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Intelligent Data Mining Techniques for Big Data in Cloud Computing: A Review

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ABSTRACT

The rapid growth of data production across diverse fields created big data as an essential area for both academic study and practical application during recent times. The spread of cloud computing provides businesses with an adaptable infrastructure that enables economical and scalable processing and storage of enormous data collections. Popular use of modern data mining methods requires dealing with major technical obstacles while analyzing massive and complicated information collections. Data mining as an intelligent methodology emerged because it unites artificial intelligence methods with machine learning techniques together with statistical approaches and database operations to resolve these difficulties. In this review paper demonstrates extensive details about Intelligent data mining solutions that operate within cloud infrastructure while handling big data. The paper presents essential details about the basic principles followed by a classification scheme which includes techniques like classification and clustering alongside association rule mining with deep learning methods and their applications for big data needs. This study analyzes data mining system integration models for clouds while it assesses their operational abilities and scalability and makes note of essential difficulties including heterogeneity and real-time processing requirements.

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1. Introduction

Businesses in the digital era experience an unexpected amount of data flow at unprecedented volume, velocity and variety across different industries. The collective name for Big Data comprises structured as well as unstructured

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and semi-structured data flowing from numerous sources including social media platforms, sensors, mobile devices, e-commerce transactions, healthcare systems, and enterprise applications. Organizations from all parts of the world face the dual challenge of extracting value from massive data collections. Big Data demands processing systems that are unable to function adequately at such size and complexity levels. The rapid growth of data storage demands advanced technological solutions as well as analytical methods for performing fast computations regarding complex operations [1]. Modern businesses depend heavily on cloud computing to succeed in their operations. Cloud platforms that include Amazon Web Services (AWS) and Microsoft Azure and Google Cloud deliver an optimal space for Big Data analytics through their unrestricted computer capabilities and elastic growth models and economical storage capabilities [2]. Big Data reveals its pinnacle strength through analysis of vast data collections to produce usable knowledge. The process requires intelligent data mining techniques according to [3]. Data mining refers to the process of discovering patterns, correlations, and anomalies in large datasets. Data mining becomes a superior knowledge discovery tool that supports decision-making through artificial intelligence techniques which include machine learning, deep learning, natural language processing and neural networks [4].

Changes in technology through integrating data mining intelligence with cloud systems have established novel opportunities in data-oriented innovation. Companies gain access to cloud-based machine learning services which enable behavioral analysis of customers while simultaneously performing real-time fraud detection and supplying chain optimization and healthcare diagnostic enhancement without requiring substantial on-site hardware investments [5]. Joint analytics tasks become more efficient because data scientists and analysts merge their skills on cloud-based platforms while sharing tools and repositories to produce faster results [6]. An intelligent data mining system deployed in cloud-based solutions provides organizations with benefits that include adjustable capacities as well as automated failure prevention capabilities and flexible operational features. The parallel ability of algorithms extends across distributed systems where the large data amounts are processed using frameworks Hadoop and Spark and services automatically scale up or down according to workload needs. The combination of strategic business assets from Big Data has become a growing opportunity for organizations and research teams[7]. This research evaluates advanced intelligent data mining approaches for managing Big Data which specifically examines their deployment and enhancement features on cloud computational platforms. The paper investigates fundamental approaches together with system designs and programming models in addition to demonstrating their applications and analyzing present and impending future challenges in this active domain.

2. Research Methodology

This section contains the theoretical study of the review, including an explanation of big data and its characteristics, a definition of cloud computing and its types, and concludes with Intelligent Data Mining.

2.1 Big Data

Large data sets become challenging for conventional data processing systems because of their considerable size as well as their complex structures and quickly growing dimensions. The definition of Big Data includes both its large quantity along with its diverse nature along with its quick processing speed and dependable essence which together form the "five Vs." New tools and technologies require development to effectively process and analyze Big Data because of its characteristic traits [8].

2.1.1 Big Data Characteristics

The paper by [9] defines these features into separate categories. 1. The quantity of data produced through multiple digital sources including social media platforms and transactional systems and sensor networks makes up the substantial volume aspect. 2. The movement of fresh data at high speeds together with its distribution speed across systems defines velocity [8]. 3. Also, diversity exists between structured and unstructured and semi-structured information which comes from different data origins. 4. According to Veracity the data carries uncertainties that include biases and noise as well as abnormal data occurrences. 5. Data analysis produces multiple benefits and potential insights that exist in the data. Multiple domains recognize Big Data's complicated nature and substantial analytic capabilities due to its five key features [10].

2.1.2 Big Data Challenges

Understanding Big Data leads to multiple organizational obstacles despite its business benefits [11]
Data analysis becomes restricted because of these two quality problems in the data: inconsistency and incompleteness. The enormous sample size together with high dimensionality creates scientific difficulties regarding scalability and storage limitations in Big Data analysis. [12] The protection of data privacy along with complete security stands as a major concern for handling sensitive information. The combination process of different source data proves challenging because different data sets employ incompatible formats and semantic rules [13].

2.1.3 Big Data Applications

Multi-sector operations receive transformative solutions from Big Data implementations [14]. Medical data evaluation through Big Data strategies helps healthcare professionals develop more effective diagnostics together with better treatment approaches for patients. Real-time information examination enables finance departments to find frauds while managing operational risks. • Retail: Customer behavior analysis and inventory management. • Urban Planning: Using sensor data for traffic management and infrastructure development. Through Big Data analytics implemented on cloud platforms organizations gain more abilities to analyze big information sets while benefiting from scalable solutions [15].

2.2 Cloud Computing

Cloud computing establishes a model which provides versatile and on-demand access to adjustable computing resources from shared computing systems that include servers and applications together with networks and storage and services that operate without service provider involvement or management complexity [16]. Times have changed for conventional information technology because cloud computing offers adaptable infrastructures that deliver affordable platforms for numerous applications[17]. On-demand self-service and broad network access with resource pooling along with rapid elasticity and measured service are the fundamental features of cloud computing which enable it to efficiently handle Big Data workloads according to [18].

2.2.1 Service models

Three main service models comprise Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) along with Software as a Service (SaaS) according to [19]. IaaS presents users with virtualized computing infrastructure through the internet to let them manage operating systems and deployed applications while avoiding direct management of the physical hardware base. Through PaaS users can build applications within the cloud by accessing pre-set development tools that exist as part of their platform service. Using SaaS users can access fully functional web-based software while the provider handles application maintenance duties and infrastructure management responsibilities [20].

2.2.2 Deployment models

Deployment models of cloud computing serve as critical elements for deciding which organizational needs the solution will best address [21]. The deployment models include public cloud services provided by third-party internet vendors in addition to private cloud solutions that serve single organizations and hybrid cloud platforms that fuse public and private solutions while community cloud solutions serve organizations with similar concerns [22]. Big Data deployment and management within real-world situations depend on the control features together with security measures and management capabilities of each cloud computing model. The parallel processing frameworks Hadoop and Apache Spark can function on cloud platforms due to their support from cloud services. Large academic and scientific organizations achieve scalable operation and real-time processing through combined Big Data and cloud computing solutions [8].

2.3 Intelligent Data Mining

The evolutionary advancement of traditional data mining techniques uses artificial intelligence methods and methods in Intelligent Data Mining (IDM) to analyze large amounts of heterogeneous datasets. The combination of

statistical patterns with analytics leads IDM to utilize artificial intelligence systems that automate and boost useful pattern detections and relationship realizations and predictive understanding. One application field of IDM involves machine learning algorithms combined with neural networks and fuzzy logic and evolutionary computation to perform data learning and information adaptation autonomously [23][24]. The approach connects fixed data evaluation to adaptive intelligence detection therefore renders it applicable across fields including business insight and medical applications and academic investigation.

2.3.1 Techniques and Mechanisms

The core foundation of IDM contains multiple AI-based methodologies which form its structural framework. The classification and clustering operations together with regression tasks uses machine learning algorithms like decision trees and support vector machines (SVMs) and ensemble methods. Neural networks has revolutionized work with unstructured data such as image and speech recognition since its deep learning models automatically extract then optimize difficult-to-find features [25]. The implementation of fuzzy logic helps organizations address uncertain and vague input data within real-world applications due to their rejection of strict decision boundary limits [26]. The evolutionary algorithms genetic programming and particle swarm optimization optimize feature selection and model parameters to deliver robust and interpretable results [27].

2.3.2 Applications in Real-World Domains

IDM's intelligent features have become a standard part in many different practical fields. Healthcare professionals benefit from IDM technology because it reveals patterns in electronic health records and genomic data to predict diseases along with recommending treatments and creating personalized medical approaches [28]. Intelligent models that work within the financial sector perform risk scoring for credit applications and fraud discovery functions and algorithmic market trading because real-time operating conditions are essential. IDM serves as an enabler for innovative intrusion detection systems which gain competence through the adaptation to evolving security threats [29]. IDM serves marketing and e-commerce sectors by enabling advanced recommendation systems along with customer group segmentation tools that boost both product field and business success.

2.3.3 Challenges and Future Directions

Despite its advantages, IDM faces several challenges. The main obstacles linked to IDM implementation are poor data quality and complex model interpretation problems in deep learning combined with the high processing needs of big-scale data systems operating in real-time. To combine heterogeneous data sources containing text images and sensor data successfully an organization needs advanced preprocessing combined with complex feature engineering approaches [30].

3. Methodology

This evaluation takes an integrative qualitative approach to examine the most recent intelligent data mining approaches that work well in cloud computing environments for handling Big Data. The research methodology included a methodical search of academic databases that included IEEE Xplore, ScienceDirect, SpringerLink as well as Google Scholar. During the research phase the papaer utilized "intelligent data mining" and "Big Data analytics" together with "cloud computing" and "machine learning" and "data mining frameworks" as their search terms. The research incorporated peer-reviewed studies and conference papers which appeared between 2016 and 2024 as part of its selection process to integrate both modern and fundamental work. Thirty core investigations were selected from a wide range for analysis due to their applicable relevance and methodological strength and clear impact on cloud-based Big Data system data mining applications.

The analysis grouped the studied papers by their intelligent processing methods (supervised learning, clustering, deep learning, evolutionary algorithms) and their cloud service types (Infrastructure as a Service, Platform as a Service, Software as a Service) and their Big Data applications (healthcare, cybersecurity, energy systems). An assessment through comparative analysis served to establish insights about system benefits and constraints as well as measurement capabilities including accuracy and resource utilization and scalability and processing speed. This review combined known patterns and identified unresolved issues before establishing the fundamental elements used for recommendations within subsequent sections.

4. Literature Review

This review will group reference studies by technical subject and field of application. This allows for clearer analysis, easier comparison, and better alignment as shown in figure 1.

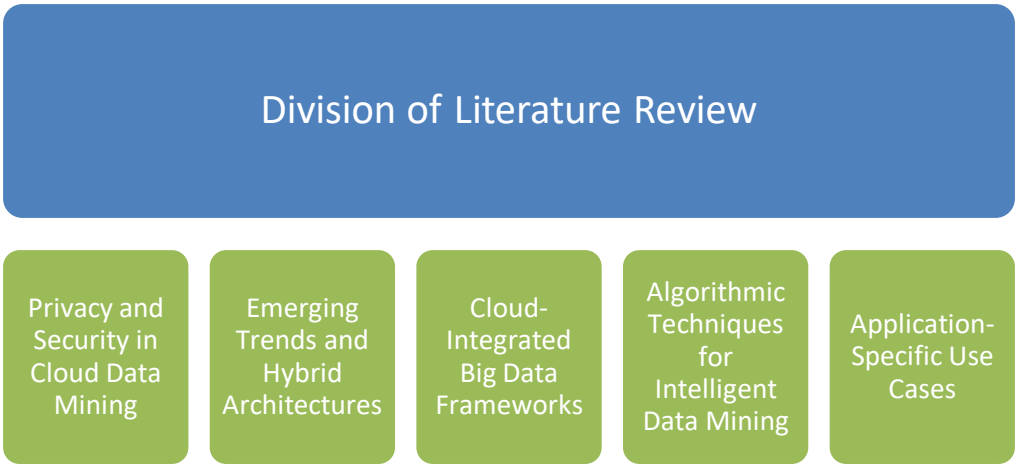

Figure 1 Division of Literature Review

The research paper [31] emphasizes how essential Intelligent data mining techniques are for improving cloud computing defense mechanisms because security functions as an essential barrier to cloud systems adoption expansion. A research study evaluated cloud service risks through an analysis of security threats which was conducted by implementing five machine learning techniques consisting of Naive Bayes, Multilayer Perceptron, Support Vector Machine, Decision Tree (C4.5), and Partial Decision Tree (PART). The experiments utilized the well-known WEKA software platform. The C4.5 decision tree methodology displayed superiority among the different models with a 94% accuracy rate while building quick models and processing minimal unclassified instances. The research data showed that 52% of inspected sample data lacked protection measures thus demonstrating the immediate requirement for improved cloud security solutions. The research benefits from its practical design because it conducted algorithm comparisons on actual threat data. The study has two main limitations because it uses a small dataset while focusing only on denial-of-service (DoS) attacks among other threats.

Research by author [32] resolves the processing speed issues along with increased data density problems in Internet of Things (IoT) devices as a result of restricted network edge computations. The researcher created a combined cloud-edge computing platform which aims to improve data processing effectiveness. The proposed approach adds early exit branches to CNNs so that edge devices execute data faster while lowering cloud server processing requirements. The implementation utilizes linear regression models to decide exit positions by combining the assessment of network status alongside device utilization. Testing involved the application of modified versions of AlexNet and ResNet architectures for validation purposes. The approach implemented in the model cuts response times by up to 9.9% better than conventional systems yet the classification accuracy remains high at 0.92 AUC. The investigation makes substantial progress for IoT system performance optimization with its effective method for reducing latency while reducing bandwidth usage.

The paper [33] explores how cloud computing enhances data extraction performance from extensive databases. Data extraction demands retaining substantial historical data while business data continues expanding briskly resulting in increased processing complexities and high computational power needs. The research strategy proposes adopting NoSQL architecture within distributed cloud networking to shift worn relational databases in order to achieve improved performance. Elasticity and system uptime performance metrics together with the

impact of cloud nodes on efficiency were evaluated using oil and gas company industrial data during the assessment of this approach.

This paper [34] focuses on the challenge of privacy protection in big data analytics. PABIDOT represents a fresh perturbation algorithm that employs optimal geometric transformations to defend confidential information from disclosure. PABIDOT performs evaluations for accuracy while testing the resistance to attacks and scalability alongside efficiency by implementing different classification models with various datasets. PABIDOT produces superior total performance when compared to present privacy-preserving algorithms according to experimental findings.

The paper [35] describes iKDPC (Improved K-Nearest Neighbor Dense Peak Clustering Algorithm) which integrates principal component analysis (PCA) to boost hierarchical talent classification. The VnfVNE-WLA method provided a solution for optimizing the virtual resource utilization through Wireless Link Support integration with Virtual Nodes. The experimental evaluation proved that iKDPC created better talent classification outcomes by providing numerical and scientific data. Through implementing the VnfVNE-WLA approach organizations gained better control of their virtual resources which enabled them to develop talents better using cloud computing platforms.

The authors in Paper [36] study methods to boost the efficiency and effectiveness of cloud-based big data mining and analytics through emerging technology adoption. The research brings attention to the restrictions of fundamental cloud computing resources when handling rapid big data growth by presenting GPUs and both AC and QC as possible integration solutions. The paper evaluates Neural Processing Units (NPUs) as future research potential within this domain.

The research paper [37] explores solutions along with barriers for data analysis which pertains to big data, cloud computing and image mining domains. The scarcity of effective methods for extracting valuable insights from data becomes more pronounced because data continues to expand in all dimensions including volume velocity and variety. The paper supports the implementation of sophisticated statistical approaches that analyze large datasets for resolving these problems. This work examines main difficulties in descriptive analytics together with mining algorithm limitations as well as hardware constraints and data blending issues while highlighting data pattern understanding problems and specific imaging challenges and scalability problems during cloud-based operations. The document presents respective solutions and methods for each identified problem.

The research in Paper [38] examines the unification of cloud computing elements with big data analytics for addressing power management system challenges. Traditional parallel computing methods encounter three main problems consisting of complex computations and large-scale data limitations and delayed real-time operations. The proposed study introduces cloud-based solutions with Hadoop and Spark and Storm frameworks to improve data storage together with processing capabilities and analysis within power systems.

A research by [39] investigates Big Data Analytics (BDA) influence on retail supply chain performance while determining optimal BDA practices from nine selection options (including data science and RFID and cloud computing) evaluated with seven performance measurement criteria (including cost and flexibility and demand management). The TODIM (Interactive Multi-criteria Decision Making) technique helps establish rankings where RFID stands out as the most suitable practice toward supply chain improvement. The research explores the dilemma retail organizations encounter while using BDA to maintain customer retention alongside cost considerations providing crucial information to new retailers about their BDA practice selection.

The authors in Paper [40] explore the privacy versus utility dilemma by reviewing modern privacy models together with data transformation, cryptographic and machine learning adaptation methods. The document showcases practical applications in healthcare and finance after analyzing research shortcomings before introducing an extensive privacy system to direct upcoming programs. The research investigates privacy models starting with differential privacy and evaluates data transformation approaches of generalization and perturbation while studying privacy-preserving machine learning and analyzes the economics of privacy before developing a unified framework for Privacy-Preserving Data Mining (PPDM).

The authors of research [41] investigate smart management systems that leverage Internet of Things (IoT) technologies to handle big data collection within heating meter operations for enterprises. The system employs a

combination of IC cards and RFID and ground sensors and OPC/PLC control protocols in addition to GPRS wireless networks for data transmission. The developed smart platform retrieves real-time heat meter data to conduct big data analysis that enables efficient decision making and operational enhancements reaching more than 30% efficiency improvements. Energy consumption optimization occurs through this system which simultaneously achieves both improved user satisfaction through personalized heating control as well as decreased administrative expenses. The research study presents two main obstacles when addressing data privacy protection requirements together with the complex implementation barriers for smart systems.

This research [42] develops a smart epidemic prediction model through combination of big data analysis and Internet of Things technology to address the COVID-19 outbreak. A healthcare decision-making system operates through four analytical stages that start with description and end with prescription. The core model made with neural networks demonstrates 99% prediction accuracy that surpasses alternative algorithms including KNN, Naive Bayes and SVM. The system gathers enormous medical data from hospitals by using smart sensors then interprets this information to identify connections among symptoms with clinical results. Although the predictive model delivers effective outcomes the project encounters obstacles because of the complex operational requirements along with privacy issues and restriction of geographical data applicability. The combination of big data technology with machine learning provides healthcare management with a strong instrument for epidemic prediction.

A study [43] demonstrates the creation of a smart solar power plant monitoring system which employs IoT technologies together with data mining algorithms. The system performs automatic continuous solar panel tracking through the measurement of voltage and current with solar radiation intensity while making reference data comparisons. The system sends instant alerts to maintenance personnel through notifications when it detects irregular performance to help experts take immediate corrective measures which improves operational efficiency and reduces operational losses. The system employs advanced sensors operated through microcontrollers and runs data visualization and analysis features on the Thingsboard IoT platform. The system demonstrates compatibility to work alongside smart systems that manage automatic panel cleaning operations and automated angle control which maximizes power production efficiency.

The research paper [44] explores big data technologies and cloud computing used together for dealing with large-scale multi-omics data storage and analysis and information sharing problems. The authors demonstrate that bioinformatics benefits from cloud computing because it enables scalable and cost-effective flexible solutions which work well for genomics proteomics transcriptomics and metabolomics research. The investigation examines diverse cloud-based tools and frameworks and platforms which demonstrate their applications in biomedical science together with personalized medicine

Research explores cloud computing functions for big data analysis by showing its ability to operate and enrich real-time analysis of substantial data volumes. The investigation evaluates both the challenges and effective solutions for using cloud computing with big data analysis [45].

A research paper investigates how machine learning approaches together with big data methods optimize smart grid renewable energy control mechanisms [46]. Powerful data processing methods have become vital because renewable energy sources like solar and wind require their support to boost operations and reliability.

Research [47] explores management and analysis methods for big data from Industrial Internet of Things (IIoT) in cloud computing but concentrates on improving energy efficiency. The EEIBDM framework utilizes RL and FL methods to develop a new system for optimized resource distribution along with minimized energy usage in cloud data center facilities. The research employs CloudSim for replicating the proposed system to measure its functionality

Research written by the authors in [48] shows how cloud computing and machine learning technologies solve big data environment problems with large-scale computing and storage needs. The research introduces DanceNN as a solution for improving distributed file system metadata management and uses Random Forest models to enhance data storage performance.

The research paper [49] presents an innovative AI framework with self-building capabilities for big data analytics within smart cities. The proposed solution addresses the management of smart city data challenges originating from

non-deterministic environments together with dynamic framework behavior because standard AI algorithms were designed to function with static systems while dealing with IoT sensor outputs.

The analysis of Big Data Analytics (BDA) effects on Supply Chain Operations (SCO) forms the basis of study [50]. The study performs a Systematic Literature Review on 88 articles which explore five essential SCO dimensions including demand planning, production and manufacturing, procurement, inventory, and logistics. The authors develop a theoretical model built around Task-Technology Fit (TTF) theory as well as Institutional Theory to investigate the determinants alongside barriers which affect BDA adoption in SCO.

The authors of [51] analyze how predictive analytics unites with big data and cloud computing solutions. The analysis shows that advanced technological solutions become necessary to deal with expanding data volumes since data contains multiple types. Healthcare systems and financial institutions use historical and present data to create upcoming occurrence forecasts that enable better management choices at all levels. The paper examines cloud environment performing big data analytics integration with predictive capabilities through illustrations of Hadoop Spark and NoSQL database structures.

The paper [52] examines how big data and cloud technology and AI-driven decision systems resolve industrial issues that affect modern business productivity as well as scalability and market leadership. The paper focuses on how these technologies create substantial transformative changes across government services alongside the finance sector along with telecommunications fields.

A study [53] investigates the power consumption challenge of cloud data facilities processing enormous data through declining energy expenditure using Deep Reinforcement Learning (DRL) merged with Long Short-Term Memory (LSTM) and Discrete Particle Swarm Optimization (DPSO). The purpose is to optimize resource scheduling and allocation through proper allocation of resources which reduces energy consumption without declining performance standards.

The study in [54] examines three main areas of improvement for Hadoop-based big data storage in cloud environments: It worksets on NameNode failure prevention and better metadata availability and strengthening encryption methods for stored and processed data and optimizing encryption and storage process to reduce operational overhead.

A research paper [55] works to improve the operational effectiveness of Cyber-Physical Systems (CPS) in smart factories by applying big data technologies with cloud infrastructure. The described algorithm arranges tasks through a hierarchical approach that enhances resource distribution and load management to achieve higher system performance.

A research investigation deals with obstacles in intelligent coal mining infrastructure development focusing on fragmented geographic information system applications and inadequate interface synchronization between multiple systems while insufficiently utilizing combined data from different sources [56]. The proposed platform uses 4DGIS to connect spatiotemporal information which improves spatial decision making and enables joint area control in mining operations.

A paper [57] presents a methodological review of big data visualization that uses natural-inspired algorithms and cloud computing technologies. Future research needs to validate and apply findings in practice to address current obstacles even though it demonstrates important security and efficiency improvements.

The research develops a thorough model to unite Big Data Analytics with cloud cybersecurity through which BDA detects and stops network attacks like DDoS and SQL Injection and Brute Force attacks effectively [58]. A system for centralized log analysis serves to both detect cloud-based malicious traffic and protect Big Data resources in the cloud.

A research study [59] presents an investigation of developing a data mining platform through cloud computing technologies to exceed traditional mining system speed and scalability challenges. The system utilizes large data management capabilities at reduced costs through its service-based architecture design.Hadoop and MapReduce were used in this research.

Evolution of an IoT Cloud Platform and big data data mining techniques for precision marketing enhancement stands as the main focus of this research [60]. The platform integrates MySQL and MongoDB databases for data storage through enhanced mechanisms which handle temporal data storage. Algorithms served as a data aggregation solution that also helped evaluate information to support better decision-making. Table 1 shows the comparison between the reference studies.

Table 1 comparison table

Ref	Year	Technologies Used	Advantages	Disadvantages	Result	Category
[31]	2016	Naive bayes, multilayer perceptron (mlp), support vector machine (svm), decision tree (c4.5 algorithm), partial decision tree (part)	The proposed research methodology allows organizations to develop models that evaluate cloud environment security which benefits their security decision systems.	A disadvantage of using small sample sizes includes limited result generalization capabilities when the study works with only 25 samples	C4.5 decision tree algorithm achieved the highest classification accuracy of 94%, outperforming other algorithms such as naive bayes, svm, and part.	Privacy and security in cloud data mining
[32]	2024	Cnn, linear regression, pca	A novel method that unites cloud computing with edge computing achieves its highest operational value based on study findings while omitting peripheral device power usage at peak ai operation levels.	Research did not test real-world industrial applications	The modified system for local processing shortened response time by 9.9% against traditional methods and loading delays decreased by 4.1% with respect to conventional approaches. The implementation of modified cnns resulted in very accurate classifications possessing an auc of 0.92.	Emerging trends and hybrid architectures
[33]	2016	Association rules	The system showed remarkable ability to process large data collections with effectiveness. Better scalability and flexibility emerged during the adaptation process due to multi-node processing of storage and data mining tasks	Moving relational system data into nosql databases demands substantial effort as part of the overall process.	When moving relational data into a nosql system located in a distributed cloud environment you achieve improved data mining query performance. The system becomes more scalable and flexible because data storage and processing is distributed across several nodes.	Cloud-integrated big data frameworks
[34]	2021	Data perturbation, Optimal geometric transformation, Classification algorithms	The new perturbation method establishes privacy rules which both increase scalability and operational efficiency when handling big data.	This paper examines the algorithm's technical element along with performance metrics without proper study of data protection and ethical implications	A more efficient version of basic perturbation methods is implemented through pabidot. The research shows that pabidot uses fewer computational	Privacy and security in cloud data mining

					resources than geometric perturbation (gp) and random rotation perturbation (rp). The method operates in a linear pattern through a time complexity scale of o(m) and uses m to represent the number of instances	
[35]	2023	Density peak clustering, principal component analysis	With ikdpc and pca tools researchers achieved better classification outcomes while dealing with data of many dimensions. Wireless links within the network developed a flexible topology because they improved overall network efficienc	The developed simulations have proven successful yet scalability issues might appear when implementing solutions to universities at full scale or large network	The ikdpc algorithm has been shown to enhance talent classification performance compared to traditional algorithms. The vnfvne-wla method improved network resource utilization, providing better support for talent development in universities.	Algorithmic techniques for intelligent data mining
[36]	2021	Clustering, associative rule	The combination of gpus with ac and qc generates accelerated performance speeds for big data mining operations	Through present cloud frameworks these technologies tend to integrate with difficulty.	The paper highlights that integrating gpus, ac, and qc with cloud computing can greatly enhance big data mining and analytics. It demonstrates that gpus can accelerate a wide range of data mining tasks.	Algorithmic techniques for intelligent data mining
[37]	2021	Hadoop, active contour models	N extensive range of analysis techniques and tools related to data analysis and cloud computing together with image mining provide essential information about implementing effective analysis solutions.	The research analysis might lack thorough assessments regarding every technological topic and issue included	Identify and outline the various challenges associated with big data analysis, cloud computing, and image mining. Highlight the significance of big data analysis in extracting valuable insights that aid in decision-making.	Emerging trends and hybrid architectures
[38]	2023	Hadoop, spark, storm, parallel computing, k-means, canopy clustering, and density-based clustering	The scalability of data is addressed by cloud computing through horizontal scaling procedures requiring low hardware investment.	However real-time applications cannot use hadoop since the batch processing delays its performance	Reduced execution time by 30-50% compared to traditional parallel computing 92% accuracy in fault prediction using advanced clustering. 70% reduction in batch job completion time.	Cloud-integrated big data frameworks

[39]	2024	Multi-criteria decision-making (mcdm) technique based on prospect theory, sensitivity analysis	Comprehensive framework: integrates qualitative and quantitative criteria for bda selection. Practical application:	Expert bias: relies on subjective inputs from a small expert pool (n=5).	Rfid scored highest in global dominance (7.4209) under default conditions (θ=1).	Application-specific use cases
[40]		Homomorphic encryption, data transformation, federated learning, hadoop-based parallel processing	Secure computation on encrypted data. Enables collaboration without data sharing.	Limited model accuracy due to data heterogeneity	Hadoop-based elastic fam-tree reduced processing time by 70% compared to single-threaded methods. Elastic fam-tree outperformed other methods in speed (8 hrs vs. 12–20 hrs for alternatives) while maintaining high privacy and accuracy (91%).	Privacy and security in cloud data mining
[41]	2021	Big data analysis, predictive mining, clustering analysis	The efficiency of corporate management surpasses 30% through improved system performance	The deployment of wireless devices with smart grids involves initial expenses that can be costly.	A smart heating management platform based on the internet of things and big data has been designed and implemented. The system is capable of monitoring heating consumption in detail, accurately, and in real time.	Application-specific use cases
[42]	2021	Neural networks, knn, svm, naive bayes, logistic regression, adaboost	Iot technology along with big data enables live processing of substantial medical data for analysis	The creation of an integrated iot network and precise data acquisition represents technical hurdles that lead to implementation complexity	The neural network-based model outperformed all other machine learning algorithms with up to 99% accuracy.	Application-specific use cases
[43]	2021	Statistical analysis, real-time data analysis, calibration-based comparison	Continuous and effective performance monitoring without the need for constant human intervention	Developing accurate calibration systems proves to be a complicated process that demands proper connection to performance measurement techniques	Tests have proven that the system can accurately monitor performance differences between solar panel arrays. The system is designed to be integrated with automatic cleaning or adjustment systems in the future to increase the efficiency of solar plants.	Algorithmic techniques for intelligent data mining
[44]	2021	Hadoop, nextflow and snakemake,	Cloud platforms feature built-in scale capabilities	The need for standardization across	Cloud-based frameworks	Application-

		supervised learning	which enable processing of enormous omics datasets during their rapidly increasing growth. The pay-per-use model reduces the necessity for expensive local infrastructure thus creating a cost-efficient solution for operations.	multiple platforms encounters difficulties when dealing with variable data formats and standards.	(e.g., hadoop, spark) enabled faster processing of genomic, transcriptomic, and proteomic datasets compared to traditional hpc	specific use cases
[45]	2024	Aws, hadoop, microsoft azure	Through cloud computing users have the capability to adjust their resources based on their current requirements	Cloud resources become excessively costly because ineffective control of these services occurs.	Complex data analysis: patterns and trends in customer data were identified using cloud analytics tools.	Cloud-integrated big data frameworks
[46]	2022	Hadoop, cnn, rf, dt	The system performs real-time processing of extensive data quantities.	Among big data analytics contexts the used data set (60,000 samples) resides at a small scale. Network stability risks arise because data breaches and tampering events could occur.	Achieving up to 96% accuracy in linear regression models. 87% accuracy in deep learning (cnn) models.	Algorithmic techniques for intelligent data mining
[47]	2022	Reinforcement learning , federated learning, cloudsim	The proposed system demonstrated improved energy efficiency through its ability to decrease energy usage because the power efficiency measure reached below 1.65 as virtual machine counts rose to 250	A complex design emerges from integrating rl and fl techniques into one system which leads to higher implementation difficulties	Low power consumption: high power efficiency was achieved, with the pue decreasing as the number of virtual machines increased. Improved performance: the proposed system demonstrated the ability to efficiently manage large data sets, while reducing execution time compared to non-uniform systems.	Emerging trends and hybrid architectures
[48]	2024	Random forest, dancenn, hdfs	The cloud platform gives users flexible and expandable solutions for big data requirements	When uniting dancenn and machine learning models for integration becomes difficult because it raises the complexity during system design stages and maintenance operations	A 40% improvement in read/write performance. An increase in data transfer rate to 5,000 operations per second. A 30% reduction in file access time.	Emerging trends and hybrid architectures
[49]	2023	Gsom, clustering,	Gsom operates by processing huge volumes of unstructured information as it occurs	Gsom algorithms need extensive computing power especially for video-based data	Gsom achieved a topology preservation ratio of up to 0.18 on some datasets,	Application-specific use

				processing tasks	compared to 0.24 for the traditional som algorithm. The system is capable of processing 7 frames per second (fps), making it suitable for near-real-time applications such as security surveillance.	cases
[50]	2024	Decision trees, fuzzy logic	The conceptual framework unites ttf and institutional theory to develop a new analysis method for bda adoption across sco	Empirical evidence in this study relies primarily on conceptual and theoretical texts apart from minimal empirical validations	Bda enhances decision-making	Application-specific use cases
[51]	2022	Hadoop, classification (naive bayes, svm, decision trees) and regression (linear regression).	The article examines various technological instruments from hadoop to spark and kafka to flume which constitute big data processing frameworks and predictive modeling systems	The publication lacks evidence from experiments or real-world cases to confirm its presented methods and frameworks	Big data and predictive analytics synergy: the integration of big data with predictive analytics enhances decision-making and recommendations in various industries. Cloud computing as an enabler: cloud platforms provide scalable and cost-effective solutions for storing and processing large datasets, facilitating predictive analytics.	Emerging trends and hybrid architectures
[52]	2022	Came framework (continuous analysis migration ecosystem), machine learning (ml) and deep learning for predictive analytics	Ai analytical techniques produce better and faster results in businesses Compact and big data systems make possible the adaptation of resources in flexible ways	The integration process of technologies needs experts who must also implement strong governance systems. Data privacy remains a central issue for public cloud environments because it is considered a critical matter	Customized ai solutions achieved 83% performance improvement in signal processing and big data analysis tasks. Ai-driven predictive analytics reduced operational costs by 30% in case studies (e.g., supply chain, automotive).	Emerging trends and hybrid architectures
[53]	2022	Lstm , dqn , discrete particle swarm optimization	The system brings together lstm and dqn alongside dpso to extract the optimal functionalities from each component.	The integration of multiple techniques increases computational complexity	13.36% improvement over dqn	Privacy and security in cloud data mining
[54]	2024	Combined hdfs federation and hdfs	The combination of dual-channel storage systems	The file splitting mechanism exceeds a	27.6% average improvement in	Cloud-integrat

		high-availability (ha) mechanisms, elliptic curve	with zookeeper prevented failure from occurring at any one point.	256 mb threshold which may not function well for different scenarios	encrypted storage efficiency Improved-hdfs: ~1.8x faster than traditional hdfs.	ed big data framewo rks
[55]	2024	Hierarchical cps architecture, hbase, spark	The hierarchical cps architecture enables the management of big manufacturing systems at large scales. Drawing from its scheduling mechanism the system achieves better resource distribution and balancing of system loads	Complex implementation occurs because the system contains several integrated technologies alongside its hierarchical structure The indicator detection rate (53.7%) leaves room for improvement	Scheduling algorithm: 15% improvement in accuracy and efficiency. Indicator detection: 53.7% average detection rate (max 78.9%).	Cloud-integrat ed big data framewo rks
[56]	2023	4dgis + digital twin integration	Scalability: the cloud-edge-device architecture supports system-level orchestration.	Complexity: high computational demands for real-time 4d modeling.	Reduced production system startup time from 32 minutes to 18 minutes. Decreased equipment idle time by 8%.	Applicati on-specific use cases
[57]	2020	Fuzzy c-means clustering, odony optimization, particle swarm optimization (pso), artificial bee colony (abc), lion optimization algorithm, teaching-learning-based optimization (tlbo)	The framework utilizes complete integration between natural algorithm models, machine learning capabilities and cloud processing systems to examine big data visualization	Numerical measurement remains absent from certain approaches because they do not provide exact numerical calculations for trust models (example: computational trust parameters)	Fuzzy c-means clustering improved channel equalization and accuracy in big data transmission Tensor decomposition reduced big biometric data size while maintaining security	Algorith mic techniqu es for intellige nt data mining
[58]	2020	Big data analytics,	Comprehensive attack detection The analysis of automatically transmitted log files minimizes manual worker intervention	Cost and complexity	Successfully identified and categorized ddos, sql injection, and brute force attacks. The cloud server's remaining size after attacks was monitored (e.g., 104.0 units)	Privacy and security in cloud data mining
[59]	2016	Hadoop distributed file system, clustering, association rules	The platform offers users on-demand service functionality	Even though system administration needs advanced technical proficiency	Increase efficiency by: Balanced task distribution across nodes. Reducing network traffic through local processing. Fault tolerance: the system automatically reschedules tasks when any node fails.	Cloud-integrat ed big data framewo rks

[60]	2022	Mongodb, baidu map api, replica sets, sharding,	Storage flexibility exists because mysql and mongodb databases allow the system to handle both structured and unstructured data types.	Technical expertise at a high level is required to handle the platform's complicated infrastructure because of the system complexity.	System error rate during testing: 0.00% (i.e., no errors were detected during the stress test).	Application-specific use cases

5. Conclusion

The integration of intelligent data mining techniques with cloud computing platforms has emerged as a critical enabler for handling the scale, speed, and complexity of modern big data environments. The review confirms that data mining solutions enabled by ai produce adaptable extraction methods for high-dimensional heterogeneous data that scale effectively. Cloud-based deployments of these techniques harness elastic infrastructure power and distributed processing together with real-time data access to enhance sectoral performance in healthcare facilities as well as smart grids and cybersecurity environments and throughout the e-commerce industry.

The field continues to advance despite the significant achievements that have already been implemented. Most systems currently in deployment focus on task-specific implementations, with limited generalization capabilities across multiple domains. Contemporary challenges exist regarding the interpretation of models as well as real-time processing and protecting user privacy and effectively using resources across multiple cloud providers. Cloud computing in harmony with intelligent data mining creates substantial opportunities for developing analytics solutions that operate better, independently, and strongly.

6. Future Work

Research should focus on creating trustable and explainable intelligent data mining systems that integrate well into distributed cloud infrastructure as well as federated cloud installations. Data privacy regulation demands the essential integration of privacy-preserving methods including federated learning combined with homomorphic encryption and differential privacy to protect workflows during cloud-based mining operations. New analysis methods require development to succeed in minimal resource environments with accuracy performance. Decision-making platforms for healthcare diagnostics and urban planning and smart agriculture should incorporate combined data analysis of text alongside image and sensor data as well as genomic information. Scientific exploration should study the combination between quantum computing technology and Big Data analytics specifically for implementations requiring maximum parallel operations along with optimization features. Developing thorough benchmarking platforms must be established to evaluate intelligent data mining strategies across cloud platforms so system architects developers and policy-makers may receive proper direction.

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