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The Basics Of AI In Analogy To The Human Brain And SWOT Analyis On AI Application

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Abstract: ***Our modern human is experiencing the advancement of technology every day and in every aspect of our lives. We use blockchain in our financial transaction; we use the internet of all things to control smart devices in our home; we use virtual realities to play our most favorite video and watch interactive movies. Among these novel technologies, artificial intelligence (AI) holds the key to various applications across hundreds of industries in the future. By mimicking the human brain's structures and behaviors, AI is a technology that can learn and become self-adaptable to cope with the external environment- like a human. AI promises to create a computer program that can function and make decisions like a human but with a faster, more data-driven, and more reliable results. Currently, AI cannot befriend and serve human-like R2 in Star War nor dominate the world like the Terminator; however, AI has already helped us in various aspects of life, such as suggesting our favorite films in Nexflix, navigating us on the shortest and faster roads on Google Map, and controlling the non-player characters in our online games. To better understand the future, this essay will provide an analogy analysis between AI and the human brain, following by the SWOT analysis of AI applications. This essay argues despite some moral and technical challenges on implementing AI, the application of this technology would drive humans into more efficient, sustainable, and innovative society.***

Keywords: Artificial Intelligence, Machine Learning, Deep Learning, Artificial Neural Networks, SWOT Analysis,

I. BASIC OF AI: MACHINE LEARNING AND ARTIFICIAL NEURAL NETWORKS

A. INTRODUCTION

From the computer science definition, artificial intelligence is a system that can simulate human thinking capacity and behavior. It performs "any task if a human carried out the same activity, we would say the human had to apply intelligence to accomplish the task." With this definition, an AI system can perform problem-solving, pattern recognition, data manipulation, and even social intelligence and creativity (Heath). AI has many sub-fields, such as computer vision, natural language processing, robotic, and machine learning. Each sub-fields gives AI a specific behavior and senses of humans. For example, computer vision mimics the eyes of a human and natural language processing to help AI understand the complex conversation between humans, even in idiomatic context. However, the two core AI principles that inspired by the behaviors and human brain structures are machine learning and neuron networks respectively.

B. MACHINE LEARNING: MIMICKING THE BRAIN'S LEARNING BEHAVIOR

Machine learning is a core basis of all AI systems because it mimics the learning behavior of the human brain, specifically baby, to create the program self-adapting and learning without the need of explicitly programmed. They learn from the "adaptive model" and "guess" behavior of the brain. To teach a child about an apple, parents normally show the child a picture of a real apple and what is not apple. After the repetitive exposure, a child will start to recognize an apple has a red color and circular shape. To achieve such object recognition like the children, a program needs to have a "smart model" and be able to "guess".

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Regarding the "guess" element, the human is not living in the binary world with only true and false. We are living in a world full of probability and possibility. "Guess" is an ability for a program to assign the output according to the generalization of input information. For example, when a machine learning program receives the picture of a red apple, a yellow mango, and an egg, it can categorize these objects into colors (red and yellow) and shape (circle and oval). An apple has a red color and a circle shape. Mango has a yellow color and oval shape. An egg has a red color and oval shape. If the researcher shows the machine learning program with a red color and circle shape, it will respond "apple".

Moreover, a "model" in machine learning is similar to our brain. It can be self-adaptable to find a pattern between input and output without the need of a programmer. This behavior is the same as our brain; we learn an apple is an apple without the need of any rigid conscious step by step instruction to our brain. Our neuron cells are automatically receiving the input/output and find the pattern to fit with the input/output. For example, humans categorize plants with different criteria, such as color, the shape of leaves, smell, type of stem, and the living habitat. Depending on the samples of plants in front of us, our brain will figure out which criteria to use for categorizing them: colors to categorize flowers or shapes of leaves for vegetables. When we see our current criteria cannot help us to efficiently categorize follow, we will change our pattern recognition. For example, we cannot only use red color and circular shape to recognize an apple when there are peach, red cherry, and tomato. We must add-in different recognition factors, such as the size of the object, the variation of red color, and the shape of leaves. A machine learning program apply this pattern recognition behavior to categorize the new dataset via Supervised Learning, Unsupervised Learning, and Reinforcement Learning**.**

Supervise learning happens when the researcher gives data a label, such as a picture of an apple is "apple" and tomato is "tomato", for a machine learning program to recognize the objects or type of data (Heath). This type of training is the same as teaching a student in the class. A teacher provides students with the lesson and classified knowledge about various subjects, such as geography, math, and even art. The goal of supervised learning is object and pattern recognition. The human behaviors that supervise learning will develop for an AI system are pattern recognition and data classification. This type of learning is suitable for the software that needs to record information, such as picture-to-text, translation, and facial recognition.

Unsupervised learning is giving a machine learning program a set of input and output data without a label, and forcing the program to recognize patterns between these data. This type of learning is applicable for grouping similar but unknown data (Heath). This type of training is seen in grading student papers. A teacher must group different types of grammar mistakes, abstract ideas, essay flow of students into A grade, B grade, C grade, or D grade. It is easy to label a grammar mistake, but it is very hard to use supervised learning for matching essay's ideas into the academic grade. For a human, the driven force for these categorizations is intuition and experience. The teacher normally does not have rigid boundaries of grades in his mind; he can feel which grade the student should receive based on his experience of excellence and bad essays in the past. This intuition and experience are called gradient descent algorithm for unsupervised learning in computer science. The experience of the teacher defines the scope of A-grade and D grade. The teacher or a machine learning program will gradually increase the grade if they feel the essay is good, and reversely if the essay is bad. The goal of unsupervised learning is to classify and grouping un-labeling data. The human's behavior that unsupervised learning will develop for an AI system is pattern recognition, data manipulation, and even social intelligence.

Reinforcement learning is a method to train a machine learning program with a suitable action to maximize reward in a particular situation (Heath). This type of training is seen academic context where an essay has a limited number of words, a limited scope of knowledge, or a step to step math problem with a), b), c) parts. As our brain hates to get punishment, we normally find suitable and smart ways to achieve the goals without getting punishment. With this type of learning, a machine learning program will generate thousands of algorithms and compared them together to find the best solution. Reinforcement learning also follows gradient descent to discard inefficient algorithms and only modify the more efficient one. This type of learning provides guidance and sets of constraints for an AI system to solve; thus, it ensures the program will develop effective, reliable, and faster solutions. The human's behavior that reinforcement learning will develop for an AI system is problem-solving. The application of reinforcement learning is chess playing, self-driving cars, and robotic hands.

Machine learning technique is how an AI system can mimic the brain's learning behavior to process information in a fast and reliable manner and how an AI system can develop the human's behaviors in problem-solving, pattern recognition, and data manipulation. The key elements are the ability to "guess" and "smart model" that can be automatically adapt to find a pattern between input and output.

C. ARTIFICIAL NEURAL NETWORKS: MIMICKING THE BRAIN'S STRUCTURE

In the previous section, we have learned that machine learning can mimic human learning and decision making behavior due to the "smart model" and "guess" ability. To create these two abilities, the AI scientists have created Artificial Neural Networks (ANN), "a model inspired by biological neural network for information processing". When human is learning regardless of subjects, such as musical instrument, sport, art, and math, our brain creates a neural pathway with muscle memory. The brain controls every movement of humans based on the signal from the brain through the neuron pathway to muscle. Neuron learning has two stages. The first stage is creating a neuron pathway and the second stage is to strengthen the pathway (Halo Neuroscience). Takes the process of kicking a ball to the goal as an example. For the first 10 trial kicks, a trainee player does not hit the goals; however, after 20 trial kicks, he will start to realize the adequate force and direction to hit the goal. If he kicks the ball goes too high, he needs to lesser his force; if he kicks far to the left, the next kick he will shift more to the

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right. This is when the neurons in his brain start to find a correct neural pathway to coordinate the suitable and correct muscle movement. As the neuron pathway is strengthened, more and more neuron signals move toward this path to support the movement of the players when he kicks the ball. This neuron pathway strengthens helps to improve muscle coordination specifically to shoot the ball.

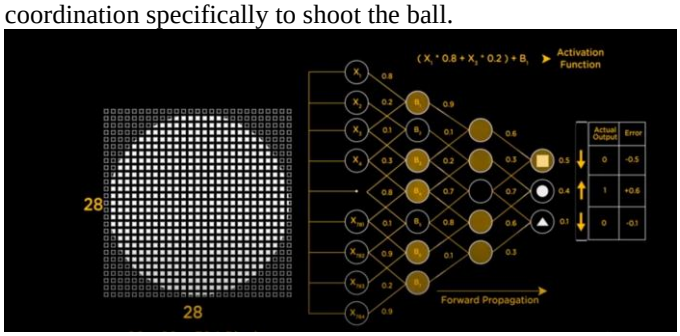

Figure 1: An Artificial Neural Networks model, taken from Halo Neuroscience

Artificial Neural Networks mimic the brain's hierarchy structure and follow the same processes. It has different nodes connecting, representing the neurons. In computer science perspectives, these nodes are a set of matrix and functions that would perform the calculation for the input into the output. In figure 1, an ANN is trying to recognize the input (circle picture). The circle is separated into different pixels and the first layers (the nodes where there is an "x" inside the circle). The network will then generate random "weight"- a random mathematical function or matrix- to each node before passing to the next layers. The output of the previous nodes will be the input for the next one. Same as the ways that the impulse transfer between the brain's neuron system. In figure 1, the ANN gives the wrong result. It said the picture is square although the input is the circle. This is equivalent to the brain creates a wrong neuron pathway or a player fail to the goal. The "weight" is equivalent to the predicted "force" that should be used to kick the ball. As the ANN gives the wrong result, the network will randomly change the weight again until it gets to the correct answer. As the ANN finds the correct weight that could lead the input to the wanted output, they will re-enforce again with other trained and modify the numerical value of the weight to increase the accuracy of the network. This is the core technological principle that gives the AI system the ability to self-adapting and learning behavior (Halo Neuroscience).

II. SWOT ANALYSIS OF AI APPLICATION

A. THE STRENGTH OF AI APPLICATION

Currently, AI has shown advantages in data analysis, data manipulation, and pattern recognition better than humans. These advantages are enhancing the living quality of people around the world and increasing the productivity of workers in various industries. From a consumer perspective, AI makes life more comfortable and convenient. Before the appearance of Siri- Apple's intelligent voice assistant, users must manually reserve a table at the restaurant or manually set up an alarm to wake up. For old people who are not compatible with the smartphone, it could be a challenging and time-consuming task to navigate within the smartphone. Today with the help of Siri, users, including elder users, could easily perform those tasks by verbally communicate with this AI assistant. Moreover, the AI system can also learn from users' interests to suggest new films and music for the audience. Examples of this application are Sound Cloud, Netflix, and Youtube. This application of AI reduces the time for users to find new music and makes users' lives more vivid from individualizing suggestion. Finally, solutions also provide certain services with a low-cost solution compared to hiring an external consultant. For example, AI can generate privacy policies for small business based on a business survey for 30-50 USD compared to 100 USD/hour for hiring a lawyer (The Legality). In short from consumer's perspectives, the strength of AI is convenience, individualize tailoring, and cost-saving solutions.

From the business perspective, AI can improve the productivity of the workforce and this technology applies to various industries. Firstly, many productivity tools rely on AI as a core technology. For example, a recruitment department could use machine learning to match the job description with the candidate CV to reduce the pool of applications. Moreover, much smart business also uses chatbot, an application of AI, to answer common questions from customers, and drive sales. Google and Facebook even use AI to understand their customers' behavior to tailor the advertisements on site. This strength of AI helps Facebook and Google to earn a commission from helping other businesses to sell their digital products. In economic theory, the main goal of a business is profit, and AI is a proven profit-making strategy.

B. THE WEAKNESSES OF AI APPLICATION

AI has shown its strength in various industries; however, it also has some weaknesses in the current development stage compared to other methods of production and technologies. Firstly, AI relied on big data to learn and create a reliable solution. In reality, it is very costly to collect a large database and it is also time-consuming to amend the system under the suggestion of AI. The cost of custom AI solutions could be ranging from 6,000 USD to 300,000 USD, and the cost of implementing a third-party AI service could cost up to 40,000 USD (WebFX). The cost of Ai implementation will exclude small businesses and start-ups to take benefit of these technologies. Moreover, the failure rate of AI start-up is 90% and the failure rate of new custom AI implementation of a corporation is 50% (Schwab). These costs and statistic questions the validity and feasibility of AI application in the business context.

Secondly, AI is very flexible in the application; however, they might not be the best technology solution when we are looking into the niche market- where there is a small market with unique customers or AI has to compete with other technologies. For example, Ocado technology uses AI to categorize and recognize products based on their computational; however, this AI project has been stopped because the barcode solution is a much cheaper and feasible way to recognize the products. IBM's Watson for Oncology

failed to deliver software that can advise on cancer because it does not have enough sample data from the hospital around the world. Facebook also has to stop its AI system to identify hate contents and rely on human detection because Facebook cannot find suitable data training (Deoras). In short, without enough data for training, AI cannot perform effectively and reliable in various niche markets.

C. THE OPPORTUNITIES FOR AI APPLICATION

AI application can open doors to new technologies across industries. For example, with the prevalent of smart wearble, doctors and researchers can collect bio-data of paitents, such as heart beat and blood pressure in real-time. These bio-date can be analyze by AI to create a digital twin- "digital twin refers to a digital replica of potential and actual physical assets (physical twin), processes, people, places, systems and devices that can be used for various purposes" (IBA Group). For healthcare, digital twin can be used to find compatible and individualize treatment. Another example is combining AI and block chain to improve the overall cybersecurity of a bussiness. The flexiblity nature allows AI to integration with other technologies and allows human to find innovative application with these hybrid technologies.

AI also help to promote the suistainable development worldwide. This opportunities come from the nature of AI: optimization, digitalization, and real-time suggestion and adaptation. AI can cosistantly evlove in the real-time based on ongoing data-feeding from IoT equipments. If human train data on reinforcement learning with the constraint of environment, AI can suggest an innovative ways to promote economic growth without the need of scarifice the environment. AI could also be used for watse caterogizing and optimal reverse logistice pathway finding. In fact, AI has been used for water preservation, forest smart tracking, suistanable arigculture, air monitoring worldwide (Joshi). Hence, AI is a promised suistainable technology for the future.

D. THE THREATS OF AI APPLICATION

The largest threat of AI application is the mass unemployment problem. AI is better than humans in pattern recognition, manufacture automatic, and market trend prediction. Since the AI technologies are developing and become more available, they might replace humans to cut down the labor costs. This scenario is executing in various big corporations already, such as Amazon, Nike, McDonald's, and Chipotle. For example, Amazon will recruit 10.000 robots to manage its warehouses, and McDonald's market research believe 92% that fast food will become a fully-automated industry in the next decades(Becker). According to Oxford Economics, "up to 20 million manufacturing jobs worldwide will be lost to robots by 2030" (Press). The lost jobs will include both blue-collar, such as taxi drivers, mail delivery, and data entry personnel, and white-collar jobs, such as data scientists and personal financial advisors. This poses a legal-economic question: who will be responsible to compensate the job-lost workers? This will cause an economic burden on the government. Moreover, since most of the manufactured workers are low-skill workers, it will be a challenge for them to cope with the new emerging technology era and fina a substitute job. The lack of employment could force a person to the poverty cycle.

Another threat is inequality and exclusion in society. For a person to get the benefits from AI, they must have internet access and a computer as a pre-requisite. However, there are four billion people in the world that still lack access to the internet (Lerner). The trend of AI will exclude nearly half of Earth's citizens out of the development. Moreover, since many people cannot access the internet, they cannot access AI-related training also. The fast development of AI will widen the skills and knowledge gap between the global population; thus, it will create inequality worldwide. Without an inclusive plan for all citizens, from suitable education and internet provision, AI will only create inequality worldwide and only benefits the privileged.

III. CONCLUSION

By stimulating the human brain's structure and behavior, the creation of artificial intelligence is a big achievement in human technological history. Mimicking the brain's neuron network and the learning behavior, the AI system allows the computer to guess the pattern and self-adapt the algorithm to fit with the input and output. These technologies have pushed the computer's ability to recognize the pattern, manipulate data, solve the problem, and other intelligent actions. Currently, AI has played a key role in our daily life, ranging from entertainment to business work. AI strength in pattern recognition and problem-solving help humans to choose our favorite film and increase the productivity of workers. Its flexibility nature opens the door to combine with other technologies and promotes sustainable development. However, AI still has a certain weakness, such as costs and the lack of training data, and creates a threat of unemployment and inequality in the future. To maximize the strength and opportunities while limit the weaknesses and threats, education and the internet must be delivered in national education and to the underprivileged citizens worldwide.

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