International Journal of Scientific Research and Engineering Development-– Volume 8 Issue 3, May-June 2025

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Exploring Innovative Big Data Analysis Techniques in Modern Computer Applications

Suganya S[1], Dakupati Guru Gowtham[1], Ratnam Akhil[1], Nelakurthi Jaswanth Sri Harsha[1]*

[1]*(Department of Computer Applications, Indian Institute of Industry Interaction Education and Research, Chennai, Tamil Nadu 600066

Email: iiiier.info.journals@gmail.com)

----------**********----------

Abstract:

This paper delves into the integration of computer application technology within big data (BD) analysis, focusing on its advancements and associated challenges. It starts by elucidating the definition, unique features, and theoretical underpinnings of Big data analysis. Through comprehensive case studies, the paper demonstrates how computer technologies significantly enhance data processing efficiency, analytical precision and decision-making processes. It also identifies critical technical, methodological, and practical challenges encountered in Big data analysis. To address these issues, the paper suggests strategic measures, including the enhancement of regulatory frameworks, the promotion of technological innovation, and the facilitation of Industry-University-Research collaboration. These strategies are vital for the progressive development of Big data analysis.

Keywords — **Data processing efficiency, Analytical precision, Theoretical underpinnings, Regulatory frameworks, Technological innovation, Industry-University-Research collaboration**

----------**********----------

I. INTRODUCTION

As information technology continues to evolve at an extraordinary rate, big data (BD) has emerged as a critical element and a significant resource of our contemporary era. Big data is distinguished by its enormous volume, wide variety, rapid processing capabilities, and relatively low value density, presenting substantial challenges to traditional data processing and analytical methods. Central to addressing these challenges is computer application technology, which serves as the foundation of information processing. This technology is pivotal for the successful analysis of Big data, as it facilitates the efficient collection, storage, management, and examination of large datasets. Through these processes, valuable insights can be extracted, aiding in informed decision-making and driving innovation across a range of industries.

Given this backdrop, it is crucial to delve into the application of computer application technology in big data analysis. This exploration holds significant theoretical and practical implications. Theoretically, the research deepens our comprehension of how computer application technology interacts with big data analysis, contributing to the refinement of theoretical models in this domain. Practically, the study offers valuable guidance on implementing big data analytics effectively, enhancing the efficiency and accuracy of data processing, and encouraging the widespread adoption of big data methodologies in various sectors. This dual approach underscores the essential role of computer application technology in harnessing the full potential of big data

II. RELATED WORK

1. Development of computer application technology

Since the mid-20th century, computer application technology has undergone remarkable evolution. Initially centered on numerical computations and basic data processing, it has broadened its scope

with advancements in hardware and software to cover information management, automatic control, artificial intelligence, and other areas. The emergence of the Internet, cloud computing, and the Internet of Things in the 21st century has deeply embedded computer technology in all sectors of society, making it a crucial driver of progress and development.

2. Core concept of computer application technology

The fundamental concepts of computer application technology encompass computer systems (comprising hardware and software), computer software (both system and application software), computer networks (facilitating information transmission and resource sharing), and databases (essential for storing, managing, and retrieving data, and supporting BD analysis)

3. Relation between computer application technology and Big Data analysis

There is a strong connection between computer application technology and Big data analysis. Computer application technology provides crucial support for Big data analysis by enabling rapid processing and examination of large datasets. Its software aids in data processing and extracting valuable insights. Computer networks facilitate information transmission and resource sharing, promoting cross-regional and cross-domain data integration for collaborative analysis. Databases ensure precise and dependable data storage and management. Conversely, big data analysis propels advancements in computer application technology, as traditional methods fall short of meeting big data analytical demands. This necessitates continuous enhancements in data acquisition, preprocessing, storage, management, analysis, and visualization tools to improve data quality, security, usability, and presentation.

III. THEORETICAL FRAMEWORK OF BIG DATA ANALYSIS

1. Theoretical basis of Big Data analysis

Big data consists of extensive data that traditional software tools find challenging to capture, manage, and process efficiently. This data comes from various sources such as social media, e-commerce, IoT devices, and log files, and it grows rapidly. Big data is notable not only for its volume but also for its complexity and variety, including both structured and unstructured data. Analyzing big data depends on statistics, data mining (DM), machine learning, and database technology. Statistics offer a framework for data collection, organization, analysis, and interpretation. Data mining reveals hidden patterns and trends in large datasets. Machine learning enables computers to learn independently and improve through algorithms, aiding intelligent data analysis. Database technology provides reliable and efficient data storage, retrieval, and management. Integrating these disciplines is essential for big data analysis, allowing the extraction of valuable insights from extensive datasets.

2. Operation and method of Big data analysis

The process of Big data analysis generally comprises four stages: data collection, preprocessing, analysis modeling, and result interpretation. Data collection entails identifying the source and employing appropriate methods for gathering data. Preprocessing involves cleaning, integrating, and transforming data to maintain quality and consistency. Analysis and modeling employ statistical methods, data mining, and machine learning to extract insights and knowledge. Result interpretation presents analysis findings in a comprehensible format to support decision-making.

Table 1: Big Data analysis method

Analysis Type	Specific Method	Description and Examples
Descriptive Analysis	Data Visualization	Present data using charts, graphs, and images to facilitate an intuitive understanding of data distribution and patterns.
	Numerical Statement	Provide basic statistical summaries, such as mean and standard deviation, by compiling and calculating the data.

Predictive Analysis	Regression Analysis	Utilize the relationship between independent and dependent variables to forecast future trends of the dependent variables.
	Time Series Analysis	Examine data in chronological order to predict future trends and developments.
Normative Analysis	Optimization Algorithm	Identify the best solution using mathematical techniques, including linear programming and genetic algorithms.
	Decision Tree	Illustrate decision-making process through diagram to assist decision-makers in selecting optimal strategy.

Table 2: Big Data analysis method

Category of Challenge	Specific Challenges	Description and Problems
Technical Challenges	Data Security and Privacy Protection	Big data analysis encounters significant data security issues due to its scale and complexity, making traditional encryption and protection methods inadequate. The increased value of data also raises risk of breaches and misuse.
Methodological Challenges	Algorithm Optimization and Model Construction	The process of big data analysis is challenged by the need for effective algorithm and model selection. Traditional techniques struggle with the expansion and complexity of data, and the diversity and dynamic nature of big data complicate the development of effective models.
Practical Challenges	Cross-Field Collaboration and Talent Development	Big data analysis requires interdisciplinary collaboration, yet differences

IV. PROPOSED WORK

1. Application of Computer Application Technology in Big Data Analysis

Computer application technology is essential for analyzing big data, covering various stages from data collection to visualization and reporting. It enables thorough data collection using methods like network crawlers, sensors, and log capture to gather structured, semi-structured, and unstructured data efficiently. Preprocessing techniques ensure data quality through cleaning, deduplication, and conversion. Storage and management are facilitated by distributed systems and data warehouses, ensuring reliability and security with backup, recovery, and encryption methods. Analysis and mining benefit from a range of tools and algorithms like statistical analysis, machine learning, and deep learning, extracting insights from large datasets. Visualization tools such as charts, dashboards, and data maps present analysis results clearly, with interactive features enhancing real-time interaction and decision-making accuracy.

2. Challenges and Countermeasures of Computer Application Technology in Big Data Analysis

3. Countermeasure and suggestion

To overcome the challenges discussed, we suggest targeted actions across policy, regulatory, and technological domains. Governments need to establish policies governing Big data collection, storage, and usage to uphold data security and privacy. Encouraging cross-disciplinary collaboration and training will foster an environment conducive to effective Big data analysis. Enterprises should allocate resources to research and development to refine algorithms and models for more accurate Big data analysis. Efforts should also be directed towards innovating and deploying data security and privacy technologies. Additionally, active involvement from all sectors is essential for collective progress in Big data analysis. Collaborative efforts among governmental bodies, industries, academia, and research institutions are vital for overcoming obstacles and promoting the sustainable growth of the BD industry.

V. CONCLUSION

This study offers a comprehensive exploration of how computer application technology contributes to Big data analysis, spanning data collection, preprocessing, storage, management, analysis, mining, and visualization. Through case studies, it showcases the practical advantages and methods of utilizing this technology in Big data analysis. The research identifies technical and practical obstacles and proposes customized solutions. Its systematic overview of application procedures and essential technologies serves as a valuable resource for both research and practical application. Case studies demonstrate the tangible benefits of employing computer application technology in Big data analysis. Additionally, the study provides strategies for overcoming challenges and contributes to policy formulation, deepening our understanding of the role of computer application technology in Big data analysis and its broader implications.

REFERENCES

[1] [1] Yao Hairui. Application of BD analysis and mining technology in marketing [J]. Computer Science and Artificial Intelligence, 2023, 1(4):24-27.
[2] [2] Chen Zhitai. Application analysis of BD mining technology in enterprise ERP [J]. Business News, 2020, No.193(03):106-107.
[3] [3] Shi Tingting, Liu Weihua, Liu Shuangyin, et al. Research on the application of DBSCAN optimization algorithm in experimental text BD analysis [J]. Computer Science and Application, 2020, 10(5):8.
[4] [4] Jin Jubo, Ge Lei, Xu Xiuli. Development and application of computer data mining technology [J]. Journal of Zhejiang College of Water Resources and Hydropower, 2019, 031 (006): 68-72.
[5] [5] Pan Xinyu, Zhang Xiaomiao. Pollutant tracking and forecasting algorithm based on BD analysis [J]. Computer and Digital Engineering, 2023, 51(5):1096-1100.
[6] [6] Wang Guojie, Yu Jiantao, Wang Liping, et al. Research on the algorithm platform of geo-temporal BD [J]. Industrial Control Computer, 2023, 36(6):113-114.
[7] [7] Shang Yunfeng. Research on computer information processing technology and application under the background of BD [J]. Computer fan, 2019, 000(002):231.
[8] [8] Li Yueen, Han Xinzhi. Research on product design method based on image data mining [J]. Design, 2023, 8(4):6.
[9] Ding Weijie, Liang Ronghua, Sun Guodao, et al. Research progress of crime data visualization [J]. Journal of Computer Aided Design and Graphics, 2023, 35(7):979-989

