acquire new knowledge and skills from data.
* Problem-solving: Identify and solve problems in a goal-oriented way.
* Decision-making: Evaluate options and make choices based on available information.

Functional Goal of Artificial intelligence are as follow-

1. **To Create Expert Systems −** The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advise their users.
2. **To Implement Human Intelligence in Machines −** Creating systems that understand, think, learn, and behave like humans.
3. **Improving Problem-solving skills -** The potential of AI in solving problems will make our lives easier as complex duties can be designated to dependable AI systems which can simplify vital jobs
4. **Include knowledge representation –** It is concerned with the representation of 'what is known' to machines by using the existence of a set of objects, relations, and concepts. The representation displays real-world data that a computer can utilize to solve complicated real-world problems, such as detecting a medical condition or conversing with humans in natural language.
5. **Facilitates Planning −** Through predictive analytics, data analysis, forecasting, and optimization models, AI-driven planning creates a procedural course of action for a system to reach its goals and optimizes overall performance. One of the principal goals of artificial intelligence is to employ its prediction to anticipate the future and determine the implications of our actions.
6. **Allow continuous learning -** Conceptually, learning implies the ability of computer algorithms to improve the knowledge of an AI program through observations and past experiences. Technically, AI programs process a collection of input-output pairs for a defined function and use the results to predict outcomes for new inputs.
7. AI primarily uses two learning models–supervised and unsupervised–where the main distinction lies in using labeled datasets. As AI systems learn independently, they require minimal or no human intervention. For example, ML defines an automated learning process.
8. **Promote creativity −** AI promotes creativity and artificial thinking that can help humans accomplish tasks better. It also offers a platform to augment and strengthen creativity, as AI can develop many novel ideas and concepts that can inspire and boost the overall creative process. For example, an AI system can provide multiple interior design options for a 3D-rendered apartment layout.

**Lecture-02**

**Application area of Artificial Intelligence**

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**Entertainment and Media**

* AI is increasingly used to **generate and curate content**, from writing articles to creating music and videos. Machine learning models can analyze vast amounts of data to identify trends, generate scripts, or even compose music, helping content creators and producers deliver engaging material more efficiently. **OpenAI's GPT-3** has been used to write articles, generate creative writing prompts, and even assist in screenwriting. Similarly, AI tools like Amper Music allow musicians to compose original pieces by generating music based on user inputs and preferences.
* AI-driven **recommendation engines** are crucial in delivering personalized content to users. These systems analyze user behavior, preferences, and historical data to suggest movies, music, articles, or games that are most likely to interest the individual, enhancing user engagement and satisfaction. **Netflix** uses AI algorithms to recommend movies and TV shows to its users. The recommendation system analyzes viewing history, ratings, and user interactions to suggest content tailored to each viewer's tastes, significantly contributing to the platform's popularity.

**Health Care**

* AI algorithms, particularly those based on deep learning, are being used to **analyze medical images** such as X-rays, MRIs, and CT scans. These systems can detect abnormalities like tumors, fractures, and infections with high accuracy, often surpassing human experts in certain cases. e.g. **Google's DeepMind** developed an AI system that can detect over 50 different eye diseases from retinal scans with an accuracy comparable to that of leading ophthalmologists. This technology can assist doctors in making quicker and more accurate diagnoses.
* AI is being used to **accelerate the** **drug discovery process** by analyzing large datasets to identify potential drug candidates. AI can predict how different compounds will interact with the human body, significantly reducing the time and cost associated with bringing new drugs to market. **IBM Watson** has been employed in drug discovery to analyze millions of data points, helping to identify new drug compounds and possible uses for existing drugs in treating diseases like cancer and Alzheimer's.

**Finance**

* AI-powered trading algorithms analyze vast amounts of market data to **execute trades at optimal times**, often within milliseconds. These systems can predict market trends, assess risks, and make split-second decisions that humans cannot. Quantitative hedge funds, like **Renaissance Technologies**, rely on AI-driven models to automate trading decisions, optimizing portfolio performance and managing risks more effectively.
* AI enables banks to offer **personalized financial services** by analyzing customer data, such as spending habits, income, and savings goals. This allows for tailored product recommendations, customized financial advice, and more targeted marketing. Banks like **Capital One** use AI to offer personalized credit card recommendations, budgeting advice, and alerts for unusual spending, enhancing customer satisfaction and engagement.

**Manufacturing and Industries**

* AI is used to predict when machinery and equipment are likely to fail, allowing maintenance to be performed before a breakdown occurs i.e. AI can be used for **preventive maintenance**. This minimizes downtime, extends the lifespan of machines, and reduces maintenance costs. **General Electric (GE)** uses AI-driven predictive maintenance in its industrial equipment, such as jet engines and gas turbines. By analyzing data from sensors, AI models can predict potential failures and suggest timely maintenance, preventing costly unplanned outages.
* AI systems are employed in manufacturing to **monitor and control the quality of products**. Machine learning algorithms can detect defects in products by analyzing images, sensor data, or other indicators, ensuring high-quality output. Companies like **Siemens** use AI-powered vision systems to inspect products on the assembly line. These systems can identify defects or deviations from quality standards with greater accuracy and speed than human inspectors, reducing the likelihood of defective products reaching customers.

**Agriculture**

* AI-driven **precision farming** involves the use of sensors, drones, and data analytics to monitor and manage crops at a granular level. AI can analyze data on soil conditions, weather patterns, and crop health to optimize planting, irrigation, and fertilization. **John Deere's AI-powered tractors** use computer vision and machine learning to monitor crop health and soil conditions in real time. Farmers can adjust their practices based on AI recommendations, leading to higher yields and reduced resource use.
* AI systems can **detect and diagnose crop diseases** early by analyzing images of plants. Machine learning models trained on large datasets of plant images can identify diseases with high accuracy, enabling timely intervention and preventing large-scale crop loss. **PlantVillage**, an AI-based app, helps farmers in developing countries by using machine learning to diagnose plant diseases from photos taken with smartphones. The app provides instant recommendations for treatment, helping to protect crops and livelihoods.

**Safety and Security**

* AI-powered **surveillance systems** are used to monitor public spaces, detect threats, and enhance security. These systems can analyze video footage, recognize faces, detect unusual behavior, and alert authorities to potential security incidents. AI is used in smart city surveillance systems to monitor public areas for suspicious activities. For instance, systems like **BriefCam** can analyze video footage to identify objects, track movements, and detect anomalies, helping law enforcement respond quickly to potential threats.
* AI is used to predict, monitor, and respond to natural disasters, such as floods, earthquakes, and wildfires. AI models analyze data from sensors, satellites, and social media to provide early warnings, assess damage, and coordinate emergency response efforts. The AI system developed by Google for **flood forecasting** uses machine learning to predict the likelihood of floods in certain regions. By analyzing weather patterns, river levels, and terrain data, the system can provide early warnings to affected communities, helping to reduce casualties and property damage.

**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, its origin, etc.

**Gaming**

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

**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 the AEG bot, AI2 Platform, are used to determine software bugs and cyber-attacks in a better way.

**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, hashtags, and requirements of different users.

**Travel & Transport**

* AI is becoming highly demanding for travel industries. AI is capable of doing various travel-related works such as making travel arrangements 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.

**Automotive Industry**

* Some Automotive industries are using AI to provide virtual assistants to their users 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.

**Robotics**

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

**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.

**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 work as a personal virtual tutor for students, which will be accessible easily at any time and any place.

**Advantages of AI**

**Reduction in Human Error**

* The reduction in human error stands out as a significant benefit of artificial intelligence, marking a pivotal shift in how tasks are executed across various fields. By leveraging AI, tasks that were traditionally prone to inaccuracies due to human oversight can now be performed with a higher degree of precision. AI systems are programmed to follow specific instructions and algorithms, which allows them to process information and make decisions based on factual data and predefined rules. This minimizes the chances of errors that can occur due to subjective judgment, fatigue, or other human limitations.

**Zero Risks**

* The concept of zero risks is another compelling advantage of artificial intelligence, particularly in contexts where human safety and well-being are paramount. AI systems can be deployed in hazardous environments or situations where human involvement would pose significant risks, such as space exploration, deep-sea exploration, and handling of toxic substances. By utilizing robots or AI-driven machinery, tasks can be performed without jeopardizing human lives, ensuring that operations are conducted safely and effectively.

**24x7 Availability**

* One of the standout advantages of artificial intelligence is its ability to remain operational 24x7, without the limitations faced by human workers such as the need for rest, breaks, or shifts. AI systems, unlike humans, do not suffer from fatigue, which allows them to perform continuous and consistent service around the clock. This aspect of AI is particularly beneficial in industries that require constant monitoring and operations, such as customer service, cybersecurity, and manufacturing.

**Digital Assistance/Daily Applications**

* Digital assistance, facilitated by artificial intelligence, represents a significant leap in how individuals and businesses interact with technology, offering personalized and efficient support. AI-powered digital assistants, such as virtual assistants on smartphones or voice-activated devices in homes, have become integral in simplifying user interactions with technology. They process natural language, understand user requests, and provide relevant information or perform tasks ranging from setting reminders to controlling smart home devices, all through simple voice commands or text inputs.

**Perform Repetitive Jobs**

* The ability of artificial intelligence to efficiently perform repetitive jobs is a substantial advantage, particularly in sectors where consistency and precision are crucial. AI excels in automating tasks that are monotonous for humans, such as data entry, transaction processing, and even intricate manufacturing operations. This automation not only accelerates processes but also allows human employees to engage in more complex and creative tasks, thereby boosting overall productivity and innovation.

Apart from the above listed; we have advantages like-

* **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 purposes, Natural language processing to communicate with the human in human language, etc.
* **New Inventions:** AI is powering many inventions in almost every domain which will help humans solve the majority of complex problems.
* **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.

**Disadvantages of AI**

**High Costs**

* The high costs associated with artificial intelligence systems represent a significant disadvantage, impacting their accessibility and adoption across various sectors. Developing, deploying, and maintaining AI technologies require substantial investments in specialized hardware, sophisticated algorithms, and vast datasets for training purposes. Additionally, the expertise needed to create and manage AI systems is highly specialized, contributing to the overall expenses due to the high demand for skilled professionals in the field of AI and data science.

**Make Humans Lazy**

* The convenience and efficiency brought by artificial intelligence can inadvertently lead to a dependency that may diminish human initiative and problem-solving skills. As AI systems take over more tasks, from personal assistants managing our schedules to smart home devices controlling our living environments, there's a growing concern that this reliance could make individuals less proactive or less inclined to engage in critical thinking. The ease with which information and services are delivered can reduce the necessity for individuals to develop or maintain certain skills, such as navigation skills in the age of GPS apps, or basic research skills with search engines providing instant answers.

**Job Displacement & Next Digital Divide**

* One of the most significant concerns associated with the rise of artificial intelligence (AI) is job displacement. As AI systems become increasingly capable of performing tasks that were once the exclusive domain of human workers, there is growing anxiety about the potential for widespread unemployment. Automation, powered by AI, is already transforming industries such as manufacturing, logistics, and customer service, where repetitive tasks can be efficiently handled by machines. While AI can lead to increased productivity and cost savings for businesses, it also raises the possibility that many jobs may become obsolete. This displacement disproportionately affects low-skill and routine jobs, potentially leading to economic inequality and social unrest as workers struggle to adapt to new roles or retrain for positions that require more advanced skills.
* As AI becomes more integrated into various sectors, the gap between those who have access to AI technology and those who do not could widen. Developed countries, large corporations, and affluent individuals may have the resources to invest in AI-driven tools, leading to significant advancements in productivity, education, healthcare, and more. In contrast, developing countries, small businesses, and economically disadvantaged populations might struggle to access or afford these technologies. This disparity could result in a new form of digital divide, where the benefits of AI are unevenly distributed, leaving some regions and communities at a significant disadvantage in terms of economic growth, opportunities, and quality of life.

**Bias and Fairness**

* AI systems, particularly those that rely on machine learning, are prone to issues of bias and fairness. These systems learn from historical data, which may contain biases related to race, gender, age, or other characteristics. If the data used to train AI models reflects societal prejudices, the AI may inadvertently perpetuate or even exacerbate these biases. For instance, AI-driven hiring algorithms may favor certain demographics over others, or facial recognition technology may have higher error rates for people of color. The lack of transparency in AI decision-making processes—often referred to as the "black box" problem—makes it difficult to identify and correct these biases. Ensuring fairness in AI requires careful consideration of the data used to train models, as well as ongoing monitoring and adjustment of AI systems to prevent discriminatory outcomes. Without these measures, the widespread deployment of AI could reinforce existing inequalities rather than mitigate them.

**Privacy Issues**

* The proliferation of AI technologies raises significant concerns about privacy. AI systems often rely on vast amounts of data to function effectively, including personal data such as location information, browsing history, and even biometric details. As AI becomes more integrated into everyday life, the collection and analysis of personal data can lead to intrusive surveillance practices and the erosion of individual privacy rights. For example, AI-driven advertising platforms track user behavior to deliver personalized ads, while smart home devices monitor activities within the home. In more extreme cases, AI-powered surveillance systems used by governments and corporations can infringe on civil liberties by monitoring public spaces or tracking individuals without their consent.

**Safety and Security**

* While AI has the potential to enhance safety and security in many areas, it also introduces new risks that need to be carefully managed. One of the primary concerns is the safety of AI systems themselves. As AI systems become more autonomous and are deployed in critical areas such as transportation, healthcare, and national defense, ensuring their reliability and robustness becomes paramount. Failures or malfunctions in AI systems can have serious, even catastrophic, consequences. For instance, autonomous vehicles that rely on AI for navigation and decision-making could cause accidents if their systems fail. Additionally, AI technologies can be exploited for malicious purposes, such as in the development of autonomous weapons or sophisticated cyber-attacks. The dual-use nature of AI—where the same technology can be used for both beneficial and harmful purposes—poses a significant challenge for regulators and policymakers. Ensuring the safe and secure deployment of AI requires stringent testing, oversight, and the establishment of ethical guidelines to prevent misuse and mitigate risks.

Apart from the here are few more disadvantages

* **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.
* **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.

**Lecture-03**

**History**

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

* **Year 1943:** The first work which is now recognized as AI was done by Warren McCulloch and Walter pits 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**.

*Hebbian learning is a theory in neuroscience that describes how neurons in the brain adapt during learning processes. It is often summarized by the phrase "cells that fire together, wire together." This means that if a neuron repeatedly helps activate another neuron, the connection between them (called a synapse) is strengthened. Over time, this strengthens the association between the neurons, making it easier for them to fire together in the future. Hebbian learning is fundamental to understanding how learning and memory formation occur in the brain.*

* **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**.

*It is a game where there are three players:*

*1. Player A: A human.*

*2. Player B: Another human.*

*3. Player C: A computer (the AI).*

*All three players communicate with each other through text, so they can't see or hear each other. Player A asks questions to Player B and Player C, trying to figure out which one is the human and which one is the computer. The goal of the computer (Player C) is to try to convince Player A that it's a human.*

*If Player A can't reliably tell which one is the computer, the computer is said to have passed the Turing Test, meaning it has shown human-like intelligence.*

*Example of a Turing Test*

*Let's say Player A types a question: "What's your favorite movie and why?"*

*Player B (the human) might respond: "I love 'Inception' because it's a mind-bending movie with amazing visuals and a complex plot that keeps you thinking.”*

*Player C (the AI) might respond: "My favorite movie is 'Inception' because it's very interesting and has great action scenes.”*

*Player A then asks more questions, like "What's your favorite food?” or "How do you feel about rainy days?” The goal is for Player A to decide which responses sound more human. If the computer (Player C) can make Player A unsure or believe that it's the human, then the computer has passed the Turing Test.*

*For the sake of better results; A number of different people play the roles of Player-A and Player-B, and, if a sufficient proportion of the Player-A are unable to distinguish the computer from the human being, then (according to proponents of Turing's test) the computer is considered an intelligent, thinking entity.*

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

* **Year 1955:** An Allen Newell and Herbert A. Simon created the "first artificial intelligence program "Which was named **"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”** was first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. For the first time, **AI was 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 that can solve mathematical problems. Joseph Weizenbaum created the **first chatbot in 1966, which was named ELIZA**.
* **Year 1972:** The first intelligent **humanoid robot** was built in Japan which was named WABOT-1.  
    
  *It was estimated that the WABOT-1 has the mental faculty of a one-and-half-year-old child. It consisted of a limb-control system, a vision system and a conversation system. The WABOT-1 was able to communicate-with a person in Japanese and to measure distances and directions to the objects using external receptors, artificial ears and eyes, and an artificial mouth. The WABOT-1 walked with his lower limbs and was able to grip and transport objects with hands that used tactile-sensors.*

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

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

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

* **Year 1980:** After AI winter duration, AI came back with an **"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 the government stopped funding for AI research due to high costs but not efficient results. 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**.

*The Roomba vacuum cleaner, developed by iRobot, is a robotic vacuum that uses AI to autonomously clean floors. It’s equipped with sensors to navigate around furniture, avoid obstacles, and detect dirtier areas that need more attention. Roomba's AI allows it to learn the layout of a room over time, optimize its cleaning patterns, and return to its charging station when the battery is low. Some models even use machine learning to improve their cleaning efficiency based on previous runs and user preferences.*

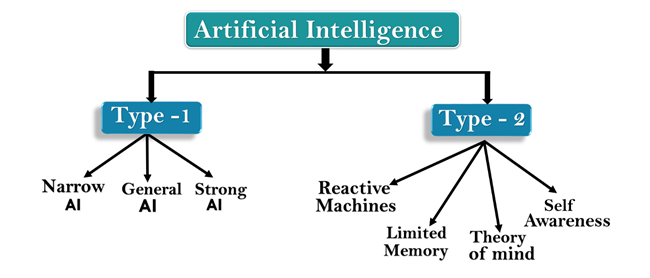
* **Year 2006:** AI came into the Business world till the year 2006. Companies like **Facebook, Twitter, and Netflix also started using AI**.

**Deep Learning, Big Data, and Artificial Intelligence (2011-present)**

* **Year 2011:** In the year 2011, **IBM's Watson** won jeopardy, a quiz show, where it had to solve 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 appointments on call, and the lady on the 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.

**Lecture-04**



**First Criteria: Based on Scope of Capabilities and Cognitive Abilities**

**1. Artificial Narrow Intelligence (ANI)/Narrow AI**

* It doesn't possess understanding or consciousness, but rather, it follows pre-programmed rules or learns patterns from data.
* Narrow AI is designed to perform tasks that normally require human intelligence, but it operates under a limited set of constraints and is task-specific.
* It's the most common type of AI that we encounter in our daily lives.
* For example: image recognition, voice assistants on our phones like Siri and Google Assistant, recommendation algorithms used by Netflix and Amazon, spam filters used by Gmail.

**2. Artificial general intelligence (AGI)/Strong AI**

* Artificial general intelligence is AI that can learn, think and act the way humans do.
* AGI has yet to be created, in theory it could complete new tasks it never received training for and perform creative actions that previously only humans could.
* It’s a theoretical concept so no example actually exists the yet following examples show that AGI may not be that far off.

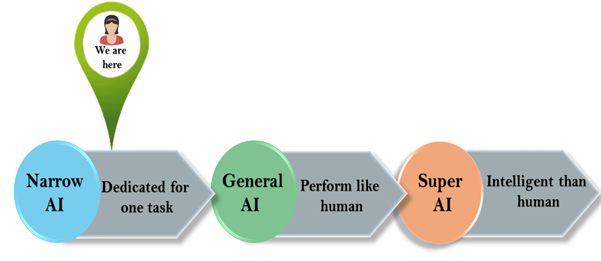
e.g. ChatGPT-4o, IBM Watson, Self-Driving Cars etc.

* Key Characteristics of AGI include:

1. Generalization
2. Understanding and Reasoning
3. Learning
4. Adaptability
5. Consciousness and Self-Awareness

**3. Artificial Superintelligence (ASI)/Superintelligent AI**

Represents an AI that not only mimics but significantly surpasses human intelligence across all fields like science, general wisdom, social skills, and more. ASI would be capable of extraordinary problem-solving and creative abilities, far beyond what current human minds can achieve.



**Second Criteria: Based on Functionality**

Classification Based on Capabilities and Cognitive Abilities:

**1. Reactive Machines**

Criteria: This classification is based on the AI's lack of memory and its ability to only react to immediate situations without considering past experiences.

* This level of A.I. is the simplest i.e. first stage & performs basic operations.
* The model stores no inputs, it performs no learning but they can still perform tasks that require some degree of problem-solving, albeit in a very constrained and limited way. They can execute complex algorithms that solve specific problems effectively. This involves some form of "intelligence," as these machines can outperform humans in narrow tasks due to their speed and accuracy.
* Reactive machines can make decisions in real-time based on current inputs. This ability to react to the present environment, even without learning or memory, can be very powerful in certain applications like video games, autonomous robots for specific tasks, or simple automated customer service systems.
* Static machine learning models are reactive machines. Their architecture is the simplest and they can be found on GitHub repos across the web. These models can be downloaded, traded, passed around and loaded into a developer’s toolkit with ease.
* An Example: IBM's Deep Blue, which defeated world chess champion Garry Kasparov (Chess GrandMaster) in 1997, is a reactive machine. It didn't learn from past games but was programmed to evaluate a vast number of possible chess moves quickly and choose the best one according to predefined algorithms. This ability to "think" many moves ahead in chess is a form of intelligence, albeit very narrow and specialized.

**2. Limited Memory**

Criteria: This classification is based on the AI's ability to learn and make decisions based on historical data or past experiences.

* Limited memory types refer to an A.I.’s ability to store previous data and/or predictions, using that data to make better predictions. With Limited Memory, machine learning architecture becomes a little more complex. There are three major kinds of machine learning models that achieve this Limited Memory type:

**2.a Reinforcement learning:** These models learn to make better predictions through many cycles of trial and error. This kind of model is used to teach computers how to play games like Chess, Go, and DOTA2. In Reinforcement learning, "prediction" is more about estimating the potential future rewards of actions and choosing actions to maximize those rewards. It doesn't predict the next data point in a sequence; instead, it learns to make decisions that lead to the best outcomes.

e.g AlphaGo, developed by DeepMind, is a famous example of reinforcement learning. It learned to play the complex board game Go by playing millions of games against itself, gradually improving its strategy through the rewards of winning or losing. Eventually, AlphaGo defeated the world's top human Go players.

**2.b Long Short Term Memory (LSTMs)**

Researchers intuited that past data would help predict the next items in sequences, particularly in language, so they developed a model that used what was called the Long Short Term Memory. For predicting the next elements in a sequence, the LSTM tags more recent information as more important and items further in the past as less important.

e.g. Speech Recognition: LSTMs are widely used in speech recognition systems. For instance, in Google’s voice search, LSTMs help model the sequential nature of speech, remembering the context of earlier words in a sentence to predict and recognize the subsequent words accurately.

**2.c Evolutionary Generative Adversarial Networks (E-GAN)**

Evolutionary Generative Adversarial Networks (E-GANs) combine the concepts of evolutionary algorithms and generative adversarial networks (GANs). E-GANs use a population-based approach to evolve a set of generators over time, where the generators compete and evolve to produce increasingly realistic data.

e.g. Human Evolution

E-GANs are still a relatively new and experimental area so no example

**3. Theory of Mind**

* In this type of A.I., A.I. begins to interact with the thoughts and emotions of humans.
* We have yet to reach Theory of Mind artificial intelligence types. These are only in their beginning phases and can be seen in things like self-driving cars.

e.g. If you angrily yell at Google Maps to take you another direction, it does not offer emotional support and say, "This is the fastest direction. Who may I call and inform you will be late?" Google Maps, instead, continues to return the same traffic reports and ETAs that it had already shown and has no concern for your distress.

**4. Self-Aware**

* Finally, in some distant future, perhaps A.I. achieves nirvana. It becomes self-aware.
* This kind of A.I. exists only in story, and, as stories often do, instills both immense amounts of hope and fear into audiences.
* A self-aware intelligence beyond the human has an independent intelligence, and likely, people will have to negotiate terms with the entity it created. What happens, good or bad, is anyone’s guess.