

Artificial Intelligence

Pragyna Karmakar¹, Satarupa Sinha², Debrupa Pal³

Student, Computer Application, Narula Institute of Technology, Kolkata, India¹

Student, Computer Application, Narula Institute of Technology, Kolkata, India²

Assistant Professor, Computer Application, Narula Institute of Technology, Kolkata, India³

Abstract: *Artificial Intelligence (A.I.) is a multidisciplinary field whose goal is to automate activities that presently require human intelligence. It refers to what information about the language structure being transmitted to the machine: It should result in a more intuitive and faster solution, based on a learning algorithm that repeats patterns in new data. Recent successes in A.I. include computerized medical diagnostics and systems that automatically customize hardware to particular user requirements. Artificial Intelligence works according to the phases like - getting the data, clean/manipulate/ prepare the data, train model, test data, and improve the data.*

Keywords: Data Security, Autonomous driving, Advanced Algorithms, Machine Learning, Application Programming Interface (API)

I. INTRODUCTION

Artificial intelligence (AI) is the ability of machines to replicate or enhance human intellect, such as reasoning and learning from experience. Artificial intelligence has been used in computer programs for years, but it is now applied to many other products and services.

AI uses techniques from probability theory, economics, and algorithm design to solve practical problems. In addition, the AI field draws upon computer science, mathematics, psychology, and linguistics. Although the concept of AI has been around since the 19th century, when Alan Turing first proposed an “imitation game” to assess machine intelligence, it only became feasible to achieve in recent decades due to the increased availability of computing power and data to train AI systems.

The field was founded on the claim that a central property of humans, intelligence — the sapience of Homo sapiens — can be so precisely described that it can be simulated by a machine. This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings, issues which have been addressed by myth, fiction and philosophy since antiquity. Artificial intelligence has been the subject of tremendous optimism but has also suffered stunning setbacks. Today it has become an essential part of the technology industry, providing the heavy lifting for many of the most difficult problems in computer science.

II. HISTORY OF AI

Artificial Intelligence is not a new word and not a new technology for researchers. This technology is much older than you would imagine. Even there are the myths of Mechanical men in Ancient Greek and Egyptian Myths. Following are some milestones in the history of AI which defines the journey from the AI generation to till date development [1-4].

- **1956** - John McCarthy coined the term ‘artificial intelligence’ and had the first AI conference
- **1969** - Shakey was the first general-purpose mobile robot built. It is now able to do things with a purpose vs. just a list of instructions.
- **1997** - Supercomputer ‘Deep Blue’ was designed, and it defeated the world champion chess player in a match. It was a massive milestone by IBM to create this large computer.
- **2002** - The first commercially successful robotic vacuum cleaner was created.
- **2005 - 2019** - Today, we have speech recognition, robotic process automation (RPA), a dancing robot, smart homes, and other innovations make their debut.

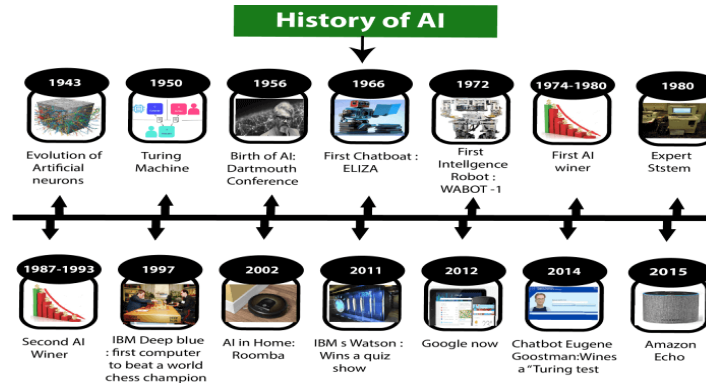


Fig 1: History and Evolution of AI

- **2020** - Baidu releases the LinearFold AI algorithm to medical and scientific and medical teams developing a vaccine during the early stages of the SARS-CoV-2 (COVID-19) pandemic. The algorithm can predict the RNA sequence of the virus in only 27 seconds, which is 120 times faster than other methods.

III. WORKING OF AI

Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. AI is an interdisciplinary science with multiple approaches, but advancements in machine learning and deep learning are creating a paradigm shift in virtually every sector of the tech industry.

AI works by combining large amounts of data with fast, iterative processing and intelligent algorithms, allowing the software to learn automatically from patterns or features in the data.

- **Graphical processing units** are key to AI because they provide the heavy compute power that's required for iterative processing. Training neural networks requires big data plus compute power.
- **The internet of Things generates massive amounts of data from connected devices, most of it unanalysed. Automating models with AI will allow us to use more of it.**
- **Advanced algorithms** are being developed and combined in new ways to analyse more data faster and at multiple levels. This intelligent processing is key to identifying and predicting rare events, understanding complex systems and optimizing unique scenarios.
- **APIs, or application programming interfaces,** are portable packages of code that make it possible to add AI functionality to existing programs and software packages. They can add image recognition capabilities to home security systems and Q&A capabilities that describe data, create captions and headlines, or call out interesting patterns and insights in data.

IV. COMPONENTS OF AI

Artificial Intelligence can give companies and organizations insight into their daily operations that they might not otherwise understand. Artificial intelligence software can help businesses, schools, and healthcare facilities perform tasks more quickly and effectively than humans. To understand how AI works, it's necessary to understand each component of AI.

Learning

Learning in AI occurs when machines or computer systems memorize specific data or new material. Specifically, advancements in deep machine learning now enable enhancements in prescriptive and predictive analytics through the use of operational data.

Machine learning can find hidden correlations in various data. With this information, the network can create a predictive model that is able to pinpoint future machine failures in manufacturing.

Machine learning may even predict when the failure will occur. This can enable companies to know when and how many parts to order.

Reasoning

AI uses the ability to make inferences when applying reasoning based on commands it is given or other information at its disposal. For example, virtual assistants will offer restaurant recommendations based on the specific orders or questions it receives.

The assistant will use reasoning to decide what restaurants to suggest based on the questions it received and the nearest location of various restaurants.

This type of reasoning involves drawing inferences. Inferences include two categories: deductive and inductive reasoning.

Problem Solving

In the most basic of terms, an AI's problem-solving ability is based on the application and manipulation of data, where the solution needs to be x.

Alternatively, in more advanced applications, problem-solving techniques in the context of AI can include the development of efficient algorithms and performing root cause analysis with the goal of discovering a desirable solution.

AI implements heuristics when solving problems by devising a solution using trial and error techniques. Specific examples of problem-solving in AI would include the use of predictive technology in the area of online shopping.

When a shopper is looking for a product and doesn't know the exact name of the product, AI can assist in dramatically reducing the possibilities.

This can occur even when the shopper types in a few related or similar words. As the entire premise of artificial intelligence is the creation of computer programs and systems that solve problems in a manner similar to that of human beings, problem-solving is perhaps the most pivotal component in terms of the development of AI.

Perception

Perception is when different sense organs, whether real or artificial, scan the environment. For example, AI scans the environment through sense components such as temperature sensors and cameras. Autonomous driving is an example of how AI implements perception. They are able to perceive and comprehend the environment around them, including traffic lights, road lines, and weather conditions.

Other examples include a GPS system or smart speakers that respond to human queries. After capturing elements of the surrounding environment, a perceiver will analyse the different objects, extract their features, and analyse the relationships among them.

Processing language

AI processes language in something as seemingly simple as spellcheck and autocorrect. Computer programs use neural networks to scan large bodies of text for misspelled words and language irregularities.

Another way AI uses language processing is when it weeds out spam in email systems. For example, spam filters delegate specific messages as spam when seeing certain words or combinations of words.

V. TYPES OF AI

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 explain the types of AI [5-8].

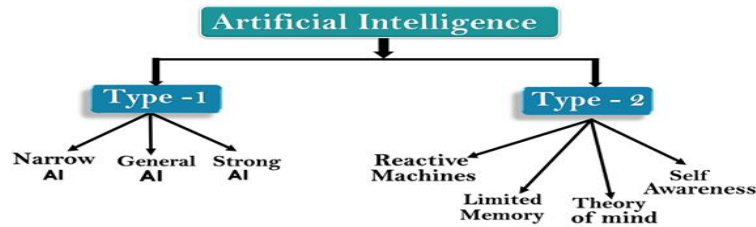


Fig 2: Types of AI

AI Type 1: Based on Capabilities

Weak AI or Narrow AI:

- Narrow AI is a type of AI which can perform a dedicated task with intelligence. The most common and currently available AI is Narrow AI in the world of Artificial Intelligence [9].
- 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 Siri is 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.

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.
- Currently, there is no such system exist which could come under general AI and can perform any task as perfect as a human.
- The worldwide researchers are now focused on developing machines with General AI.
- As systems with general AI are still under research, and it will take lots of efforts and time to develop such systems.

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. It is an outcome of 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.
- Super AI is still a hypothetical concept of Artificial Intelligence. Development of such systems in real is still world changing task.

Artificial Intelligence Type 2: Based on Functionality

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.

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.

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 is still not developed, but researchers are making lots of efforts and improvement for developing such as AI machines.

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 still, and it is a hypothetical concept.

VI. ADVANTAGES OF AI

1. Reduction in Human Error.
2. Zero Risks while executing tasks.
3. Can work for 24 hours a day (24*7 Availability).
4. Provides Digital Assistance.
5. Driving Force Behind Numerous Inventions.
6. Unlike humans who have emotions A.I. gives unbiased decisions.
7. Can perform repetitive tasks without getting bored like humans while humans can do more creative jobs.
8. Daily Applications like Siri, google maps, Alexa uses A.I. We can even see daily weather.
9. One of the main benefits of artificial intelligence is this. By creating an AI robot that can perform perilous tasks on our behalf, we can get beyond many of the dangerous restrictions that humans face.

VII. DISADVANTAGES OF AI

1. High Costs, the ability to create a machine that can simulate human intelligence is no small feat. It requires plenty of time and resources and can cost a huge deal of money.
2. No creativity, a big disadvantage of AI is that it cannot learn to think outside the box. AI is capable of learning over time with pre-fed data and past experiences but cannot be creative in its approach.
3. Unemployment, one application of artificial intelligence is a robot, which is displacing occupations and increasing unemployment.
4. Make Humans Lazy, AI applications automate the majority of tedious and repetitive tasks. Since we do not have to memorize things or solve puzzles to get the job done, we tend to use our brains less and less. This addiction to AI can cause problems to future generations.
5. No Ethics, Ethics and morality are important human features that can be difficult to incorporate into an AI. The rapid progress of AI has raised a number of concerns that one day, AI will grow uncontrollably, and eventually wipe out humanity.
6. Emotionless, Humans function as a team, and team management is essential for achieving goals. However, there is no denying that robots are superior to humans when functioning effectively, but it is also true that human connections, which form the basis of teams, cannot be replaced by computers.
7. No Improvement, Machines can only complete tasks they have been developed or programmed for; if they are asked to complete anything else, they frequently fail or provide useless results, which can have significant negative effects. Thus, we are unable to make anything conventional. If we want any adjustments or improvements, we must manually alter the codes.

VIII. APPLICATIONS OF AI



Fig 3: Representation of Applications of AI

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.

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.

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.

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.

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

AI in Travel and 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.

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 Tesla Bot, an intelligent virtual assistant.

- Various Industries are currently working for developing self-driven cars which can make your journey more safe and secure.

AI in Robotics

- Artificial Intelligence has a remarkable role in 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 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.

AI in Agriculture

- Agriculture is an area which requires various resources, labour, 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.

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, colour, or even brand.

IX. AI ALGORITHMS

Artificial Intelligence has grown to have a significant impact on the world. With large amounts of data being generated by different applications and sources, machine learning systems can learn from the test data and perform intelligent tasks.

Artificial Intelligence is the field of computer science that deals with imparting decisive ability and thinking ability to machines. Artificial Intelligence is thus a blend of computer science, data analytics, and pure mathematics [10-11].

Types of AI:

There are three major categories of AI algorithms: supervised learning, unsupervised learning, and reinforcement learning. The key differences between these algorithms are in how they're trained, and how they function.

Under those categories, there are dozens of different algorithms. We'll be talking about the most popular and commonly used from each category, as well as where they are commonly used.

Supervised Learning Algorithms

The first, and most commonly used category of algorithms is "Supervised learning." These work by taking in clearly-labelled data while being trained and using that to learn and grow. It uses the labelled data to predict outcomes for other data. The name "supervised learning" comes from the comparison of a student learning in the presence of a teacher or expert.

Building a supervised learning algorithm that actually works takes a team of dedicated experts to evaluate and review the results, not to mention data scientists to test the models the algorithm creates to ensure their accuracy against the original data, and catch any errors from the AI.

Unsupervised Learning Algorithms:

It may at this point be relatively easy to guess what unsupervised learning algorithms mean, in comparison to supervised learning. Unsupervised learning algorithms are given data that isn't labelled. Unsupervised learning algorithms use that unlabelled data to create models and evaluate the relationships between different data points in order to give more insight to the data.

Reinforcement Learning Algorithms:

The last major type of AI algorithm is reinforcement learning algorithms, which learn by taking in feedback from the result of its action. This is typically in the form of a “reward”.

A reinforcement algorithm is usually composed of two major parts: an agent that performs an action, and the environment in which the action is performed. The cycle begins when the environment sends a “state” signal to the agent. That queues the agent to perform a specific action within the environment. Once the action is performed, the environment sends a “reward” signal to the agent, informing it on what happened, so the agent can update and evaluate its last action. Then, with that new information, it can take the action again. That cycle repeats until the environment sends a termination signal.

X. FUTURE SCOPE OF AI

Freshers should analyse their competencies and skills and choose a better AI role with the potential for upward mobility. The future scope of Artificial Intelligence continues to grow due to new job roles and advancements in the AI field. The various roles in an AI career are as follows:

- AI Analyst and Developers
- AI Engineer and Scientists
- AI Researcher
- AI Algorithm Expert
- Robotics Specialist
- Military and aviation specialist
- Maintenance and mechanical engineering
- Surgical AI technician

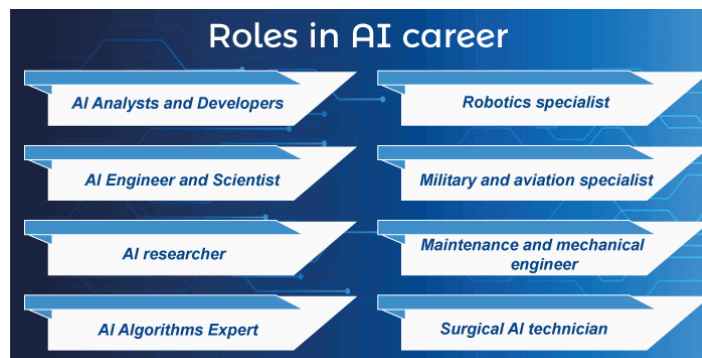


Fig 4: Roles of AI in career

The Future of AI

The future of Artificial Intelligence is bright in India, with many organizations opting for AI automation. It is essential to understand the recent developments in AI to find suitable job roles based on your competencies.

The scope of Artificial Intelligence is limited to domestic and commercial purposes as the medical and aviation sectors are also using AI to improve their services. If AI is outperforming human efforts, then opting for AI automation will reduce costs in the long run for a business.

Automation in operational vehicles has created a buzz in the logistics industry as it is expected that automated trucks/vehicles may soon be used.

Due to the bright scope of Artificial Intelligence in the future, the number of AI start-ups is expected to increase in the coming years. Indicating the opportunities, the number of AI start-ups in India has increased significantly.

Moreover, India's talent gap for specialist AI developers is huge, and AI experts are needed by businesses more than ever. Businesses don't want to miss out on any technology that can revolutionize their business processes.

XI. CONCLUSION

AI is redefining the way business processes are carried out in various fields, such as marketing, healthcare, financial services, and more. Companies are continuously exploring the ways they can reap benefits from this technology. As the quest for improvement of current processes continues to grow, it makes sense for professionals to gain expertise in AI. Artificial Intelligence algorithm is a broad field consisting of Machine Learning algorithms and Deep Learning Algorithms. In the above article, we have explored the wide area for an approach for learning (Supervised, Unsupervised, and Reinforcement learning) where these algorithms are used to draw conclusions. Further, these algorithms are categorized into three categories according to the type of problems namely: classification, regression and clustering methods. We have discussed Naïve Bayes' algorithm for classification, Random Forest algorithm for regression, and K-means clustering algorithm for the clustering problem.

REFERENCES

- [1] Muthukrishnan, N., Maleki, F., Ovens, K., Reinhold, C., Forghani, B., &Forghani, R. (2020). Brief history of artificial intelligence. *Neuroimaging Clinics of North America*, 30(4), 393-399.
- [2] Xu, F., Uszkoreit, H., Du, Y., Fan, W., Zhao, D., & Zhu, J. (2019). Explainable AI: A brief survey on history, research areas, approaches and challenges. In *Natural language processing and Chinese computing: 8th cCF international conference, NLPCC 2019, dunhuang, China, October 9–14, 2019, proceedings, part II 8* (pp. 563-574). Springer International Publishing.
- [3] Brooks, R. A. (1999). Buchanan, B. G. (2005). A (very) brief history of artificial intelligence. *Ai Magazine*, 26(4), 53-53. MIT press.
- [4] Benko, A., &Lányi, C. S. (2009). History of artificial intelligence. In *Encyclopedia of Information Science and Technology*, Second Edition (pp. 1759-1762). IGI global.
- [5] Schank, R. C. (1991). Where's the AI?. *AI magazine*, 12(4), 38-38.
- [6] Sarker, I. H. (2022). AI-based modeling: techniques, applications and research issues towards automation, intelligent and smart systems. *SN Computer Science*, 3(2), 158.
- [7] Boden, M. A. (2016). *AI: Its nature and future*. Oxford University Press.
- [8] McCormick, K. (1985). *AI Technology. From GI to Z: A Generational Guide to Technology*.
- [9] Page, J., Bain, M., &Mukhlis, F. (2018, August). The risks of low level narrow artificial intelligence. In *2018 IEEE international conference on intelligence and safety for robotics (ISR)* (pp. 1-6). IEEE.
- [10] Shi, Y., Yang, K., Jiang, T., Zhang, J., &Letaief, K. B. (2020). Communication-efficient edge AI: Algorithms and systems. *IEEE Communications Surveys & Tutorials*, 22(4), 2167-2191.
- [11] Bengio, Y., &LeCun, Y. (2007). *Scaling learning algorithms toward AI*.