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Overview of Machine Learning

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Abstract: *The machine learning field, which can be briefly defined as enabling computers make successful predictions using past experiences, has exhibited an impressive development recently with the help of the rapid increase in the storage capacity and processing power of computers. Together with many other disciplines, machine learning methods have been widely employed in bioinformatics. The difficulties and cost of biological analyses have led to the development of sophisticated machine learning approaches for this application area. In this chapter, we first review the fundamental concepts of machine learning such as feature assessment, unsupervised versus supervised learning and types of classification. Then, we point out the main issues of designing machine learning experiments and their performance evaluation. Finally, we introduce some supervised learning methods*

Keywords: Machine Learning, Artificial Intelligence.

I. INTRODUCTION

Machine learning (ML) is a branch of artificial intelligence (AI) that enables computers to "self-learn" from training data and improve over time, without being explicitly programmed. Machine learning algorithms are able to detect patterns in data and learn from them, in order to make their own predictions. In short, machine learning algorithms and models learn through experience In traditional programming, a computer engineer writes a series of directions that instruct a computer how to transform input data into a desired output. Instructions are mostly based on an IF-THEN structure: when certain conditions are met, the program executes a specific action.

Machine learning, on the other hand, is an automated process that enables machines to solve problems with little or no human input, and take actions based on past observations While artificial intelligence and machine learning are often used interchangeably, they are two different concepts. AI is the broader concept – machines making decisions, learning new skills, and solving problems in a similar way to humans – whereas machine learning is a subset of AI that enables intelligent systems to autonomously learn new things from data instead of programming machine learning algorithms to perform tasks, you can feed them examples of labelled data (known as training data), which helps them make calculations, process data, and identify patterns automatically Put simply, Google's Chief Decision Scientist describes machine learning as a fancy labelling machine. After teaching machines to label things like apples and pears, by showing them examples of fruit, eventually they will start labelling apples and pears without any help – provided they have learned from appropriate and accurate training examples.

Machine learning can be put to work on massive amounts of data and can perform much more accurately than humans. It can help you save time and money on tasks and analyses, like solving customer pain points to improve customer satisfaction, support ticket automation, and data mining from internal sources and all over the internet.

II. SCOPE OF MACHINE LEARNING

The scope of Machine Learning in India, as well as in other parts of the world, is high in comparison to other career fields when it comes to job opportunities. According to Gartner, there will be 2.3 million jobs in the field of Artificial Intelligence and Machine Learning by 2022. Also, the salary of a Machine Learning Engineer is much higher than the salaries offered to other job profiles. According to Forbes, the average salary of a Machine Learning Engineer in the United States is US$99,007. In India, it is □865,257. Let us look at the graph of top job profiles listed by Indeed.

This shows that the Machine Learning scope is extremely high in terms of salary and the number of job opportunities. Thus, it is a good option to make a lucrative career in ML by becoming a Machine Learning professional. Further, in this blog on the future scope of Machine Learning, we will look into the skills that are required to become a Machine Learning Engineer.

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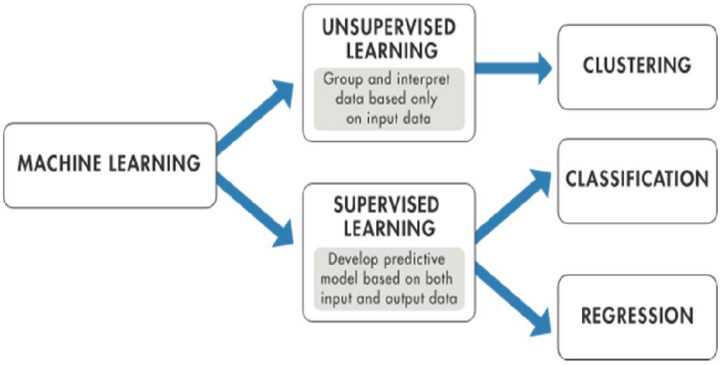
III. HOW DOES MACHINE LEARNING WORKS

Machine learning uses two types of techniques: supervised learning, which trains a model on known input and output data so that it can predict future outputs, and unsupervised learning, which finds hidden patterns or intrinsic structures In input data.Machine learning is a form of artificial intelligence (AI) that teaches computers to think in a similar way to how humans do: Learning and improving upon past experiences. It works by exploring data and identifying patterns, and involves minimal human intervention. Almost any task that can be completed with a data-defined pattern or set of rules can be automated with machine learning. This allows companies to transform processes that were previously only possible for humans to perform—think responding to customer service calls, bookkeeping, and reviewing resumes.

IV. TYPES OF MACHINE LEARNING



4.1 Supervised Learning

Supervised machine learning builds a model that makes predictions based on evidence in the presence of uncertainty. A supervised learning algorithm takes a known set of input data and known responses to the data (output) and trains a model to generate reasonable predictions for the response to new data. Use supervised learning if you have known data for the output you are trying to predict Supervised learning uses classification and regression techniques to develop machine learning models Classification techniques predict discrete responses—for example, whether an email is genuine or spam Classification models classify input data into categories. Typical applications include medical imaging, speech recognition, and credit scoring.

Use classification if your data can be tagged, categorized, or separated into specific groups or classes. For example, applications for hand-writing recognition use classification to recognize letters and numbers. In image processing and computer vision, unsupervised pattern recognition techniques are used for object detection and image segmentation.

Common algorithms for performing classification include support vector machine (SVM), boosted and bagged decision trees, k-nearest Naïve Bayes, discriminant analysis, logistic regression, and neural networks.

Regression techniques predict continuous responses—for example, changes in temperature or fluctuations in power demand. Typical applications include electricity load forecasting and algorithmic trading.

4.2 Unsupervised Learning

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Unsupervised learning finds hidden patterns or intrinsic structures in data. It is used to draw inferences from datasets consisting of input data without labelled responses Clustering is the most common unsupervised learning technique. It is used for exploratory data analysis to find hidden patterns or groupings in data. Applications for cluster analysis include gene sequence analysis, market research, and object recognition For example, if a cell phone company wants optimize the locations where they build cell phone towers, they can use machine learning to estimate the number of clusters of people relying on their towers. A phone can only talk to one tower at a time, so the team uses clustering algorithms to design the best placement of cell towers to optimize signal reception for groups, or clusters, of their customers.
Common algorithms for performing clustering include k-means and k-medoids, hierarchical clustering, Gaussian mixture models, hidden Markov models, self-organizing maps, fuzzy c-means clustering, and subtractive clustering.

V. MACHINE LEARNING CHALLENGES

The advancement of machine learning technology in recent years certainly has improved our lives. However, the implementation of machine learning in companies has also brought up several ethical issues regarding AI technology. A few of them are:

5.1 Technological Singularity

Although this topic attracts lots of attention from the many public, scientists are not interested in the notion of AI exceeding humans' intelligence anytime in the immediate future. This is often referred to as superintelligence and superintelligence, which Nick Bostrom defines as "any intelligence that far surpasses the top human brains in virtually every field, which includes general wisdom, scientific creativity and social abilities." In spite of the fact that the concept of superintelligence and strong AI isn't a reality in the world, the concept poses some interesting questions when we contemplate the potential use of autonomous systems, such as self-driving vehicles. It's impossible to imagine that a car with no driver would never be involved in a car accident, but who would be accountable and accountable in those situations? Do we need to continue to explore autonomous vehicles, or should we restrict the use of this technology to produce semi-autonomous cars that encourage the safety of drivers? The jury isn't yet out on this issue. However, these kinds of ethical debates are being fought as new and genuine AI technology is developed.

5.2 AI Impact on Jobs

While the majority of public opinion about artificial intelligence revolves around job loss, the issue should likely be changed. With each new and disruptive technology, we can see shifts in demand for certain job positions. For instance, when we consider the automotive industry, a lot of manufacturers like GM are focusing their efforts on electric vehicles to be in line with green policies. The energy sector isn't going away, but the primary source that fuels it is changing from an energy economy based on fuel to an electrical one. Artificial intelligence must be seen as a way to think about it, as artificial intelligence is expected to shift the need for jobs to different areas. There will be people who can control these systems as data expands and changes each day. It is still necessary resources in order to solve more complicated issues within sectors that are more likely to suffer from demand shifts, including customer service. The most important element of artificial intelligence and its impact on the employment market will be in helping individuals adapt to the new realms that are a result of the market.

5.3 Privacy

Privacy is often frequently discussed in relation to data privacy security, data protection, and security. These concerns have helped policymakers advance their efforts recently. For instance, in 2016, GDPR legislation was introduced to safeguard the personal information of individuals within Europe's European Union and European Economic Area, which gives individuals more control over their data. Within the United States, individual states are creating policies, including the California Consumer Privacy Act (CCPA), that require companies to inform their customers about the processing of their data. This legislation is forcing companies to think about how they handle and store personally identifiable information (PII). In the process, security investments have become a business priority to remove any potential vulnerabilities or opportunities to hack, monitor, and cyber-attacks.

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5.4 Bias and Discrimination

Discrimination and bias in different intelligent machines have brought up several ethical issues about using artificial intelligence. How can we protect ourselves from bias and discrimination when training data could be biased? While most companies have well-meaning intentions with regard to their automation initiatives, Reuters highlights the unexpected effects of incorporating AI in hiring practices. As they tried to automate and make it easier to do so, Amazon unintentionally biased potential candidates based on gender in positions in the technical field, which led them to end the project. When events like these come to light, Harvard Business Review (link located outside of IBM) has raised pertinent questions about the application of AI in hiring practices. For example, what kind of data could you analyse when evaluating a candidate for a particular job.

Discrimination and bias aren't just limited to the human resource function. They are present in a variety of applications ranging from software for facial recognition to algorithms for social media.

5.5 Accountability

There isn't a significant law to control AI practices. There's no mechanism for enforcement to make sure that ethical AI is being used. Companies' primary motivations to adhere to these standards are the negative effects of an untrustworthy AI system on their bottom lines. To address the issue, ethical frameworks have been developed in a partnership between researchers and ethicists to regulate the creation and use of AI models. But, for the time being, they only serve as a provide guidance the development of AI models. Research has shown that shared responsibility and insufficient awareness of potential effects aren't ideal for protecting society from harm.

VI. HISTORY OF AI AND MACHINE LEARNING

Artificial intelligence originally set out to make computers more useful and more capable of independent reasoning.

Most historians trace the birth of AI to a Dartmouth research project in 1956 that explored topics like problem solving and symbolic methods. In the 1960s, the US Department took interest in this type of work and increased the focus on training computers to mimic human reasoning.

For example, the defence Advanced Research Projects Agency (DARPA) completed street mapping projects in the 1970s. And DARPA produced intelligent personal assistants in 2003, long before Google, Amazon or Microsoft tackled similar projects.

This work paved the way for the automation and formal reasoning that we see in computers today.

Machine learning was first conceived from the mathematical of neural networks. A paper by logician Walter Pitts and neuroscientist Warren McCulloch, published in 1943, attempted to mathematically map out thought processes and decision making in human cognition.

In 1950, Alan Turning proposed the Turing Test, which became the litmus test for which machines were deemed "intelligent" or "unintelligent." The criteria for a machine to receive status as an "intelligent" machine, was for it to have the ability to convince a human being that it, the machine, was also a human being. Soon after, a summer research program at Dartmouth College became the official birthplace of AI.

From this point on, "intelligent" machine learning algorithms and computer programs started to appear, doing everything from planning travel routes for salespeople, to playing board games with humans such as checkers and tic-tac-toe.

Intelligent machines went on to do everything from using speech recognition to learning to pronounce words the way a baby would learn to defeating a world chess champion at his own game. The infographic below shows the history of machine learning and how it grew from mathematical models to sophisticated technology.

VII. CONCLUSION

Machine Learning can be a Supervised or Unsupervised. If you have lesser amount of data and clearly labelled data for training, opt for Supervised Learning. Unsupervised Learning would generally give better performance and results for large data sets. If you have a huge data set easily available, go for deep learning techniques. You also have learned Reinforcement Learning and Deep Reinforcement Learning. You now know what Neural Networks are, their applications and limitations. Finally, when it comes to the development of machine learning models of your own, you looked at the choices of various development languages, IDEs and Platforms. Next thing that you need to do is start

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learning and practicing each machine learning technique. The subject is vast, it means that there is width, but if you consider the depth, each topic can be learned in a few hours. Each topic is independent of each other. You need to take into consideration one topic at a time, learn it, practice it and implement the algorithm/s in it using a language choice of yours. This is the best way to start studying Machine Learning. Practicing one topic at a time, very soon you would acquire the width that is eventually required of a Machine Learning expert

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