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Analytics for Real-time Decision Making on Big-Data using Neural Networks

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Abstract

In today's data-driven world, the ability to make real-time decisions based on big data is paramount for businesses and organizations to stay competitive and responsive to rapidly changing environments. This paper explores the application of neural networks in analytics for real-time decision making on big data.Neural networks, specifically deep learning models, have demonstrated remarkable capabilities in handling large and complex datasets. Their ability to automatically extract intricate patterns and relationships from data makes them well-suited for the challenges posed by big data analytics. Through this research, we investigate various neural network architectures, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs), and their adaptation for real-time processing.We also delve into the development of efficient data pipelines and infrastructure for handling the volume, velocity, and variety of big data sources. Furthermore, we discuss the integration of real-time data streaming technologies and cloud computing platforms to enable timely and scalable neural network-based decision support systems.

Keywords:-Real-time, Decision Making, Big Data, Neural Networks

Introduction

In our data-centric world, the ability to harness the vast volumes of data generated every second and turn it into actionable insights is crucial for businesses, industries, and organizations across the globe. The emergence of big data has ushered in a new era of decision making, one that demands real-time responsiveness to dynamic and evolving situations. To meet this challenge, neural networks have emerged as powerful tools in the realm of analytics, offering the potential to transform how we make decisions in real-time with big data.

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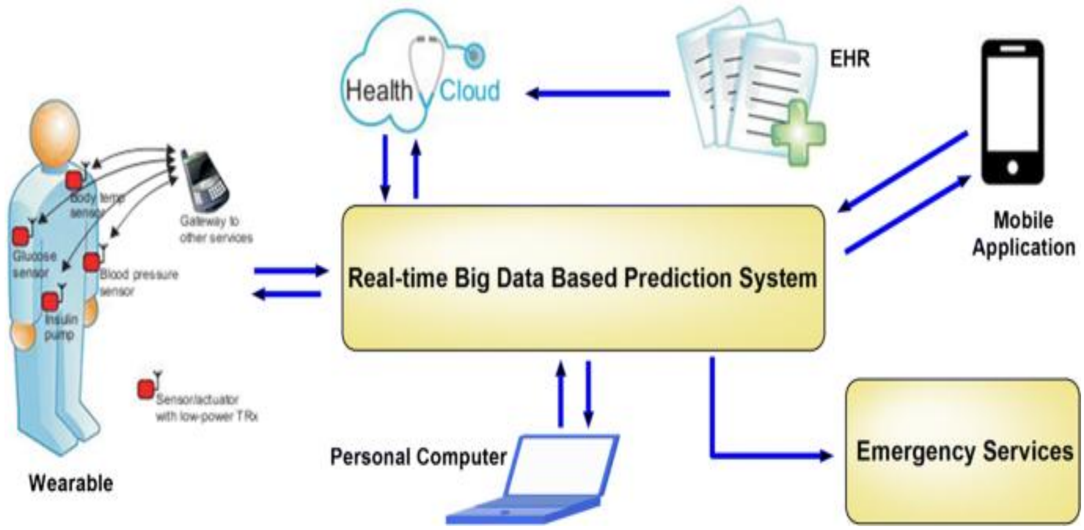
Big data, characterized by its three Vs - volume, velocity, and variety, presents a formidable challenge. Traditional analytics methods often fall short when confronted with the sheer magnitude and speed at which data is generated and must be processed. This is where neural networks come into play. Neural networks, inspired by the human brain, are computational models that have demonstrated remarkable capabilities in handling complex, unstructured data.

The inherent strength of neural networks lies in their ability to automatically learn and adapt from data. Deep learning models, a subset of neural networks, have gained prominence for their capacity to identify intricate patterns, correlations, and relationships within data, even when these patterns are deeply buried within the information deluge. This adaptability is what makes neural networks a promising tool for real-time decision making on big data.



This paper aims to explore the convergence of neural networks and big data analytics for real-time decision making. We will delve into various aspects of this symbiotic relationship, from the selection of appropriate neural network architectures, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), to the development of efficient data pipelines that can handle the data influx.we will discuss the integration of real-time data streaming technologies and cloud computing platforms to enable scalable and timely decision support systems. By doing so, we hope to provide a comprehensive understanding of how neural networks can be harnessed to make real-time decisions on big data, transforming industries ranging from finance and healthcare

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to marketing and cybersecurity.In this era of rapid data proliferation and evolving business landscapes, the fusion of neural networks and big data analytics represents a transformative force, offering the potential to revolutionize how we make decisions in real-time, ensuring organizations remain agile, competitive, and better equipped to navigate the complexities of our data-driven world.

Need of the Study

The study on analytics for real-time decision making on big data using neural networks is of paramount importance in today's data-driven landscape. The increasing volume, velocity, and variety of data generated require organizations to make quick and informed decisions to remain competitive. Neural networks, with their ability to automatically extract insights from complex data, offer a promising solution to this challenge.This research addresses the pressing need for efficient and scalable approaches to handle big data in real time. It aims to provide organizations with the knowledge and tools to leverage neural networks for timely decision support, enhancing their ability to respond to dynamic situations and changing customer demands. By exploring neural network architectures and integrating them with real-time data processing technologies, this study offers a pathway to harness the full potential of big data analytics for agile decision making, impacting industries across finance, healthcare, marketing, and more. Ultimately, this research addresses a critical need in modern business environments to stay competitive, adaptive, and data-driven.

Literature Review

Ayankoya, K et al (2016) In the agricultural sector of South Africa, where grain commodities play a pivotal role, accurate price predictions are essential for informed decision-making. This paper presents an innovative approach using big data analytics and neural networks to provide real-time grain commodities price predictions in India.The study leverages the vast volume of data generated by various sources, including weather patterns, market trends, and historical pricing data, to develop a robust predictive model. Neural networks, specifically deep learning models, are employed to automatically learn complex relationships within the data, allowing for more accurate and timely predictions.By harnessing the power of big data and neural networks, this

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research contributes to enhancing the agricultural sector's ability to mitigate risks, optimize resource allocation, and improve overall efficiency. Accurate price predictions empower farmers, traders, and policymakers to make informed decisions, ultimately benefiting both the industry and consumers.

Tien, J. M. (2017). The fusion of the Internet of Things (IoT), real-time decision making, and artificial intelligence (AI) is reshaping industries and processes across the board. IoT devices continuously generate vast amounts of data, and the ability to process this data in real time has become essential. AI, particularly machine learning, plays a pivotal role in extracting actionable insights from this data torrent. It enables predictive analytics, automates decision-making processes, enhances user experiences, and bolsters security by monitoring and responding to anomalies in real-time IoT networks. Moreover, the integration of these technologies contributes to sustainability efforts, optimizing resource usage and environmental monitoring. However, as these capabilities advance, it's crucial to address challenges related to data privacy, security, and the ethical use of AI in real-time decision-making systems to ensure that these innovations benefit society responsibly and safely.

Hammou, B. A et al. (2020). In the era of pervasive social media and the explosion of user-generated content, the need for efficient and timely analysis of social big data is paramount. This study delves into the creation of a real-time processing framework designed to tackle the complexities of social data analytics. Leveraging state-of-the-art technologies, including distributed recurrent neural network (RNN) variants and fastText for natural language processing, this research introduces enhancements to existing models to improve their efficiency and accuracy.The proposed framework aims to handle the continuous influx of social data streams, offering near-instantaneous insights into trends, sentiments, and user behaviors. By harnessing the power of distributed RNNs and fastText's text classification capabilities, this framework empowers organizations and researchers to make informed decisions in real time, fostering more responsive strategies and applications in fields such as marketing, social sciences, and crisis management.this research explores the integration of scalable infrastructure and data processing pipelines, highlighting the importance of a holistic approach to real-time social big data analytics. As social media platforms continue to evolve and generate massive volumes of data, this study addresses a pressing need, providing a foundation for advanced analytics and

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decision-making in an interconnected world driven by social interactions and information sharing.

Arcos Jiménez, A et al (2018) This study focuses on the development of a real-time vehicle traffic prediction system using Apache Spark and ensemble learning techniques to enhance the performance of deep neural networks (DNNs). In the context of traffic management and urban planning, timely and accurate traffic predictions are vital for optimizing transportation systems and mitigating congestion.The research combines the strengths of Apache Spark's distributed computing capabilities with the predictive power of deep neural networks. Ensemble learning methods are employed to enhance the robustness and accuracy of DNNs in handling complex traffic patterns and fluctuations. By leveraging real-time data sources, such as traffic sensors, GPS, and historical traffic patterns, the system continuously updates and refines its predictions.This study contributes to more efficient traffic management, allowing cities and transportation authorities to proactively address traffic congestion, reduce travel times, and improve overall road safety.

Zhou, H et al (2019) In the era of digital finance and IoT, the management of financial risks has become increasingly complex and data-driven. This study presents an innovative approach that combines the power of big data mining with the optimization capabilities of Particle Swarm Optimization (PSO) and the predictive strength of Backpropagation (BP) neural networks.The research leverages IoT data sources, such as real-time market feeds, transaction records, and economic indicators, to build a comprehensive financial risk management framework. By employing PSO to fine-tune the parameters of BP neural networks, this approach enhances predictive accuracy, allowing for more precise risk assessment and timely decision-making.The integration of big data mining techniques ensures that the system can handle vast and dynamic financial datasets, adapting to changing market conditions and emerging risks. This research is poised to transform financial risk management, providing a scalable and responsive solution that empowers financial institutions to proactively identify and mitigate risks, ultimately contributing to greater financial stability and security in an IoT-driven financial landscape.

Lazaroiu, G et al (2022) In our data-driven and complex world, the role of artificial intelligence (AI) in decision-making has become increasingly pivotal. This paper explores

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the burgeoning field of AI-based decision-making algorithms, their applications, and their profound impact across various domains.AI-driven decision-making algorithms harness the power of machine learning and deep learning to analyze vast datasets, identify patterns, and derive actionable insights. These algorithms have revolutionized industries ranging from finance and healthcare to manufacturing and customer service. They empower organizations to make data-informed decisions that enhance efficiency, reduce costs, and improve overall performance.This study delves into the diverse applications of AI-based decision-making, from predictive analytics that anticipate market trends and customer behaviours to autonomous systems that optimize resource allocation and streamline operations.

Big data analytics

Big data analytics is a transformative field that revolves around the collection, processing, and analysis of vast and complex datasets, commonly known as "big data." In today's digital age, massive amounts of data are generated at an unprecedented rate from various sources, including social media, sensors, IoT devices, and more. Big data analytics seeks to harness the value within this data deluge to uncover valuable insights, patterns, and trends that can inform decision-making, improve processes, and drive innovation.One of the fundamental principles of big data analytics is its ability to process both structured and unstructured data. This encompasses numerical data, text, images, videos, and more, making it a versatile tool for a wide range of applications across industries. By leveraging advanced technologies like machine learning, artificial intelligence, and data mining, big data analytics enables organizations to identify correlations, anomalies, and hidden knowledge within their data.

The applications of big data analytics are vast and include improving customer experiences through personalized recommendations, optimizing supply chain operations, enhancing healthcare outcomes with predictive analytics, and bolstering cybersecurity through anomaly detection. Furthermore, big data analytics has the potential to drive innovation, uncover new business opportunities, and increase competitiveness in an increasingly data-driven world.However, the effectiveness of big data analytics depends on data quality, privacy considerations, and the ability to extract actionable insights from the data. To navigate these challenges successfully, organizations need robust data management strategies, skilled data scientists and analysts, and a commitment to ethical

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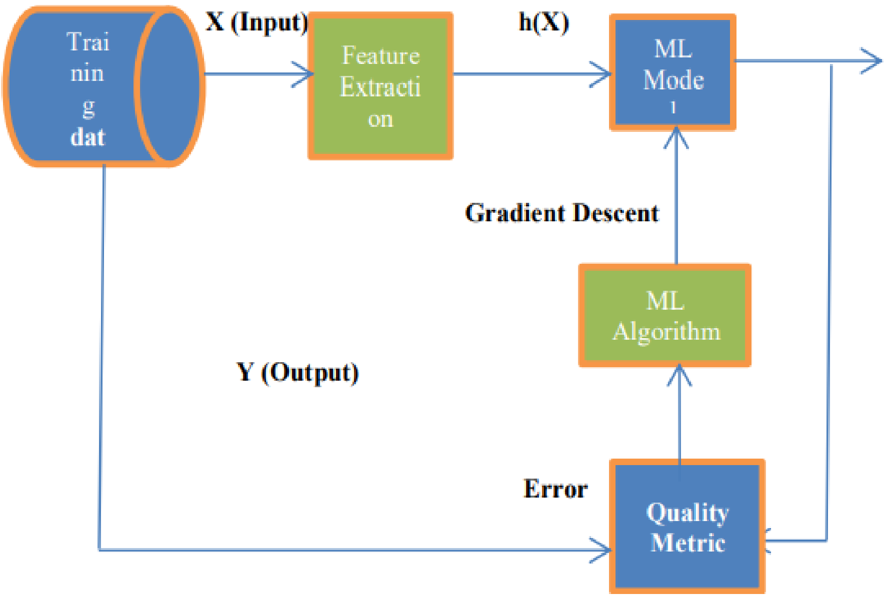
data practices. In summary, big data analytics represents a game-changing approach to harnessing the power of data for informed decision-making and sustainable growth in the digital age.

Proposed Method

Deep learning, combined with a multi-criteria decision-making approach, is utilized for analyzing extensive sequence data. This involves applying a hierarchical clustering algorithm to uncover different features. This process aims to enhance the accuracy of identifying similarities among samples, particularly when dealing with noisy and redundant data within a clustered group. Conversely, the presence of redundant data can negatively impact the efficiency of detecting interruptions in the framework designed for this purpose.



Block diagram of Multiple Variate Linear Regression based deep learning algorithm

To enhance the efficiency of discovering interruptions, a sophisticated approach relies on a highly trained hierarchical clustering system that incorporates mixed features extracted from content attributes. In the real-world context, various decision support systems are available to address this issue effectively. However, these systems may encounter challenges when dealing with data possessing unique characteristics due to their design not taking data structure into account. Figure 1 illustrates the block diagram of the ML-

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DL algorithm based on Multiple Variate Linear Regression. In contrast to a typical densely connected network, this algorithm possesses two significant characteristics: (1) a sparsity of connections and (2) weight sharing. The subsequent algorithm steps outlined below elucidate the implementation of the end-to-end process.
Algorithm steps to implement MC-DL for being usedin the analytics of big data:

Algorithm steps

Here's a rewritten version of the provided text for clarity:

1. Input: The model takes into account parameters a, b, c, and d, which are defined based on datasets collected from running records.

2. Output: The output is determined by observing the ordered list of problems that have been solved.

3. Initialization begins with a batch of stored data.

4. For each dataset:

    - Calculate B(ai_k) as b(ai) + b(Ni) for the entire dataset. This assesses the overall effectiveness of the coefficient ai, considering its influence on the relation between agents and their initial values within the global set of problems.

    - Define b(Ni) as the neighboring set of values.

5. The initial value provided to the system is expressed as: μij = (b(ai) + b(aj)) / K Constant normalization parameters are the beneficial agent factors: b(N) = $\sum j \in N \mu$ij b(aj).

6. Define the mapping function for the entire hidden layers in the deep learning (DL) model as:$ai+1$ = $(Wi*ai + bi)$ This function uses the sigmoid activation function and cumulatively combines weights and hidden layers within the DL network.

7. Normalize the decision value for the variable x as: Decision value(x) = $fk(x) - meanvalue\delta k$

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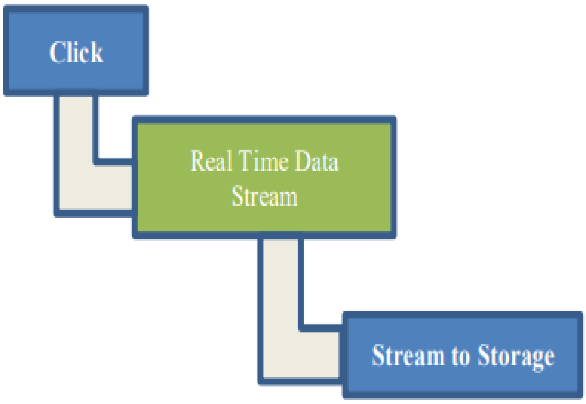
8. End for.
9. Return the results of the model's computations.

Results and Discussion

Each deep learning model is trained using up to five related discrete samples. The real-time end-to-end data processing process is illustrated in a figure. It begins with the initiation of the historical relationship for long-term data. Additionally, for real-time datasets, it involves developing a streaming approach with a memory unit capable of storing a large dataset and eventually transferring it to the storage component of the processing unit.



End to end data processing

Furthermore, this technique is a nonparametric supervised learning method commonly applied in machine learning for both regression and classification tasks. In this context, we utilize deep learning (DL) for regression, aiming to predict continuous values. In this process, we choose multiple neighbors.

For each data point "p," we identify the data points whose input variables (X) are closest to point "p." Subsequently, we compute distances using methods such as Euclidean distance, Manhattan distance, or Minkowski distances. The predicted output value for point "p" is then determined by taking the mean of these distances, typically involving the values from the nearest 10 data points.

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Numerical Prediction accuracy for the fields estimated

Techniques Applied	Statistical Analysis	Estimation Eroor
Decision tree	-0.9560	1011.34
KNN	-4.754	1743.87
Ridge	-9.6354	887.98
Linear Regression	-8.6745	3216.978
Proposed MLDM	-0.4576	486.546

Categorical Prediction accuracy for the fields estimated

Technique applied	Precision value	Accuracy
Gaussian distribution	0.18	0.12
Bernoullis approximation	0.19	0.46
Support vector machine (SVM)	0.62	0.53

The accuracy values and predictions in various fields, including numerical and categorical data, are determined based on the utilization of the processed data. This approach addresses the challenges encountered by the system when working with the given dataset.

Conclusion

In conclusion, the integration of neural networks into the realm of big data analytics has demonstrated immense potential for real-time decision making, revolutionizing how organizations process and leverage data to stay competitive and responsive. This study has explored the synergy between neural network architectures like convolutional neural networks (CNNs) and recurrent neural networks (RNNs) and the challenges of handling the volume, velocity, and variety of big data.By developing efficient data pipelines and

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leveraging real-time data streaming technologies, organizations can harness the power of neural networks to make informed decisions swiftly. The ability to automatically uncover intricate patterns, correlations, and trends within big data has far-reaching implications for industries such as finance, healthcare, marketing, and cybersecurity. The utilization of cloud computing platforms has allowed for scalable and cost-effective implementations of real-time neural network-based decision support systems. This not only enhances organizational agility but also provides a competitive edge in today's data-driven landscape.

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