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Modelling AI agents for business data optimization

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Abstract

In an era where data-driven decision making is paramount, businesses face the challenge of efficiently managing and optimizing vast amounts of data. This doctoral dissertation presents the development of an artificial intelligent (AI) agent designed to enhance business data optimization through advanced modeling techniques. Utilizing an Object-Oriented Analysis and Design Methodology (OOADM), this research provides a structured framework for the systematic design and implementation of the AI agent. The proposed model leverages python as the primary programming language offering robust libraries and tools for machine learning and data analysis. The Ai agent integrates various algorithms such as neural network and SVM, identify patterns and generate actionable insights that aid in strategic decision-making processes. The AI agent is evaluated demonstrating significant improvements in data handling and decision-making speed. This study contributes to the field of business intelligence by providing scalable and adaptable solution for organizations seeking to harness the power of AI in optimizing their data driven strategies.

Keyboard: AI Agent; Business Data Optimization; Machine Learning (ML); Data Mining

1. Introduction

The field of AI has witnessed remarkable advancements in recent years, particularly in areas such as machine learning, deep learning, and reinforcement learning. These advancements have paved the way for the development of sophisticated AI agents capable of handling complex tasks in diverse domains, including finance, healthcare, manufacturing, and marketing. Artificial intelligence and machine learning models are computational and mathematical algorithmic models which execute trained data and humanoid experiences input to produce a decision an expert would make when provided that same information [2]. In other sense, artificial intelligence (AI) is the capability of a processor to accomplish jobs that are analogous (at least in a limited sense) to that of human wisdom and decision production [2]. In the 1950s, John McCarthy thinks up the term "artificial intelligence," and Marvin Minsky was a well-known scientist in the field [3] [7]. A model attempts to do from scratch a specific decision method that a group of specialists would make if they could analyze all existing data [7][11]. In the context of business data optimization, AI agents can be employed to automate data analysis, predict future trends, optimize resource allocation, personalize customer experiences, and enhance overall business performance. The emergence of Artificial Intelligence (AI) and, more specifically, intelligent agents, offers a transformative approach to navigating organizational data-rich environments. AI agents, autonomous software entities capable of perceiving their environment and taking actions to achieve specific goals, are uniquely suited to address the complexities of 1 business data optimization. Their ability to learn from data, adapt to changing conditions, and operate autonomously makes them powerful tools for automating tasks, identifying hidden insights, and making optimal decisions in real-time. Artificial intelligence (AI) has been changing businesses as proven by Airbnb, Ola,Uber, Flip cart, e-Bay, Amazon, Mantra, etc. and other enterprises that have incorporated its use to instrument state-of-the-art business models [11]. This embryonic and quickly advancing technology impacts digital platform business model innovation [4], although many businesses are being made exposed to new entrants armed with the technology.

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Unfolding AI technology as the promoter of digital business model innovation, this study outhouses gracefully depending on issues influencing digital business model innovation start up through evolving technology [1]. The goal line of artificial intelligence in business is to look out advance cutting-edge research in the fields of AI and machine learning, as well as interrelated arenas like cryptography, cryptocurrency, and innovation to develop a way out that is utmost impactful to the business's customers and industries [16]. In this way, continuous intelligence (CI) is a design pattern in which online real-time data analytics are cohesive into business processes, meeting out contemporary and chronological data to advise movements in comeback to business ticks and other significant measures [9]. Applied intelligence (AI) is a smarter, faster, and more effective approach to collecting, processing, and analyzing data, creating insights which help identify clear opportunity to act on and automating those actions where possible to unlock business significance [16]. It is advantageous for businesses to gaze at AI from side to side on the lens of business proficiencies rather than expertise with technology. AI can upkeep three significant business essentials [11][33] computerizing automated business process 2 from back office executive and business activities; acquisition of intuitions through data scrutiny, breakdown, data analysis, and performance metrics; and engaging with consumers and workforces [7]. Data and knowledge, learning from experiences, reasoning and planning, safe human interaction through AI technology, multi- agent systems, secure and private artificial intelligence communication, and machine vision and language processing are some of the key hubs of artificial intelligence [8][11].

Aim and objectives of the study

The aim of this thesis is the modeling of AI agents for business data optimization and the specific objectives are as follows:

- To develop an API integration component that will automatically gather data from various business sources.
- To develop web scrapping tools to collect unstructured data from online platforms, such as customers reviews and competitor analysis.
- To design algorithms for data cleaning and preprocessing to ensure quality of data being analyzed.
- To design interface that allows users to interact with the agent and access data insights easily.

2. Literature Review

2.1. Deep Learning in AI

The main focus of today's Fourth Industrial Revolution (Industry 4.0) is typically technology-driven automation, smart and intelligent systems, in various application areas including smart healthcare, business intelligence, smart cities, cybersecurity intelligence, and many more [28]. Deep learning approaches have grown dramatically in terms of performance in a wide range of applications considering security technologies, particularly, as an excellent solution for uncovering complex architecture in high-dimensional data. Thus, DL techniques can play a key role in building intelligent data-driven systems according to today's needs, because of their excellent learning capabilities from historical data. Consequently, DL can change the world as well as humans' everyday life through its automation power and learning from experience. DL technology is therefore relevant to artificial intelligence [28], machine learning [28]and data science with advanced analytics that are well- known areas in computer science, particularly, today's intelligent computing. In the following, we first discuss regarding the position of deep learning in AI, or how DL technology is related to these areas of computing. Nowadays, artificial intelligence (AI), machine learning (ML), and deep learning (DL) are three popular terms that are sometimes used interchangeably to describe systems or software that behaves intelligently. In Fig. 1, we illustrate the position of deep Learning, comparing with machine learning and artificial intelligence. DL is a part of ML as well as a part of the broad area AI. In general, AI incorporates human behavior and intelligence to machines or systems [28], while ML is the method to learn from data or experience, which automates analytical model building. DL also represents learning methods from data where the computation is done through multi-layer neural networks and processing. The term "Deep" in the deep learning methodology refers to the concept of multiple levels or stages through which data is processed for building a data-driven model.

Thus, DL can be considered as one of the core technologies of AI, a frontier for artificial intelligence, which can be used for building intelligent systems and automation. More importantly, it pushes AI to a new level, termed "Smarter AI". As DL is capable of learning from data, there is a strong relation of deep learning with "Data Science" [as well. Typically, data science represents the entire process of finding meaning or insights in data in a particular problem domain, where DL methods can play a key role for advanced analytics and intelligent decision-making [27]. Over- all, we can conclude that DL technology is capable to change the current world, particularly, in terms of a powerful computational engine and contribute to technology-driven automation, smart and intelligent systems accordingly, and meets the goal of Industry 4.0.

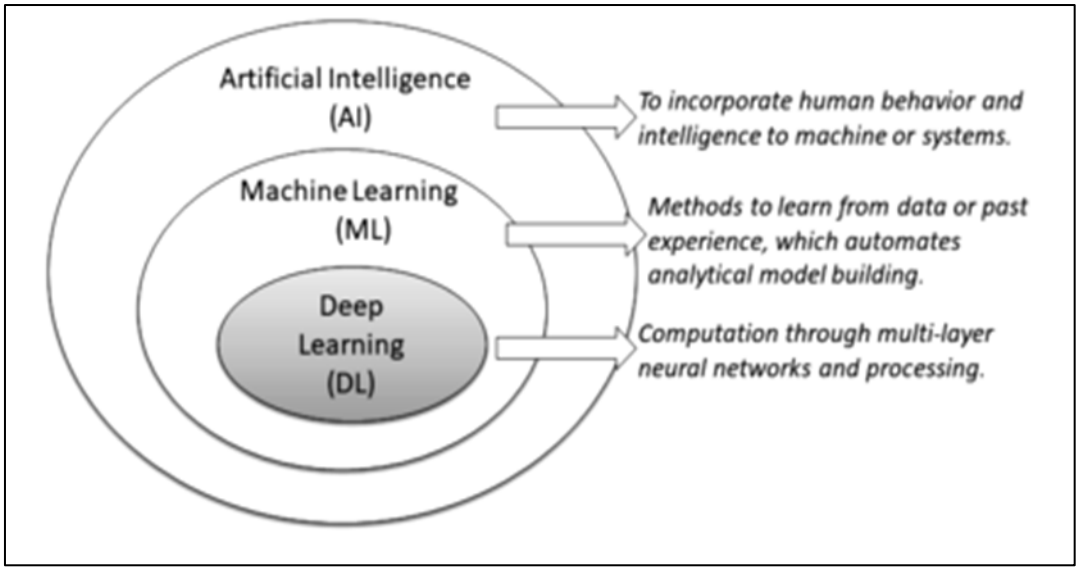

Figure 1 An illustration of the position of deep learning (DL), comparing with machine learning (ML) and artificial intelligence (AI)

2.2. Decision Theory

According to Simon, the Nobel laureate in economics, "management is decision making". Decision making is about choosing from multiple options. What we want is to get the best result behind each choice, but the choice is often uncertain, how to choose? What is the basis for the choice? Decision theory and methods is a new discipline that studies decision making behavior, combining knowledge from different disciplines such as management, statistics, operations research, and systems science. Decision theory and methods are known as decision analysis. Decision analysis first appeared in the 18th century, pioneered by BBERNOULLI, and began to develop rapidly after World War II, after which the development of several scholars such as SAVAGE again formed the classical expected utility theory. Although expected utility theory played an important role in decision analysis and laid the foundation for the subsequent development of decision science, it still had many shortcomings. After the 20th century, scholars began to incorporate psychology into decision analysis, of which EDWARDS was the first to apply psychology to the descriptive study of decision analysis. Decision science started late in China and after nearly 40 years of theoretical research and development, the research on decision theory and methods in China has seen a fully blossoming result. The development of decision science depends not only on the efforts of scholars but also on the support of the state. Since 1987, the Department of Management Science of the National Endowment Committee has funded research on decision theory and methods, and research projects on decision theory and methods have grown steadily with the support of the state. This study will summarize, sort out and analyze the research literature about decision theory and methods in the past 20 years at home and abroad initially, and clarify the research status and application of decision theory and methods in recent years [12].

In recent years, the continuous research of decision theory and methods has become an important research focus. From the perspective of decision problems, the research focus of decision theory and methods is concentrated in the empirical research, and it is in the empirical research that the corresponding decision measurement laws are found by analyzing the decision behavior, to construct model hypotheses for research, and this kind of research appears very frequently in the fields of economics and management. In recent years, the debate on decision making has focused on the following aspects: (1) whether one should make every effort to analyze decisions to develop theoretically "optimal" decisions. (2) The influence of pre-information processing systems on the conscious processing of decisions. In addition, it is believed that in some cases subconscious processes override conscious processes. Consciousness plays a supporting and rationalizing role in behavior, but not in decision making. Furthermore, scholars such as Moshman, Klaczynski, and impress argue that although decisions are sometimes made unconsciously, this does not mean that they lack rationality. The key issue that has given rise to these debates is the role and importance of conscious decision-making processes and whether they are more likely to lead to appropriate outcomes than conscious, deliberate decisions.

2.3. Decision base theory

Decision theory is a theoretical approach that is applied to management decision problems formed by the synthesis of multiple disciplines such as system theory, operations research, and computer science, and the diverse development of

decision theory is based on decision grounded theory. The earliest basic theory of decision making is the expected utility model proposed by Bbernoulli, and then the modern theory of utility functions was formed based on the V-M system of the expected utility model established by Neumann. After that, several scholars extended the system. Utility theory research was the earliest research in decision analysis, focusing on the outcome and monetary utility in the early years, and after 1970, the focus shifted to evaluating the utility and multi-attribute utility functions. There are many utility models, functions, and systems in addition to utility theory. With the development of science and technology and theory, research on the basic theory of decision making can be broadly divided into two areas: research on decision methods and research on decision information.

The relevant concepts and systematic analysis methods proposed to solve future decision problems with uncertainty are called decision methods, which mainly assist decision making by improving the decision process. As far as decision analysis is concerned, decision methods mainly focus on various aspects of decision methods such as graph theory, gray theory, lattice theory, optimization techniques, and comprehensive evaluation. Among them, [12] used graph theory to study the supply chain under the uncertainty of the new crown epidemic [12]. Yi et.al used graph theory and machine learning methods to infer the traffic volume. Optimization techniques are mathematically based and used for solving various engineering problems with optimal solutions and are mainly reflected in various optimization algorithms. Optimization algorithms are very richly developed and so far there have been very many optimization calculations, namely, Ant Colony Algorithm (ACO), Hill Climbing Algorithm, Taboo Algorithm (Tabu Search), Particle Swarm Algorithm (PSO), Fireworks Algorithm (FWA), Firefly Algorithm (FA), and many other algorithms, and also many scholars have applied optimization analysis to the above algorithms according to the different realistic situations.

According to the decision-making needs before the decision needs to be made certain decision Information to be able to make a correct and accurate decision. According to the source of information, decision information can be divided into internal information and external information, and both types of information can lead to incomplete information due to their characteristics and dissemination channels, which makes decision making difficult. In the Art of War, Sun Tzu wrote, "If you know yourself and your enemy, you will never lose a hundred battles." Simon also said that "the connection of information is essential in the decision making process." All these prove that decision information is very important in decision analysis. Gong Zaiwu scholars use computer technology to explore how to make decision processing under disabled information and how to make effective analyses through individual judgment and group judgment.

3. Methodology

The Object-Oriented Analysis and Design Method (OOADM) was adopted as suitable methodology. It captures the dynamic behavior, modularity, and user-centric nature of the cyberbullying speech detection system. OOADM's diagrams, such as use case, interaction, and package diagrams, were used to illustrate the processes, interactions, and modular design of the system. The OOADM uses a formal methodical approach to the analysis and design of information systems. Object-oriented design (OOD) elaborates the analysis models to produce implementation specifications. The OOADM approach is motivated by the kind of system we desire to develop. We desire to build a usable and evolvable application. OOADM promotes modularity and reusability. In this sense, we can divide the system into manageable modules or objects that can be reused across different parts of the system. In a complex project like this study, involving multiple techniques and components, modularity and reusability are essential to ensure efficient development and maintenance. OOADM provides a flexible and scalable framework for designing systems that can adapt to changing systems requirements and accommodate new features or technologies. This is critical in a dynamic domain like data optimization, where new data is constantly frequently coming in and requiring processing.

In this recharch, the AGILE practice will be used within the development process. OOADM is flexible enough to be integrated into iterative development cycles, allowing for continuous refinement based on feedback.

3.1. Analysis of the proposed system

In this section, we analyze the proposed system for modeling AI agents aimed at optimizing business data. The objective is to assess the efficiency, effectiveness and potential impacts of the system within a business context. This analysis will focus on several important components such as the architecture of the AI agent, the data optimization strategies employed, the integration with existing business processes and platforms and the expected outcomes.

The agent begins by identifying and accessing various data sources, such as databases, CRM systems, ERP solutions, social media platforms and IOT devices. Then the agent scans for inconsistencies, missing values and outliers in the collected data. It applies techniques like imputation for missing values and normalization to ensure uniformity. Raw

data is then converted into suitable format for analysis. This may involve aggregating data, creating derived variables or encoding categorical variables. The agent conducts initial analysis to summarize the main characteristics of the data, using visualizations (histograms, scatter plots) and statistical measures (mean, medians). Through EDA, the agent identifies patterns, correlations and anomalies that could inform business decision.

3.2. High level model

In the high-level model shown in the fig.3.2, the subsystems/modules are shown as, user interface, data collection points and the analytic engine.

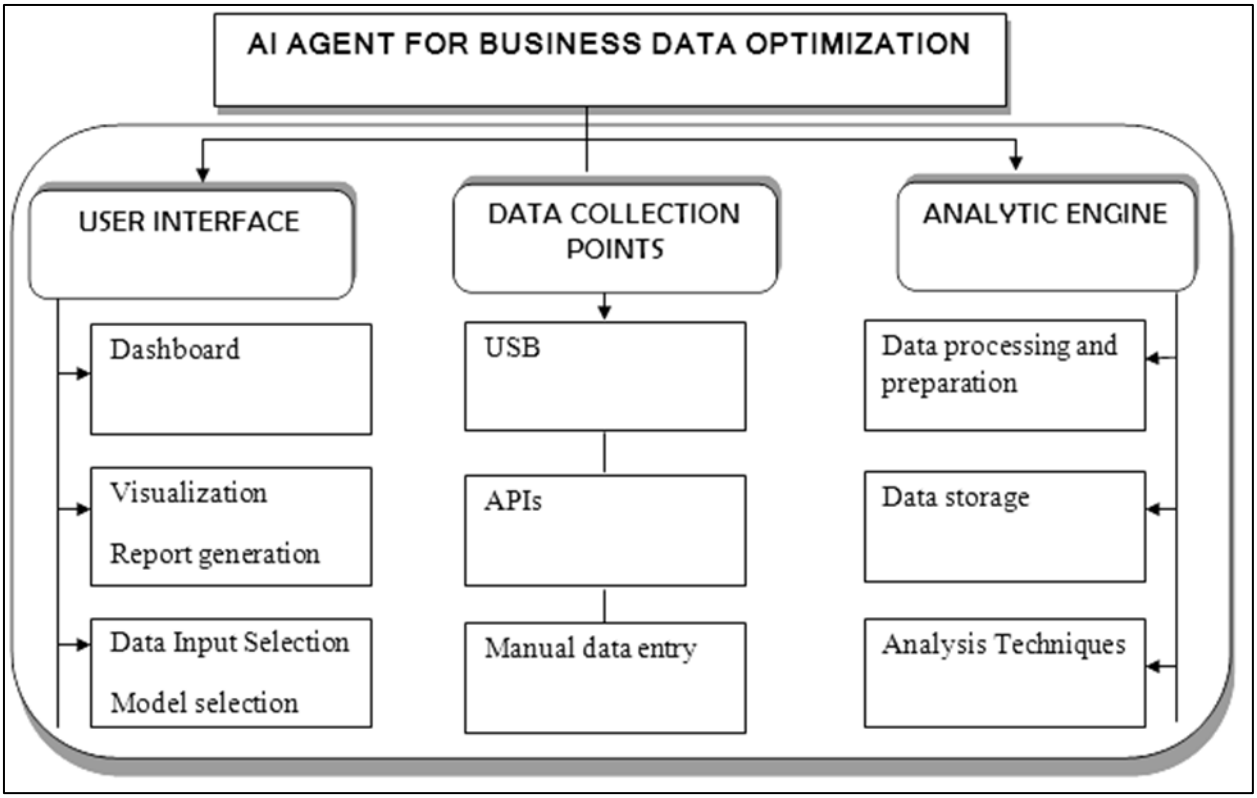

Figure 2 High Level Model diagram of proposed system

The interface would enable users of select model technique for analysis, view visualizations and generate reports. The data collection sources would include databases, CRM systems, ERP systems, spreadsheets and other internal repositories where business data is stored. APIs from third party services, social media platforms (twitter), market research, IOT devices and publicly available datasets. Analytic engine would perform both descriptive and prescriptive analytics to summarize historical data and visualize trends as well forecast future events /outcome using historical data.

4. Conclusion

In conclusion, the thesis affirms that AI agents hold immense potential for optimizing business data and enhancing operational efficiency. The integration of AI into business processes can lead to informed decision-making and a competitive edge in the rapidly evolving marketplace. However, successful implementation requires careful consideration of factors such as data integrity, model transparency and user engagement.

Recommendations

Based on the finding of this thesis, several recommendations are proposed for businesses looking to implement AI agents for data optimization:

- Invest in data quality: organizations should prioritize data governance frameworks to ensure high-quality, accurate, and comprehensive datasets for AI training and analysis.

- Foster collaboration: encourage collaboration between data scientists and business unit so as to ensure that AI models are aligned with strategic objectives and industry-specific requirements.
- Data security protocols: strengthen data protection measures and comply with relevant regulations to safeguard sensitive business information when utilizing AI technology.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest. As this is the contribution of the aforementioned authors.

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