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A Comparative Study of Business Intelligence and Artificial Intelligence with Big Data Analytics

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Abstract: Business intelligence systems give important and competitive information to business planners and decision-makers by combining operational and historical data with analytical tools. Business intelligence (BI) aims to increase the timeliness and quality of data, allowing managers to better comprehend their company's position with rivals. For example, changes in market share, consumer behavior and spending patterns, customer preferences, corporate capabilities, and market circumstances may be analyzed using business intelligence tools and technology. In addition, analysts and managers may utilize business intelligence to determine which changes are most likely to adapt to shifting trends. The nontrivial extraction of implicit, previously unknown, and possibly beneficial information from data is known as data mining. Clustering, data summarization, learning classification rules, discovering dependency networks, analyzing changes, and detecting anomalies are all examples of technological techniques. The introduction of the data warehouse as a repository, advancements in data purification, better hardware and software capabilities, and the emergence of web architecture have all combined to produce a richer business intelligence environment than previously accessible. This document tries to give a framework for developing a business intelligence system. AI has been used to find and investigate security flaws. Manipulation and movement When given a limited static environment, AI robots can readily detect and map their surroundings.

Keywords: Business Intelligence, Artificial Intelligence, Big Data

1. Introduction

Business is the act of producing something useful to meet someone's needs, earn a livelihood, and improve the world. Business actions are documented on paper or electronically, and then these records are transformed into data. As a result, more information about consumers' answers and the industry is available. This information can be studied and mined using specialized tools and procedures to discover patterns and intelligence representing how the company operates. These suggestions may then be pushed back into the company, allowing it to improve and become more successful at meeting client demands [1]. The cycle goes on and on. In any industry, business intelligence encompasses tools and strategies for data collection, analysis, and visualization to aid executive decision-making. Statistical and machine-learning approaches are used in data mining to create decision-making models from raw data. Decision trees, regression, artificial neural networks, cluster analysis, and other data mining techniques are addressed in this book. Text mining, web mining, and big data are also discussed straightforwardly.

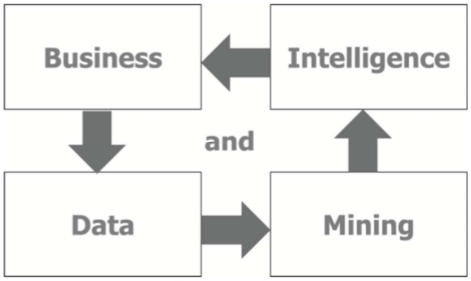

Figure 1. *Business intelligence and data mining cycle.*

Any firm must constantly evaluate its business operations and progress to change its future strategies quickly. Business

intelligence involves keeping an eye on the industry, rivals, suppliers, and customers. Executives usually choose which metrics to follow depending on their key metrics (KPIs) or key outcome areas [2]. Customized reports must be created to ensure that each executive receives their desired information. These reports may be turned into customized dashboards that give information quickly and in a style that is easy to understand. Business intelligence is a broad category of information technology (IT) solutions that include tools for acquiring, analyzing, and reporting data to users about an organization's performance and its surroundings. These IT solutions are among the highest-priority investment opportunities.

Consider a retail chain that offers a variety of goods and services both online and in real places worldwide. It gathers information on sales, purchases, and costs from various places and periods. Analyzing this data might aid in the identification of hot-selling goods, regional hot-sellers, seasonal hot-sellers, and fast-growing client categories, among other things. It could also help you think about what things sell well together, who buys what products, etc. These insights and knowledge may be used to create better promotion programs, product bundles, and shop layouts, contributing to a more profitable business [3]. Data mining is the process of identifying nuggets of information or decision-making expertise in large amounts of data and extracting them to be used in fields like decision support, prediction, forecasting, and estimate. The data is frequently large, but it is of little value since it cannot be used directly; the hidden information in the data is helpful. A pattern is a design or model that aids in understanding something. Patterns aid in the connection of seemingly unrelated items. Patterns can help cut through the clutter and show more easily comprehended trends. Patterns can be as firm as rigid scientific principles, such as the sun rising in the east every day.

Machine intelligence is known as artificial intelligence (AI). Artificial intelligence (AI) is a technique for simulating human intellect using a collection of algorithms to create a new computer that can accomplish similar tasks to humans while also performing parallel computing. Machine learning is a subfield of artificial intelligence that paves the way to creating intelligent computers. Deep learning is a subtype of machine learning that uses established model architectures to represent data abstraction. Deep learning simulates the human brain's data-processing functions, creating patterns, reducing them if feasible, and producing correct results. The methodologies of AI, applications, hardware and software resources employed, and some of the research issues are all described in this study. ML is a type of new Artificial Intelligence (AI) technology that has been used by a growing variety of disciplines to automate complicated decision-making and problem-solving processes during the last several years. ML refers to a group of techniques that aim to teach machines how to solve problems by exposing them to historical examples [4]. Among the different ways available, the most prominent is the Artificial Neural Network (ANN), which was inspired by biological neural networks in the human brain and began as an attempt to simulate human learning skills. Other methods include inductive learning, case-based reasoning, genetic algorithms, natural language processing, etc.

The Statistical Analysis System (SAS) was the cornerstone of a North Carolina State University's (NCSU) agriculture department project in the mid-1900s, which kicked off the digital era of data science [5]. When data science was originally introduced to the industry, the goal was to create more accurate and dependable answers than those found through business analysis. Sought Skillsets were those abilities that an analyst needed to work in the data science area, such as data processing, predictive modeling, and visualization. Python and R are the most popular data processing languages at the moment. On the other hand, Google's Go programming language may be utilized for data processing and analysis in the future. Data science is advancing exponentially because of the abundance of tools, technology, and resources. It tackles a variety of real-world issues and provides hopeful solutions.

2. Literature Review

Because it is founded in the DSS field, BI has seen significant evolution in recent years and is now a DSS area that gets a lot of interest from both industry and scholars. It can be described as an architecture, tool, technology, or system that collects and stores data, analyses it with analytical tools, facilitates reporting and querying, and delivers information and knowledge that allows organizations to improve decision making. Although BI is a form of DSS, it has a much broader definition. It is the process of acquiring high-quality and relevant information on the topic matter being studied to assist the individual(s) in analyzing the data, drawing conclusions, or making assumptions, BI is taking enormous volumes of data, processing it, and providing a high-level collection of reports that condense the core of that data into the foundation of business operations, allowing management to make basic everyday business choices. According to Cui et al, BI is a strategy and method of boosting corporate performance by giving strong support to executive decision-makers, allowing them to have actionable information at their fingertips. BI tools are considered a technology that improves the effectiveness of company operations by increasing the value of corporate data and, as a result, the way that data is used. According to Zeng et al, BI is "the process of gathering, processing, and disseminating information to reduce uncertainty in the making of all strategic choices." According to, BI is a "business management term used to describe applications and technology used to acquire, offer access to analyzed data and information about a company to enable them to make more informed business choices". According to Van Drune, BI differs from its predecessor, "decision support," in that it is a strategic tool designed to aid in planning and performance monitoring rather than Purdy operational choices [6].

Similarly, Cui et al. argue that BI tools have evolved from Executive Information Systems (EIS). Decision Support Systems (DSS) provide much more flair in information delivery and the ability to support techniques such as query, reporting, ad hoc analysis, and multidimensional analysis, all of which are referred to as Online Analytical Processing (OLAP). This diversity of capacity enticed businesses to begin investing in these sorts of intelligence systems. Organizations should, however, have a defined BI strategy as part of their IT strategy [7]. While business intelligence (BI) is defined as an organization's capacity to comprehend and apply data to its benefit, Enterprise BI is a method for bringing synergies to business operations and new efficiencies across business areas. BI provides businesses with "one version of the truth," ensuring that data is consistent and harmonized across all departments. According to Arents, three major criteria must be met to ensure data consistency across several applications in a complex organization:

Timeliness: All other apps should be synced with the data in the system.

Accuracy: Every data from any other application should be included in the data;

Acceptance: Users who are confident in the data's timeliness and correctness should be able to use the system as a decision-making tool actively.

Companies have been compelled to rethink their strategy due to fast-changing business dynamics such as globalization, deregulation, mergers and acquisitions, and technology innovation [8]. In this competitive climate, business intelligence (BI) plays a critical role in assisting decision-making and enhancing competitiveness by establishing a strong relationship between company strategy and IT. BI technology is always evolving and improving to address increasingly complicated business problems. Data warehousing (DW), online analytical processing (OLAP), and data mining are the most extensively used BI enabling technologies that have evolved (DM). BI technology attempts to assist individuals in making "better" business choices by providing them with accurate, current, and relevant data when they need it. Competitive firms gather BI to analyze the environment to achieve a lasting competitive edge, and in some cases, such intelligence may be regarded as a valued core capability.

2.1. Machine Learning

Machine learning technology has existed. In 1990, the data-driven method gave way to machine learning. There was a change in emphasis toward natural language search and information retrieval. The neural network initially tested in 1957 for the first neural network computers, made a resurgence in 2005 [9]. Machine Learning is one of those technologies that has had a lot of successes and some failures, but there is a chance that it may become widespread shortly (2 to 5 years). To keep up with the expansion of the machine learning sector, some of the things that influence it, such as infrastructure and technical capabilities, need also increase.

2.2. Deep Learning

Alexey Grigoryevich Ivakhnenko and Valentin Grigor' evich Lapa invented Deep Learning in 1965. They employed statically analyzed models with polynomial functions and sophisticated equations. In 1995, a technique was created for detecting and mapping related or similar data. Long short-term memory for recurrent neural networks was created around 1997 [10]. During the late 1990s, with the introduction of processors with high computational speeds, which finally quadrupled the computational speed by 1000, GPUs became more efficient at processing photos. Various layers of pre-training and improvements to long short-term memory were utilized in the early 2000s. By 2011, with the increased speed of GPUs, computers could operate on convolutional neural networks without needing to pre-train layer by layer. Deep Learning is now used to handle large amounts of data. AI and Deep Learning are advancing, and more sophisticated concepts are emerging [11].

2.3. Artificial Intelligence (AI)

The corporate world is changing quickly, and company procedures are becoming more complicated, making it more difficult for managers to grasp the sector fully. Modernization, liberalization, acquisitions and mergers, contestability, and technological development have forced businesses to rethink their strategies. To gain a competitive advantage, many large businesses have turned to Business Intelligence (BI) techniques to help them understand and control business processes [12]. BI is largely used to increase information quality and timeliness and assist managers in better understanding their company's competitive situation. Companies may analyze shifting market share trends, changes in consumer behavior and spending patterns, customer preferences, corporate capabilities, and market circumstances using business intelligence (BI) tools and technology. Analysts and managers may use it to determine which modifications are most likely to respond to shifting patterns. It's evolved into a paradigm for analyzing data and assisting decision-making units. In 1951, the Ferranti Mark 1 computer created and ran AI programs. During a summer workshop at Dartmouth College in 1956, the area of AI research was born. At the time, there was a difficulty with computer hardware resources for computations. In the 1980s, businesses and the government poured billions of dollars into AI development at the government's request [13]. Following the funding and attention exhibited to advance the subject of AI, there was a boom in the field from 2000 to 2010. After the emergence of sophisticated computer hardware, machine learning became an effective approach to various challenges in industry and society [14].

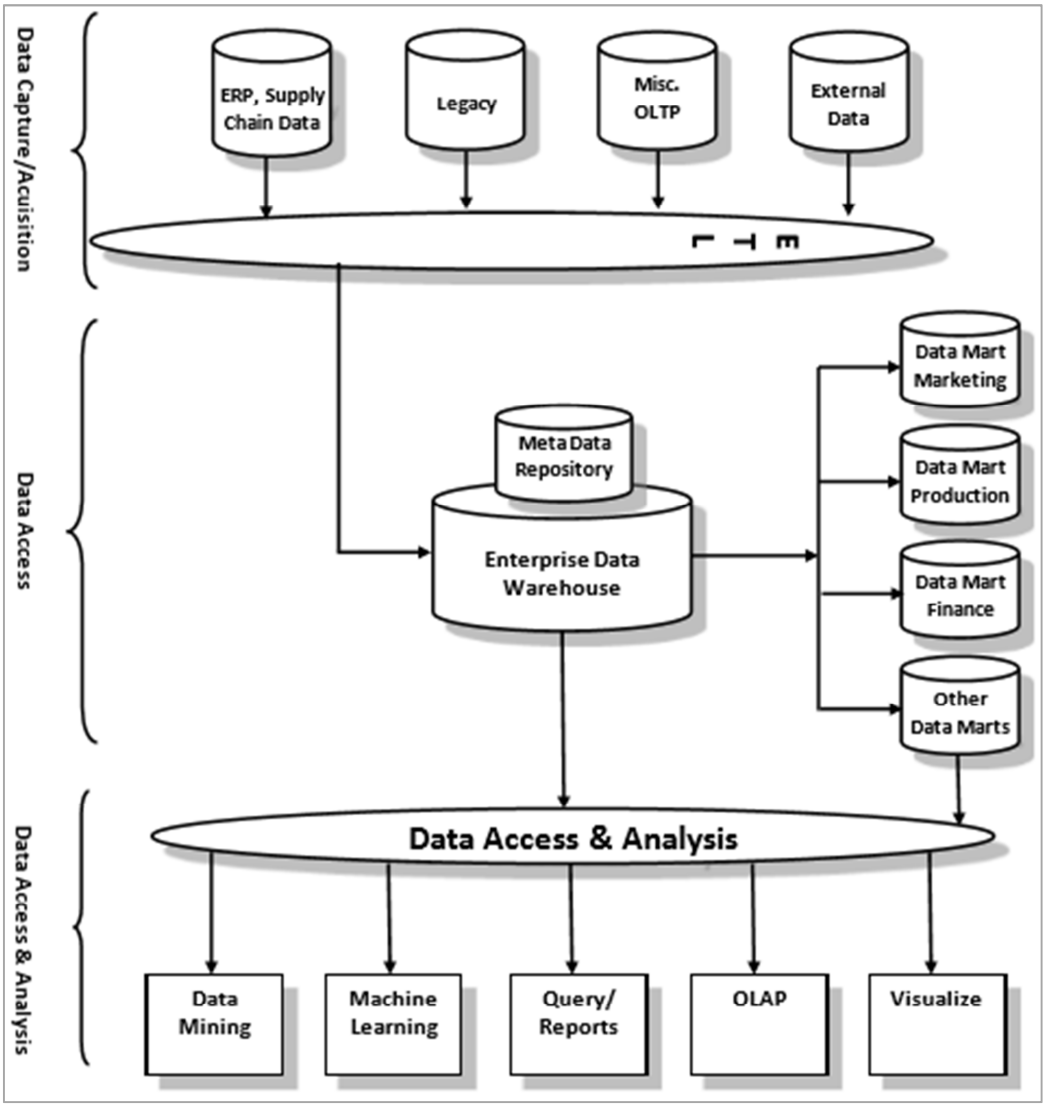

Figure 2. *Framework of Business Intelligence (Valter et al., 2017).*

2.4. Role of Artificial Intelligence in Data Analytics

In many regions of the globe, artificial intelligence and data analytics are popular study issues. Developing countries are pouring millions of dollars into gaining global fame. However, only a few invest even a tiny amount in unclassified AI research. Artificial intelligence is a boon to a variety of businesses. The acquisition component is the data warehousing system's back end, and it comprises systems that connect with operational systems to put data into the warehouse [15]. Data is initially input or processed through an OLTP-based daily business process and then stored in an operational database, including Oracle, DB2, Informix, SQL Server, SAP R/3, and others. Data must be processed through the following processes before being put into the data warehouse from operational databases and external sources:

2.5. Extraction & Cleanse

Data is gathered from various sources, including operational systems, during data extraction. Next, the chosen data is combined and filtered to exclude different types of pollutants. Finally, data cleansing is validating and cleaning up extracted data to fix inconsistent, missing, or inaccurate values. Triggers, error reporting, and remedial processes are used in this stage [16].

2.5.1. Transform

Data transformation is converting data into standard formats and applying business rules to map data to the warehouse schema. We imputed attributes and aggregates.

2.5.2. Load

The cleaned data is loaded into the data warehouse using data loading.

2.6. Machine Learning Methods

Decision trees are decision trees that employ variables or decision nodes in a hierarchy to provide solutions step by step. They're handy for analyzing lists of distinguishing attributes and characteristics. The support vector machine is a supervised learning model for classification and regression analysis that

examines data [17]. They are useful for binary classification of one variable vs. other variables, and the connection between variables does not have to be linear. The Naive Bayes classifier is based on the notion of probabilistic classifiers based on the Bayes theorem and feature independence requirements. They calculate the conditional probabilities of various qualities when they are combined [18].

2.7. Deep Learning Methods

The backpropagation technique is used to generate gradients required for network weight computation. There are two learning modes: stochastic and batch. Dropout is a deep learning training strategy that involves dropping units at random. Its primary purpose is to reduce the number of parameters. Skip-gram is a strategy that compares two vocabulary words only if they have the same context. When given the word amid a phrase, it looks at neighboring words and chooses one at random [19]. The network will calculate the chance of using a neighboring word in our vocabulary.

2.7.1. Data Marts

Data marts, also known as localized data warehouses, are mini data warehouses often developed by particular departments or divisions to help them with their decision-making. A data mart, for example, may be built for certain goods or purposes, such as customer management, marketing, and finance.

2.7.2. Metadata

Users require knowledge about the data warehouse system and its content to comprehend and find data. Format, encoding/decoding techniques, domain limitations, and data definitions are all included in the metadata or data about data. Business definitions, data quality warnings, organizational changes, business rules and assumptions, and other business-related things are included [20]. Metadata assists the business user in comprehending what is accessible, how to access it, what it means, which data to use, when to utilize it, and so on. Metadata browsers offer a clear picture of the data warehouse.

2.7.3. Data Access and Analysis

The front end of the BI is the component that allows users to access the data. It's a set of tools and techniques that give a business user direct, interactive, or batch access to data while masking the technical complexity of data retrieval. The interface presents information in an intuitive, business-like manner that is simple enough for a non-technical person to use [21]. This is accomplished by using business intelligence (BI) tools, which are a set of software tools that provide a graphical user interface (GUI) with a variety of reporting and business analysis features [22].

3. Software and Hardware Resources

3.1. Hardware Resources

Many researchers, data scientists, and research organizations use NVIDIA or INTEL hardware GPU components for deep learning algorithm training, testing, and acceleration. GPU efficiently completes parallel computing tasks for data, images, videos, and graphics in less time. Nvidia Ai Chip-new Nvidia's Jetson Xavier computer is a small computer with a lot of processing power. It has a Volta tensor core GPU, an 8-core ARM 64 CPU, two NVDLA accelerators, and image and video processors. It has nine billion transistors and can perform 30 trillion operations per second (TOPS) while drawing only 30 watts of power. The Intel AI Chip-Neural network processor provides flexible support for all deep learning primitives by making efficient core hardware components. It maximizes computation efficiency and scales multiple compute nodes while using less power [23-25].

Resources for Software Artificial intelligence and deep learning software and tools are described. Pylearn2 is a Python library for machine learning algorithms that is flexible and extensible and includes a GPU and CNN library. Torch is an AI and DL tool that provides an open-source machine learning library. Lua is the scripting language used. One of the most popular tools due to its flexibility and computational efficiency. However, reimplementation logic is not supported, which is a disadvantage. Technet is a new open-source framework that is easy to use and maintain. Theano is a Python library that allows you to evaluate mathematical expressions quickly. Multidimensional arrays are involved. Theano Because it uses mathematical expressions, it is faster than the CPU in data-intensive calculations. Deep learning networks are used to train for large data sets. Caffe is an open-source framework for AI deployment architecture that supports various libraries such as C++, Python, MATLAB, and CUDA [26, 27].

Cuda-convent: C++, CUDA, and Python are all supported by this fast neural network. Convolutional neural networks are used. Deeplearning4j is an open-source framework that works with various libraries, including C, C++, Java, and Scala. GPU support for the distributed framework library is included. Almost all deep neural networks are supported. TensorFlow is an open-source numerical computation framework. It is used when computations can be modeled as a data flow graph. Python allows it to run faster. It supports CUDA, has C++ interfaces, and is also available on embedded platforms [28].

3.2. Trends and Market Analysis

Due to its widespread implementation in various industries, such as automobiles, finance, healthcare, consumer electronics, and so on, the global AI market is expected to grow at a rapid pace over the next five years. Furthermore, rising investments, combined with an increase in the number of start-ups acquired by major players such as Google, IBM, Microsoft, and others, are propelling the global artificial intelligence market. According to a survey conducted by the global AI market 2012-2022, the CAGR between 2017 and 2022 is expected to be over 60%. According to data analysis, NLP, audio and video processing, image recognition, and gesture control have a large share of the global AI market [29]. In 2016, the global artificial intelligence market was dominated by image recognition. It is expected to maintain

its dominance over the next five years [29-32].

3.3. Research Challenges of Data Science and Data Analytics

Because there were so many possible combinations for a problem in the late 1980s and early 1990s, the algorithm used to provide solutions for large reasoning problems was insufficient [33]. As the problems grew larger and larger, this caused the computational speeds dropped exponentially. As a result, the concepts of probability and economics were developed by AI researchers as solutions to deal with information uncertainty or incompleteness [34].

3.4. Security

Object identification becomes harder to program when given a dynamic environment or when mobility involves physical touch with the item. When it comes to implementing BI in their enterprises, it can be difficult for executives to select successful solutions and have a significant impact [35].

4. Conclusion

We are moving closer to artificial intelligence in today's society, seeing its widespread use. It's also crucial to recognize these technologies' capabilities in reducing hazards safely. To forecast analytics, machine learning techniques are increasingly being deployed. Deep learning is said to offer greater advantages in providing accurate results than traditional machine learning approaches. However, the more advance we make in this sector, the more complicated it becomes and the more difficult. In today's highly competitive market, a company's business information quality and timeliness may differ between profit and loss; it can also mean the difference between survival and bankruptcy.

Nevertheless, no corporation can deny the value of business intelligence. According to recent industry analyst forecasts, millions of individuals will utilize BI visual tools and analytics daily in the next years. In summary, this study suggests that big data, business intelligence, and artificial intelligence (AI) technologies are genuine development pillars for businesses since they aid in decision-making, forecasting, and the corporate economy. Moreover, if these technologies are backed up by strong leadership and training, the growth potential is larger.

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