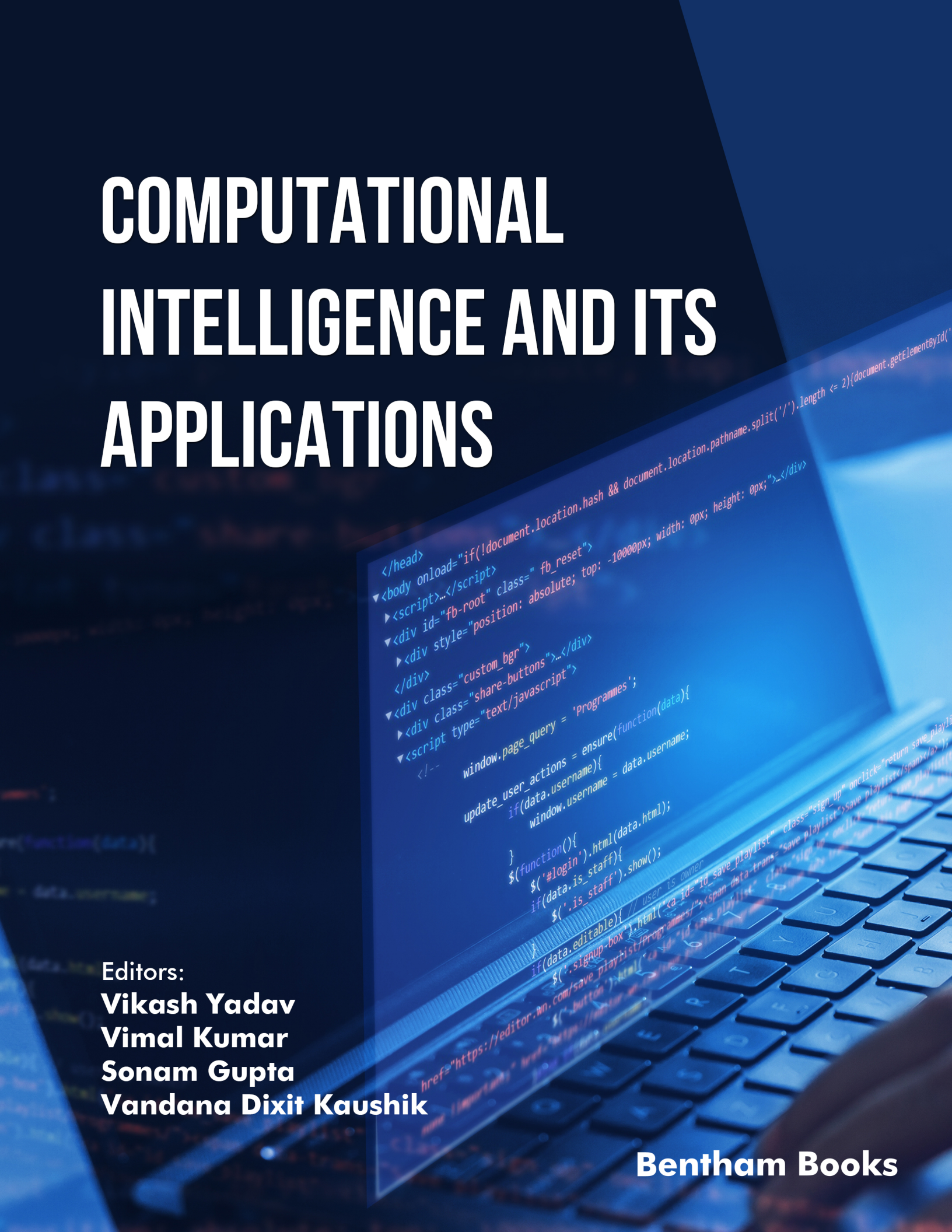
COMPUTATIONAL INTELLIGENCE AND ITS APPLICATIONS



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PREFACE

In the rapidly evolving landscape of technology, where the boundaries between the digital and physical worlds blur, computational intelligence stands as a beacon of innovation and problem-solving process. As the digital era continues to permeate every facet of our lives, the need for intelligent systems that can adapt, learn, and make decisions becomes increasingly vital. This book, "Computational Intelligence & its Applications", delves deep into the heart of this transformative field, exploring its theoretical foundations and practical applications that are reshaping industries, societies, and the very nature of human-machine interaction.

Computational intelligence, an interdisciplinary domain drawing from computer science, mathematics, engineering, and cognitive sciences, encompasses a rich tapestry of techniques inspired by nature, evolution, and human cognition. From neural networks that emulate the workings of the human brain to evolutionary algorithms that mimic the process of natural selection, computational intelligence methodologies empower machines to solve complex problems, optimize processes, and learn from data in ways that were once deemed the exclusive realm of human intelligence.

From healthcare and finance to manufacturing and transportation, the impact of computational intelligence is profound and multifaceted. In the pages that follow, readers will encounter compelling case studies and examples showcasing how computational intelligence algorithms are revolutionizing medical diagnosis, enabling autonomous vehicles, predicting market trends, optimizing supply chains, and enhancing the overall quality of life. Each chapter is crafted to provide a balance between theoretical knowledge and practical insights, making this book an invaluable resource for students, researchers, and practitioners alike.

Additionally, this book explores the ethical dimensions of computational intelligence, addressing the societal implications of intelligent systems, including privacy concerns, bias in algorithms, and the ethical responsibility of AI developers. As we venture deeper into the era of artificial intelligence, understanding these ethical considerations is paramount to ensuring that computational intelligence serves humanity's best interests.

We invite readers to embark on a journey through the realms of computational intelligence and witness firsthand the transformative power of intelligent algorithms. Whether you are a student eager to explore the frontiers of AI, a researcher seeking inspiration for your next project, or a practitioner aiming to harness the potential of computational intelligence in your industry, this book offers a wealth of knowledge and insights to guide you on your intellectual quest.

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CHAPTER 1

Emerging Frontiers: Post-Quantum Cryptography and Secure Communication

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Abstract: The field of cryptography is facing a significant challenge due to fast updates in computer history. This chapter explores the key concepts, techniques, and challenges associated with post-quantum cryptography (PQC). The chapter begins by introducing the fundamental principles of quantum computing and the threats it poses to traditional cryptography systems. Each family is examined in detail, highlighting its underlying mathematical foundations, security assumptions, and implementation considerations. The chapter also discusses the ongoing standardization efforts in post-quantum cryptography led by organizations such as the "National Institute of Standards and Technology" (NIST). Furthermore, the chapter explores the challenges and open research questions in the field, such as the efficient implementation of post-quantum algorithms, the impact on existing protocols and systems, and the integration of post-quantum cryptography into real-world applications.

Keywords: Cryptography protocols, Message authentication codes (MACs), NIST, Post-quantum cryptography, Post-quantum algorithms, Quantum computers.

INTRODUCTION

PQC is a field of study and research focusing on cryptography protocols that can withstand quantum computers. Quantum computers can potentially solve the underlying mathematical problems upon which current encryption algorithms are based, rendering them ineffective. PQC's goal is to develop new cryptography algorithms that can resist attacks by quantum computers. These algorithms are designed to provide security against both classical and quantum computers, ensuring that encrypted data remains protected in a post-quantum computing era. Secure communication involves protecting the content of the communication from unauthorized access, preventing any unauthorized modifications or tampering with the data, and verifying the identity of the communicating parties. To achieve secure communication, various cryptography techniques and protocols are employed. These techniques involve the use of encryption, which transforms the original message into an unintelligible form, making it difficult for eavesdroppers

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to understand. Only authorized recipients with the necessary decryption keys can decipher the encrypted message and retrieve the original information. Secure communication protocols also address the issue of data integrity. They ensure that the message remains unaltered during transit by employing message authentication codes (MACs) or digital signatures. These techniques verify the integrity of the data by attaching a small piece of information that is computed using cryptography algorithms [1].

Furthermore, secure communication involves establishing the authenticity of the communicating parties. This is achieved through techniques like digital certificates and public key infrastructure (PKI), where each participant is issued a unique digital certificate that binds their identity to a public key. By verifying the digital certificate, the recipient can be assured of the sender's identity and establish a secure channel for communication. Secure communication is crucial in various contexts, including online banking, e-commerce, government communications, and sensitive data exchanges. It protects against eavesdropping, data tampering, impersonation attacks, and other forms of cyber threats, ensuring that sensitive information remains confidential and trustworthy throughout the communication process.

Key Concepts: Fundamental Techniques and Cryptography Protocols

There are several fundamental techniques and cryptography protocols used to achieve secure communication [2]. Here are some commonly employed techniques:

1. Encryption: It is the process of coding plaintext (original message) into ciphertext (encrypted message) using an encryption algorithm and a secret key. It ensures that even if intercepted, the message cannot be understood without the corresponding decryption key. Popular encryption algorithms include AES and RSA.
2. Symmetric Key Cryptography: It uses the common key for both coding and decoding, and the key must be shared through the proper channel. This approach is efficient for encrypting big data. Examples are AES, DES, and Blowfish.
3. Asymmetric Key Cryptography: It involves a public and private key for encryption and decryption, respectively. It is used in secure key exchange and digital signatures. Examples are RSA, ECC, and Diffie-Hellman key exchange.
4. Hash Functions: It converts the input of an arbitrary string to an output of a fixed string known as a message digest. Popular hash function algorithms are SHA-2, SHA-3, and message digest algorithm (MD5).
5. Digital Signatures: These use asymmetric key cryptography to provide data

integrity and non-repudiation. The sender uses its private key to make a unique digital signature, and the verifier verifies it using the corresponding public key.
6. Transport-Layer Security TLS or Secure-Sockets Layer (SSL): These protocols provide secure communication over the Internet. SSL/TLS is commonly used in web browsing, email, *etc*.
7. Virtual Private Networks (VPNs): VPNs create secure communication over public networks. VPNs are widely used for remote access, securing Wi-Fi connections, and maintaining privacy online.

These techniques and protocols can be combined and tailored to specific communication needs, providing layers of security to protect sensitive information and ensure secure communication between parties [3].

The following section examines the techniques and challenges associated with post quantum cryptography [4 - 7].

Techniques/Challenges in Post-Quantum Cryptography

Researchers are exploring various mathematical problems and cryptographic primitives believed to be intractable against quantum computers. Some of the promising approaches include:

1. Lattice-based Cryptography: It includes Learning with Errors (LWE) and Ring Learning with Errors (RLWE) schemes, which offer security against attacks by both classical and quantum computers.
2. Code-based Cryptography: It employs error-correcting codes to provide security. Schemes like McEliece and Niederreiter cryptosystems utilize the difficulty of decrypting the linear codes to achieve resistance against quantum attacks.
3. Multivariate Cryptography: It is based on the hardness of solving multivariate polynomial equations. It involves schemes like Rainbow and the Unbalanced Oil and Vinegar (UOV) cryptosystems.
4. Hash-based Cryptography: It employs cryptographic hash functions to construct digital signatures and key exchange protocols. Merkle trees and the Lamport signature scheme are examples of hash-based post-quantum cryptographic techniques.
5. Supersingular isogeny-based cryptography: These schemes are based on elliptic curves and isogenies, and security relies on the hardness of certain isogeny problems.

CHAPTER 2

Chatbot with Machine Learning: Latest Advancements

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Abstract: The aim of this chapter is to enhance the conversational skills of a chatbot through the use of machine learning methods. The chatbot is going to be created in a way that it comprehends conversational input and offers suitable answers to inquiries made by users. To teach the machine learning model how to generate fitting responses, it will undergo training using an extensive collection of spoken interactions among humans for pattern recognition purposes. The Natural Language Processing (NLP) framework will serve as the foundation for the upcoming chatbot, which will utilize the Python programming language for its development. The model intends to apply advanced deep learning algorithms, including recurrent neural networks (RNN) as well as long short-term memory (LSTM), to analyze and interpret natural language and produce suitable replies. The model's accuracy will be enhanced by training it on a conversational log dataset, enabling it to learn from genuine interactions. Due to the swift advancement of technology and the emergence of the chatbot idea, the amount of time and effort can be conserved. A multitude of specialized frameworks have been developed to facilitate the creation and use of chatbots. The chatbot is dependent on artificial intelligence.

Keywords: Artificial intelligence, Chatbot, LSTM, Machine learning, NLP, RNN.

INTRODUCTION

Chatbot refers to a computer program designed to communicate with humans using everyday language. Incorporating technologies such as NLP (Natural Language Processing), which utilizes artificial intelligence, to achieve the desired outcome [1]. The chatbot should be made more engaging and trustworthy. Due to the recent epidemiological situation, there has been a rising need and dependence on electronic devices. The curfew that has been enforced is making it challenging

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to attend university and obtain an education. The university's scholars have only a restricted ability to obtain information due to this [2].

The utilization of AI chatbot programs is increasingly widespread among organizations and associations as a means of engaging with their clientele in live conversations. By using these computer programs, companies are able to address inquiries from customers and provide support in resolving any issues they may encounter. The aim of this project report is to present the development process of a real-time chat application with an automated bot using Django [3].

Our creation of an AI chatbot will enable customers to interact with companies instantly. It will be possible for customers to initiate a conversation with a business and receive responses to their inquiries. Firms will be able to receive and respond to chat messages. We will utilize Django, which is a Python-based web framework that allows for the speedy development of web applications, to develop the requested application [4].

Artificial intelligence's subbranch, machine learning, has made a significant impact on the development and utilization of chatbots. By implementing machine learning, chatbots are capable of learning from information, advancing with time, and providing users with more precise and customized answers [5].

In the past, chatbots were typically created using rule-based systems, whereby developers would manually establish guidelines for the chatbot to adhere to. The chatbots that were based on rules had constraints when it came to comprehending conversational language and providing fitting answers to user inquiries. Chatbots can learn from vast amounts of human conversational data using machine learning, and consequently, they will be capable of comprehending the context and producing correct responses.

In addition, chatbots now have the ability to tailor their answers to specific users using information such as their preferences, past interactions, and situational data, thanks to the advancement of machine learning. Customization of this degree has the ability to enhance the satisfaction of the user and increase their interaction with the chatbot. To sum up, the incorporation of machine learning into chatbots has brought about a significant change in the creation and usage of chatbots. Chatbots have become more efficient and beneficial in numerous industries due to their ability to comprehend natural language, retain context within conversations, and supply tailored answers to users, all of which have been made possible by the implementation of machine learning.

The understanding and interpretation of human language, also known as natural language processing, poses a significant obstacle in constructing AI chatbots.

Django offers various resources and collections for Natural Language Processing (NLP), such as spaCy, NLTK (Natural Language Toolkit), and Python. NLTK is a commonly used NLP library that offers multiple resources, including tokenization, anchoring, and part-of-speech tags. spaCy offers advanced functionalities like identifying names and analyzing dependencies, making it a potent NLP library [6].

NLP is a section of AI that concentrates on how computers and human language interact with each other. The technology of NLP allows computers to comprehend, analyze, and create human speech, which is crucial for constructing programs that entail interactions with people, like chatbots, virtual aides, and language conversion.

To sum up, the incorporation of machine learning into chatbots has brought about a significant change in the creation and usage of chatbots. Chatbots have become more efficient and beneficial in numerous industries due to their ability to comprehend natural language, retain context within conversations, and supply tailored answers to users, all of which have been made possible by the implementation of machine learning [7].

AI chatbots can be integrated with various other technologies to enhance their functionality [8]. For example, it can be integrated with voice assistants such as Amazon Alexa or Google Assistant to allow users to interact with the chatbot using voice commands. It can also be integrated with messaging platforms like Facebook Messenger or Slack to allow users to interact with chatbots through that platform [9]. Additionally, it can be integrated with analytics tools such as Google Analytics or Mixpanel to track user behavior and improve chatbot performance.

LITERATURE REVIEW

Machine learning has prompted substantial research and advancement in the realm of chatbots. In this field, a literature review of recent studies and developments is provided below. The Journal of Intelligent Information Systems documented a research project where scientists created a machine learning-based chatbot for customer service on the Internet. The conversational abilities of the chatbot were enhanced through deep learning algorithms by using a set of customer interactions as a training dataset. According to the research, the chatbot was capable of delivering correct and beneficial replies to clients, which boosted client contentment and reduced turnaround duration [10].

A recently released article in the Journal of Ambient Intelligence and Humanized Computing concentrated on creating an AI-powered automated chat assistant for medical assistance through the usage of machine learning techniques. The main

CHAPTER 3

Stock Price Prediction: A Gateway to a Prosperous Future Using Data Science and Machine Learning

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Abstract: Predictive analysis is a powerful tool for predicting future trends and events, and it can be useful for predicting stock prices as well. In this paper, predictive analysis for stock price prediction is done using machine learning algorithms. Predictive analysis is a kind of analytics in which we use archival data equipped with statistical models and machine learning algorithms to predict future outcomes, and it is effectively used here for stock price prediction. The intended outcome of stock forecasting is to make more briefed and calculated investment decisions. We have used a stock price prediction system that blends mathematical equations, predictive analytics, and contextual factors to enhance the accuracy of stock price predictions and generate profitable trades. For experimentation, a real-life dataset of ICICI bank is used, and the results show that our model is able to forecast future stock prices with high accuracy.

Keywords: Data science, Decision tree regression, Machine learning, Predictive analytics, Random forest regression, Regression, Support vector regression, Simple linear regression.

INTRODUCTION

Predictive analysis can be a useful tool for predicting stock prices. There are various techniques and models that can be used for this purpose. However, it is important to bear in mind that stock prices are influenced by a multitude of factors, including market trends, economic indicators, company performance, and even geopolitical events. Therefore, while predictive analysis can provide insights and help identify potential opportunities, it is not a guarantee of success.

There are different approaches to predictive analysis for stock price prediction, incorporating both technical and fundamental analysis. Technical analysis is the

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process of examination of previous stock price charts and patterns in order to spot trends and projections of future price fluctuations. Fundamental analysis examines a company's financial performance and other factors, such as industry trends and competitive landscape, to determine the intrinsic value of the stock and make predictions about its future price.

A collection of recent research works on machine learning in investments includes "Neural Networks for Portfolio Analysis With Cardinality Constraints [16]", which focuses on optimizing portfolio allocation under constraints, enhancing diversification and risk management [16]. In "Neural Networks for Portfolio Analysis in High-Frequency Trading [18]", the effectiveness of neural networks in identifying optimal trading strategies in dynamic markets is explored, thereby improving portfolio performance [18]. "A Novel Recurrent Neural Network Based Online Portfolio Analysis for High-Frequency Trading [15]" introduces a dynamic approach to portfolio analysis, leveraging recurrent neural networks to adapt to real-time market dynamics [15]. "Using Quadratic Interpolated Beetle Antennae Search for Higher Dimensional Portfolio Selection [19]" integrates nature-inspired optimization with machine learning for robust portfolio selection in complex landscapes [19]. Finally, "A Novel Dynamic Neural System for Nonconvex Portfolio Optimization with Cardinality Restrictions [17]" develops a flexible system for optimizing portfolios under constraints, enhancing investment decision-making. These works collectively contribute to advancing machine learning applications in investment, offering insights into portfolio management, trading strategies, fraud detection, and optimization [17]. There are also various other tools and techniques used in predictive analysis, such as time series analysis, regression analysis, artificial intelligence, and machine learning. These methods can aid in the discovery of patterns and correlations in data that can be used to forecast future stock price movements.

Overall, predictive analysis can be a valuable resource for stock price prediction, but it is important to approach it with caution and keep in mind that many factors can influence stock prices. It is also important to have a solid understanding of the underlying data and analysis techniques, as well as the risks involved in investing in the stock market.

We propose to create a system for predicting stock prices that uses a combination of mathematical functions, predictive analysis, and other factors. The goal of this system is to boost stock price forecast accuracy and support traders in making lucrative transactions.

In our work, we examine various methods and models that are used to predict stock prices. We will begin by discussing the importance of stock price

forecasting and the various factors that can affect stock prices. We then examine the most commonly used methods for predicting stock prices, including time series analysis, technical analysis, fundamental analysis, and machine learning. We also explore the most common algorithms used in machine learning for stock price prediction, such as ARIMA, GARCH, and LSTM [1]. We examine the performance of these methods and algorithms and evaluate their strengths and weaknesses. Finally, we discuss the future of stock price forecasting and the potential for future research. This research paper strives to give a thorough review of the current state of stock prices and to identify the most effective methods and algorithms for this task. By understanding the pros and cons of different techniques, investors and traders can make more informed decisions about investing in the stock market.

The paper is organized as follows: a description of the various techniques and models that can be used for predicting stock prices is described in Section 2. Section 3 discusses the proposed system. The fourth portion discusses the experimentation and results. Sections 5 and 6 describe the analysis and conclusion.

DATA SCIENCE AND MACHINE LEARNING: AN OVERVIEW

Predicting stock prices is an important task in finance as it can provide valuable insights to investors and traders. The ability to predict stock prices helps individuals make informed decisions about buying, selling, or holding particular stocks. In recent years, the advent of big data and advances in artificial intelligence and machine learning has greatly improved the accuracy of stock price prediction models. Various techniques and models can be used for predicting stock prices, including:

Time Series Analysis: This strategy entails looking at past pricing and volume data to find patterns and trends. Future price predictions can be made using strategies including moving averages, exponential softening, and ARIMA (autoregressive integrated moving average) models.

Machine Learning Models: To predict future prices, a variety of machine learning methods, including decision trees, neural networks, and support vector machines (SVM), can be trained on past data. These models can take into account a wide range of factors, such as market sentiment, news events, and economic indicators, to make predictions.

Sentiment Analysis: This approach involves analyzing social media and news data to gauge market sentiment and identify trends. Natural Language Processing (NLP) techniques can be used to analyze text data, and sentiment analysis

CHAPTER 4

Cloud, Edge, and Fog Computing: A Study on their Broader Scope

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Abstract: This paper presents comprehensive evaluations and assessments of cloud, fog, and edge computing platforms. The main objective of the study is to evaluate and compare the characteristics, advantages, and disadvantages of these platforms and to identify the most suitable platform for various use cases. The paper begins by providing an overview of cloud computing and the various deployment techniques that are available. The concept of fog computing is then discussed, including its architecture and key components. Finally, this study examines the benefits of computing, including its architecture, advantages, and limitations. The study also compares the three platforms based on various criteria, such as scalability, latency, reliability, security, and cost. The results of the study demonstrate that the platform choice is impacted by the specific requirements of the application and that each platform has its own strengths and weaknesses. The study concludes by highlighting the importance of considering the trade-off between performance and cost when choosing the most appropriate platform for a particular use case.

Keywords: Cloud computing, Edge computing, Fog computing, Networking and resource management, QoS of cloud computing, QoS of fog computing, QoS of edge computing.

INTRODUCTION

Cloud computing has been an essential part of the modern era, but with increasing demands for low-latency, high-bandwidth applications, and data processing, fog and edge computing have emerged as complementary technologies. In this literature review, we analyze the latest research on cloud, fog, and edge computing platforms and their applications. Additionally, the background of the study section should provide a brief overview of the current trends and developments in cloud, fog, and edge computing. This can include the increasing demand for these platforms, the growth of the market, and the innovations in technology. The section will also provide a brief overview of the key players in the industry, such as major technology companies that offer cloud, fog, and edge computing services and products. It is also important to mention the challenges and limitations associated with each platform and how these challenges are being

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addressed. Problems with security, data privacy, scalability, and a lack of standards could be a few of these.

Finally, the background of the study will outline the objectives and research questions that the study aims to answer. This section will clearly state the study's purpose and objectives. The background of the study will be comprehensive enough to provide a clear understanding of the context and significance of the title of this review work.

The key issues associated with third-party data storage and computation (Cloud, fog, and edge computing) are discussed in this review. Some of the major issues are mentioned below:

i. Inadequate understanding of the key differences between cloud, fog, and edge computing, including their respective benefits and limitations.
ii. This is only a brief comparison of cloud, fog, and edge computing platform types, which makes it difficult for organizations to make informed decisions about which platform to use for different applications and workloads.
iii. The lack of standardization and compatibility across cloud, fog, and edge computing platforms creates challenges for organizations looking to integrate these platforms into their existing IT infrastructure.
iv. The need for improved scalability, performance, and cost-effectiveness of cloud, fog, and edge computing platforms to meet the demands of organizations of all sizes.

Highlights of the Study

i. To compare the key characteristics, benefits, and limitations of cloud, fog, and edge computing platforms.
ii. To evaluate the security, privacy, and reliability of cloud, fog, and edge computing platforms and recommend measures to improve these aspects.
iii. To assess the scalability, performance, and cost-effectiveness of cloud, fog, and edge computing platforms and identify ways to improve these aspects.
iv. To identify the key players in the cloud, fog, and edge computing market and analyze their offerings.
v. To provide recommendations for organizations looking to adopt cloud, fog, or edge computing platforms based on their specific needs and requirements.

Scope of the Study

i. The study will primarily focus on the technical aspects of cloud, fog, and edge computing, including security, privacy, reliability, scalability, performance, and cost-effectiveness. It will not include an in-depth analysis of the legal and

regulatory aspects of these platforms, as shown in Fig. (**1**).

ii. The study will compare and contrast the key characteristics, benefits, and limitations of cloud, fog, and edge computing platforms and will not provide a detailed analysis of individual platforms or companies.

iii. The study will be limited to the examination of cloud, fog, and edge computing platforms in a general sense and will not include an analysis of specific applications or use cases.

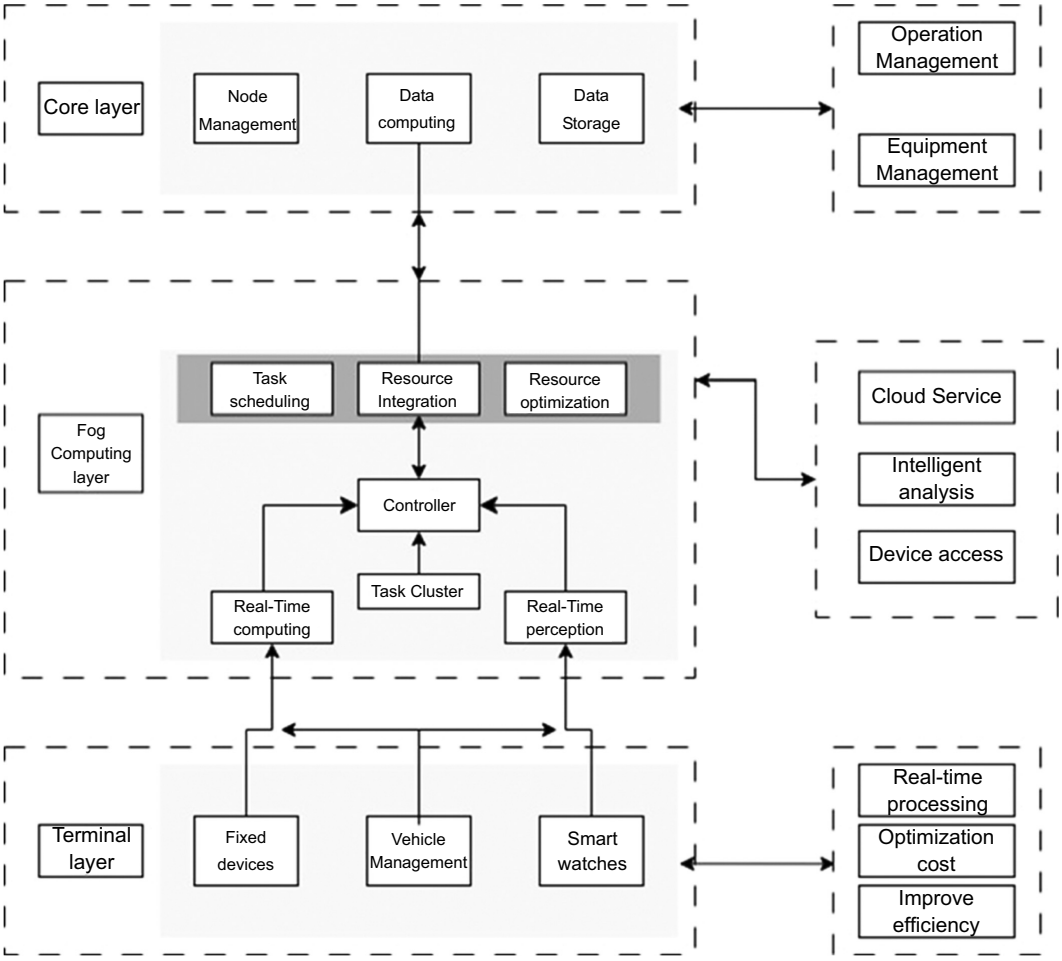

Fig. (1). Cloud-fog computing architecture.

LITERATURE REVIEW

Overview of Cloud Computing

The architecture for cloud-fog-based computing is illustrated in Fig. (**1**). A cloud-

CHAPTER 5

Data-Driven Approach of Species DNA Sequencing Based on Similar Patterns Using Machine Learning

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Abstract: Bioinformatics is majorly used to infer hidden information from biological datasets using advanced techniques. Genomics uses machine learning and deep learning extensively to understand hidden facts and dependencies in new biological hypotheses. Recent advancements in dataset development have increased hope in understanding biologically inherited diseases, and a lot of computational models have shown promising results in deoxyribonucleic acid (DNA) sequencing to detect similar and dissimilar kinds of species. Two sequences are called homogeneous if similarities exceed, and we can conclude that two sequences are likely to have an evolutionary relationship. It has already been proven that chimpanzees are ancestors of humans, but can we prove it based on DNA similarity? This work is an effort to understand DNA structure and species of similar kinds based on genome sequencing. We have used the human, chimpanzee, and dog datasets to interpret their DNA sequence. The result shows that humans and chimpanzees share closeness in terms of DNA sequence, which confirms that both organisms are related to each other. Naïve Bays algorithm has shown similarity between chimpanzees and humans by scoring 99.30% and 98.40%, which are the closest figures compared to the dog with a score of 92.60%. This work has a lot of future scope to testify different species and their ancestor, which will help us understand life sciences more closely.

Keywords: Bioinformatics, Deep learning (DL), DNA, Genomics, Machine learning (ML).

INTRODUCTION

Computational intelligence techniques are widely used in DNA sequencing to analyze, interpret, and understand the genetic information encoded in DNA. Sequencing of DNA is the process of getting the order of nucleotides (A, T, C, G) in a DNA molecule, which is crucial for various applications in genetics, such as

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diagnosing genetic disorders, tracking the spread of infectious diseases, and identifying genetic mutations related to cancer. CI techniques, such as ML and artificial neural networks, are used in DNA sequencing to identify patterns and extract meaningful information from large and complex datasets. For example, ML algorithms can be used to predict the likelihood of certain mutations occurring in each DNA sequence based on the analysis of known mutations and associated genetic features. Artificial neural networks can also be trained to recognize specific patterns in DNA sequences, which can be used to identify disease-causing mutations or to classify sequences based on their origin or function. Additionally, CI techniques are also used for DNA sequence alignment and assembly, which involve comparing and merging multiple sequences to create a complete and accurate representation of a genome. These tasks require complex algorithms that can handle errors, gaps, and variations in the data, and CI techniques such as genetic algorithms and particle swarm optimization are often used to optimize the sequence alignment and assembly process [1].

As a data-driven science, genomics extensively utilizes ML and DL approaches to find data dependency and utilize different concepts of artificial intelligence to find similar patterns among different species in the world. It is a challenging task to propose new frameworks and algorithms that can be used to predict DNA sequences more accurately in biological datasets. Bioinformatics is an interdisciplinary domain that uses mathematics, statistics, and artificial intelligence to analyze the relationship between data points of huge complex datasets. According to research, biological data is being recorded and stored at a massive rate nowadays due to the availability of simulators, sensors, and labs. It is interesting to see how ML methods and biological approaches collectively help to find hidden patterns in biological datasets and provide useful knowledge discovery [2]. Data preparation, data collection, and data analysis using recent next-generation sequencing (NGS) techniques are still major challenges in this domain. DNA sequencing has numerous applications in different fields like pathology, genetics, virology, microbiology, systematics, and forensics.

There are many applications of ML in genome sequencing, such as genetic disorder classification, gene theory, prediction of genetic disorders caused by mutations, personalized medical treatment, molecular genetics, genomic medicine, enzyme replacement, drug supply prediction, and food management. Classification, clustering, and neural network models play important roles in the prediction and analysis of DNA sequencing and coding and their side effects. With the rapid growth in artificial intelligence (AI), AI can unlock a better understanding of genome sequencing, coding, and instruction forming, with better acceleration of scientific progress and, finally, huge benefits to society.

Fig. (**1**) shows the workflow of DNA sequencing, which is still an error-prone process, although it has become cheaper and faster. A lot of next-generation sequencing (NGS) technology-based companies like Illumina have shown 1% error, while third-generation companies have shown around 15% error. Biological datasets still need to be processed and cleaned before being applied to ML and DL models. Higher-quality datasets are still a major challenge to apply in artificial intelligence fields to get better results [3]. The main motive of this article is to understand DNA structure as well as to develop a more accurate computational model that can predict DNA sequence among species.

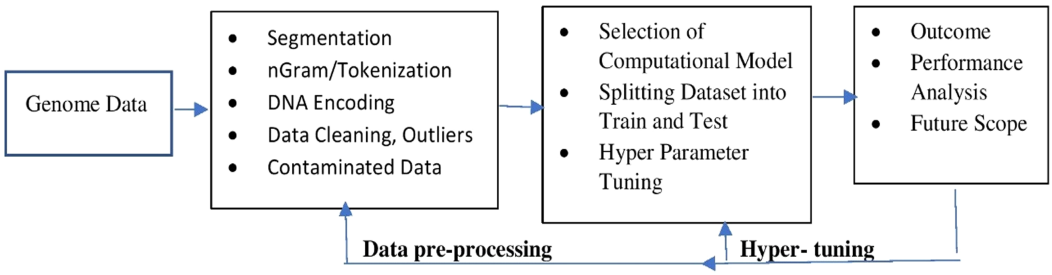

Fig. (1). Workflow of DNA sequencing using ML [1 - 3].

Background

DNA is like printed information that needs to be understood in terms of stored characters, words, or sentences. It is a language to learn. Understanding the complete glossary of DNA from A to Z is a very complex task. There are different kinds of structures possible in DNA based on base sequence. Research shows that only F, Q, U, V, and Y are the characters that are available to form a new kind of structure for the future. Several recent structures show mixed types of nature. Analysis of such a structure should be done very carefully before allocating new characters to a new structure [4]. A DNA sequence is the structure of a polynucleotide chain. DNA and RNA are genetic materials that are responsible for inheritance. A nucleotide is composed of three components called (i) Phosphate group, (ii) Five-carbon sugar or pentose, and (iii) Nitrogenous base. A nitrogenous base is made up of (i) Purines: A-Adenine and G: Guanine and (ii) Pyrimidines: Cytosine (C), Thymine (T), and Uracil (U). Genes are the building blocks of species. They give instructions to make proteins that are responsible for your physical chrematistics. DNA and RNA both perform different kinds of jobs in the human body. Genes are inherited from parents. Genes have the power to reproduce themselves again and again to form enough genes in an organism's body to fill an instructional manual. Chromosomes, which are made up of one molecule of DNA and proteins, give instructions to cells to make each unique in nature. DNA, genes, and chromosomes all work together to make a person's

CHAPTER 6

Enhancing Intrusion Detection Performance with a Hybrid Module on KDD99 Dataset

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Abstract: The internet and its connectivity have revolutionized the world, enabling people to share ideas, collaborate, and assist each other across various domains. Despite its benefits, the progress of technology comes with the inherent danger of being targeted by cybercriminals, which can compromise individuals' privacy and security online. Intrusion detection systems (IDSs) are used to identify and prevent such threats. This paper presents a hybrid ensemble module that uses a diverse set of weak learners to build a robust IDS capable of detecting new attacks that signature-based methods may miss. The research utilizes various ML techniques to develop a classification model that addresses the challenge of selecting suitable modules for IDS based on datasets. The proposed hybrid ensemble module provides an effective solution to enhance the accuracy and efficiency of IDS and mitigate the risk of cyberattacks in various fields, including healthcare, food service, and education.

Keywords: Hybrid ensemble learning, IDS, ML.

INTRODUCTION

As the utilization of interconnected computer systems and the internet continues to expand, the importance of network security has become increasingly critical. The rise in cyber threats has prompted organizations to employ network IDS to protect their connections against hostile assaults. IDSs operate by monitoring network traffic and detecting any suspicious behavior or recognized threats.

There are two primary detection methods utilized by IDS systems: Pattern-matching detection and Behavior-based detection. Signature-based detection operates by matching a specific pattern or set of rules from an attack database to determine whether an operation is dangerous. Anomaly-based detection, on the other hand, attempts to identify new forms of threats that may not be identified through pattern-matching detection.

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While behavior-based detection is capable of detecting previously unknown threats, it has the potential to produce a high number of false positives. This is because it operates by identifying deviations from normal network behavior, which can include legitimate activities. However, ML approaches have emerged as a promising solution to accurately detect network system attacks.

Over the past few years, there has been an increasing use of ML in network security, with a focus on vulnerability scanning. This process involves categorizing and analyzing data to identify potential vulnerabilities that can be exploited by attackers. Pattern recognition in data can be done with the help of ML systems to detect any anomalies that may indicate a potential attack.

To enhance the precision of detection while minimizing erroneous results, a blended ensemble approach to instruction can be used. This model merges multiple weak learning algorithms to create a stronger and more accurate system. In this approach, the results of each weak learner are combined to produce a final prediction.

One of the challenges of developing a hybrid ensemble learning model is selecting the appropriate weak learners to use. This can involve choosing algorithms with different strengths and weaknesses to ensure that the final prediction is as accurate as possible. Additionally, it is critical to think about the processing resources needed to train and operate the algorithm, as this can affect its practical application.

Once the appropriate weak learners have been selected, they can be combined using various techniques, such as bagging, boosting, or stacking. Bagging involves training multiple instances of the same algorithm by applying the algorithm to distinct data subsets and consolidating their predictions. Boosting implies the sequential training of several weak learners, where each one concentrates on the samples that were wrongly classified by the previous learner. Conversely, stacking refers to the simultaneous training of multiple weak learners on the same data, and their predictions are then combined using a meta-learner model.

To assess the effectiveness of the blended ensemble learning approach, several metrics can be utilized, such as accuracy, precision, recall, and F1 score. These measurements can help evaluate the model's capacity to accurately categorize instances and identify cyber-attacks.

In addition to the hybrid ensemble learning model, other ML techniques can be used to improve network security. For example, DL algorithms, such as CNNs and RNNs, have been applied to network intrusion detection with promising

results. Manual feature engineering is unnecessary as these algorithms can learn features from raw network data and autonomously detect anomalies.

DL algorithms pose a challenge in that they necessitate vast quantities of labeled data for training purposes. This can be difficult to obtain in network security, as collecting labeled data can be time-consuming and costly. Additionally, DL algorithms can be computationally expensive and require powerful hardware to train and run.

In conclusion, the rise in cyber threats has made network security a crucial issue for organizations. IDS systems perform an essential function in identifying and preventing network system attacks. While traditional detection methods, such as signature-based and anomaly-based detection, have their strengths and weaknesses, the application of ML approaches, such as hybrid ensemble learning and DL, has the potential to enhance the accuracy of detection and reduce false positives.

LITERATURE REVIEW

In their research paper [1], the authors proposed a novel architecture for cloud-based systems that aims to mitigate the risks associated with sharing resources and data in cloud environments. The authors identified various security challenges, such as security breaches, hacked accounts, injection flaws, misuse of features, and DDoS attacks, that are prevalent in cloud computing. To address these challenges, the proposed architecture uses log files to detect known attacks, Instantly prevents possibly dangerous activities and safeguards confidential information, and dynamically updates security rules to better adapt to evolving threats. The authors also emphasize the importance of regular security audits and monitoring to maintain the security and integrity of cloud-based systems. The proposed architecture offers a comprehensive approach to cloud security by leveraging multiple security measures, such as access control, data encryption, and intrusion detection. The authors argue that their architecture can enhance the overall security posture of cloud-based systems and increase customer reliance on cloud service providers. Overall, this research paper highlights the importance of addressing the security challenges associated with cloud computing and presents a promising solution that can mitigate these risks. The proposed architecture offers a practical and effective approach to enhancing cloud security, and future research can build upon this work to further improve the security of cloud-based systems.

The paper proposes [2] the use of an IDS to find out known and unknown attacks in cloud computing. The authors suggest the use of a hybrid algorithm of K-means clustering and SVM classification can be leveraged to enhance the IDS's precision. They tested their approach using the UNSW-NB15 dataset and

CHAPTER 7

A Comprehensive Study on Crop Disease Detection Using Machine Learning and Deep Learning Models

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Abstract: Crop diseases can significantly affect agricultural productivity, resulting in huge economic losses for farmers and food shortages for the population. To address this challenge, several researchers have explored the use of machine learning and deep learning algorithms for crop disease detection. These algorithms use image processing techniques to identify and classify diseases in crops and have shown promising results in accurately detecting and diagnosing crop diseases. In particular, deep learning models, especially convolutional neural networks (CNNs), have demonstrated high accuracy in crop disease detection. Researchers have also developed various mobile and web applications based on these models, which can help farmers identify and manage crop diseases in real time. However, there is still a need for more research to improve the accuracy and effectiveness of these models and to ensure their scalability and accessibility for use in the field. Overall, the application of machine learning and deep learning algorithms for crop disease detection holds great potential for addressing the challenges of crop disease management and improving agricultural productivity. This paper studied various pieces of research to enhance and conclude the best algorithm with high accuracy, precision, and recall for the detection of crop diseases.

Keywords: CNN, Crop diseases, Deep learning, Machine learning.

INTRODUCTION

For a large section of India's population, agriculture provides the primary means of subsistence and makes a substantial contribution to the country's GDP. However, the equilibrium between the supply and demand for food caused by the world's constantly expanding population is a troubling issue. Crop loss from pests and diseases that significantly reduce yields is one of the causes of this imbalance. Second, the effects of climatic changes worsen the likelihood of diseases spreading quickly. If these diseases are identified in their early stages, the yield

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can be maintained, and economic loss can be reduced. The conventional method of disease detection by a plant pathologist is time-consuming and expensive. Pesticides are another old technique. Pesticides are typically applied haphazardly across the entire canopy, and excessive application can result in soil pollution and a decline in soil quality. Crop diseases are mostly influenced by:

- Environmental elements including temperature, humidity, and rainfall.
- The availability of nutrients and the state of the soil.
- Disease susceptibility and plant genetics.
- Insect and pest infestations.
- Pathogens from bacteria, viruses, and fungi.
- The presence of water and irrigation methods.
- Agronomic practices, such as crop rotation and pesticide application.

There can be various forms of disease in plants, including diseases in crops, leaves, *etc*. It is very important to cure these diseases in crops to prevent the loss of farmers, as these diseases cause monetary loss to the farmers as well as substantial agricultural loss. To prevent this, the farmers have already taken various measures, including different pesticides and insecticides. These measures helped in a certain way to prevent diseases in crops up to a certain level, but they could be a more efficient and effective measure to prevent diseases in them.

Crop diseases can have a devastating effect on agricultural productivity and food security. Crop diseases can be broadly classified into three categories—fungal, bacterial, and viral [1]. The identification of the particular pathogen causing the disease is necessary for developing successful management methods because each type of disease has unique symptoms and means of transmission. These illnesses have the potential to quickly spread through crops, causing significant harm that lowers yield and quality. Crop infections can, in extreme circumstances, destroy whole crops, causing farmers to suffer large financial losses and food scarcity in their communities. Pesticides can also harm the environment and human health when used to treat these diseases. The impact of crop diseases must be reduced, and sustainable agricultural production must be ensured through early identification and effective management techniques.

The timely detection and prevention of crop diseases are therefore critical for ensuring food security and sustainable agriculture. We are looking for an automated and more accurate way to prevent this problem in crops. Since a few decades ago, it has been demonstrated that crop disease diagnosis utilizing image processing techniques is quick and accurate. We are looking for an automated and more accurate way to prevent this problem in crops, which is showing great promise in the automated detection and diagnosis of crop diseases.

In this paper, we present a comprehensive review of recent research on crop disease detection and prevention using machine learning and deep learning techniques. This paper highlights the significant potential of machine learning and deep learning techniques for automated crop disease detection and prevention. By combining computer vision algorithms with IoT devices, mobile applications, and conventional disease management practices, researchers and farmers can quickly and accurately diagnose and prevent crop diseases, ultimately leading to higher yields and more sustainable agriculture.

Our review covers several topics, including the use of convolutional neural networks (CNNs) for crop disease detection [2] and the development of mobile applications for real-time disease diagnosis. Along with this, it also studies the use of Internet of Things (IoT) sensors for continuous crop monitoring [1] and the potential of transfer learning and data augmentation techniques for improving model performance. It analyzes the accuracy, precision, recall, *etc*., of different ML and DL algorithms, as shown in Figs. (**1-4**). We also explored the challenges and opportunities in the field, including the availability of high-quality datasets, the lack of standardization and interoperability of data formats and models, and the need for effective collaboration and knowledge sharing among stakeholders.

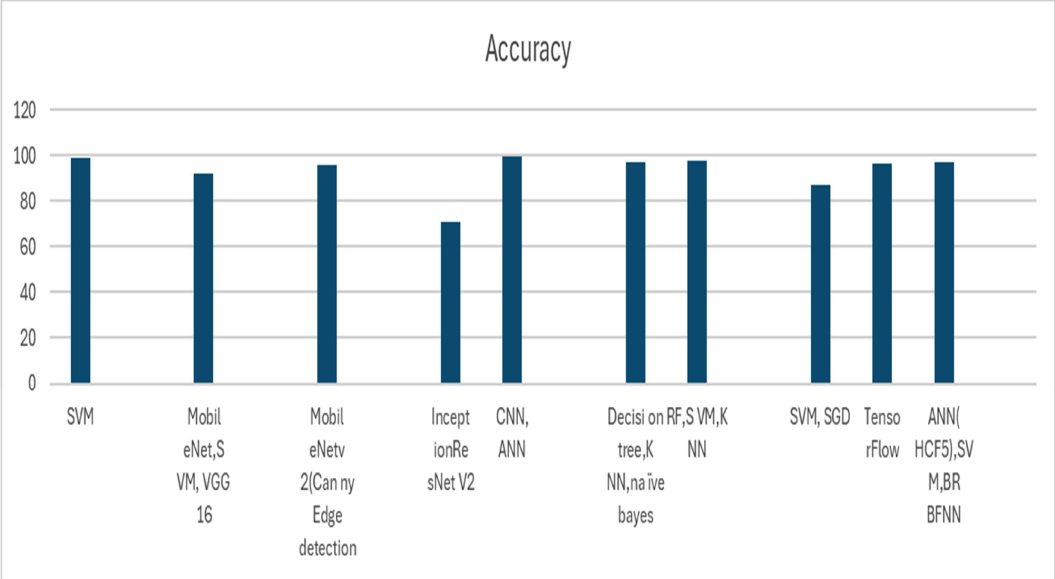

Fig. (1). Accuracy for ML Algorithms.

CHAPTER 8

Machine Learning Approaches for Natural Language Processing and Sentiment Analysis

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Abstract: The exponential growth of digital content has necessitated the development of effective techniques in natural language processing (NLP) and sentiment analysis. This review paper aims to provide a comprehensive overview of machine learning approaches employed in NLP tasks, with a specific focus on sentiment analysis. We explore various algorithms such as support vector machines (SVM), recurrent neural networks (RNN), and transformer models that have shown promising results in analyzing and classifying sentiments expressed in textual data. Additionally, we explore pre-processing techniques like tokenization and feature engineering that play a vital role in enhancing the performance of these machine learning models. Through an extensive evaluation using benchmark datasets, we compare the strengths, weaknesses, and suitability of different machine learning methods for sentiment analysis tasks. Furthermore, we highlight recent advancements such as transfer learning and explainable AI that have demonstrated potential in improving NLP capabilities. Finally, we discuss emerging trends and future research directions aimed at leveraging machine learning advancements to further enhance natural language processing techniques.

Keywords: AI, BERT, NLP, RNN, SVM.

INTRODUCTION

Machine learning approaches have revolutionized natural language processing (NLP) and sentiment analysis, allowing us to extract valuable insights from textual data. With the advancements in machine learning algorithms and techniques, researchers have made significant strides in understanding and processing human language. In recent years, supervised learning algorithms such as support vector machines (SVM), random forests (RF), recurrent neural networks (RNN), convolutional neural networks (CNN), and transformer-based

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models like BERT [1] and GPT-3 [2] have been widely employed for various NLP tasks. These approaches enable machines to learn patterns, relationships, and representations from labeled or unlabeled text data. Sentiment analysis has emerged as a prominent application of NLP powered by machine learning. It involves automatically identifying subjective information like opinions, sentiments, and emotions expressed in text documents [3]. By leveraging machine learning models trained on annotated sentiment datasets, it becomes possible to accurately classify text into positive, negative, or neutral sentiments. The availability of large-scale annotated corpora has played a pivotal role in training these models effectively. Datasets such as IMDb movie reviews or Twitter sentiment datasets [4, 5] provide labeled examples that enable supervised learning algorithms to generalize well across different domains. Furthermore, transfer learning methods using pre-trained language models have shown remarkable performance improvements across various NLP tasks. Models like BERT capture rich contextual representations by training on massive amounts of unlabeled data before fine-tuning them for specific downstream tasks with limited labeled data availability. However, there are still challenges that need attention for further advancement. Multilingual sentiment analysis is one area requiring robust models capable of handling diverse languages' linguistic structures effectively [6]. Additionally working towards explainable AI approaches that enhance transparency in decision-making processes is essential for building trust among users.

The machine learning approaches have transformed the field of NLP and sentiment analysis by enabling accurate predictions, efficient text processing, and extraction of valuable insights from textual data. The utilization of supervised learning algorithms, transfer learning techniques using pre-trained models, and the availability of annotated datasets have contributed to these advancements. Addressing challenges such as multilingual sentiment analysis and improving transparency in AI systems will continue to be focal points for future research in this dynamic field.

MACHINE LEARNING ALGORITHMS FOR SENTIMENT ANALYSIS

Support Vector Machines (SVM)

SVM is a powerful machine learning algorithm widely used in sentiment analysis tasks, particularly for binary or multi-class classification problems. SVMs aim to find an optimal hyperplane that separates data points of different classes by maximizing the margin between them. In the context of sentiment analysis, SVMs operate by representing textual data as feature vectors in a high-dimensional space. Each feature represents a specific aspect or attribute related to the text,

such as word frequencies or presence/absence indicators for certain keywords. These features capture important information relevant to sentiments expressed within the text.

The SVM algorithm finds an optimal decision boundary that maximizes the distance between support vectors – representative instances from each class located closest to the decision boundary. The choice of kernel functions plays a crucial role in SVM's ability to handle non-linear relationships among features and improve its overall performance [7].

For binary sentiment classification, where sentiments are classified into positive and negative categories, SVM constructs a linear separator that divides these two classes with maximum margin while minimizing misclassification errors. In cases where multiple classes need to be considered, extensions like one-*vs*-one or one-*vs*-all strategies can be employed using multiple binary classifiers based on SVM principles.

One advantage of SVMs is their ability to handle high-dimensional feature spaces efficiently, allowing them to effectively model complex relationships between features and sentiments expressed in textual data. Additionally, due to their mathematical formulation and convex optimization nature, they provide theoretical guarantees regarding generalization capabilities even with limited training samples.

However, it's important to note that SVMs have limitations when dealing with large-scale datasets due to their computational complexity during the training phase involving quadratic programming optimization algorithms. Moreover, selecting appropriate kernel functions and tuning hyperparameters can significantly impact performance; improper choices may lead to either overfitting or underfitting models, resulting in poor generalization abilities on unseen data.

Despite these limitations, SVMs have demonstrated promising results in sentiment analysis tasks and continue to be widely used due to their interpretability, robustness, and ability to handle both linear and non-linear classification problems effectively [8].

Kernel functions play a crucial role in Support Vector Machines (SVM) by allowing them to capture non-linear relationships between features. SVM is a powerful machine learning algorithm that aims to find an optimal hyperplane to separate data points belonging to different classes. However, in cases where the data is not linearly separable, SVM uses kernel functions to map the original feature space into a higher-dimensional space where separation becomes possible. The choice of kernel function depends on the nature of the data and the problem at

CHAPTER 9

From Data to Big Data: An Exploration of the Evolution and Impact of Large-Scale Data Analytics

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Abstract: The epidemic growth of information has led to the big data era with vast volumes of diverse and complex data. This paper aims to provide a comprehensive overview of the transition from traditional data to big data, highlighting its transformative impact on various aspects of society, businesses, and scientific research. We begin by tracing the evolution of data, starting from structured data stored in traditional databases to the current era characterized by unstructured and semi-structured data from a wide range of sources. We delve into the technological advancements and challenges that have enabled the processing and analysis of big data, including distributed computing frameworks, scalable storage solutions, and advanced machine learning algorithms. Overall, this paper provides a comprehensive understanding of the transition from data to big data, elucidating the technological advancements, applications, and implications of large-scale data analytics. By examining the transformative power of big data, we hope to inspire further research and innovation in this rapidly evolving field, ultimately leading to a more data-driven and informed society.

Keywords: Big data, Structured data, Semi-structured data, Unstructured data.

INTRODUCTION

The digital revolution of the past few decades has brought about unprecedented growth in the amount and variety, leading to the emergence of the big data era. This transformation has had a profound impact on various aspects of society, businesses, and scientific research. The ability to collect, store, and analyze vast volumes of data has opened up new opportunities for understanding complex phenomena, making informed decisions, and driving innovation. The objective is to provide an overview of the evolution and impact of large-scale data analytics,

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from traditional data to the realm of big data. By examining the technological advancements, applications, and implications of big data analytics, we aim to shed light on its transformative power and inspire further research in this rapidly evolving field. To achieve this objective, we will explore the historical progression of data, from structured data stored in traditional databases to the diverse and unstructured data landscape of the big data era. We will discuss the challenges associated with collecting, storing, and processing big data and examine the technological solutions that have enabled its analysis at scale [1].

Moreover, we will delve into the applications of big data analytics in various domains, highlighting its impact on businesses and scientific research. In the business realm, organizations are leveraging big data to gain actionable insights into customer behavior, optimize operations, and drive innovation [2]. We will showcase real-world examples, such as personalized marketing, fraud detection, and supply chain optimization, to demonstrate the transformative potential of big data in decision-making processes. In scientific research, big data has revolutionized fields such as genomics, climate modeling, and particle physics. Researchers can now analyze massive datasets to uncover patterns, correlations, and anomalies that were previously unattainable due to limited data availability or computational constraints [3]. This has led to breakthroughs in understanding complex systems and has accelerated the pace of scientific discovery. However, along with the immense opportunities presented by big data, there are also challenges and concerns that need to be addressed. These include privacy and ethical considerations, data quality and veracity, and the need for robust security measures to protect sensitive information [4]. Understanding and addressing these challenges will be critical to harnessing the full potential of big data in a responsible and sustainable manner.

In summary, this paper aims to provide a comprehensive understanding of the transition from data to big data, elucidating the technological advancements, applications, and implications of large-scale data analytics. By examining the transformative power of big data, we hope to inspire further research and innovation in this rapidly evolving field, ultimately leading to a more data-driven and informed society.

EVOLUTION OF DATA

The evolution of data has witnessed a significant shift from structured data stored in traditional databases to the current era dominated by unstructured and semi-structured data from diverse sources. This transition has been driven by technological advancements and the exponential growth of digital information [5]. Structured data, characterized by well-defined schemas and organized in tables or

relational databases, has long been the cornerstone of data storage and analysis. Traditional databases, such as those based on the relational model, provided a structured framework for capturing and managing data, ensuring consistency and integrity. The structured nature of the data facilitated efficient querying and analysis, making it suitable for well-defined applications and domains.

The shift towards unstructured and semi-structured data has been driven by various factors. The proliferation of social media platforms, online communication, and multimedia content has contributed to the exponential growth of unstructured data. Furthermore, the rise of IoT devices generating sensor data, machine logs, and telemetry data has further fueled the influx of semi-structured data. To effectively handle and derive value from this diverse and complex data landscape, new technologies and approaches have emerged. Distributed file systems, such as Apache Hadoop, have provided scalable storage and processing capabilities, enabling the storage and analysis of large volumes of unstructured and semi-structured data across clusters of commodity hardware [7]. The impact of this evolution in data has been profound. Organizations can now tap into vast amounts of unstructured and semi-structured data to gain deeper insights, make data-driven decisions, and unlock new business opportunities. Researchers can leverage diverse data sources to explore complex phenomena and drive scientific discovery. Table **1** shows the overview of the evolution of big data.

IMPACT OF BIG DATA ANALYTICS ACROSS DIFFERENT DOMAINS

The impact of big data analytics has been profound across various domains, revolutionizing decision-making processes, driving innovation, and enabling new discoveries [8-10]. This section explores some notable examples of the impact of big data analytics in different domains.

Finance

The finance industry has witnessed a significant impact from big data analytics. Financial institutions can leverage large-scale data analytics to detect fraudulent activities, assess risk, and make informed investment decisions. By analyzing diverse data sources, including transaction records, market data, social media sentiment, and news articles, organizations can identify patterns, anomalies, and market trends in real time, enabling proactive risk management and market insights [6]. Big data analytics has also enabled the development of algorithmic trading strategies and personalized financial services [11].

CHAPTER 10

Analysis Study on Blockchain Technology

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Abstract: Blockchain is a one-off innovation for the decentralized sharing of conditional information across a huge, distributed network, where non-believing individuals can cooperate with one another without a mediator in an undeniable way. A shared, unchangeable ledger called blockchain is used to record transactions, monitor assets, and establish trust. In this study, we examine the fundamentals of blockchain, including its uses, variations, and mode of operation. Behind this imaginative method, the security, protection issues, and agreement systems of this innovation are likewise significant and involve concern. In this chapter, we discuss the problems associated with blockchain technology, the pros and cons, and future aspects.

Keywords: Blockchain, Bitcoin, Consensus mechanism, Distributed, Security.

INTRODUCTION

Stakeholders in a wide range of sectors, including finance, medicine, utilities, property investment, and government, have recently become interested in blockchains. The centralized trusted party that underpins all conventional transactions creates several issues with efficiency, security, and transaction cost. The concept of blockchain technology is presented here to deal with these concerns and accomplish more secure, quicker, and clearer deals. We refer to the blockchain as enabling unreliable networks because transactions can occur even when parties do not trust one another. Transaction parties can reconcile more rapidly in the absence of a trustworthy mediator. Blockchain networks' heavy use of encryption, which grants all network interactions authority, is a significant aspect of these networks.

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Satoshi Nakamoto introduced the blockchain technology [1]. Bitcoin is one application of the blockchain technology in the financial management industry. A distributed ledger system is all that the blockchain is. It conducts business dealings between individuals and organizations without the involvement of a third party.

Fig. (**1**) gives a graphical representation of the structure of blockchain technology. The components of blockchain innovation are:

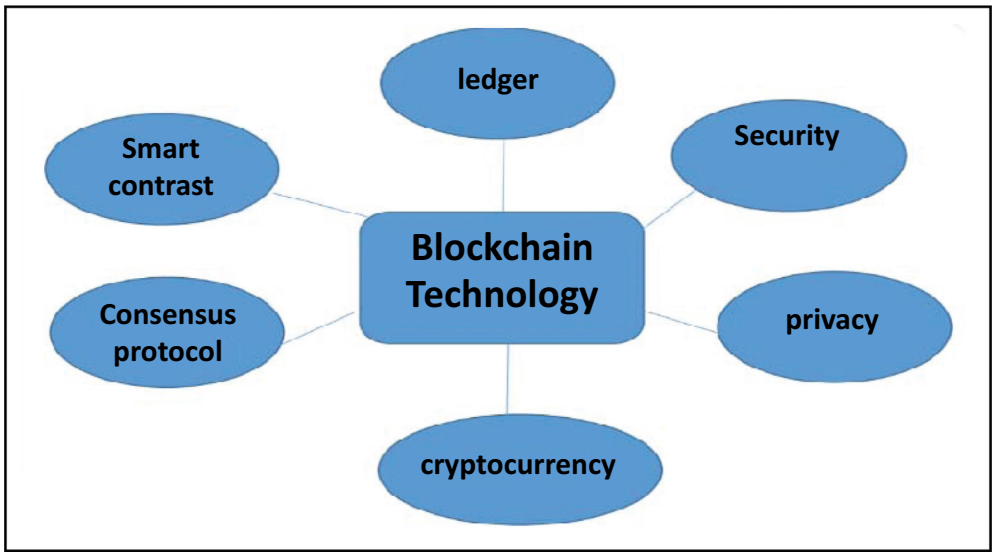

Fig. (1). Architecture of Blockchain Technology [1].

1. Ledger: Blockchain is a distributed ledger system that implies that everyone using the network has a copy of the same record. The blockchain lacks a centralized authority and a reliable third party.
2. Consensus Protocols: Exchange ought to be checked by all gatherings in an organization. Making a block and adding to its ledger is likewise a decentralized interaction. It is only a mining interaction. Every hub in the organization ought to settle on the exchanges recorded on the recently mined block.
3. Security: Blockchain makes use of public key cryptography and digital signatures to confirm the authenticity of network transactions.
4. It is created as a digital asset that functions as a medium of exchange for delivering safe transactions using encryption.
5. Privacy: The blockchain allows for the storage of any kind of data. If sensitive data, such as health information or citizen service, is being processed, the privacy regulations are relevant.

6. Smart contract: These agreements are actions having the capacity for self-execution and self-enforcement. These contracts rely on data from outside sources; thus, in order to prevent data tampering, cryptographic evidence should be given.

This is how the chapter is organized. Section II provides the definition of a blockchain; Section III discusses the technologies of a blockchain network and the types of blockchain; Section IV discusses the security concern of blockchain, followed by Section V, which discusses the privacy associated with blockchain and the applications of blockchain; the next section talks about the pros and cons, and the last section deals with the conclusion and future work that can be done.

LITERATURE REVIEW

According to Satoshi Nakamoto, bitcoin is a chain of computerized marks. The use of signatures can confirm the ownership chain. The Byzantine understanding and idea of the record in a conveyed setting were the creator's vital areas of interest [2]. Blockchain is a novel technology that is employed in applications like human enhancement, smart contracts, and artificial intelligence, among others, as the author [3] described in his work. An author [4] outlined Bitcoin's attributes as well as associated ideas like technical analysis of distributed currencies and proof of work. The author [5] developed an elliptic curve cryptographic paradigm for Bitcoin trading. A decentralized smart contract system's transactional privacy was investigated by the author [6] in this article.

BLOCKCHAIN TECHNOLOGIES

A block is a unit of the blockchain that contains all the transactions and, once they are complete, adds them to a permanent database. Transparent information sharing within a firm network is made feasible by a sophisticated database mechanism known as blockchain technology. In a blockchain database, information is kept in blocks that are connected to one another in a chain. The data is constant chronologically because it is impossible to break or alter the chain without the consent of the entire network. As a result, an unchangeable record for monitoring orders, payments, accounts, and other transactions may be made using blockchain technology. Blocks in blockchain are associated with a steady progression like a connected rundown. Each block comprises the hash of the past block, as displayed in Fig. (**2**) [7].

A network of nodes constructed like a peer-to-peer network makes up a blockchain. Users can communicate with one another on the blockchain by using public and private keys. They address the private key on the network with the public key and use it to sign their own transactions. In the network, it offers

CHAPTER 11

A Study on Remote Sensing Image Segmentation and Classification

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Abstract: The image is a composition of many pixels. These pixels include two pieces of information: coordinate or position and intensity value. The image includes several objects; extracting the crucial objects from the image is critical. Based on the similarity of patterns, classes, groups, and segments of contained objects in the image can be created. Assigning the labels to the pixels is necessary to make the image more informative for analyzing features and decision-making. This study addresses segmentation techniques and classifying images pertaining to remote sensing images. Thereafter, Land Use Land Cover (LULC) mapping is discussed, which classifies the remote sensing images.

Keywords: Classification, Image segmentation, Remote sensing.

INTRODUCTION

The information contained in satellite photographs is sufficient to describe the geographical regions. Both quantitative and qualitative information is provided through remote sensing and satellite photographs, which minimizes the need for human effort in field surveys. The technique of classifying similar pixels into informative groups is known as image classification. The process of classifying satellite photos can also be thought of as information extraction. The ability to extract and decipher useful data from huge satellite photos requires effective and efficient processes and is the high need of the hour.

Segmentation further divides an image into its individual regions or objects [1, 2], depending on the problem being solved or how long it takes to isolate the object of interest. Image segmentation subdivides an image into well-distinguishable regions such that any newly formed region contains pixels with similar attributes.

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Fig. (**1**) constitutes three different objects with a uniform background. So, image segmentation is the process that will segment the image into four different regions, A, B, C, and D, based on either homogeneity of pixels or abrupt/ sharp local changes on boundaries of objects A, B, and C.

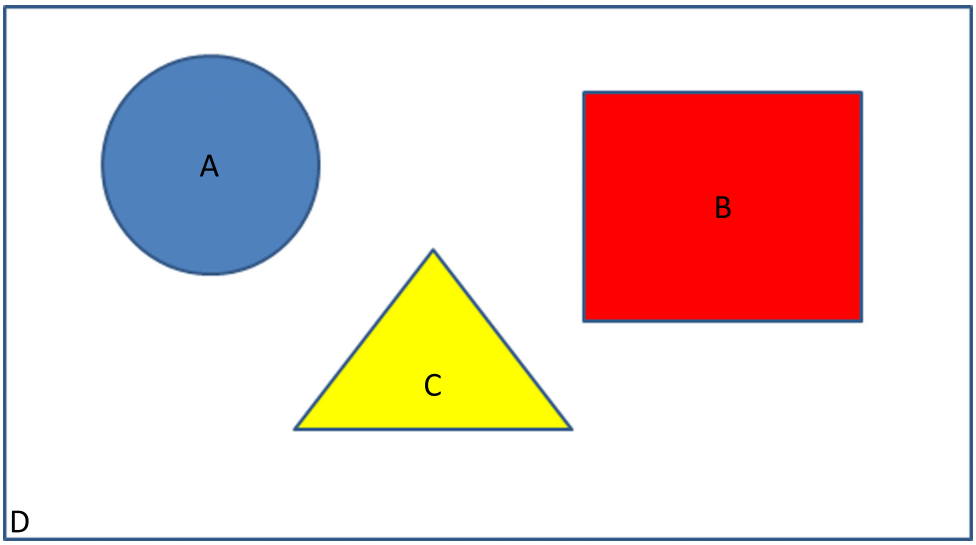

Fig. (1). Image with four different regions.

There are several applications of image segmentation, which are listed below:

a. Vehicle motion analysis [3] (object tracking).
b. Biometric/Thumb, signature [4, 5].
c. Arial image/ satellite image classification [6 .
d. Finding tumors, veins, *etc*., in medical images [7].
e. Finding people in surveillance images summarizing video, *etc* [8].

Segmentation Fundamentals

Let R be the entire image. Through the image segmentation, R is partitioned into n sub-regions, as R_1, R_2, R_3, R_4..... R_n [3], such that:

- R_1 U R_2 U R_3 U. . . . . R_n = R.
- R_is can be combined to generate R for i=1,2,3…. N, *i.e*., the set of R_is is connected.
- $R_i \cap R_j = \Phi \ \forall \ j \neq i$
- $Q(R_i)$=True [similarity of pixels in a particular region].
- Q(RiURj)=FALSE [dissimilarity of pixels in two different regions].

There are two segmentation approaches based on either of two basic properties of intensity value [4]:

- Discontinuity-based segmentation.
- Similarity-based segmentation.

DISCONTINUITY-BASED SEGMENTATION

This method detects sharp local changes in intensity. Predefined similarity criteria are partitioning an image into regions. Isolated points, lines, and edges are the three image features to find sharp changes. Derivatives, either of first-order and/or second-order, are utilized to find an image's difference or abrupt changes.

First Order Derivatives (FOD)

The FOD at point x of a one-dimensional function g(x) is produced by extending a function g(x+Δx) into a Taylor series about x while taking into account Δx=1 and keeping only the linear term as follows:

$$\frac{\partial y}{\partial x} = g'(x) = g(x+1) - g(x)$$

In an area of continuous intensity, FOD must be zero. However, it must be non-zero at the beginning of an intensity step or ramp and at certain locations along it.

Second Order Derivative (SOD)

SOD is obtained as follows:

$$\begin{aligned}\frac{\partial^2 g(x)}{\partial x^2} &= \frac{\partial g'(x)}{\partial x^2} = g'(x+1) - g'(x) \\ &= g(x+2) - g(x+1) - g(x+1) + g(x) \\ &= g(x+2) - 2g(x+1) + g(x)\end{aligned}$$

Our interest is in the second derivative about point x; hence, the expansion is around (x+1), *i.e.*,

$$= g(x+1) - 2g(x) + g(x-1)$$

- FOD usually produces a thicker edge corresponding to the image.
- SOD responds more strongly to little features like solitary points, thin lines, and

CHAPTER 12

Depression Detection on Social Media Using the CNN-LSTM Model

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Abstract: Depression is a disease that destroys the whole life of a person. Through this, that person creates their own zone so that she/he is alone and cannot talk to anyone. Some of the most common types of depression are major bipolar disorder, persistent depressive disorder, depression, and seasonal depressive disorder. Two types of depression that are mainly detected in women are perinatal depression and PMDD or premenstrual dysphoric disorder. Depression makes people lose their identity. When dealing with audio signals, CNN-LSTM models can be used to recognize emotions in speech. CNNs process audio spectrograms to capture acoustic features, and LSTMs capture the dynamics of speech over time, achieving better emotion classification. For tasks like recognizing hand gestures or sign language, CNN-LSTM models can effectively capture both the static hand positions (using CNNs) and the dynamic gestures over time (using LSTMs), leading to improved accuracy. In this paper, we can merge two algorithms to improve the accuracy. Firstly, we can find the individual accuracy of 6 algorithms and compare them with each other, then we can use the proposed model. When combining CNN and LSTM networks, there are two primary methods: Using the CNN output as the input to the LSTM. In this approach, the output of the CNN is passed as input to the LSTM. By doing so, the LSTM can learn and extract features from the input data that have been learned by CNN. Alternatively, the output of the LSTM can be used as the input to the CNN.

Keywords: CNN, LSTM, PMDD.

INTRODUCTION

Depression is a mental disease that is characterized by an enduring feeling of melancholy and a loss of curiosity in things and pastimes that you formerly loved. It can also impair cognitive abilities, including recall, dining, and resting. A mood illness, often known as mood disease, is a mental health problem that predominantly affects your feelings. It can generate long-lasting melancholy, elation, and/or fury. Treatment for emotional disorders is generally a mix of both

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medication and psychotherapy/or talk therapy. Depression is not only difficult to deal with; it is also linked to the heart. “Depressive” illness or degeneration signs in adolescents can occur for a variety of reasons. If you notice mood or cognitive alterations that last more than a few weeks, it is a good idea to discuss this with your doctor or contact a psychologist. Dr. Nancy Donovan, a psychology professor at the Medical School of Harvard, suggested consulting a psychologist to help sort out possible causes. The most prevalent forms of mental illnesses are severe depression, chronic SAD, bipolar disorder, and major depression (previously known as dysthymia). According to the findings of the Pew Research Centre, 69% of grownups and 81% of teenagers in the US use online platforms. Recognizing a person's mental condition (stress, depression, or anxiety) is an essential subject of research to avert any negative events. Issues such as the failing economy, viral fear, and social estrangement have lately contributed to the increase in despair and anxiousness that has occurred since the pandemic's inception. In any given year, one out of 15 people (6.7%) suffers from melancholy. In addition, one out of every six persons (16.6%) will experience melancholy at some point in their life. Melancholy can hit at any age, although it occurs most commonly during the latter stages of adolescence and mid-20s. Women are more prone than males to suffer from depression. According to certain research, one-third of women will have a significant crisis of depression over their lifetime. There is a considerable degree of heredity factors (about 40%) when people in their immediate family (parents/children/siblings) suffer from melancholy. I used the LSTM and CNN models, which take just one number as an input and output. In this approach, the output of the CNN is passed as input to the LSTM. By doing so, the LSTM can learn and extract features from the input data that have been learned by CNN. Alternatively, the output of the LSTM can be used as the input to the CNN.

Related work

In a paper [1], the author suggests that depression has become a major issue that is impacting mental health. Furthermore, the rapid rise of social media allows for a wealth of information on one's online presence. Twitter is a 140-character-p-r-tweet program that allows users to convey their opinions and thoughts quickly and directly. The tagged Twitter messages are uploaded into a machine-learning system that classifies them into relevant groups. The selected machine learning algorithms, Naive Bayes and NBTree, are deployed on two different sizes of Twitter datasets to determine the algorithm's accuracy in identifying depressing Tweets and Tweets that are not depressing. NBT is an algorithm that classifies depressed and non-depressive tweets with an accuracy of 97.31% on the 3000 Twitter posts dataset as well as 92.34% on the one thousand Twitter posts dataset. Naive Bayes, in contrast, earns 97.31% on the 3,000 Twitter posts dataset and

92.34% on the 1000 Twitter posts dataset. By providing the same accuracy value in the investigation, both NB and NBT are effective in equal measure. The initiative, however, is confined to text alone. The work may be improved in the future by focusing on a certain user and their tweets at a specific moment and determining the condition of depression.

In another paper [2], the author divided depression into two categories and applied to a total of six algorithms, with each method providing the best accuracy on a typical basis. 90% of test information and 91% of the training information were used. The design was created and evaluated using the Bengali text as one characteristic. According to our manner and demonstration, a single data point is anticipated to be depressed, with 1 indicating depression. The extension of this unique work allows for the detection of the most frequent symptoms or features of depressive disease and the generation of an alarm for this mental condition and the common phenomenology of depression. Our DT correctness was 90% for CountVectorizer and 90.1% for Tf-Idf, for RF, the accuracy was 90.3% for CountVectorizer and Tf-Idf, and for NB and LR, the accuracy was 90.2% and 90.3% for CountVectorizer and Tf-Idf, respectively. The first poll was conducted in 2005. There is a proportion of 16.1% mental disorders in adults. In Bangladesh, 15.3% of individuals are relatives, 6.7% have a psychiatric disease, 4.5% have anxiousness, 2.1% have psychosomatic neuropsychiatric instability, and 0.9% have sleep-wake disorders. Moreover, 0.7% of people have OCD, which stands for obsessive-compulsive disorder, and 0.3% have developmental problems problem, while 0.3% have neuropsychological illness.

In a paper [3], the author suggests that conventional approaches are hindered by characteristics such as face-to-face communication and hesitancy to express oneself; therefore, machine learning used to identify suicide intention and depression in individuals is beneficial. In the future, I'd like to go deeper into context analysis using the retweet history and external connections. Although ML appears to be a superior method, it has specific constraints, such as the need for human involvement to validate the ML model's recommendations, it is restricted to diagnosing suicidal inclinations and depression, and the methodological approach since the data obtained lacks prior background explication. The findings can be enhanced by studying the data to see which terms appear the most frequently and what tendencies the postings follow. Thirty nine occurrences of Class 0 were discovered, indicating suicide tweets, 398 cases of Class 1 were identified (depressed tweets), and 3,393 instances of Class 6 were discovered (irrelevant tweets). The emphasis is on a limited subset of the data corpus. The detection of a higher propensity of suicide must be expanded by analyzing persons who send out these problematic Tweets. A dataset of 4443 tweets was utilized to develop the algorithms. They were gathered using Twint, an open-

CHAPTER 13

Evaluating Twitter Sentiments *via* Natural Language Processing

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Abstract: Daily content sharing has increased significantly as a result of the quick expansion of user-created data on *social media* sites like *Instagram*, *Twitter*, and *Snapchat*. This content covers a wide range of topics as users express their opinions. This research aims to uncover the emotions hidden in these user posts, particularly focusing on sentiments related to product purchases, use of public services, and similar contexts. Sentiment analysis, a common method in research, seeks to reveal the emotional aspects of opinions in text. Recent research has looked at attitudes about a range of topics, including movies, consumer goods, and societal challenges. Users frequently communicate their ideas on Twitter among various channels. Analyzing sentiments through Twitter data has gained attention, and there are two main approaches: one based on existing knowledge and the other using machine learning. The feelings expressed in tweets about electronic items like laptops and smartphones are evaluated in this study using machine learning-based methods. The impact of domain knowledge on sentiment analysis can be tested by concentrating on particular regions. A novel method has been presented for categorizing tweets into positive or detrimental sentiments and for extracting individuals' viewpoints on various subjects. The study explores various techniques for sentiment analysis, encompassing machine learning and lexicon-based methods, along with the metrics employed to assess their performance. The suggested model attains an accuracy ranging from 52% to 67% in its outcomes.

Keywords: ANN, Assessment, Datasets, Emotions, ML techniques, NLP.

INTRODUCTION

A significant portion of the population engages with social networking platforms to express their feelings, thoughts, and daily experiences [1, 2]. This signifies that individuals possess the freedom to share their preferences and dislikes openly. Online platforms offer an avenue for individuals to communicate their view-

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points and impact others. Additionally, social media serves as a forum for companies to engage with their clients, whether through advertising or by actively seeking client comments and thoughts. Conversely, consumers have full autonomy over the content they wish to engage with and their subsequent responses.

The successes and setbacks of companies are disseminated through informal communication. Nevertheless, social media possesses the potential to shape consumer behaviors and choices. Surprisingly, a significant number of researchers in this domain assert that approximately 87% of "internet users are influenced by customer reviews" when they decide whether or not to purchase a product [3]. Consequently, if a company can swiftly grasp the sentiments of its customers, it gains a competitive edge by promptly adapting and devising effective strategies.

Despite the existence of technologies capable of capturing individuals' sentiments toward specific products or services, companies, and other data practitioners still encounter difficulties in data extraction. The expansive expansion of the World Wide Web has led to the widespread adoption of social media platforms like Twitter. This results in the generation of substantial volumes of opinion-based content, primarily in the form of tweets, which can serve as valuable resources for conducting sentiment analysis [4]. Considering the human perspective, this signifies a significant data load, posing challenges in efficiently extracting phrases, comprehending, assessing, analyzing, and structuring them into a coherent format within a reasonable time frame [4].

Informal communication is defined as the use of colloquialisms, slang, and other language features that deviate from the formal rules of spoken English, for instance, contractions like "wouldn't", "couldn't", *etc*. This informal communication may make it difficult for different algorithms to detect sentiment, which could impede analysis and decision-making [5]. Emoticons, which visually depict human facial expressions, play a role in drawing the recipient's attention to the emotional tone of a sender's written communication, compensating for the absence of body language and spoken cues, thus enhancing the receiver's understanding and interpretation of the message [6]. For example, an emoticon like a happy face conveys a positive mood. Currently, existing systems lack the necessary context to accurately interpret emotions conveyed through emoticons. Humans commonly resort to using emoticons when verbal expression is limited [7]. Failure to decipher emoticons leaves organizations without valuable insights. The use of short forms is pervasive, even in concise message services like Twitter, where the constraint of a 140-character limit encourages the frequent use of abbreviations to conserve space [8]. For instance, the abbreviation "Tba" is used to represent "To be announced."

The intention of this research is to delve into sentiment patterns within micro-blogging platforms, specifically focusing on analyzing the feedback provided by customers about a particular organization's product. The aim is to create an effective model that can categorize a substantial volume of tweets into meaningful classes for conducting *sentiment analysis*. The structure of the paper is as follows: the most popular micro-blogging platforms are presented in Section II. The common machine learning approaches for sentiment analysis are outlined in Section III. Methodologies for analyzing tweet sentiment are illustrated in Section IV. The result analysis of sentiment trends in tweets is presented in Section V. Lastly, Section VI presents a discussion of the findings and concludes the paper.

COMMON BLOGGING PLATFORMS

The most popular micro-blogging platforms that are widely used across the globe:

Sentiments Analysis

Sentiment analysis constitutes a crucial domain within natural language processing (NLP), computational linguistics, and text mining. It involves the computational examination of sentiments, perspectives, and emotions. The term "sentiment" denotes a standpoint or attitude that stems from emotions rather than pure logic [9], thus forming the basis of sentiment analysis or opinion mining. This field finds diverse applications, spanning disciplines, for instance, accounting, education, research, technology, politics, law, entertainment, and marketing [10]. Various online social platforms have emerged as avenues enabling internet users to openly express and engage in discussions regarding their viewpoints and thoughts [11].

Digital Social Networks

Online networking platforms comprise a group of web-based applications built upon the principles and technological foundations of Web 2.0. These platforms enable users to produce and share original material [17]. In the United States, the total amount of time spent on social media and mobile devices, including PC use, increased significantly by 37%. In 2011 and 2012, it was 88 and 121 billion minutes, respectively. Businesses use social networking sites to find and communicate with clients, yet it has been noted that social media might reduce productivity [18]. Rapid sharing of private information on social media can lead to potential harm [12]. The advantages of engaging with social media have expanded beyond mere social sharing, encompassing activities like enhancing an organization's reputation, fostering job opportunities, and financial gains [19]. Furthermore, social media finds applications in advertising for promotions by corporations, professional networking, recruitment, online education, and e-

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