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Recent Techniques in Machine Learning: A Review

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ABSTRACT

A branch of artificial intelligence (AI) called machine learning (ML) enables computers to learn and make judgements without the need for explicit programming. It is a technology tool that operates on the premise that a computer can learn information without human assistance. To identify unique patterns, it uses algorithms to analyse enormous volumes of data called training data. This system analyses these patterns, classifies the data, and makes predictions. In conventional machine learning, the computer learns to analyse data after humans label it. The different machine learning techniques are covered in this study.

Keywords: Supervised learning, Unsupervised Learning, Machine learning, Semi Supervised learning, Reinforcement learning

INTRODUCTION

Machine learning (ML) is a branch of artificial intelligence and computer science that focusses on using data and algorithms to assist AI replicate human learning processes and get increasingly more accurate. It entails providing enormous volumes of data to algorithms so they can recognise patterns, forecast outcomes, and resolve challenging issues. Machine learning (ML), a branch of artificial intelligence (AI), enables computers to automatically learn from data and past experiences to identify patterns and make predictions with the least amount of human involvement. Machine learning approaches allow computers to operate autonomously without explicit programming. Machine learning applications can learn, develop, evolve, and adapt on their own when they are given new data. Numerous software programs and business applications incorporate machine learning. Search engines, spam filters in emails, fraud detection software in banks, chatbots, and apps that use speech recognition and predictive text are all common uses for it. Additionally, it can be utilised for security-related tasks like examining internet or email usage. Machine learning may also help organisations by automating processes, which saves time and money. Machine learning turns proven to be useful, especially in today's large data environment.

To mention a few of the technologies it supports, it can identify voice commands on our phones, recommend songs on Spotify or Amazon to purchase next, and even use Waze to determine the quickest route to your position. Machine learning helps doctors diagnose diseases more rapidly and correctly in the healthcare sector. It assists the banking industry in spotting fraudulent conduct that differs from the usual spending habits of its clients. In machine learning, algorithms are trained on data sets to generate expected outcomes, such as identifying an object or seeing a pattern. The process of refining a model to anticipate the right answer from training data samples is known as machine learning. Assuming the training data is of high quality, the more training samples the machine learning algorithm receives, the more accurate the model will become. The algorithm adjusts the model to the data during the "fitting process," which is a step in the training process. If the outcome does not match the desired outcome, the algorithm is retrained again until it generates the correct response.

In essence, the algorithm decides if the input and the response fit into a line, cluster, or other statistical association by using the knowledge it has gained from the data.Machine learning is based on data, which can be text, photos, or statistics. Bank transactions, pictures of people or even particular baked items, repair logs, sensor time series data, and sales reports are a few examples of data. The data is gathered and prepared to be used as training data, or the information that will be used to train the machine learning model. After that, programmers choose a machine learning model to use, supply the data, and let the computer model train on its own to spot patterns or predict what will happen next. A human programmer can help the model provide increasingly accurate results by adjusting its parameters over time.

RECENT TECHNIQUES ON MACHINE LEARNING

AI technologies are becoming more widely available and effective, and recent advancements in machine learning (ML) are transforming a number of industries.

1. No-Code and Low-Code Machine Learning: There is a growing trend of platforms that let users create and implement machine learning models without knowing any code. With drag-and-drop interfaces, these tools—including Microsoft's Power BI and Google's AutoML—make it simpler for non-technical users to apply machine learning (ML) to commercial activities like fraud detection and consumer sentiment analysis.

2. TinyML: TinyML makes machine learning possible on low-power gadgets like IoT devices and microcontrollers. This breakthrough brings real-time data processing and decision-making to fields like wearables, smart sensors, and robotics by extending AI capabilities to a variety of tiny, battery-operated devices.

3. Generative Adversarial Networks (GANs): In 2024, GANs—which are made up of two competing neural networks—are advancing quickly. These days, they are commonly utilised to create realistic synthetic data, such as pictures and movies, having uses in design, entertainment, and medical imaging.

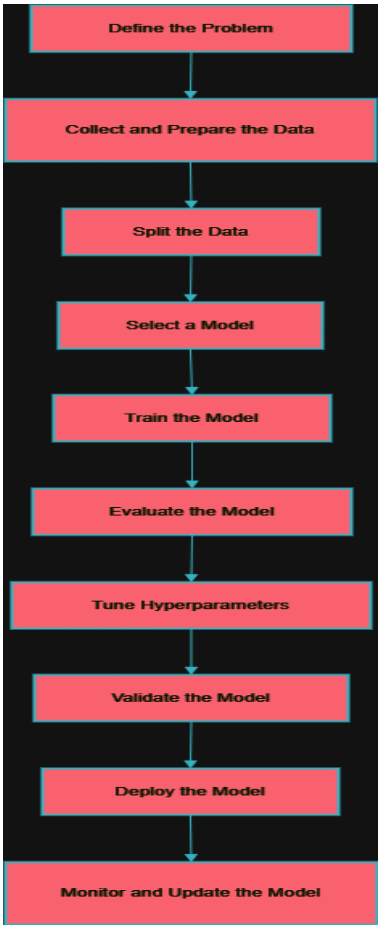
4. Automated Machine Learning (AutoML): AutoML solutions make machine learning more accessible to those without extensive knowledge by automating a large portion of the ML process, from data collection to hyperparameter tuning. This speeds up model development for both novice and experienced developers.

5. Machine Learning Operations (MLOps): Focussing on managing the lifecycle of machine learning models from development to deployment and maintenance, MLOps is a methodology that is comparable to DevOps. MLOps is essential for guaranteeing effectiveness and teamwork as companies expand their ML initiatives.

6. Explainable AI (XAI): As AI gets more complicated, there's a growing demand for interpretable models. The goal of XAI is to increase the transparency of machine learning models by offering insights into the decision-making process, which is essential for industries like healthcare, finance, and law.

SUPERVISED LEARNING

In supervised machine learning, algorithms are trained on data sets that have been labelled with tags that characterise each data item. A "answer key" that offers instructions on how to interpret the data is sent with the data to the algorithms. For instance, an algorithm may be given pictures of fruits with tags for each kind of fruit in order to identify fruits when they are shown in new photos. Supervised machine learning is commonly used to create machine learning models for classification and prediction.



UNSUPERVISED LERNING

One kind of machine learning model that finds patterns in unstructured, or unlabelled, data is called unsupervised learning. Unlike supervised learning, the "correctness" of the output is not known beforehand. Instead, the algorithm learns from the data without human input (i.e., it is unsupervised) and categories the data based on qualities. For instance, when the algorithm is shown pictures of apples and bananas, it can tell which one is an apple and which is a banana by itself. Unsupervised learning is particularly effective in two domains: pattern matching and descriptive modelling. The most popular unsupervised learning methods nowadays are fuzzy means, K-means clustering, hierarchical clustering, and partial least squares.

SEMI SUPERVISED LEARNING

The third of four machine learning models is semi-supervised learning. Ideally, all data would be labelled and organised before being entered into a system. However, when large volumes of raw, unstructured data are available, semi-supervised learning emerges as a viable solution because that is clearly not possible. Small bits of labelled data are fed into this model in order to supplement unlabelled data sets. In essence, the labelled data gives the algorithm a head start and can significantly increase learning accuracy and speed. The machine is instructed to evaluate the labelled data for correlative qualities that could be applied to the unlabelled data by a semi-supervised learning approach.

REINFORCEMENT LEARNING

Reinforcement learning is a machine learning training method that rewards good behaviour and penalises bad behaviour. Usually, the object being taught, also known as a reinforcement learning agent, is able to perceive and understand its environment, act, and gain knowledge through making mistakes. In the Reinforcement Learning problem, an agent has to explore an unknown environment to achieve a goal. Reinforcement learning (RL) is based on the notion that any goal may be described by maximising the projected cumulative reward. The agent must become capable of seeing and changing the state of the environment to reap the maximum benefit.

APPLICATIONS OF MACHINE LEARNING

Applications of machine learning (ML) are numerous and span many industries, revolutionising the way companies and organisations function. The following are some prominent fields where machine learning is having a big influence:

1. Healthcare: By enhancing drug development, diagnostics, and individualized care, machine learning is transforming the healthcare industry. In certain situations, algorithms may identify diseases like cancer and heart disease from medical imaging before human physicians can. Furthermore, by suggesting possible compounds for clinical trials, ML models aid in medication discovery, optimize hospital operations, and forecast patient outcomes.

2. Finance: Machine learning is used in finance for risk management, algorithmic trading, fraud detection, and credit scoring. Massive datasets can be analysed by ML models to forecast market trends, detect fraudulent conduct in real time, and evaluate a person's or business's trustworthiness. Furthermore, AI trading algorithms are able to make high-frequency trades by identifying patterns that human analysts would overlook.

3. Retail and E-Commerce: Machine learning is used by retailers to estimate demand, analyse customer sentiment, and make tailored suggestions. With chatbots and virtual assistants, ML models enable organisations anticipate inventory demands, optimize pricing tactics, and enhance customer service. Machine learning-powered personalisation engines make product recommendations based on historical user behaviour, increasing customer satisfaction and revenue.

4. Autonomous Vehicles: By allowing self-driving cars to understand their surroundings, make judgements instantly, and increase safety, machine learning is essential to these vehicles. Autonomous cars are getting closer to completely autonomous mobility by using deep learning, computer vision, and sensor data to identify objects, map their environment, and anticipate the actions of other drivers.

5. Natural Language Processing (NLP): A branch of machine learning, NLP finds extensive usage in voice assistants, chatbots, sentiment analysis, and language translation. Because machine learning algorithms can comprehend and produce human language, using technology becomes more natural. NLP powers well-known programs like Google Assistant, Alexa, and Siri, and machine learning keeps them getting better.

6. Manufacturing and Supply Chain Optimisation: Predictive maintenance uses machine learning to track the condition of equipment, anticipate possible breakdowns before they happen, and reduce downtime. ML lowers

operating costs and improves service delivery in supply chains by forecasting demand, managing inventories, and optimising routes.

7. Marketing and Customer Insights: Through consumer behaviour analysis, ad targeting optimisation, and customer segmentation, machine learning improves marketing efforts. Large volumes of consumer data are processed by ML models, which yield insights that assist companies enhance customer engagement and improve marketing strategies.

8. Energy Management: Machine learning is used in the energy sector to better integrate renewable sources into networks, forecast energy demands, and optimise power distribution. Additionally, it contributes to the improvement of energy efficiency in all industrial activities and predictive maintenance for infrastructure.

9.Medical application: In cases of widespread epidemics, plans must be put in place to prioritise preventative efforts for those who are most at risk of catching HIV. Using population-level HIV testing data from rural Kenya and Uganda, HIV risk scores were created, and their ability to identify seroconversions was assessed. Machine learning[1] yielded superior outcomes when compared to a model-based approach for classifying individuals at risk of HIV acquisition. Case-based reasoning and closest neighbour analysis were used to build a method [2] for evaluating patients' chances of survival for colorectal cancer. This study included 216 patients with complete clinic pathologic records and a five-year follow-up. They were separated into a test group consisting of 54 cases and a core database of 162 cases, with follow-up on every patient.

Obesity and overweight have been linked to an increased risk of acquiring some types of cancer. Oestrogens and insulin-like growth factors (IGFs) are implicated in the pathogeneses of numerous cancers, according to research done on adults. Hormone alterations in prepubertal obese children are associated with an increased risk of cancer in obese adults. 40 obese children between the ages of 6 and 9 and a control group that was matched for both sex and age were employed in the study [3]. The threat that financial transaction fraud poses to individuals and businesses has led to the development of innovative detection and prevention strategies.

The use of real-time monitoring systems and machine learning algorithms to improve fraud detection and prevention in financial transactions is examined in this research study [4]. Adaptive thresholds and dynamic risk scoring are two proactive fraud prevention strategies that are now being researched. Scalability and deployment factors are also covered, as well as data security and legal compliance.

Slope collapses were predicted using a Swarm-Optimized Fuzzy Instance-based Learning technique [5], which involved employing the firefly algorithm to optimise the FKNN hyper-parameters. The proposed model fared better than other comparison methods.A novel fuzziness-based semi-supervised learning approach[6] that uses unlabelled examples with the help of supervised learning algorithms was presented in order to improve the classifier's performance for the IDSs. Following training of a single hidden layer feed-forward neural network (SLFN) to generate a fuzzy membership vector, the fuzzy quantity is utilised to categoriseunlabeled samples into low, mid, and high fuzziness sectors.

CONCLUSION

Machine learning algorithms are trained to find links and patterns in data. Using historical data as input, they reduce dimensionality, classify information, cluster data points, make predictions, and even help create new content. The many machine learning approaches and their uses are reviewed in this study. Healthcare professionals utilise machine learning to diagnose patients and suggest therapies. Other common machine learning use cases include spam filtering, fraud detection, malware threat detection, corporate process automation, and predictive maintenance.

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