Application Development: Emerging Technologies

ARTIFICIAL INTELLIGENCE

TUPAS, RAMWELL P.
NIFAS, HENDRICKSON R.
ARELLANO, MICKO JAMES D.
FERNANDEZ, TRISTAN JAY H.

Bachelor of Science in Computer Science
Technological University of the Philippines

CONTENTS

INTRODUCTION

Imagine a world where we can do our daily tasks without even giving too much effort. Learning new knowledge by asking your devices. Make everything automatic. That sounded like a Sci-Fi movie plot that can have a conflict of technology taking over humanity. This might be a futuristic dream back in the day, but in our present time, this dream became a reality. The emergence of Artificial Intelligence (AI) made the automation of modern technology possible, it became the future of technology and a new tool for humanity. Although automation has existed for many decades, the rise of AI made automation similar to that of humans. This is how revolutionary AI is in our modern world. But do we know enough about it? To what extent can we use them? Are they even safe for humanity to use in the future? We will uncover these questions in this paper.

AI refers to the simulation of human intelligence in machines programmed to mimic cognitive functions such as learning, problem-solving, and decision-making. It encompasses a wide range of techniques, algorithms, and methodologies that enable machines to exhibit intelligent behaviour. AI has become increasingly important in today's world, with applications ranging from self-driving cars and virtual assistants to fraud detection and medical diagnosis. As technology continues to advance, AI is expected to play an even greater role in our lives, transforming the way we work, communicate, and interact with the world around us. But as we use this technology in our world, the more we need to be responsible. We must learn to adapt these things in our everyday lives with responsible use, else, it will cause harmful effects on our world.

ERAS OF ARTIFICIAL INTELLIGENCE (AI)

To appreciate the evolution of AI, it is crucial to familiarize ourselves with the eras of AI.

Precursor (Antiquity)

The seeds of modern Artificial Intelligence (AI) were planted by philosophers, alchemists, and writers who have characterized that human thought can be turned into mechanical manipulation of symbols. Originated in antiquity with myths, tales, and rumors about man-made intelligent or sentient beings created by great craftsmen.

- Myths and Legends

  In Greek Mythology, there was a giant built of bronze named ***"Talos"*** who acted as a protector for the island of Crete. He made three daily loops around the island's perimeter while hurling stones at the invading ships.

  Another legend was the story of Pygmalion, a renowned king and sculptor, who fell in love with his sculpture named **"Galatea"** made of ivory. The reason for his creation was he became disgusted with the women in his society who prostituted themselves and decided to create a perfect woman in his likeness.

  In Eleazar ben Judah of Worms writings, a Golem could be attained by inserting a piece of paper with any of God's names on it into the mouth of the clay figure.

- Alchemy

  The alchemist Paracelsus, who was born in Switzerland, describes a method in his book Of the Nature of Things that he says can create a "artificial man" The mixture can be made into a living child by putting "man's sperm" in horse dung and feeding it "Arcanum of Man's blood" after 40 days.

In Islam alchemical texts primarily in the works of Jabir ibn Hayyan, Takwin, the artificial creation of life was a frequent topic on those texts. This creation ranges from artificial plants to animals.

In Johann Wolfgang von Goethe's Faust: The Second Part of the Tragedy, an alchemically created homunculus who is destined to live forever in the flask in which he was created tries to give birth to a whole human body. But as soon as this change starts, the flask breaks and the homunculus perishes.

- Automation

The religious statues of ancient Egypt and Greece are the earliest automata that have ever been discovered. The faithful thought that the craftsmen had endowed these figures with incredibly genuine minds, capable of intelligence and emotion.

These fabled automata were believed to have the supernatural capacity to respond to questions throughout the early modern era. Roger Bacon, a proto-protestant alchemist of the late medieval era, is said to have created these automatas called **“brazen heads.”**

- Modern Fiction

By the 19th century, concepts of artificial men and thinking machines had been developed in literature Mary Shelley's Frankenstein or Karel apek's R.U.R. (Rossum's Universal Robots), speculation Samuel Butler's "Darwin among the Machines", and actual events Edgar Allan Poe's "Maelzel's Chess Player",

- Formal Reasoning

The premise behind artificial intelligence is that human thought can be mechanically reproduced. Mechanical or "formal" reasoning has long been the subject of study. In the first millennium BCE, philosophers from China, India, and Greece all created organized techniques for formal deduction. Ideas that helped in creation of AI we now know today are Aristotle's reasoning that developed into **Syllogism** - a type of logical argument that uses deductive reasoning to draw a conclusion from two declared or assumed to be true propositions, Euclid's Elements which was the foundation of Model of Reasoning, al Kwharizmi's algebra that helped create algorithms.

Leibniz, Thomas Hobbes, and René Descartes all investigated the idea that all rational thought might be made to be as systematic as algebra or geometry in the 17th century. Hobbes famously wrote in **Leviathan**, such that "there would be no more need for disputation between two philosophers than between two accountants," reducing debate to math.

The crucial discovery that made artificial intelligence seem realistic in the 20th century came from the study of mathematical logic. Works like **Boole's The Laws of Thought** and **Frege's Begriffsschrift** had laid the groundwork for this. In 1913, Russell and Whitehead published their magnum opus, the **Principia Mathematica**, which provided a formal study of the principles of mathematics.

With Russel and Whitehead's success, he challenged mathematicians saying, "can all of mathematical reasoning be formalized?" Their response was surprising in two different ways. They began by demonstrating that mathematical logic had its limitations. Second, and more importantly for AI,

their research demonstrated that, under these constraints, any type of mathematical reasoning might be automated.

AI Foundations (1952-1956)

A few scientists from a number of disciplines (mathematics, psychology, engineering, economics, and political science) started debating the viability of developing an artificial brain in the 1940s and 1950s. In 1956, the academic discipline of artificial intelligence research was established.

- Cybernetics and early neural networks

Neurological studies in recent years have demonstrated that the brain is an electrical network of neurons that fires in pulses of all-or-nothing activity. The **theory of computing** developed by Alan Turing demonstrated that any type of computation may be stated digitally. These concepts' striking resemblance made it seem like an electronic brain might be feasible to create.

In 1943, Walter Pitts and Warren McCulloch examined networks of hypothetical artificial neurons and demonstrated how they could carry out straightforward logical operations. They were the first to define what later researchers would refer to as a **neural network**.

Young Marvin Minsky, a graduate student at the time, was one of the pupils influenced by Pitts and McCulloch. He was 24 years old at the time. He created the first neural network system, the **SNARC**, in 1951 (together with Dean Edmonds). Over the next 50 years, Minsky would become one of the most significant figures in AI.

- Turing Test

In 1950 Alan Turing published a landmark paper in which he speculated about the possibility of creating machines that think. He noted that "thinking" is difficult to define and devised his famous Turing Test. If a machine could carry on a conversation (over a teleprinter) that was indistinguishable from a conversation with a human being, then it was reasonable to say that the machine was "thinking".

- Game AI

Checkers was the first program to demonstrate that computers can learn and not just perform what they are programmed to do. Checkers attracted media attention and learned to play at a level high enough to challenge a decent amateur human player (Samuel 1960).

- Logic Theorist

38 theorems from Principia Mathematica have been proved by the l**ogic theorist**, who also introduced some crucial Heuristics, list processing, "reasoning as search," and other artificial intelligence principles are examples. (Newell)et al. 1962).

- Dartmouth Conference

The 1956 **Dartmouth conference**, which gave AI its name and purpose. The phrase "artificial intelligence," which McCarthy first used, is now the name of a scientific subfield. The conference's main claim was that "Every aspect of any other feature of learning or intelligence should be accurately described so that the machine can simulate it" (Russell and Norvig 2016). Ray Solomonoff, Oliver Selfridge, Trenchard More, Arthur Samuel, Herbert A. Simon, and Allen Newell were among the attendees.

Symbolic AI (1956-1974)

A few scientists intuitively understood that the manipulation of symbols may very well represent the essence of the human mind when access to digital computers became feasible in the middle of the 1950s. They understood that a machine that could manipulate numbers could also manipulate symbols. This was a novel method for building intelligent devices.

- Reasoning as search

The same fundamental algorithm was utilized by several early AI programs. They took small steps, like looking through a maze, in order to obtain some goal (like winning a game or proving a theorem), going backwards everytime they came to a dead end. The phrase "reasoning as search" described this paradigm.

An application of this paradigm was the first versatile mobile robot with reasoning capabilities was **Shakey the Robot**. This initiative brought together robotics research, computer vision research, and natural language processing research, resulting in being the first undertaking that integrated reason and deed (Bertram 1972).

- Natural Language

To enable computers to converse in natural languages like English is a key objective of AI research.

A natural language processing program called ELIZA mimicked a doctor. ELIZA answered inquiries in a way that a therapist would. Until the interaction reached its limits and turned into nonsense, some users believed they were speaking with another human being (Weizenbaum 1966).

- Micro-worlds

The MIT AI Laboratory's Marvin Minsky and Seymour Papert advocated that AI research should concentrate on **micro-worlds**, which are intentionally simplistic scenarios. They emphasized that fundamental concepts were frequently better comprehended with spartan models, such as frictionless planes or completely rigid bodies, in successful sciences like physics.

The world of blocks came to life at the same moment when Minsky and Papert created a robot arm that could stack blocks. Terry Winograd's **SHRDLU**, which could plan and carry out activities and communicate in everyday English words, was the pinnacle of the micro-world program.

- Automata

The WABOT project was started at Waseda University in Japan in 1967, and the **WABOT-1**, the first full-scale "intelligent" humanoid robot, or android, was finished in 1972. With the use of touch sensors, its limb control system enabled it to move things with its hands and lower limbs while walking. Using external senses, fake eyes and ears, and its vision system, it was able to determine the distances and directions to things. Additionally, using an artificial mouth and its dialogue system, it was able to speak Japanese with a human.

First AI Winter (1974-1980)

AI faced criticisms and financial losses in the 1970s. Researchers in AI had undervalued how challenging their issues were. Because of their extreme optimism, expectations were set unrealistically high, and funding for AI vanished when the anticipated results did not emerge.

These were the reasons:

- Lack of processing speed and memory prevented the use of the computer for anything genuinely beneficial.
- In 1972, Richard Karp demonstrated that many issues are likely only solvable in exponential time (in terms of the amount of the inputs), building on Stephen Cook's 1971 argument. Except in the case of small situations, finding optimal solutions to these problems takes unfathomable amounts of computer time.
- Numerous crucial applications of artificial intelligence, such as vision and natural language, necessitate a vast amount of knowledge about the outside world in order for the computer to have any chance of understanding what it might be looking at or discussing. For this to be possible, the program must possess a great deal of the same knowledge about the world as a young child.
- Computers can prove theorems and solve geometry problems relatively easily, but it is quite challenging for them to perform seemingly basic tasks like facial recognition or navigating a room without running into anything. This explains why robotics and vision research had not advanced much by the middle of the 1970s.
- John McCarthy and other logic-based AI researchers found that they could not portray routine deductions that incorporated planning or default reasoning without altering the structure of logic.
- The organizations that provided financing for AI research (such as the British government, DARPA, and NRC) were upset with the lack of advancement and eventually stopped providing practically all of it. The trend started in 1966 when the ALPAC report criticizing machine translation attempts was published. After spending $20,000,000, the NRC stopped all support.
- A number of philosophers vigorously refuted the claims being made by AI researchers. John Lucas was one of the first to assert that Gödel's incompleteness theorem showed that a formal system (such a computer

program) could never see the truth of some assertions, whereas a human being could. Hubert Dreyfus claimed that human reasoning actually entailed very little "symbol processing" and a considerable lot of embodied, intuitive, unconscious" thinking, mocking the shattered promises of the 1960s and criticizing the assumptions of AI.

BOOM (1980-1987)

- Expert systems

An expert system is a computer software that uses logical rules deduced from the expertise of experts to answer questions or solve issues related to a particular field of knowledge. The first illustrations were created by Edward Feigenbaum and his pupils. Beginning in 1965, Dendral used spectrometer results to identify chemicals. The 1972 invention of MYCIN allowed for the diagnosis of blood infections. They provided evidence that the strategy was workable.

- Knowledge Revolution

The 1980s also saw the development of Cyc, the first effort to directly target the issue of commonsense knowledge by building a sizable database that would store all the banal knowledge that the ordinary person possesses. The project's founder and leader, Douglas Lenat, stated that there is no fast cut and that humans must educate robots by hand, one notion at a time, how to understand human concepts. It was anticipated that the project would take decades to complete.

- The money returns: the Fifth Generation project

For the Fifth Generation Computer Project, the Japanese Ministry of International Trade and Industry allocated $850 million in 1981. They decided on Prolog as the main computer language for the project. Their goals were to write programs and create robots that could communicate, translate languages, decipher images, and reason like humans.

- The revival of connectionism

According to Hopfield (1982), a particular type of neural network known as "Hopfield net" learned and processed information in a novel way. "Backpropagation" and the "Hopfield net" (Rumelhart et al. 1985) revived the connectionism branch of AI.

Machine Learning and Deep Learning (1987-Present)

- Deep Learning

DL is a branch of ML and AI. A multi-layer neural network architecture was introduced by DL. various degrees of abstraction that learns data representations (LeCun et al. 2015). architectures for DL neural networks consist of convolutional neural networks, deep belief networks, recurrent neural networks, and (CNN) Networks.

TYPES AND OF AI

Now, let us delve into the various types and approaches of AI. AI can be broadly categorized into three types: Narrow AI, General AI, and Superintelligent AI. Narrow AI, also known as Weak AI, is designed to perform specific tasks efficiently, such as voice recognition or image classification. General AI, on the other hand, aims to exhibit

human-like intelligence across a broad range of tasks. Lastly, Superintelligent AI refers to highly advanced AI systems that surpass human intelligence in almost every aspect.

Within these types, AI can be approached through different methodologies, including rule-based systems, genetic algorithms, expert systems, natural language processing, and machine learning. Machine learning, in particular, has gained tremendous traction in recent years, with its subfields of supervised learning, unsupervised learning, and reinforcement learning empowering AI systems to learn from data and improve their performance over time.

BASED ON CAPABILITIES

- **Narrow AI or Weak AI**

  Narrow AI refers to AI systems that are designed to perform specific tasks or functions within a limited domain. These systems are trained to excel in one particular area and are not capable of generalizing their knowledge or skills to other domains.

  EXAMPLES:

  - **Apple Siri**
  - **Google translate**
  - **Playing chess**
  - **Purchasing suggestions on e-commerce site**
  - **Self-driving cars**
  - **Speech recognition**
  - **Image recognition**

- **General AI or Strong AI**

  General AI refers to AI systems that possess the ability to understand, learn, and apply knowledge across multiple domains, similar to human intelligence. These systems can perform any intellectual task that a human being can do. General AI would be capable of reasoning, understanding natural language,

learning new concepts, and adapting to various situations. However, achieving true General AI remains a significant challenge, and no systems have yet reached this level of capability.

- **Super AI (also known as Artificial Superintelligence)**

  Super AI refers to AI systems that surpass human intelligence across almost all domains and tasks. These systems would possess an intellect far superior to that of the most brilliant human minds and could potentially outperform humans in virtually every intellectual endeavor. Super AI would have the ability to rapidly improve itself, leading to an exponential increase in its capabilities. The concept of Super AI raises significant ethical and existential questions, as its potential impact on society and human existence would be profound.

BASED ON CAPABILITIES

- **Reactive Machines**

  Reactive machines refer to artificial intelligence systems that operate based on a set of predefined rules and inputs without the need for any internal state or memory. These machines react to immediate sensory inputs and produce outputs based solely on the current input. They do not have the ability to store or recall past information, nor do they possess the capability to plan or strategize for the future. Reactive machines are primarily concerned with the present moment and responding to the stimuli they receive.

- **Limited Memory**

  Limited memory, also known as bounded rationality, is a concept in artificial intelligence and cognitive science that describes the notion of systems or agents having constraints on their memory capacity. In the context of AI, it refers to machines or algorithms that possess some form of memory but with a finite capacity. This limited memory may restrict their ability to retain and process large amounts of information or to store data for extended periods. As a result, these

systems must make decisions and operate within the constraints of their available memory resources.

- **Theory of Mind**

  Theory of mind refers to the cognitive ability to understand and attribute mental states, such as beliefs, desires, intentions, and emotions, to oneself and others. It involves recognizing that individuals have thoughts, feelings, and perspectives that may differ from one's own. In the context of AI, theory of mind pertains to developing machines or algorithms that can infer and understand the mental states of human agents they interact with. This understanding enables the AI system to better predict and respond to human behavior, intentions, and needs.

- **Self-Awareness**

  Self-awareness is the ability to recognize and have a conscious understanding of one's own existence, sensations, thoughts, and emotions. It involves having a sense of individuality and introspection. While self-awareness is commonly associated with human consciousness, in the field of AI, self-awareness refers to the potential development of machines or algorithms that possess a level of consciousness or reflective capacity. This would mean that the AI system has knowledge of its own internal states, processes, and capabilities, and is able to reason about itself as a distinct entity. However, achieving true self-awareness in AI remains a subject of ongoing research and debate.

APPROACHES OF AI

1. **Thinking Humanly (The Cognitive Approach)**

   The thinking humanly or cognitive approach in artificial intelligence (AI) and machine learning draws inspiration from human thinking and learning patterns. Its objective is to create AI systems that can replicate human thought processes and behaviors, including perception, reasoning, and problem-solving.

Instead of solely relying on statistical or mathematical models, the cognitive approach places significance on comprehending human cognition and finding ways to replicate it in machines.

An instance of the cognitive approach can be observed in the creation of expert systems. These computer programs are designed to tackle intricate problems within specific domains, like medical diagnosis or financial planning.

2. **Acting Humanly (The Turing Test Approach)**

The approach of acting humanly, also known as the Turing Test approach, is centered around creating artificial intelligence (AI) and machine learning systems that can replicate human-like behavior and thought processes to the extent that they become indistinguishable from humans.

This approach derives its name from the Turing Test, which was proposed by Alan Turing, a prominent British mathematician and computer scientist. According to this test, a machine can be deemed intelligent if it can successfully deceive a human evaluator into believing that it is another human during a natural language conversation.

The Turing Test involves the evaluator engaging in a conversation with both a machine and a human without knowing their identities. If the machine can convincingly pass as the human, leading the evaluator to mistake it for a fellow human, it is considered to have passed the Turing Test.

The Turing Test approach has paved the way for the development of various AI technologies, including chatbots, virtual assistants, and recommendation engines, that aim to emulate human-like interaction and decision-making processes.

3. Thinking Rationally (The Laws of Thought Approach)

The rational thinking or laws of thought approach in artificial intelligence (AI) and machine learning relies on formal logic and reasoning principles. Its objective is to create AI systems that can engage in logical reasoning and make decisions based on predefined rules.

In the laws of thought approach, AI systems are programmed to engage in deductive reasoning. They begin with a set of premises and utilize logical rules to reach conclusions. This approach is commonly employed in expert systems, where a knowledge base consisting of facts and rules is utilized to solve intricate problems within specific domains.

4. Acting Rationally (The Rational Agent Approach)

The approach of acting rationally, also referred to as the rational agent approach, is focused on creating artificial intelligence (AI) and machine learning systems that are capable of acting intelligently in order to achieve their objectives. This approach is rooted in the concept of rationality, which involves making decisions that maximize the likelihood of accomplishing goals, given the available information and resources.

The rational agent approach highlights the significance of designing agents that can reason effectively in uncertain situations and adapt to changing environments, rather than merely following pre-established rules.

APPLICATIONS OF AI

- **Health**

In the field of health, AI has proven invaluable in medical diagnosis, drug discovery, and personalized healthcare. AI-enabled systems can analyze vast amounts of medical data, detect patterns, and assist in diagnosing diseases more accurately. Since AI can analyze large amounts of data faster, it was able to contribute to medical research and provide scientific studies relevant to the research. Some examples of invented artificial intelligence for medicine and health development are the following (Prajapati et al., 2022):

1. In 2009, the University of Manchester in the United Kingdom developed Eve, an artificially-intelligent robot. Eve has made a major contribution to drug discovery, especially on malaria and anti-cancer drugs.
2. The Institute of Cancer Research utilizes AI to scan their Species at Risk (SAR) database from patients to determine which are the targets for the cancer drugs.
3. AI Systems are also used in hospitals and healthcare facilities to research to determine which clinical studies the patients can be categorized.

- **Agriculture**

Similarly, in agriculture, AI can optimize crop yields, predict weather patterns, and enhance pest control, thereby revolutionizing farming practices and ensuring food security. According to the International Monetary Fund (IMF), the global population is expected to reach 9.7 billion by the year 2050. As the population increases, the demand for food supply will increase putting agriculture, one of the most important sectors, in a tough spot. To develop a faster, more efficient, and a productive solution for this issue, Artificial Intelligence was introduced to agriculture. It helped in replacing the traditional methods we used with cost-friendly, harmless, and efficient methods.

1. New technologies that utilize AI are used to detect the status of the crops in the farm, analyzing if the quality of plants, what part needs to be

treated, and if there is any infestation. The AI will utilize this data to respond and spray chemicals on those parts that needed attention.

2. Robots that are programmed with AI are used now to harvest crops and check the quality of the crop.
3. Weather is also important when it comes to agriculture, in which AI can analyze the weather conditions to help the farmers on deciding the approach they can do in that weather condition.

- **Business**

AI can transform operations, enhance customer experiences, and enable intelligent decision-making in businesses. It can automate repetitive tasks, analyze consumer behaviour, and provide valuable insights for strategic planning. It is essentially valuable for companies that require handling large amounts of data every day and a single error can cause a disastrous impact on the company. The following are the uses of AI in the business field:

1. AI for Cybersecurity, since most of the data are now stored in cloud storage it is important to secure these important data. AI helps the cybersecurity of the company to analyze the system of the company and identify if there are any vulnerabilities and help secure it.
2. Analysis on the data gathered from the customers will be helpful to identify the strategies that the company must utilize. Without data, they won't be able to check the customer trends and will be a loss of profit. That's why AI is utilized to analyze the vast amount of data in the database of the company.
3. As the Internet became the global gathering point, businesses took advantage of this and started to build their own platforms online. But with the emergence of AI, they were able to analyze the search trends in different platforms to implement a business model that will fit in those trends.

- **Education**

Moreover, AI has found its way into education, facilitating personalized learning, intelligent tutoring, and adaptive assessments. AI-powered educational tools can adapt to individual learning styles and provide targeted support to students. It boosted the educational experience, especially in higher education. The following are the possible approaches to AI in the field of education:

1. AI systems can produce educational programs to the student's needs by data analysis of their capabilities.
2. AI systems can reduce the efforts and uncertainty of trial-and-error methods, this is helpful for students conducting their educational research and learning new topics. They will be provided with a comprehensive guide and resources by the AI.
3. Efficient admission can be implemented by using AI to gather and analyze data from student applicants.
4. AI systems will give students the flexibility to learn regardless of location, who teach them, and the manner of gaining basic skills.

FACTORS THAT INFLUENCED THE ADVANCEMENT OF AI

Several factors have contributed to the recent advancements in AI. These include the exponential growth of computing power, the availability of vast amounts of data, the development of sophisticated algorithms, and the rise of cloud computing. Additionally, interdisciplinary collaborations, increased research funding, and the active participation of both academia and industry have propelled the rapid progress of AI.

A huge amount of data is available. The invention of cloud storage has made it simple to access data that was previously secured and not made public. Before cloud storage became popular, data scientists who needed data for research had to pay a hefty fee to access it. However, with the advent of cloud storage, governments, research organizations, and corporations are now able to access data that was previously restricted to tape cartridges and magnetic disks. Data scientists want sufficient data for

accurate precision and efficiency while training machine learning models. Research facilities now have the option to train ML models to solve complicated problems using the data at their disposal because of the simple availability of data.

Improvement in innovations. The development of a new generation of processors, such as the graphics processing unit (GPU), has sped up the training of machine learning models. The GPU has a large number of cores to help in ML model training. The future of artificial intelligence depends on GPUs, which are present in everything from consumer electronics to virtual machines in the public cloud. The Field Programmable Gate Array is another invention that is advancing artificial intelligence. The FPGA is a type of programmable processor designed specifically for a certain computing task, such as building machine learning models. General-purpose computing is the domain of conventional CPUs, although FPGAs may be programmed on the fly once they have been produced. Furthermore, data scientists are being drawn to run high-performance computing tasks on the readily accessible bare metal machines in the public cloud.

Efficiency and interests. AI applications can now collect and analyze fresh data thanks to machine learning and deep learning, which is advantageous for both businesses and sectors. Due to the competition among businesses that are vying for efficiency and their desire to obtain a competitive edge, artificial intelligence is growing. A rise in interest in AI technology and development is also attributable to the financial backing of well-known corporations. In addition, artificial intelligence has a significant impact on how Software Quality Assurance (SQA) testing processes are changed. SQA can become a project success hurdle as software applications get more sophisticated, especially when agile methods rely heavily on manual testing. However, the manual testing procedure can be accelerated by artificial intelligence. QA testers can use AI to prioritize test cases based on already-created cases and logs, putting the most crucial functionality first.

Deep learning is a branch of artificial intelligence that enables systems to discover patterns in data and enhance their performance. The most crucial components of the development of artificial intelligence are deep learning and artificial neural networks. Artificial neural networks, which are designed to resemble the human brain, can be trained on a large number of cores to quicken the generalization of learning models. Traditional machine learning models are being replaced by artificial neural networks. Image processing is undergoing a revolution thanks to cutting-edge computer technologies like Single Shot Multibox Detector (SSD) and Generative Adversarial Networks (GAN). The application of computer vision research will be crucial in the future of artificial intelligence in the medical field and other fields. The development of ML methods like Transfer Learning and Capsule Neural Networks (CapsNet) will therefore alter how ML models are developed and used. They will be able to gather precise data for problem-solving and data analysis, resulting in precise forecasts and outcomes.

HUMAN WAY OF THINKING AND AI

An intriguing aspect of AI is its relationship with human thinking. While AI systems emulate human cognitive processes, they differ significantly from human intelligence. Understanding this relationship helps us appreciate the strengths and limitations of AI systems. Humans possess creativity, emotional intelligence, and ethical reasoning, which remain challenging to replicate in machines. Nonetheless, AI complements human intelligence by augmenting our decision-making capabilities and enabling us to tackle complex problems more efficiently.

1. Human Influence on AI Systems

AI systems are designed and developed by humans, which means they are initially shaped by human thinking. The algorithms, models, and data used to train AI systems reflect human decisions, biases, and perspectives. Human thinking influences the design choices, the selection of training data, and the objectives set for the AI system.

2. **Mimicking Human Thinking**

Some AI systems are explicitly designed to mimic or replicate human thinking processes. These systems, often referred to as "strong AI" or "artificial general intelligence," aim to simulate human cognition, reasoning, and problem-solving abilities. However, current AI technologies, including the most advanced deep learning models, are still limited in their ability to truly replicate human thinking.

3. **Augmenting Human Thinking**

Another approach is to use AI systems to augment human thinking and decision-making processes. These systems, known as "weak AI" or "narrow AI," are designed to perform specific tasks or assist humans in specific domains. For example, AI-powered recommendation systems can help humans make better choices by analyzing large amounts of data and providing personalized suggestions.

4. **Differences between Human and AI Thinking**

Human thinking is deeply rooted in our biological and psychological makeup. It involves subjective experiences, emotions, intuition, and contextual understanding, which are currently challenging to replicate in AI systems. On the other hand, AI thinking is based on algorithms and mathematical models that process vast amounts of data using computational methods. AI can often analyze data more quickly and accurately than humans but lacks the broader understanding and adaptability that humans possess.

5. **Ethical Considerations**

As AI systems become more advanced and capable, ethical considerations arise regarding their impact on human thinking. Issues such as privacy, bias, transparency, accountability, and the potential displacement of human labor need to be carefully addressed. It is essential to ensure that AI systems align with human values and respect fundamental principles of fairness, justice, and autonomy.

AI RESEARCH FOCUS AREAS

In the vast landscape of AI research, several focus areas have emerged. These include (Stone et al., 2016):

- **Natural Language Processing** - is the branch of AI that focuses on giving a machine the ability to analyze and understand human texts and languages. Some of the researches done in this branch is question answering, decision-making, information retrieval, etc. (Information Sciences Institute, 2023.)
- **Large-Scale Machine Learning** - one of the problems machine learning is facing now is the scale of the data set it can handle, when it comes to handling large data sets AI may face several challenges. That's why researchers are trying to improve the scalability of machine learning to be able to handle extremely large amounts of data.
- **Deep Learning** - this is a subfield of machine learning but utilizes artificial neural networks instead, inspired by a human brain. Compared to machine learning, it can analyze more complex problems and data sets. Researchers are trying to improve its performance in different areas such as audio, speech, natural language processing, etc.
- **Multimodal AI** - an AI that can analyze multiple inputs or data types (such as photos, speech, text, and numerical data). It is used to detect deepfakes, misinformation, multimedia analysis, face recognition, and several media.
- **Computer Vision** - due to the rise of deep learning, computer vision have been improved. It can now detect visual classification tasks easily. Current research on this area is focused on automatic video and image captioning.
- **Robotics** - the robotic field has been greatly improved after years of research. Robots back then can only perform slow movement and non-complex tasks. But nowadays, they are able to perform complex movements such as dancing, going outside to do tasks, etc. Research in this field is to improve the robot's perception, vision and learning abilities.

- **AI Fairness** - researchers have also been implementing fairness on AI, letting them detect biases, understand cultural values, preferences, and prevent misinformation. Analyzing literature and studies on gender and cultural biases.

Researchers strive to push the boundaries of AI, making breakthroughs that redefine what is possible and opening doors to exciting new applications.

REAL-WORLD APPLICATION OF AI

- **Applications**

  Speaking of real-world applications, let's highlight a few remarkable examples. Virtual personal assistants, such as Siri and Alexa, have become ubiquitous, demonstrating the potential of AI in human-computer interaction. Self-driving cars are transforming transportation, with companies like Tesla and Waymo leading the charge. AI is revolutionizing the financial sector by enabling algorithmic trading and fraud detection. In healthcare, AI systems assist doctors in diagnosing diseases, analyzing medical images, and predicting patient outcomes. Additionally, AI-powered chatbots are becoming increasingly prevalent in customer service, providing personalized and efficient support.

- **Platforms and Tools**

  To facilitate your journey into the world of AI, various platforms and tools are at your disposal. TensorFlow, developed by Google, is a popular open-source library for machine learning, allowing you to build and train neural networks. PyTorch, another widely used framework, offers a flexible and dynamic approach to deep learning. Additionally, scikit-learn provides a comprehensive set of tools for data mining and analysis. These platforms, alongside cloud-based services such as Amazon Web Services (AWS) and Microsoft Azure, provide accessible and scalable AI infrastructure for experimentation and deployment.

Amazon Go lets you grab anything you want in the store and get out without going through people. Before you can enter the store, you have to scan your Amazon Go application with their machine. Once you are in the store, you can just grab anything that you like, and their cameras will catch every angle of you, scanning the barcode of the product that you are holding and adding that to your shopping cart, which will be deducted from your e-cash once you get out of the store.

Self-driving cars are one of the best innovations since the AI is doing all the work for you, can prevent you from getting into car accidents by up to 90%, and lets you do anything you like in the car while it's on autopilot.

Manufacturing robots is one of the best ways to have quality control and assembly of the product, but it comes at a huge price since it will be replacing a human.

Grammarly is being used by a lot of people nowadays to detect any grammatical errors in your message before pressing the send button; sometimes it even provides you with a different message that still has the same idea as yours but is improved.

Siri mostly provides information and assists users with a variety of tasks. Playing music, managing smart home appliances, checking the weather, making phone calls, sending texts, scheduling events on the calendar, setting alarms and reminders, and many more things are just a few of the many things it is capable of.

CONCLUSION

Artificial Intelligence represents an extraordinary frontier of human knowledge and innovation. Humans have been implementing the concept of creating a human-like machine ever since the Period of Antiquity although it may not be fully developed. But as time passes, so is our technology improves. The computational speed and data storage

capacity have greatly advanced that's why in the 21st century, AI has advanced far greater.

AI has now become the new and our future technology. It is now used in major fields such as health, agriculture, business, and education. Companies have been implementing AI to improve their services and products. Some of our traditional methods are now incorporating AI to enhance work efficiency. Today, researchers are still trying to find advancements in AI that can help humans in their everyday work and add to our workforce. This is the age of Artificial Intelligence, we now have the technology that centuries of research have achieved. But our world now has this technology, and we must learn to use it responsibly to prevent the harmful side of AI to terrorize our digital world.

REFERENCES

Eras of AI

European Commission (2020). AI Watch, Historical Evolution of Artificial Intelligence: Analysis of the Three Main Paradigm Shifts in AI. Retrieved from https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120469/jrc120469_historical_evolution_of_ai-v1.1.pdf

Chandra, A. L. (2022). McCulloch-Pitts Neuron — Mankind's First Mathematical Model Of A Biological Neuron. *Towards Data Science*. Retrieved from https://towardsdatascience.com/mcculloch-pitts-model-5fdf65ac5dd1

Eckroth, J. (2017). General Problem Solver (GPS). *Creative Commons*. Retrieved from http://web.cse.ohio-state.edu/~stiff.4/cse3521/gps.html

Perceptrons (n.d.). *W3Schools*. Retrieved from https://www.w3schools.com/ai/ai_perceptrons.asp

Applications of AI

Williams, K. and Bilsland, E. et al. (2015). Cheaper faster drug development validated by the repositioning of drugs against neglected tropical diseases. Retrieved from https://www.cam.ac.uk/research/news/artificially-intelligent-robot-scientist-eve-could-boost-search-for-new-drugs

Prajapati et al. (2022). Aspects of Artificial Intelligence in Agriculture, Healthcare and Education. Retrieved from https://www.ijraset.com/research-paper/aspects-of-ai-in-agriculture-healthcare-and-education

AI research trends (n.d.). One Hundred Year Study on Artificial Intelligence (AI100). https://ai100.stanford.edu/2016-report/section-i-what-artificial-intelligence/ai-research-trends

Types and Approaches

Biswal, A. (2023). 7 Types of Artificial Intelligence That You Should Know in 2023. Simplilearn.com. Retrieved from https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/types-of-artificial-intelligence

Tripathi, A. S. (2023). Approaches of Artificial Intelligence. Scaler Topics. Retrieved from https://www.scaler.com/topics/approaches-of-artificial-intelligence/

Influenced the advances of AI

Trends, M. (2021). *What are the important factors that drive artificial intelligence?*. Analytics Insight. Retrieved from https://www.analyticsinsight.net/what-are-the-important-factors-that-drive-artificial-intelligence/

AI Research Focus Areas

Stanford University (2016). *Ai research trends*. One Hundred Year Study on Artificial Intelligence (AI100). Retrieved from https://ai100.stanford.edu/2016-report/section-i-what-artificial-intelligence/ai-research-trends

University of Southern California (n.d.). *Information Sciences Institute*. Artificial Intelligence. Retrieved from https://www.isi.edu/ai/research-areas/

Real-world Applications of AI

Aldaba, R.M. (2020). The national artificial intelligence (AI) strategy for the Philippines. Department of Trade and Industry. Retrieved from https://innovate.dti.gov.ph/wp-content/uploads/2020/07/AI-Roadmap-Usec-Aldaba.pdf