IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

AI and Big Data: Harnessing the Power of Data-Driven Decision Making

Vijaya R Varma Pothuri[1] and Umesh Marappa Reddy[2]
Lead Software Engineer, Salesforce Inc., San Francisco, USA[1]
Senior Software Engineer, Salesforce Inc.. San Francisco, USA[2]

Abstract: *AI and Big Data are intertwined concepts that have remarkably shifted business organizations' decision-making approaches in different fields. This paper aims to discuss the use of artificial intelligence in big data in extracting pertinent information, improving the efficacy of predictive analysis, and improving decision-making processes. It details the new techniques for developing and designing AI algorithms, the structure of Big Data systems, and their integration. The study also explores the issues related to the successful application of the method, the main ethical concerns and future trends. By way of identifying the literature, explaining the method, and presenting the result and discussion sections, this paper delineates the use of AI and Big Data in driving decisions in the future*

Keywords: Artificial Intelligence (AI), Big Data, Data-Driven Decision Making, Predictive Analytics, Machine Learning, Data Analytics, Neural Networks, Deep Learning

I. INTRODUCTION

Today, with the emersion of digitalization and big data, organizations receive a huge volume of information from different sources, including social media channels, IoT gadgets, and organizational systems. In its original meaning, big data categorizes this type, amount, and data speed as impenetrable for traditional data processing systems. By nature, big data's volume, variety, and velocity demand the use of AI technologies, especially ML and DL algorithms. [1-3] These AI techniques allow for the definition of patterns and information that are significant for meaningful decision-making using big data.

The combination of these technologies has completely changed sectors ranging from medical, banking, advertising, and transportation. For example, in the sphere of health care, AI provides recommendations on diseases' respective prediction as well as individualized treatment. In finance, the appropriate use of AI involves AI instruments using analytics to detect fraudulent transactions and the use of analytics in recommending the most appropriate investment decisions, among others. This paper attempts to understand the various methods, uses, issues and prospects concerning AI and Big Data in decision-making using data.

II. LITERATURE SURVEY

2.1. Evolution of Big Data

Big Data has transpired through various stages, from DBMS to the current systems characterized by distributed computing frameworks. Obviously, early systems such as relational databases became ineffective when dealing with a large amount of data. [4] The arrival of NoSQL, such as MongoDB or Cassandra, offered an ideal choice for large volumes and unstructured data types.

It should be noted that the appearance of Hadoop as the framework introduced a shift in Big Data processing. Thanks to Hadoop, the distributed file system HDFS, and the map Reduce approach, large datasets could be processed in parallel. Later, in the case of Apache Spark, in-memory computing was integrated, making the processing faster and more efficient.

2.2. Techniques Applied in the Analysis of Big Data

It is found that Big Data analysis would not be possible without using MSEs, and AI techniques involving ML and DL are highly effective in this process. [5] Therefore, algorithms, including regression, classification, clustering, and

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

reinforcement learning, are often applied to the solutions of predictive analytics, anomaly detection, and recommendation systems.

One of the most used categories of ML is called deep learning, which implies neural networks with many layers. Convolutional Neural Networks (CNNs) are catered to image recognition problems, and Recurrent Neural Networks (RNNs) are used in sequential problems like time series and natural language processing (NLP).

2.3. Learning How AI and Data Analysis Work Together

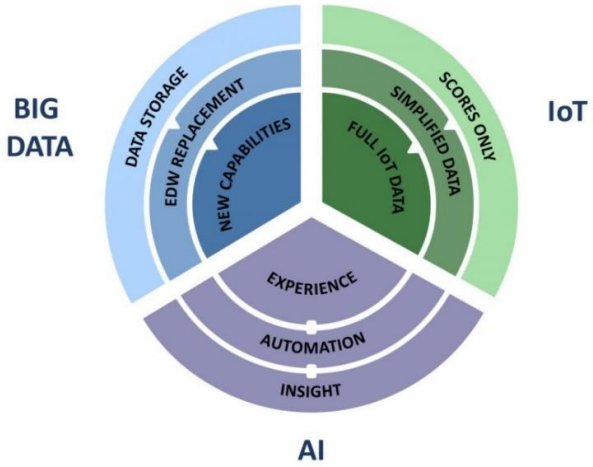

Figure 1: Big Data and AI Will Work

The Learning How AI and Data Analysis Work Together shows the relationship between Big Data, IoT, and AI in the contemporary world where data is indispensable. [6] Each segment describes and emphasizes various aspects of these technologies' roles and effectiveness. Here's an elaboration on each topic within the diagram:

2.3.1. Big Data

1. Data Storage: Big Data solutions are storage systems which cater to large amounts of data that can be classic data, semi-Classic and unclassic data. Big data filesystems, such as Hadoop Distributed File System (HDFS) and cloud storage solutions, are usually deployed (AWS S3, Google Cloud Storage). Through data durability, availability, and capability to retrieve the required data with such systems, organizations can store and utilize vast datasets without accruing high infrastructure expenses.

2. EDW Replacement: More and more EDWs are becoming a subset of Big Data platforms or are being replaced by them. The existing EDWs do not meet modern data characteristics, such as being vast and intricate. There are other more flexible and more scalable technologies known as Big data technologies, such as Data Lakes that can manage and store big data. Such a transition makes managing and analyzing data easier and more comprehensive.

3. New Capabilities: Big Data presents new abilities that go further than data processing abilities have been able to present in previous years. Big Data frameworks also encompass capabilities for advanced analytics, real-time processing of Big Data, and integration of the machine learning functionality. Apache Spark and Flink are used for formulating real-time stream processing techniques, or formulation of data for machine learning-based platforms like TensorFlow and PyTorch.

2.3.2. IoT (Internet of Things)

1. Scores Only: In some cases, IoT devices could send back only aggregates or scores computed from the raw sensor data. This approach reduces the bandwidth and processing required for cases where not the whole data set but only

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

specific metrics or alarms are required. For instance, a smart thermostat may send an alert stating the temperature values and/or a health monitor may report on the patient's vital statistics.

2. Simplified Data: Many IoT systems transmit abstract or preprocessed data to big systems. It refers to the Edge computing techniques used to do the first data processing at the place where it is produced, cutting the latency time significantly. This allows devices to preprocess and condense data to make the information sent much more useful in the following processing stages.

3. Full IoT Data: What is called for here is full IoT data, the complete, unprocessed data fed to sensors and devices. Collecting partial data and the data completely allows for understanding all of its details, which is useful for analytics and for utilizing the results from machine learning algorithms. Collecting all data is important for tasks like predictive analysis, in which extensive sensor measurements can predict equipment damage.

2.3.3. AI (Artificial Intelligence)

1. Insight: It utilizes data mining, machine learning, and deep learning techniques to extract and derive viable and value-added solutions from raw data. In computing's present definition, algorithms are used to get out meaningful patterns, trends, and even outliers on data that can benefit decision-making. In business, insights from Artificial Intelligence help improve operations work on customer satisfaction and idea generation.

2. Automation: AI makes digital processes more efficient, and the impact of human error is reduced since several processes are automated. Artificial Intelligence used in areas such as Robotic Process Automation (RPA), self-driven cars, and smart personal assistants are cases where work, process, and decision-making are all performed autonomously, leading to efficiency and cost benefits.

3. Experience: AI improves users' satisfaction because it makes them interact and get services with a more individual approach. AI technologies which enhance the interfaces include recommendation systems, natural language processing (NLP), and computer vision. In e-commerce, recommendations enhance the consumers' satisfaction ratings while applying Artificial Intelligence in diagnosing patients' illnesses in the healthcare industry and offering customized solutions to the patients.

2.4. Integrated Ecosystem

When used in conjunction, Big Data, IoT and AI make it possible to have a continuous flow of data from collection to storage and even analysis to action. Normal IoT devices produce data while Big Data structures keep and analyze it, and AI algorithms provide outputs from the data and execute decisions. This complementarity enables creativity and effectiveness in different domains like health, money, industry and intelligent built environments.

The above analysis breaks down the relations of Big Data, IoT, and AI in the current technological map, showing that despite the interconnectivity of the three, they each have unique functions. The synergy created by these two is that organizations can tap into the value added by data and analytics for decision-making.

2.5. Big Data Analysis:

2.5.1. Applications of AI and Big Data

Healthcare: In the healthcare segment, one of the advanced uses of AI is in analytical for more precise prognosis of patient results and individual risk identification of patients and individualized treatment models. IBM Watson Health is probably one of the most prominent examples in the field, which applies AI techniques to consider the figures of patients' health records, studies, and clinical information data. As a result, it furnishes the physicians with the necessary treatment plans and understanding, thus assisting in decision-making. Reporting AI models can predict a disease's probable progression, help allocate hospital resources more effectively, and, in some cases, even help diagnose a sickness, such as cancer or heart disease, early. Such capacity also helps in the early identification of possible complications, which probably can enhance the quality of the care delivered and decrease the expenses in the health sector.

Finance: In finance, AI algorithms play a crucial role in increasing safety, regulating risks, and improving investment processes. Fraud detection involves using algorithms to detect unusual transaction behaviour; any activity that resembles fraud is detected in real-time. It will be useful for financial institutions that have plans to safeguard their

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

customers and their property. Furthermore, according to the credit analysis results, the likelihood of an applicant's default is evaluated by analysing his/her credit history, work experience and other factors that cause more accurate credit scoring. Within investment management, AI in hedge funds such as Two Sigma entails AI algorithmic trading where complicated models work on analyzing the data on the market in search of trading opportunities and at the appropriate trading times. This strategy entails the highest revenues while seeking the lowest possibility of risks and uses advanced, sufficient planning systems.

Marketing: When it comes to marketing awareness, AI plays a significant role, especially in the fields of customer classification, promotional campaigns, and monitoring consumers' attitudes. Marketing data allows for separating the target audience into groups based on goals and actions, gender, age, etc. This segmentation enables the creation of very targeted marketing strategies likely to better fit the audience. Some firms that apply recommendation systems managed by artificial intelligence include Netflix and Amazon. These systems use the tendency to view related products or content purchased by other buyers. They offer these clients the same products or content that can attract their interest in purchasing the same or similar products/content. It also examines sentiments in social media and other online sites to offer information concerning the customers' feelings regarding a certain product, which is quite helpful for marketing techniques.

Logistics: The intelligence field in logistics involves the utilization of resources to predict market demands, organize ways of transport, and generally increase the chain supply, generally making the system more efficient as compared to the cost incurred. For example, UPS uses AI to determine efficient delivery routes in what is called the ORION (On-Road Integrated Optimization and Navigation) system. This system encompasses features such as traffic condition, destination address priority, and vehicle carrying capability to choose the correct path. The consequence is a decrease in fuel utilization, operating expenses, and increased delivery capability. Demand forecasting is another application of AI where models determine the future demand for the products based on historical sales data and current trends. This foresight aids organizations in putting in place the right depth of stocks to avoid instances where they build up large stocks beyond their utilization rate or fail to meet their clients' demands.

2.6. Benefits of data-driven decision making

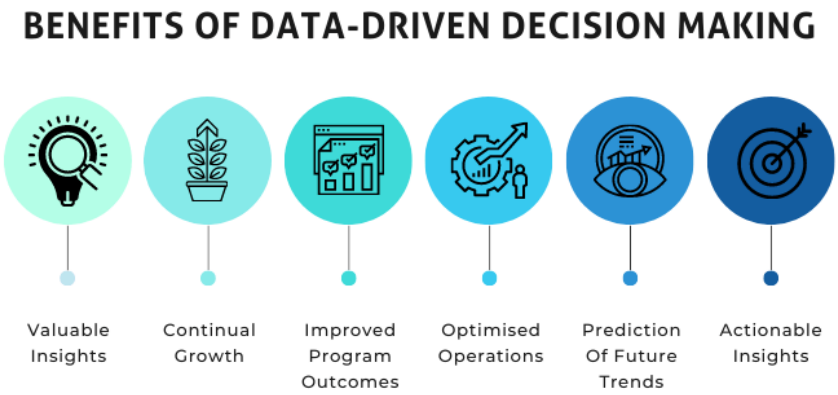

Figure 2: Benefits of Data-Driven Decision Making

Concerning the flow of the infographic and its content, [11] it is divided according to the benefits that can be gained from data-driven decision-making. Every one of them is symbolized by the respective icon. Let's elaborate on each of these benefits:

1. Valuable Insights

Big data technology enables decision-making, bringing out detailed and relevant information obtained from big data processing. These insights are beneficial when determining patterns, trends, and relations that conventional decision-making methods cannot decipher.

Example: In retail, big data allows customers' buying habits and cycles to be determined to adjust marketing strategies and stock.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

2. Continual Growth

Applying data allows for constant control and development of business processes. It is essential to observe that performance measurement provides feedback, helps discover ineffective organizational activities and implements corrections that will contribute to its development.

Example: It can also be applied in a manufacturing firm to analyze the belt's efficiency and then optimize it to increase output /decrease downtime.

3. Improved Program Outcomes

The strategic utilization of data fosters improved goal accomplishment regarding various programs and related initiatives because it is grounded in factual evidence as opposed to conjecture. It helps to manage the resources better and achieve more objectives and targets regularly.

Example: In healthcare, data analytics will enhance patient care programs by determining the best practices for treatment and the outcomes of the patients.

4. Optimized Operations

Decision-making that is informed by data greatly improves the efficiency of the organization's operations. Based on operational data analysis, processes become optimized, losses are minimized, and resources are used rationally.

Example: It is evident that logistics companies employ data management to enhance the delivery routes to conserve fuel while enhancing the delivery time.

5. Prediction of Future Trends

Predictive analytics is one of the sub-processes in the operationalization of data-driven decision-making, which helps an organization gain insight into future events and trends. It enables one to plan and hence remain one step ahead of the competitors in the market.

Example: Banking and financial organizations apply indicators to predict the future stock movement and consequently change their strategies.

6. Actionable Insights

Finally, analytical decision making does not bring raw information but information that can be enacted and put into practical use. Such findings are customized to individual business requirements and assist in targeted, proactive and competent decisions.

Example: In the context of the application, data analytics can be used to, for instance, strengthen the presence of an e-commerce platform and enhance sales with the help of product recommendations for customers.

2.7. Ethical and Legal Considerations

When AI and Big Data are combined, serious legal and ethical issues arise regarding data privacy, bias and accountability. Three main issues regarding AI models need to be solved: making AI models transparent, protecting personal information, and avoiding algorithm discrimination.

2.8. Future Trends

Machine learning and big data involve using technologies such as federated learning, which involves training models using decentralized data sources without exposing the data. Numerical and quantum analysis will bring breakthroughs in problem-solving at much greater rates. Besides, integrating AI with technologies such as blockchain and the Internet of Things will take data analysis to the next level.

III. METHODOLOGY

3.1. Data Collection

3.1.1. Sources of Data

User Data: This involves information gathered from the users through traffic data and other related activities on the website, application and others. [15] User data can include name, age, activity, likes and dislikes, comments, etc.

Sensor Data: In the aspect of data type, data obtained from IoT devices, which are sensors, contains actual data about the physical environment like temperature, motion, humidity and more. Such sort of data is highly important for such industries as manufacturing, healthcare, transport, etc.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

Transaction Data: This involves the documents of business activities involving sales, purchases, returns, and other financial activities. Transaction data is one of the most essential sources of information concerning the purchaser's conduct and economic profitability.

Social Media Data: Information gathered from Social Media platforms such as Twitter, Facebook, or Instagram which is useful in developing an understanding of trends, sentiments, as well as consumers' attitudes.

Figure 3: Data-Driven Decision-Making Process

3.1.2. Tools:

Web Scraping: Web scraping is a technique of scraping large volumes of data from the web for analytics purposes where the information retrieved is public.

APIs (Application Programming Interfaces): API stands for application programming interface-one, enabling different software systems to exchange information. They are employed to obtain data from third parties such as social sites, payment interfaces, etc.

IoT Devices: These devices are attached to other devices and receive and/or send data to the internet. Some examples of such devices are smart thermostats, wearables (fitness trackers), and industry sensors.

3.2. Data Storage

3.2.1. Storage Solutions

Cloud Storage: A RAID system that can easily adapt to the modern world of data storage and where companies can store their data in servers in other parts of the country/continent or even the world that can be accessed through the internet. Cloud storage is cheap, and the data can easily be accessed in remote areas.

Data Warehouses: Reporting and analysis are done in a data warehouse, a central repository for structured data. They assimilate data and information from other analytic tools to enable business intelligence processes.

Data Lakes: A database file that avails large raw data that have undergone very simple data processing and analysis before storage. Data lakes can handle structured, semi-structured, and unstructured data, making them suitable for the storage of big data.

3.3. Data Processing

3.3.1. Cleaning and Preprocessing

Data Cleaning: The methodology of data validation with a view to its improvement and purging it from any error, inaccuracy, and inconsistency to sieve out its various flaws in an endeavour to produce the most refined data sets for analysis.

Data Transformation: Pulling data into a structure customized for analysis, usually, data preprocessing includes normalization, aggregation, and encoding.

3.3.2. Tools and Techniques

ETL (Extract, Transform, Load): A technique employed in creating architecture for the purpose of retrieving data from different sources, cleaning the data, and depositing it in data marts or other data repositories.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

Data Integration: The act of integrating information from multiple sources to get one integrated picture. The concordance and availability of data guarantees that a corporate information system will incorporate data in the best way.

3.4. Data Analysis

3.4.1. Descriptive Analytics

Data Visualization: The process which involves the presentation of data in pictorial or graphical form, such as charts and graphs. Data visualization also plays a role in enabling trends, patterns, and outliers' analysis of the data.

Statistical Analysis: A process of applying and using statistics to make conclusions regarding the associations, trends and possible causes of the data gathered.

3.4.2. Predictive Analytics:

Machine Learning Models: Machine learning systems that utilize data from the past to decide on a prediction without the programming of its instructions. Some of the processes that involve the use of machine learning models include classification, regression and clustering.

Predictive Modelling: The ability to infer what might happen in the future by applying mathematical and/or statistical models and other artificial intelligence techniques to past data.

3.5. Decision Making

3.5.1. Insight Generation

Reports: This includes documents that are structured in a manner likely to contain analysis results, findings, and recommendations that may help a decision maker better make decisions.

Dashboards: Live panels are virtual presentations of the data in the form of signed parameters or KPIs for data analysis and monitoring.

3.5.2. Decision Support:

Automated Decision Systems: This involves using graphs and models where decisions are made automatically according to data analysis, and usually, no input from human beings is required.

Human-in-the-Loop: A process of decision-making where automatic systems have partly done the decision-making while the difficult and unclear situations are solved by human beings.

3.6. Action and Optimization

3.6.1. Implementation

Business Strategy Adjustment: Employing recommendations based on data trends in development and adjustment of the business processes in line with market characteristics and organizational objectives.

Process Optimization: Making changes to the business to gain a better understanding of their operations, identify weaknesses and bottlenecks, and eventually fix them through the use of analyzing statistical data.

3.6.2. Feedback Loop:

Monitor Results: Recurring evaluation of the outcomes stemming from the performed actions with a view to evaluate their efficiency and define the improvements to be launched.

Continuous Improvement: Continual improvement to improve goods and services offered, streamline work procedures and integrate customer/ consumer feedback into the formation of ongoing development.

IV. RESULTS AND DISCUSSION

4.1. Enhanced Predictive Analytics

Specifically, the use of AI in Big Data improves the models used in predictive analytics. A McKinsey & Company study showed that companies that had adopted AI-anchored Big Data saw their output increase by a fifth. Using machine learning algorithms, it allows companies to anticipate future trends, consumer behavior, and market

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

circumstances. For instance, Netflix applies the same to parse copious amounts of user data, resulting in its extremely high customer loyalty, with its customers' retention rate above 90%.

4.2. Improved Operational Efficiency

In integration with Artificial Intelligence, big data enhances various business operations by automating them without the need for manual operation. For example, PwC, in its report, revealed that organizations that pioneered the use of AI for Big Data operations saw their operations' costs decrease by 40%. For a concrete example, Amazon applies AI to the supply chain, seeking the fastest and cheaper methods of delivery based on the trends identified by AI algorithms, for instance, in terms of logistics and inventory management.

4.3. Enhanced Customer Experience

Big data, together with AI, makes it easy for a firm to offer a customized service to a customer. Accenture found that the consumers who are ready to shop with personalization are 91 percent of total consumers. Retailers such as Walmart apply AI in examining customer buying behavior to facilitate promotional activities that will increase client satisfaction.

4.4. Data-Driven Innovation

AI and Big Data are particularly useful in business because they reveal trends and potential for innovation. Research by IBM showed that companies that used AI for Big Data analysis were likely to launch new products or services in business. For example, the healthcare industry applies AI to diagnose patients' information, significantly improving individualized treatment and early diagnosis.

V. DISCUSSION

5.1. Big Data Analytics: The Part AI Plays

Big Data analytics is made possible, more effective and significant with the help of AI. The conventional approaches to data analysis cannot handle data categorized by the 3 Vs: volume, velocity, and variety. Due to technological advancements, the use of AI in most digital businesses involves implementing machine learning and deep learning models to process this big data and arrive at insights that would have taken human analysts more time to realize.

5.2. Challenges and Ethical Considerations

However, the integration of AI with big data analytics comes with some risks, especially in the aspects of data privacy and security. Cambridge Analytica issue is one of the best and most vivid examples of understanding how data misuse can result in more severe ethical issues. As organizations turn to AI for data analysis, questions of data protection, data openness, and ethically correct use of AI are crucial.

5.3. The Future of Decision-Making for Business Intelligence

Decision-making in the future largely remains in the further entwinement of AI and Big Data technologies. As the application of advanced AI technologies advances, it will be possible to obtain an even more profound analysis of organizational processes and make more accurate and timely decisions. Gartner shows that AI will continue to be integrated in Big Data analysis with the market for AI-based Big Data solutions set to touch $200 billion in the coming five years.

VI. CONCLUSION

The application of AI, along with Big Data, has brought a drastic change in the decision-making process of various sectors. This way, AI strengthens organizations' capabilities to make better decisions by improving such facets as predictive analytics, the efficiency of core business processes, and breakthrough data-driven innovations. However, the use of Artificial Intelligence in analyzing data is increasingly growing; hence handling issues concerning data security and ethics shall be important. The outlook of data decision-making is promising, with AI and Big Data as its leading components.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 4.819
Volume 5, Issue 1, June 2019

REFERENCES

[1]. Dean, J., & Ghemawat, S. (2008). MapReduce: Simplified Data Processing on Large Clusters. Communications of the ACM, 51(1), 107-113.

[2]. Kune, R., Konugurthi, P. K., Agarwal, A., Chillarige, R. R., & Buyya, R. (2016). The Anatomy of Big Data Computing. Software: Practice and Experience, 46(1), 79-105.

[3]. Ng, A. Y. (2004). Feature Selection, L1 vs. L2 Regularization, and Rotational Invariance. Proceedings of the Twenty-first International Conference on Machine Learning (ICML '04).

[4]. Data Driven Decision Making: A Comprehensive Guide to Leveraging Data Power, Trantor, online. https://www.trantorinc.com/blog/data-driven-decision-making#:~:text=Data%20Analytics%20Techniques%3A%20Leveraging%20various,and%20inform%20decision%2Dmaking%20processes.

[5]. Shu, H. (2016). Big data analytics: six techniques. Geo-spatial Information Science, 19(2), 119-128.

[6]. Unlock the Power of AI and Analytics: Azure Data Lake as Your Innovation Platform, aegissofttech, online. https://www.aegissofttech.com/insights/ai-analytics-azure-data-lake/

[7]. What is the Internet of Things?, Talend, online. https://www.talend.com/resources/internet-of-things/

[8]. What is AI Analytics? Harnessing the Power of Artificial Intelligence for Data Analysis, Digitalocean, online. https://www.digitalocean.com/resources/articles/ai-analytics

[9]. The role of Big Data and AI in decision making: Leveraging technologies for business success, oneadvanced, online. https://www.oneadvanced.com/news-and-opinion/the-role-of-big-data-and-ai-in-decision-making-leveraging-technologies-for-business-success/

[10]. Helbing, D. (2019). Societal, economic, ethical and legal challenges of the digital revolution: from big data to deep learning, artificial intelligence, and manipulative technologies (pp. 47-72). Springer International Publishing.

[11]. Provost, F., & Fawcett, T. (2013). Data science and its relationship to big data and data-driven decision making. Big data, 1(1), 51-59.

[12]. What are Data Storage Solutions?, secoda, online. https://www.secoda.co/glossary/what-are-data-storage-solutions

[13]. Tuboalabo, A., Buinwi, J. A., Buinwi, U., Okatta, C. G., & Johnson, E. (2024). Leveraging business analytics for competitive advantage: Predictive models and data-driven decision making. International Journal of Management & Entrepreneurship Research, 6(6), 1997-2014.

[14]. Andrew McAfee and Erik Brynjolfsson, Big Data: The Management Revolution, Harvard Business Review, online. https://hbr.org/2012/10/big-data-the-management-revolution