ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING – THE FUTURE OF COMPUTING DOMAIN WITH HIGH REAL WORLD PROSPECTIVE

Abstract

The fourth (4^{th}) industrial revolution has been sparked by emerging technologies including artificial intelligence (AI), the internet of things (IoT), Machine Learning, data analytics, block-chain technology, and robotics. This revolution encompasses many creative new solutions and is transforming daily life as we know it. This essay examines artificial intelligence (AI) and how it has advanced recently, opening up new, creative options and solutions. The AI and ML will shape the future of computing industry and will penetrate almost every facets of modern life including industrial automation, health care systems and agriculture. In this chapter, we have introduced Artificial Intelligence, ML, DL, etc. We also covered important application domains of AI & ML. The chapter is limited with introductory only.

Keywords: Artificial Intelligence, Machine Learning, Smart Farming, Robotics, AI Algorithms, Automation, IOT.

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I. INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) refers to any sorts of task carried out by a system or program or machine that would otherwise have need of a human to utilize astuteness to complete. Making machines with intelligence, particularly those with decision-making, visual perception, speech recognition and language translation, requires a amalgamation of science and engineering. AI is the simulation of human intelligence processes by machines, specifically computing systems. This involves knowledge representation, self-correction, planning, reasoning, motion, manipulation, and creativity. It also includes learning.

It is a 'super science' and a collection of computational methods that draw inspiration from how humans use their bodies and neural systems to feel, remember, reason, and act. Machine and deep learning are related to AI, with machine learning using algorithms to find patterns and derive insights from the data it is working with. Deep learning is a branch of machine learning that moves AI one step closer to its objective of making it possible for robots to think and function as humanly as possible.

The topic of artificial intelligence (AI) is controversial and frequently portrayed negatively; some would consider it a disguised blessing for businesses, while others believe it to be a technology that threatens the very existence of humanity because it has the potential to subjugate and dominate humans. However, in reality, AI has already had an impact on our way of life, directly or indirectly, and is helping to shape the prosperous world. Despite the indispensable uses of digital assistants for mobile phones, driver-assistance-systems, bots, texts and speech-translators, and systems that help with product and service recommendations and personalized learning, AI has already become an integral part of our daily lives and has significantly impacted our way of life.

AI systems typically consume a sizable amount of labeled training data, analyze it for correlations and patterns, and then use these patterns to predict future states. An image recognition tool may learn to identify and describe items in images by studying millions of examples, just as a chatbot that is shown examples of text chats can learn to have realistic conversations with people.

The three core focuses of AI programming are learning, reasoning, and self-correction. Procedures for education. The goal of this branch of AI programming is to collect data and create the rules that will allow the data to be turned into knowledge. The rules, usually referred to as algorithms, provide computing devices with thorough instructions on how to perform specific tasks.

II. HISTORY AND BACKGROUND OF AI

Since ancient times, the idea of giving intelligence to inanimate objects has been present. Myths describe the Greek god Hephaestus making robot-like servants out of gold. Egyptian engineers created statues of gods that priests could animate. Aristotle, Ramon Llull, René Descartes, and T. Bayes, all of them are Spanish priest of a 13th-century, employed the methods and reasoning of their periods to characterize human thought processes as symbolic information, providing the foundation work for notions in artificial intelligence such general knowledge representation.

Artificially intelligent robots became well known during 20th century because of science fiction. Both the "heartless" Tin Man and the humanoid robot who played Maria in Metropolis are examples of this. By the end of the 1950s, the concept of artificial intelligence (AI) had been deeply ingrained in the minds of scientists, mathematicians, and philosophers. One such individual was the British polymath Alan Turing, who investigated the mathematical potential of artificial intelligence.

Turing reasoned that if individuals can solve problems and make decisions using readily available knowledge and reason, why shouldn't robots be able to do the same? These logical progressions were used to construct his 1950 research, CMI, which studied how to build intelligent machines and how to evaluate their intelligence.

III. TYPES OF ARTIFICIAL INTELLIGENCE

AI can be divided into four categories, starting with the task-specific intelligent systems that are currently in widespread use and moving on to sentient systems, which do not yet exist.

Type – 1; reactive machines: This is the most fundamental forms of AI are utterly reactive; they lack the capacity to remember past events or draw conclusions about the present from them. The ideal illustration of this kind of device is Deep Blue, developed by IBM, is a chess-playing supercomputer that conquered world champion Garry Kasparov in the late 1990s. Deep blue ha ability to recognize the chess pieces and also understand their individual manoeuvres. It is capable of predicting potential next steps for both it and its adversary, and it is entirely capable to select the best possible moves from available range of options.

This form of intelligence entails the computer directly observing the outside world and responding accordingly. It is independent of any personal worldview. AI expert Rodney Brooks stated that we must only create machine technology like this in a major study. His fundamental argument was that, contrary to what is commonly believed in the field of artificial intelligence (AI), people are not very effective at creating realistic computer simulations of the real world.

Type – 2; limited memory: These tools have the ability to peer into the past. Self-driving cars and trucks have already finished finishing some of this. For instance, they watch the direction, movement and speed of other moving vehicles. That cannot be capable to pursue these in a single instant; rather, it calls for the identification of certain things and continuous observation of them. These explanations are further added to the pre-programmed models that the self-driving cars already have, which also include traffic signals, lane markings and other significant features, such as bends in the road. They are taken into account when the car considers whether to change lanes in order to avoid hitting another vehicle by one nearby. However, these basic tidbits of historical knowledge are just temporary. They are never saved. Similarly human drivers build up experience over years of driving, so the automobile can't learn from them.

Type – 3; theory of mind: We may bring to an end here and entitle this as the crucial dividing line between the current generation of computers and those that will be created in the future. To converse the kinds of representations, machines must make and what those

representations must be about, it is preferable to be more explicit. The following, more sophisticated class of intelligent machines crafts illustrations not only of the environment but also of various other representatives or things existing in it. The initiative that people, animals, and in animate objects in the world might have opinion sand emotions that trigger their own behavior. This is called as "theory of mind" in term of Psychology subject.

Because they made it possible for us to interact socially, this is essential to understanding how humans created societies. Working collectively is at best challenging, at worst impossible without knowledge of one another's intents and motivations, as well as without taking into consideration what someone else may know about me or the environment. AI systems must be able to comprehend that each of us has thoughts, feelings, and expectations for how we will be treated if they are to ever live among us. They will also need to change their behavior properly.

Type – 4; self awareness: The creation of systems that can create representations of themselves is the last stage in AI development. In the end, it will be up to AI researchers to create conscious machines in addition to understanding consciousness. In a way, this is an expansion of the "theory of mind" that Type 3 AI possess. For a good reason, consciousness is frequently referred to as "self-awareness." Conscious beings are self-conscious, attentive of their internal circumstances, and capable of anticipating the emotions of others. Given how we feel when we honk at other drivers, we automatically believe that someone honking at us in traffic is annoyed or frustrated. We could not draw those kinds of conclusions in the absence of a theory of mind.

We must ponder our endeavors on understanding reminiscence, learning, and the capacity to draw conclusions from the past even though we are probably a long way from building robots that have self-awareness. To grasp human intellect on its own, this is a crucial step. And it is essential if we want to build machines that are exceptionally good at classifying the world around them.

IV. STRONG AND WEAK ARTIFICIAL INTELLIGENCE (AI)

1. **Weak AI:** An AI system that is formed and erudite to perform a specific task is termed as weak AI. This type of AI is also infamous as narrow-AI. Weak AI is utilized by automatic vehicles, industrial robots, virtual-personal-assistants, etc. Weak AI depends on human intervention to specify the learning algorithm's parameters and to supply the necessary training data to assure correctness.

2. **Strong AI:** This AI is commonly known as artificial general intelligence (AGI), It is a name utilized to depict computer programming that can imitate cognitive functions of human. An influential AI system can make use of fuzzy logic to relocate data between locations and come up with a solution using its own solitary empire when given a surprising task. In theory, a significant AI programmed must possesses efficiency to pass the Chinese-room test and Turing test as well.

   Although powerful artificial intelligence has yet to be demonstrated, the field is innovating quickly. Artificial super-intelligence (ASI), often known as super intelligence or Super AI, is a new AI theory. Strong AI cannot compare to this form of AI in terms of

intelligence or capabilities. Super AI, however, is still totally hypothetical since we haven't yet produced Strong AI examples.

V. USE AND EXAMPLES OF AI TECHNOLOGY

There are numerous live examples of AI technology. . Some of the conspicuous technologies are summarized below:

1. **Automation:** Automation tools can increase the number and variety of jobs carried out when used in conjunction with AI technologies. Robotic – Process – Automation (RPA), a sort of software that automates cyclic and rule-based data processing operations often carried out by humans, is an example. RPA can automate larger portions of corporate jobs when paired with machine learning and new AI tools, allowing RPA's strategic bots to transmit intellect from AI and react to process changes.

2. **Machine learning:** ML is a technology of getting a computer or machine to act without programming is described here. In simplest terms, one could think of deep learning as the automation of prognostic analytics. A part of machine learning is called deep learning.

   There are three types of machine learning algorithms

   - **Supervised ML:** An algorithm known as supervised machine learning is trained from labeled training data to assist in assembling prophecy about unanticipated data. In supervised ML, we educate the computer using suitably "labeled" data. It specifies that some material has previously been appropriately tagged. Similar to studying while being observed by the management or a teacher. In ML, supervised learning facilitate us to group data or generate data output from previous experiences. This assists us in resolving a variety of computation-related difficulties that arise in the real world. Some supervised ML algorithms are:

     Regression: The regression method predicts a single output value using training data. Regression can be used to anticipate the cost of a flat or home using training data. The input variables will include the neighborhoods, size of house, location value, available facilities, etc.
     Robustness: This algorithm can be regularized to avert over-fitting, and outcomes can always be interpreted probabilistically.
     Weaknesses**:** Logistic regression could not work well when there are plenty of them or when the decision boundaries are not linear. This method cannot capture interactions that are more complex due to its rigidity.

     - **Logistic Regression**: To estimate distinct values based on a set of independent variables, the logistic regression method is utilized. By adjusting data to a logit function, you may anticipate the likelihood that an event will occur. It is also known as logistic regression as a result. Its output value, which represents the likelihood prediction, ranges from 0 to 1. Some of the Logistic Algorithms are summarized here:

- **Classification:** To classify anything is to group the outcomes. An algorithm's attempt to divide information into two categories is known as binary classification. The process of selecting between several classes is known as multiclass classification. Choosing whether or not someone will default on a loan is an example..
  Robustness: Classification tree performs admirably in actual use.
  Weaknesses: Individual trees are much prone to over-fitting when unconstrained.

Some of the classification algorithms are:

- **Naive bayesian model:** The Naïve-Bayesian-Model (NBN) is straightforward to construct and enormously effective for massive datasets. Direct acyclic graphs with one parent and multiple offspring make up this methodology. The independence of offspring nodes that have been cut off from their parent is assumed.

- **Decision tree:** By ordering instances according to the feature value, decision trees categorize instances. Each mode in this methodology represents a particular feature of an instance. Each and every branch represents a value that the node can adopt, and it should be categorized. It is a method of classification that is frequently employed. This approach uses a decision tree, a type of tree, for classification. It help us in the estimation of actual values, for example, cost to purchase a bike, number of inquiry, total monthly, quarterly or yearly sales, etc.

- **Support Vector Machine (SVM):** The learning algorithm known as the support vector machine (SVM) was created in 1990. This approach is entirely based on findings from Vap Nik's statistical-learning-theory. A key idea for the majority of learning problems, kernel functions, are closely related to SVM machines. SVM and the kernel framework are applied in many different disciplines. Bioinformatics, pattern recognition, and multimodal information retrieval are all included.

- **Unsupervised ML:** Unsupervised learning frequently called as unsupervised ML, analyzes and assembles unlabeled datasets by making use of ML algorithms. Unsupervised algorithms spot concealed patterns and data clusters without getting intervention of a human. This one is the best available options for investigative analysis of data, consumer segmentation, identification of picture and cross-selling strategies, and because of its capability to find resemblance and dissimilarity in information.

  Some prominent unsupervised learning methods are described below:

  - **Clustering:** Unlabeled data are grouped using the data mining technique of clustering according to their similarities and/or differences. The algorithms called clustering are used to organize unclassified and raw data objects as groups that can be visualized as patterns or structures in the data. Several types of clustering

algorithms, including probabilistic, exclusive, overlapping and hierarchical methods, can be distinguished.

- Exclusive Clustering: According to the grouping technique known as exclusive clustering, a data point can only be included in a single cluster. This is entitled as "hard" clustering. Exclusive clustering is exemplified by the K-means algorithm.

- Overlapping Clustering: Contrary to exclusive clustering, data points can be members of several clusters with varied degrees of membership under overlapping clusters. Overlapping clustering is demonstrated by a fuzzy k-means clustering.

- Hierarchical Clustering: Hierarchical clustering, also known as hierarchical cluster analysis (HCA), is a type of unsupervised clustering that can be categorised as either agglomerative or divisive. Agglomerative clustering is referred regarded as a "bottoms-up approach." When one cluster has been generated, the data points are gradually blended based on similarity after being first divided into several categories..

- Divisive Clustering: The antithesis of agglomerative clustering, referred to as divisive clustering, operates from the top down. In this instance, divisions between data points inside a single data cluster are made.

- Probabilistic Clustering: Density estimates, often known as "soft" clustering problems, can be solved using an unsupervised technique called a probabilistic model. In probabilistic clustering, data points are categorised based on how likely it is that they will fit into a particular distribution. One of the most popular probabilistic clustering methods, the Gaussian Mixture Model (GMM), was created in the 1960s.

- Reinforcement Learning: The study of decision-making is called reinforcement learning (RL). It involves understanding how to act in a situation to reap the most benefits. Similar to how children explore their environment and discover the behaviors that enable them to accomplish a task, this ideal behavior is taught through interactions with the surroundings (environment) and observations of how it responds.

The learner must autonomously determine the order of behaviors that maximizes the reward in the absence of a supervisor. This technique of discovery resembles a trial-and-error search. The current rewards that an action generates as well as any prospective future rewards determine its quality. Reinforcement learning is an extremely potent algorithm because it can learn the behaviors that lead to success in an unobserved environment without the assistance of a supervisor.

3. **Machine vision:** A machine can now sight thanks to this technology. With the use of a camera, analog-to-digital conversion, and digital signal processing, machine vision software can record and examine visual data. Sometimes compared to human vision, machine vision can be programmed to, for example, see through walls and is not limited by biological science. Applications for it span from medical picture analysis to signature

identification. Machine vision and computer vision are normally confused, with computer vision concentrating on automated image processing.

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4. **Natural language processing:** This is how a computer system deduces human language. One of the first and widely used applications of NLP is the detection of spam/unwanted mail, which evaluates subject line and body of e-Mail to conclude whether it is spam or not. The methods used in NLP today are based on machine learning. Text translation, sentiment analysis, and speech recognition are examples of NLP tasks.

5. **Robotics:** This area of engineering is devoted to the creation and design of robots. The Robots are frequently utilized to complete jobs that are challenging for humans to complete or constantly complete. For instance, NASA uses robots to handle heavy objects in space or to build cars on auto assembly lines. Academics, engineers, scientists and inventors are using machine learning to build socially intelligent robots.

6. **Self-driving cars:** Its mix of computer vision, image recognition, and deep learning is used in autonomous vehicles to build-up automatic capability at driving a motor vehicle while keeping in a set lane and shunning unanticipated obstacles, such as pedestrian's lines.

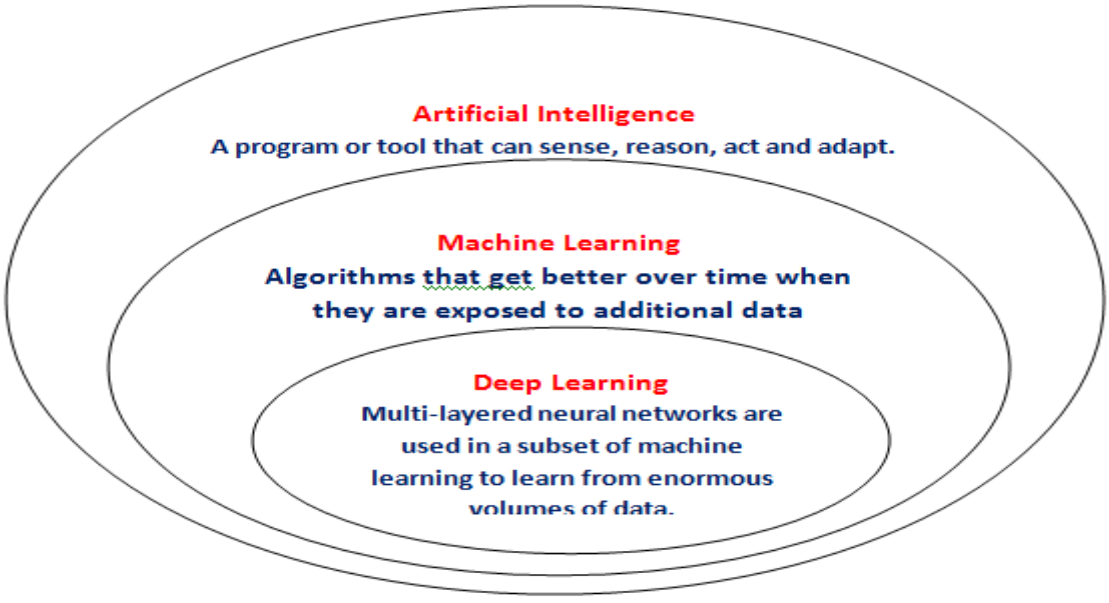

Figure 1: Companion of Artificial Intelligence

VI. APPLICATIONS AREA OF AI

AI has penetrated various areas, such as, sales, marketing, industrial automation, healthcare, agriculture, farming and many more. The application areas of AI is still counting and increasing day by day. Some of the most conspicuous AI applications are briefly described below;

1. **Healthcare:** The biggest bets are on raising patient outcomes and lowering expenses. Businesses are using machine learning to diagnose issues more swiftly and precisely than humans. A prevalent and well-known healthcare technology is IBM's Watson. It understands everyday language and can respond to questions. Using patient related data and other accessible data sources, the system develops a hypothesis, which it then presents with a confidence rating scheme for. Using chatbots and virtual health assistants online to help patients and healthcare consumers with administrative activities like booking appointments, comprehending bills, and locating medical information is another application for AI. Recently we have observed massive use of AI during Corona Pandemic.

2. **Manufacturing:** To classify anything is to group the outcomes. An algorithm's attempt to divide information into two categories is known as binary classification. The process of selecting between several classes is known as multiclass classification. Choosing whether or not someone will default on a loan is an example.

3. **Security:** AI and machine intelligence are at the apex of the list of catchphrase used by security providers today to distinguish their solutions. These names also allude to real, marketable technologies. Machine learning is used by businesses in domains like security information and event management (SIEM) software to find abnormalities and spot unusual behavior that could be a sign of dangers. By examining data and using reasoning capabilities to find parallels to known hazardous code, AI can alert to new and developing attacks much earlier than human employees and previous technological iterations. Organizations stand to gain significantly from the developing technology as it helps prevent cyber-attacks.

4. **Banking and finance:** Banks are successfully utilizing chat-bots to manage tasks that don't require human participation and to educate customers of services and possibilities. AI based virtual-assistants are being employed to streamline and reduce the cost of adhering to banking standards. Numerous banking institutions are also utilizing AI to better select the loans they authorize, as well as to set credit limits and identify profitable investment opportunities.

   Financial institutions are also making use of artificial intelligence in personal finance software like TurboTax, Intuit Mint, etc. Applications gather individual information and offer monetary supervision or direction to their customers. The process of buying a home has been used with other technologies, such as IBM's Watson. Today, a large segment of Wall-Street buy and sell is performed using AI integrated software.

5. **Transportation:** Above and beyond playing a critical part in driving self-directed vehicles, AI and ML tools and technology are also used in the transportation sector to

predict airline delays, manage traffic, and enhance the safety and effectiveness of maritime shipping.

6. **Education:** AI can completely automate grading, giving mentors much more time. It is possible to assess students and meet their needs, allowing them to study at their own swiftness. Pupils can receive additional guidance to help them stay on track from AI tools and techniques. Additionally, it might change where and how students receive their education, and perhaps even move some instructors..

7. **Business:** In order to find out how to better serve clients, ML algorithms are being included into analytics and CRM platforms. In order to offer customers instant help, chat-bots have been integrated into websites. Academicians and IT analysts are now debating the topic of job automation.

8. **Law services:** For humans, the legal discovery process (which entails shifting through documents) is frequently overwhelming. AI is being used to speed up labor-intensive legal sector operations and enhance client service. Law companies use computer vision to identify and extract information from documents, machine learning to characterize data and forecast results, and natural language processing to comprehend information request.

9. **Pattern recognition:** In many applications, deep neural networks are utilized to improve pattern recognition. The AI can filter out extraneous data, create meaningful correlations, and increase the effectiveness of big data computation by identifying patterns of interesting data points that are often missed by humans.

10. **Behavioral prediction:** AI will become more powerful as a result of prediction algorithms, which will have uses ranging from forecasting the weather and the financial market to, even more intriguingly, predicting human behavior.

VII. RELATED CHALLENGES

Every new technology inspires both excitement and mistrust. In certain contexts, AI can be a source of benefits and drawbacks. Before we can fully appreciate the potential and enormous transformative power of this emerging technology, there are a few obstacles we must overcome. Major challenges related with AI applications are:

1. **AI-Human interface:** Due to the fact that artificial intelligence is a new technology, there is a severe lack of working people with data science and analytics abilities who can be assigned to projects to maximize its potential. Businesses struggle to find qualified personnel who can handle the demand and work with AI as it advances. For their employees to fully profit from new technology, business owners must train them.

2. **Trust building:** People find it challenging to trust AI because it is based on science, technology, and algorithms, which most people aren't familiar with. A larger section of people do not rely on AI applications rather they have fear factor and reluctant to apply AI.

3. **Cost factor:** Not every businessman, enterprise owner or management can afford to spent money in AI because it involves a lot of computational resources and occasionally hardware acceleration using GPU, FPGA, or ASIC is required to run machine learning models efficiently. Additionally, the businesses of those who have implemented AI are still in their infancy, which has slowed the use of AI technology at a large scale and prevented them from reaping the benefits of scale in terms of cost.

4. **Non-invisible:** AI has its own limitations, just like any other technology, and it cannot completely replace all tasks. But it will lead to the materialization of a new job sector with a distinctive quality job profile.

5. **Security of data:** The basis for machine learning and decision-making capabilities of AI and AI applications is vast quantities of classified data, which is frequently delicate and private in nature. Due of this, it is vulnerable to serious issues including identity theft and data breaches. Businesses and governments frequently use AI-based tools that are typically worldwide networked and hence difficult to manage or rein in as they seek profit and power, respectively.

6. **Malfunction of software:** Since machines and algorithms govern AI, technologies that are powered by code are automatically given the power to make decisions. Automation makes it challenging to pinpoint the root of errors and malfunctions. Furthermore, as automated systems proliferate and become more complex, humans have less and less control over the system due to their inability to grasp and comprehend how these tools function.

7. **Algorithmic bias:** Data and algorithms are the foundation of AI. AI's ability to make accurate decisions is solely dependent on how accurately it has been taught using real, equitable facts. If data utilized for training is tainted with cultural, gender, communal, or ethnic biases, unethical and unfair outcomes are inherent in crucial decision-making. Given that several AI systems will continue further to be taught using flawed data, such biases will probably become more marked.

8. **Lack of data:** The effectiveness and relevance of the supervised and labeled training and test datasets directly affect the power and the capabilities of artificial intelligence (AI) and AI applications. Data with high quality labels are hard to come by. Although efforts are being made to develop methodology to enable AI models to learn despite the lack of high-quality labeled data, they will only make the issue worse. These approaches include active learning, transfer learning, unsupervised learning and deep learning.

9. **High degree of expectations:** A large group of scientists and technologists working on artificial intelligence projects have different goals, motivations, and areas of interest. Research is primarily focused on figuring out the mechanisms that underlie cognition and intelligence, with a strong emphasis on solving the puzzles surrounding human thought and intellect. Not everyone is aware of how artificial intelligence works and may have unrealistic expectations of its performance.

VIII. CONCLUSION

Numerous potential and difficulties in the fascinating field of AI are covered in this chapter. In our society, AI is becoming more and more significant. Even after decades of study and learning, it continues to be the most esoteric topic in computer science and a popular catchphrase. The benefits of this happening phenomenon are widely acknowledged in a variety of fields, including medicine, security, consumer applications, and business. Until recently, it was primarily the subject of discussion and work among science fiction writers; it was restricted to university research labs. With the use of machine learning, highly responsive, sensitive, highly logical and working machines are being created.

REFERENCES

[1] Jennifer Nelson Keith Braafladt (2012) Technology and Literacy, a text book published by ALA Editions. (ISBN No: 978-0-8389-1108-2)
[2] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1925038/
[3] Piaget's Theory of Constructivism https://www.teach-nology.com/currenttrends/constructivism/piaget/ (Accessed on 08-08-2022)
[4] Designing tangible programming languages for classroom use - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/A-collection-of-tangible-programming-parts-from-the-Quetzal-language_fig1_221308672 (accessed 8 Nov, 2020)
[5] Oke, S.A. A literature review on artificial intelligence. Int. J. Inf. Manag. Sci. 2008, 19, 468–476.
[6] Kotsiantis, S.B.; Zaharakis, I.; Pintelas, P. Supervised machine learning: A review of classification techniques. Emerg. Artif. Intell. Appl. Comput. Eng. 2007, 160, 8–19.
[7] Duan, Y.; Edwards, J.S.; Dwivedi, Y.K. Artificial intelligence for decision making in the era of Big Data— Evolution, challenges and research agenda. Int. J. Inf. Manag. 2019, 48, 51–59.
[8] De Felice, F.; Petrillo, A.; Zomparelli, F. Prospective design of smart manufacturing: An Italian pilot case study. Manuf. Lett. 2018, 15, 66–77
[9] Wuest, T.; Weimer, D.; Irgens, C.; Thoben, K.D. Machine learning in manufacturing: Advantages, challenges, and applications. Prod. Manuf. Res. 2016, 4, 23–45
[10] Ivarsson, M.; Gorschek, T. A method for evaluating rigor and industrial relevance of technology evaluations. Empir. Softw. Eng. 2011, 16, 360–363
[11] Petersen, K., Feldt, R. Mujtaba, S. Mattsson, M. Systematic mapping studies in software engineering. In Proceedings of the 12th International Conference on Evaluation and Assessment in Software Engineering (EASE) 12, Bari, Italy, 26–27 June 2008; pp. 2–7.
[12] Vijay, V.C.; Lees, M.; Vakaj, E. Introducing knowledge based augmented reality environment in engineering learning—A comparative study. In Proceedings of the 2020 IEEE Learning with MOOCS, Antigua Guatemala, Guatemala, 29 September–2 October 2020; pp. 137–141
[13] Romero, C.; Ventura, S. Data mining in education: Data mining in education. Wiley Interdiscip. Rev. Data Min. Knowl. Discov. 2013, Vol. 3, 17–23
[14] Guan, C.; Mou, J.; Jiang, Z. Artificial intelligence innovation in education: A twenty-year data-driven historical analysis. Int. J. Innovation. Stud. 2020, 4, 135–144.
[15] Popenici, S.A.D.; Kerr, S. Exploring the impact of artificial intelligence on teaching and learning in higher education. Res. Pract. Technol. Enhanc. Learn. 2017, 14, 21.
[16] https://www.ibm.com/in-en/cloud/learn/what-is-artificial-intelligence
[17] https://theconversation.com/understanding-the-four-types-of-ai-from-reactive-robots-to-self-aware-beings-67616

