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An exploratory study of Machine Learning and It's future in the United States

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Abstract**—***This paper explores the concept of Machine learning and its emergence as a useful technological advancement in various industries over the years as well as what its future looks like in the United States. This research paper is exploratory. There will be the use of secondary data obtained from various scholars who have documented how Machine Learning has been growing and transforming various sectors of the economy over the years. Most organizations have adopted the use of Machine Learning in this competitive era as most industries look at taking over huge segments of the economy. Machine Learning has been the talk of various stakeholders in the technological world but there are high expectations that it will grow more beyond its current status. Most industries have undergone massive technological changes in this competitive era. Many organizations are prepared to embrace the changes and as they intend to be more competitive* [1]*. The scope of artificial intelligence (AI) in various sectors of the economy like e-commerce, education, and health has increased over the years.*

Many companies are now investing in developing their AI and machine learning technologies to be efficient as compared to the traditional approaches. In the education field, Artificial intelligence has been adopted to reach out to students in remote areas. AI applications have supported personalized education and dialog system, a review of student progress reports, facilitate in game-based education as well as student support Chabot system. The study concludes that all sectors need to embrace the Machine learning framework to boost business operations in various economic sectors [2]*.*

Since its inception, technologists have taken great steps to benefit from machine learning. Despite progress and advancements in machine learning, several main issues still prevail in organizational scaling due to manual processes and poor collaboration as well as overlapping resources that impede agility. Luckily, organizations particularly strive to make the most out of machine learning in the future [3]*. Computer system specialists will now continue to increase their skills by designing, delivering, and improving on quality assurance to be prepared for the future artificial intelligence level. Every project team must be equipped to confront many important challenges that may arise. With the introduction of a robotic system, this trend has taken an exponential pace. Currently, the machine learning progression continues to build on improved coordination and automation concepts to improve application features, designs, and testing. In the U.S. the ongoing improvements of machine learning are noticeable in an almost limitless market. Machine learning is becoming a critical component of economic growth in this highly competitive age of technology* [3]*. Machine learning was a key element and shaped the technological environment, and many experts expect machine learning to be the norm and increase dramatically in the coming years.*

Keywords*-Artificial intelligence, machine learning Automation, Software architecture*

I. INTRODUCTION

Machine Learning, an artificial intelligence (AI) subdomain, basically relates to computer algorithms that can detect and learn from data automatically. When ML is integrated with data analytics properly, it can eventually maximize the usage of Big Data [3]. Current AI and computer technology innovations have led to the rapid creation of powerful deep learning (DL) algorithms that can extract hierarchical patterns from data, improve prediction and lessen involvement from human beings. Due to the current technological advances, Machine Learning (ML) algorithms have demonstrated the ability to adapt to a wide range of interrelated challenges and extracting knowledge. Today, modern computers can process a high speed of vast quantities of information – 200 petaflops for the most efficient supercomputer in the world [5]. During the last decade, ML technology has taken a major step forward, with computers displaying superior competency in automated data analytics, handling millions of events per second in real-time. Three phases are regarded as the modern and short-term evolution of AI [6]. The first wave of AI (the 1970s–1990s) dealt extensively with the representation of knowledge within well-defined domains, allowed thinking about narrowly-determined problems (for example, rule engines) [7]. The second stage in AI (the 2000s–present) is characterized by improvements in statistics and learning shown by the occurrence of a large number of unattended and tracked ML algorithms, which has greatly enhanced uncertainty management, but has still not achieved a degree of reasoning and generalization. The third and future AI wave (the 2020s and above) will involve technologies that can learn with minimum supervision, increased reasoning abilities, and contextual adaption. This parallel advancing of computer hardware and ML algorithms, which have powerful predictive modeling and increased contextual reasoning attributes, has led to the growth of knowledge in data analytics in recent times [7]. However, it is worth pointing out that different AI waves do not replace each other but instead serve a variety of roles and work on sub-sets of sometimes coexisting AI problems. As automation gets more advanced, engineers will spend more time efficiently designing and delivering applications [8]. This research focuses primarily on conducting an in-depth analysis of Machine learning and assessing its future in Building blocks of DevOps in the United States.

II. RESEARCH PROBLEM

Machine learning has made tremendous progress over the past decades especially powering economic growth in regions. However, different regions are moving at a different pace in adopting this technological advancement leaving others behind. It is therefore important to explore the contributions that have been made in adopting machine learning and what the future looks like in advancing this technology, especially for the United States. The area of concern, in this case, is to understand the research findings being brought to advance Machine learning and evaluate how the future of the technology will look like based on the original contributions. To fully address this research problem, some of the research questions that one would ask themselves are: What key achievements have been made in machine learning? What future trends can we anticipate for machine learning technologies? How is machine learning smoothening various sectors of the economy like businesses, health, and education? What progress has the United States made in making sure that it is not left behind in advancing the adoption of machine learning?

III. LITERATURE REVIEW

A. Building blocks of Machine learning

The development of an effective machine learning and AI system involves a lot of elements. Some of these elements are the combination of hardware and software features. Machine learning is a subfield of AI which provides frameworks capable of gaining from data and improving without being specifically modified after some time [8]. To create and refine rules, machine learning algorithms require access to information. At this same stage, the computer will choose how to respond according to what the data are gained. The idea here is the fact that data is given the ability to control the implementation rules Machine Learning algorithms can use various types of information, especially unstructured or semi-organized data in understanding the context that leads to actions and decisions [8].

The architecture for machine learning evolves and improves as it draws on its data experience. Machine learning could be seen as a box whereby data set are delivered and then trains itself and later ideal outcomes are obtained. It is like training a child for a test and allowing them to do the test on their own after enough practice. The question is, therefore: what are the most critical building blocks of a good machine learning system?

The building blocks of machine learning are classified into five components [9]:

1. Data capture
2. Model
3. Algorithm optimization
4. Regularization
5. Output.

1.Data capture

Machine learning systems require loads of data to function effectively since big decisions are made based on the information gathered by the machine and not just such random data [9]. The captured data must be relevant to the setting in which the machine is operating in. The capture of data can therefore be classified as the first machine learning building block.

2. Model

It is important to know where the collected data go. The data is supplied to the models that can be an algorithm. Every model has to have a mathematical link between both the independent and dependent variables. The essence of model training generally means training/exploring that algorithm, which can be useful in predicting and classifying new datasets, to establish a relationship between two variables.

Data are fed that is typically an algorithm or a specific function [10]. The following is an example of a basic model.

$xw + b = y$

x = input(s), w = weight(s), b= bias where y = output(s) (es)

This is ML's most simple model equation that can generate more complex systems based on this equation. This model is called the Model Linear. In this formula, weight and bias are learning parameters that are randomly initialized but can be modified and managed to generate the desired output.

3. Algorithm optimization

Upon training a model, the next step would be to refine the algorithm or correct it to ensure the highest degree of accuracy [10]. Optimization aims to adjust the parameters to produce the desired outcome; the optimization process

should be repeated until all the parameter values achieve the desired result.

4. Regularization

One of the most important steps is regularization which can be described as a technique that prevents learning a more versatile or complicated model, to avoid the possibility of unnecessary adaptation that is required to make a system work better [11].

5. Output unit

The output unit is where the machine learning system communicates with the outside world and behaves accordingly and comes to action after the building blocks above are set up. Fundamentally, the model is now able to carry out and make big improvements and processes easier and smarter.

B. Machine learning architecture

Machine learning architecture has been classified into three types based on the various algorithms used to training data. These types of ML architecture are Reinforcement Learning, supervised learning, unsupervised learning [11].

The architectural type of machine learning

Supervised Learning

In this type of ML, the machine is trained on the captured data by utilizing a mathematical model consisting of the inputs and outputs required. Each input has a given output, often referred to as the supervisory signal. The system will calculate the correlations between input and output via the available training matrix and use the same matrix in corresponding inputs to evaluate the relevant result [12]. The supervised research can be further extended based on performance parameters into classification and regression analysis.

2. Unsupervised Learning

Unsupervised Learning utilizes output-free data when training a machine on capture data. Unsupervised Learning determines relation inputs based on patterns, mutual characteristics, and outputs based on the presence or absence of these trends in user input [12].

3. Reinforcement Training

Reinforcement Training is effective in training the machine on various algorithms to evaluate the appropriate approach in the current situation for a specific relevant context. These are commonly used to run user inputs by training gaming portals [13].

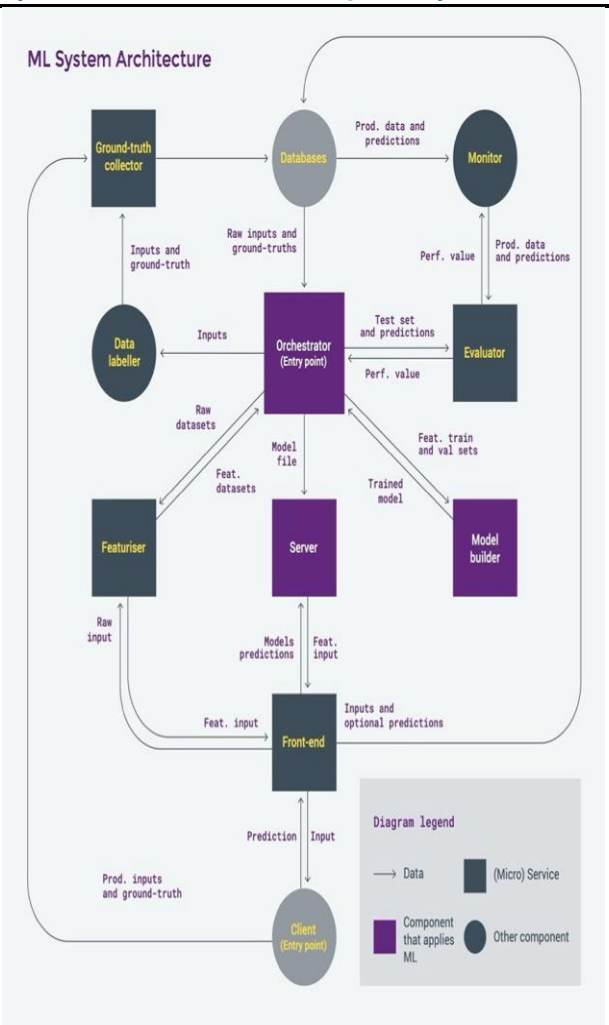

Fig i: Components found in ML system

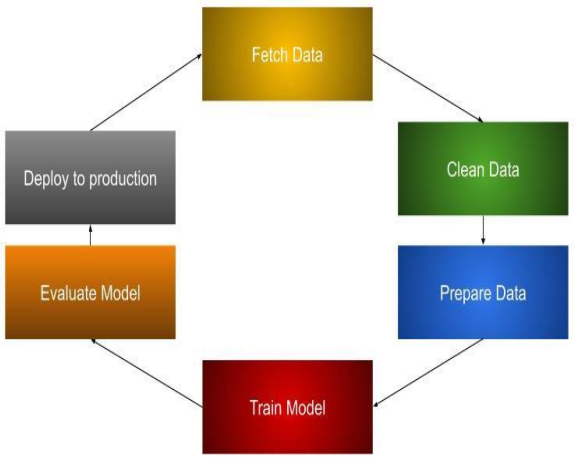

Fig ii: A basic ML architecture

IV.RESEARCH FINDINGS ON THE FUTURE OF MACHINE LEARNING IN THE U.S

The machine learning market was projected to increase by 44.1% which represents USD 1.03 billion in 2016 and an estimated USD 8.81 billion by 2022 [13]. In the U.S, most Organizations use machine-driven technologies to boost customer service, ROI and to stay ahead of the competition in the market. The ML opportunities are now being leveraged by major players in places like IBM, Google, Apple, Microsoft, and Salesforce [13]. Among the ML applications, we will see in the long run are enhanced unsupervised algorithms. The future of machine learning will be influenced by improved unsupervised ML algorithms, used in many industrial sectors [13].

More advances in unsupervised ML algorithms can be expected in the coming years with the evolution of the

language. ML applications will impact the future of ML and contribute to more precise research. There will also be an increase in the adoption of quantum computing [14]. Algorithms in Quantum Machine Learning is expected to have a tremendous potential that can change ML's future. When built into machine learning, quantum computers contribute to faster data processing. This will further increase the capacity of a given dataset to interpret and gain useful insights. This improved performance allows companies to produce great results with classic ML strategies that were not possible. Organizations are now struggling to leverage the potential of quantum computing for improved technology [14].

Microsoft and Google already revealed their plans in the coming years to adopt the technology. It would not be wrong to regard quantum computing as a significant application that will decide the future of ML [15].

In the future, increased use of robotics will be a major boost for conducting business operations. Since robots perform tasks faster, robotic technologies will be used by many companies in the U.S to improve their productivity. A study from Market Research Engine estimates that the world market for service robotics could hit almost $24 billion in 2022 [15]. There is a projected compound annual growth (CAGR) rate of over 15 percent which is anticipated in the sector. We can expect smarter robots to conduct our business operations as systematic progress in the field of machine learning will be made [15]. Increased company acceptance of robots will contribute to the future of machine learning in the technology sectors.

V. SIGNIFICANCE OF THIS RESEARCH TO THE UNITED STATES

The significance of this research to the United States is to know its progress in the implementation of Machine learning in various sectors of the economy [16]. Understanding the progress, the country has made in adopting various machine learning architectures will help in knowing the gains that have been made and what the future will be in technological advancement. The United States will also assess the competencies that it must fully develop to make sure that it is not left behind in meeting the demand f machine learning techniques that can compete in the technological industry [16]. As machine learning develops into a massive technological advancement, various operations will be made easier which will boost the overall operations in various sectors. New competencies in machine learning will need to be integrated into various operations to ensure a continuous machine learning cycle. Some companies and institutions still lag behind in adopting the use of quantum computing and robotics in their operations [17]. The country will benefit from this research to make sure that machine learning techniques are adopted at a quick pace to make sure services are improved and changes are made on how the technology is used.

VI. CONCLUSION

Machine learning works like learning humans. It takes a person some practice and making errors to perfectly fulfill an obligation. Machines must also be professionally qualified to do well. The above four are the building blocks to determine the ideal stage of machine learning and to deliver impeccable results after a lot of preliminary errors. The difference between ML and human learning is that machines can learn a lot faster than ordinary humans with the data set and models and that directly support people in achieving their objectives. The future of machine learning is bright with the expansion in the use of artificial intelligence in various sectors. ML technologies demonstrated tremendous potential in decision-making, science exploration, and process optimization through the analysis of data. Various innovations powered by ML are being pursued to automate information mining and reduce the information intake gaps. In the U.S, an increase in adopting ML will be expected in the future with companies like IBM, Apple, Microsoft, Google and leading the way.

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