Application of Generative Artificial Intelligence in Business Analytics: Innovations and Challenges

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Abstract: Generative Artificial Intelligence (GAI) is increasingly being used in the field of business analytics (BA) and has important research significance. The main question of this study is to explore how GAI can improve the efficiency of BA and solve existing problems. Through literature review and case analysis, this paper deeply explores the application of GAI in predictive analysis, sentiment analysis and customized services, as well as its actual cases in real estate search and enterprise operations. The main conclusion is that GAI can significantly improve the efficiency and effectiveness of BA through efficient data processing and analysis, personalized services and operational optimization. However, GAI also faces challenges such as data accuracy, copyright infringement and complexity of the generation process, which need to be addressed by enhancing content accuracy and transparency and strengthening data security measures. This paper recommends the formulation of relevant regulations to ensure the ethical use of GAI and promote the continuous improvement of technology to achieve the best application of GAI in BA.

Keywords: Generative Artificial Intelligence, Business Analytics, Predictive Analytics, Customer Service, Operational Efficiency.

1. Introduction

1.1. Development of GAI

GAI is now in full swing, and various GAI software are emerging in an endless stream. Among them, the mainstream GAIs are ChatGPT, DALL-E, Bard, Bing Chat, etc. Artificial intelligence-generated content (AIGC) is one of the most cutting-edge technologies, which enables users to automatically create content such as images, texts, and videos according to personalized needs. ChatGPT is a representative tool among them. It has exceeded 100 million monthly active users in just two months since its launch [1]. ChatGPT relies on deep learning, unsupervised learning, instruction fine-tuning and other technologies to demonstrate powerful language understanding and generation capabilities [1]. The development history of ChatGPT includes continuous iterations from GPT-1 to GPT-4. GPT-1 introduced unsupervised learning [1], and GPT-2 used more network parameters and data for training, which improved the generalization ability of the model [1]. GPT-3 combined meta-learning and contextual learning, greatly improving the generalization ability of the model [1]. GPT-4 further improved the ability to solve multimodal tasks [1].

In addition to ChatGPT, there are many GAIs. Google's Bard is an experimental conversational AI service, initially powered by LaMDA and later by PaLM 2 LLM [2]. Bard also demonstrated the power of GAI in conversation and text generation. Another GAI launched for browsers is bing chat. It is an AI chat tool launched by Microsoft to supplement the Bing search engine [3].

1.2. Possible Problems in the BA Process and Improvements that GAI can Make

BA is now very popular in the business field. As a business discipline that integrates many business applications such as fraud detection, risk mitigation, product pricing, marketing campaign optimization, financial planning, employee retention, talent recruitment and actuarial estimation, BA is almost widely used in all aspects of business [4].

However, BA is also facing many problems with the continuous development of modern business. First, modern enterprises are faced with massive amounts of data, and traditional data processing and past analysis methods are difficult to meet the needs.

Secondly, although the speed of business development is constantly increasing, data scientists in the market, that is, BA professionals, are very scarce [4]. Big data is usually messy and dirty, and needs to be processed strategically to be transformed into actionable insights. In addition, data security and privacy protection are also important issues. The emergence of GAI has solved these problems of BA to a certain extent. Because GAI has high computational efficiency [5]. By automating data processing and analysis, efficiency can be greatly improved [4]. GAI can also fill this gap to a certain extent, reducing dependence on professional talents through automated analysis and report generation, and improving data quality through automated data cleaning and classification. It can reduce costs through the as-a-service model, making it easier for enterprises to implement [4]. Even though ChatGPT may not be a decision maker in business, it possesses human creativity and the ability to present comprehensive summaries from different perspectives that humans may not have considered [6]. This article introduces several popular GAIs and their principles and technologies, and explores the application scenarios of GAI in BA. It analyzes in detail the actual applications of GAI in reality, discusses the challenges faced by GAI in BA, and puts forward relevant solutions and future development suggestions.

1.3. Features and Advantages of GAI

GAI has significant advantages in many aspects. First, it optimizes the software development process by leveraging large-scale language models (LLMs) and GPT-based services, automates the developer environment, optimizes tools and workflows, and promotes continuous process improvement [7]. GAI is particularly good at improving developer productivity, especially when dealing with repetitive and templated tasks [7]. However, GAI still faces some challenges for tasks that require high creativity or complex skills [7].

Different types of AI, including GAI, supervised learning, unsupervised learning, and reinforcement learning, all play an important role in software development [7]. Combining these AI types can further improve productivity, such as by automating system configuration to adapt to user preferences [7]. The collaborative use of various types of AI drives continuous improvement in the software development process [7].

The main research question of this paper is to explore the application of GAI in the field of BA and the advantages and challenges it brings.

2. Principles and Technologies of GAI

The history of generative artificial intelligence (GAI) can be traced back to Alan Turing's basic research and the birth of the chatbot ELIZA [8]. The earliest technologies included rule-based expert

systems and recursive neural networks. With the development of machine learning and deep learning, the field has made great progress [8]. In this field, generative models came into being, using neural networks to generate new content based on existing data [9]. These models are trained to understand complex data distributions and generate data outputs similar to the real world [9].

Deep generative models create new and similar samples by learning high-dimensional probability distributions from limited data sets [9]. In recent years, AI has become a trend. After the emergence of GAI represented by ChatGPT, the field of artificial intelligence has ushered in another innovation. Prior to this, the development of artificial intelligence has gone through several stages. During the Industrial Revolution, people learned to make machines to help humans achieve a leap in productivity. Today, the birth of GAI and artificial intelligence further reflects the transformation of productivity. Generative AI tools such as OpenAI's GPT and Google's Bard all use Transformer-based models to generate text, pictures, videos, audio, and code [8]. The rapid popularization of these tools has greatly improved the creativity and productivity of the industry and changed the landscape of multiple industries in the future [8]. The application of GAI has evolved from simple text generation to complex applications that can produce high-quality and diverse content [8]. GAI's applications cover multiple fields and can generate unique content in multiple modalities, including text, images, videos, code, sound, etc. [9]. The GAI application system architecture contains three main layers: model layer, connection layer, and application layer, which interact with users and data to produce diverse and innovative outputs [9].

3. Use Cases of Generative AI in Business Analytics

With the development of GAI, many GAIs have emerged, and the most famous one is ChatGPT. So, taking ChatGPT as an example, what benefits ChatGPT can provide in the BA field? In the BA field, GAI can provide higher efficiency in terms of prediction, analysis, and mapping, capturing newer data, and more efficient summarization. It can process vast amounts of information quickly and accurately, providing valuable insights.[8].

By asking the ChatGPT4.0 model, we can get what answers ChatGPT can do for the BA field (see Figure 1).

Figure 1: ChatGPT's answer

3.1. Analyzing Data

According to discussions with ChatGPT and a review of relevant literature, one significant application of ChatGPT in BA is predictive analytics. By analyzing historical data, ChatGPT can generate forecasts and identify trends, aiding businesses in making informed decisions about future market behaviors and consumer preferences [5]. At the same time, GAI further improves model accuracy by using advanced algorithms to enhance historical data, identify patterns, and refine predictions. This improves accuracy in predictive analysis. [10].

Studies have found that ChatGPT performs better than human analysts in data analysis and has smaller prediction errors. This is because human analysts tend to provide more optimistic predictions, while ChatGPT is more conservative. In other words, ChatGPT predictions can correct the optimistic bias inherent in human analysts' predictions [11]. GAI can provide more impartial advice, reduce

emotional bias and promote rational choices. The combination of man and machine promotes skill development, wise decision-making and improves market efficiency in the virtual world [12].

3.2. Sentiment Analysis

ChatGPT has proven effective in sentiment analysis, ESG (Environmental, Social, and Governance) content analysis, and corporate culture assessment [13]. By evaluating textual data from various sources, such as financial reports, news articles, and social media, ChatGPT can provide nuanced insights into public perception, company reputation, and stakeholder sentiment. These capabilities enable businesses to better understand their market environment and respond proactively to emerging trends and potential risks.

From the results of Cao and Zhai's research, they believe that GPT-4 knows how to analyze text and generate sentiment values related to keywords based on the ESG keyword list it has just generated. That is to say, the breakthrough achievements of GAI represented by ChatGPT in natural language processing can understand human natural emotions and generate sentiment values, which greatly reduces the technical requirements for researchers, because GAI's technical requirements for researchers are negligible. Cao and Zhai said that researchers only need to invest minimal technical effort in GPT-4, allowing them to focus on studying and analyzing specific problems in the finance and accounting fields. This shift could lead to a surge in research advances in the field.

3.3. Customized Services

Because of the progress of GAI such as ChatGPT in natural language understanding and the unsupervised learning model, GAI may be able to generate customized needs and services for each customer's different needs. That is, customized services for customers. ChatGPT can write automatic replies based on customers' questions, generate exclusive solutions for customers through query processing, reduce labor costs, and reduce customers' time loss. That is very important cause consumers are more likely to chat live for customer service. This can greatly increase transaction rates and promote promotions [14]. ChatGPT's reasoning ability enables them to provide customized insights [15].

The application of ChatGPT in BA has a far-reaching impact, and its wide application has caused shock not only in the business field. Not mentioning the ethical issues of artificial intelligence, the application of GAI in BA has undoubtedly promoted the development of innovation capabilities and productivity.

4.   Generative AI Application Cases in Business Analytics

How can GAI help enterprise personnel to take advantage of BA? The following are two specific cases of using GAI to help enterprises conduct BA, changing the structure of the enterprise and improving efficiency.

4.1.   Transforming Property Search with Generative AI

First, a business case using GAI methods was found on the Data Nectar website. (https://www.data-nectar.com/case-study/generative-ai-based-property-search-in-the-real-estate-industry/) This case is about using GAI to change real estate search. In this case, this website uses personalized real estate search for customers, manages customer relationships, manages data quality, and achieves customer-centric design. There are two specific applications (see Figure 2).
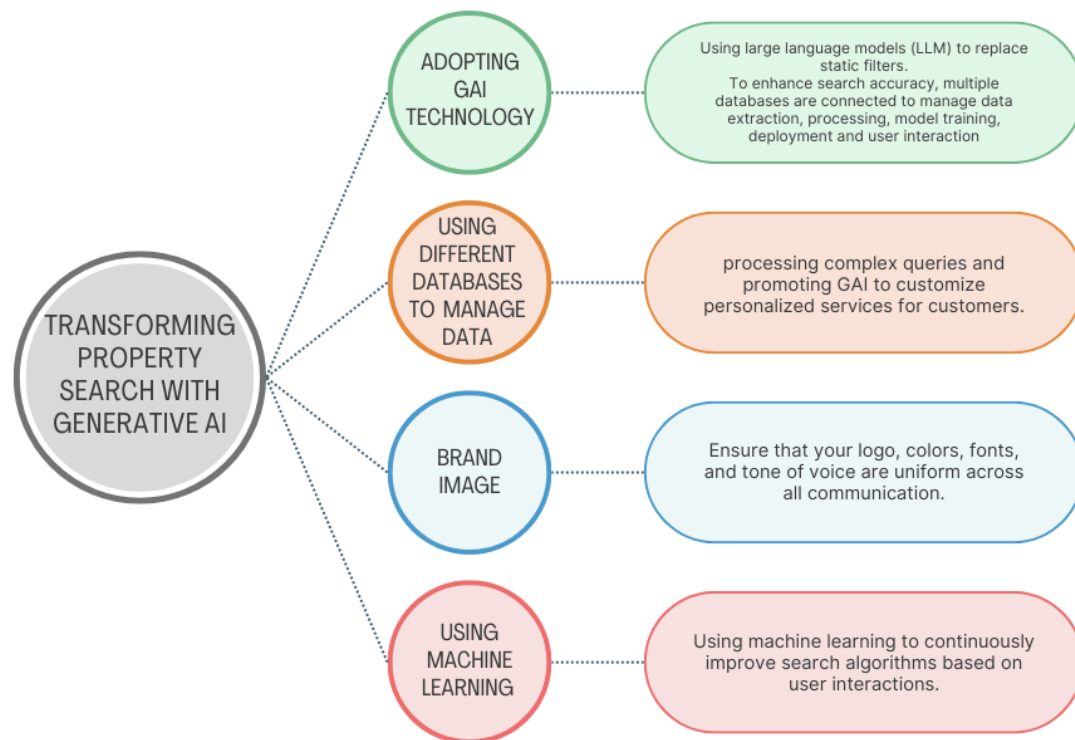
Figure 2: Transforming Property Search with Generative AI

First, adopting GAI technology: using large language models (LLM) to replace static filters, enabling users to search for real estate using natural language queries.Several hot models on the current market are pre-trained, such as: Openai, Llama, Claude, Mistral, Mixtral and Gemini models. For question-answering and text-generation tasks.

At the same time, in order to enhance search accuracy, multiple databases are connected to manage data extraction, processing, model training, deployment and user interaction. GAI is used to interpret user preferences and provide tailored real estate lists, asking questions and the relevance of countermeasure answers. Analyzing and interpreting user queries to understand potential preferences, even if they do not fully meet the specified criteria, helps retrieve relevant listings.

Second, using different databases and to centralize data management, implementing data centralization to organize customer interactions and preferences, it can break down complex queries into smaller parts, understand the relationship between different criteria, and generate optimized search results, thereby effectively balancing conflicting preferences, thereby processing complex queries and promoting GAI to customize personalized services for customers.

Third, using machine learning to continuously improve search algorithms based on user interactions. GAI can use machine learning technology to continuously learn from user interactions and preferences, and provide personalized recommendations and search results based on the unique needs of each user.

4.2. Using Generative AI to Help Enterprise Customers Enhance Operational Capabilities and Improve Production Efficiency

Secondly, a case study of using GAI to help enterprise customers enhance operational capabilities and improve production efficiency was also found on the AWS website (https://aws.amazon.com/cn/solutions/case-studies/innovators/infor/).The company's vision is to provide AI-driven insights into customer workflows and operations to optimize business processes. Infor uses GAI technology on the AWS platform to enhance its enterprise resource planning system and develop richer and more complete solutions to help companies gain more access to data, processes and customer relationships and gain insights from them. Specific applications include:

4.2.1. Intelligent Supply Chain Management:

Review and analyze historical data through GAI, use GAI to generate more accurate demand forecasting models, and improve inventory management efficiency. And monitor the supply chain status in real time, automatically handle abnormal situations, and reduce inventory backlogs and shortages. Improve the company's efficiency

4.2.2. Financial Management:

GAI identifies anomalies in financial data and prevents fraud. At the same time, the application of GAI in financial management can help effectively identify and prevent potential risks to ensure the financial health of the company.

Provide financial forecasts and budget planning to help companies make smarter financial decisions.

4.2.3. Data Analysis Drives Decision-making:

Through GAI analysis, companies can make data-based decisions to improve accuracy and efficiency. This is a significant improvement in the rapid expansion of new markets. GAI analysis discovers customer advantages and helps accurately position companies in which regions their demand is growing, and accurately provides more services in regions with growing demand. This helps improve the company's decision-making efficiency and optimize resource allocation.

5. Challenges of Generative AI

5.1. Authenticity of GAI-generated Content

The application of GAI (GAI) is becoming more and more widespread, but its adverse effects have also attracted the attention of many scholars and industry experts. The first is the issue of the authenticity and reliability of the content. The authenticity of data is crucial in BA. When using the ChatGPT3.0 model, ChatGPT often generates wrong answers and the accuracy is not high. For example, if you want ChatGPT to output some answers based on the text provided by the provider, sometimes ChatGPT only generates some confusing answers based on the provider's large question statements, and cannot truly output the content that the questioner wants. Kar's research also mentioned that GAI may be used to create false news and deep fakes to mislead the public [16]. When using the ChatGPT4.0 model, this situation has improved and the accuracy has also increased, but sometimes unsatisfactory answers are still generated. This is because GAI is generated based on a large amount of training data, and the generated text may contain inaccuracies, biases, and other forms of misinformation, thereby undermining the credibility of academic research and public information [4].

5.2. GAI's Copyright Infringement and Data Security Issues

Therefore, when GAI is used in the business field, the output of some results should also be particularly careful. Because the data accuracy required in the business field is more accurate than the usual scenarios of using GAI. If GAI makes a mistake at this time, it may cause an irreversible disaster. Secondly, the infringement of AI is also a more serious part. Using existing photos to train AI models has caused copyright issues [16]. After pictures, data, and documents are captured by AI learning, they are borrowed without authorization or consent of the original author, which will cause serious data infringement. And during the test process, if ChatGPT is asked to write a paper summary, even if the source of the document is given, if ChatGPT is not told to cite it in some form in the dialog box, ChatGPT will not actively indicate the author and source. This has led to the situation where some technicians in the data analysis process infringe the copyright without knowing it. Data may be lost, leaked, illegally accessed, tampered with, and even involve user privacy and corporate secrets. Therefore, data security protection in a big data environment is a major challenge facing BA [17]. In addition, due to the complexity of GAI, its generation process lacks transparency and explainability, which makes it more difficult to evaluate and control the generated content [17].

6. Conclusion

Applying GAI (GAI) to BA brings both opportunities and challenges. The research questions in this paper revolve around what GAI is, how GAI can be used to enhance analytical efficiency, specific cases of GAI in BA, and challenges that GAI still faces in BA applications. The research steps involve a comprehensive literature review and case studies, focusing on the integration of GAI in various business scenarios.

Main conclusions: GAI, especially ChatGPT, significantly improves the efficiency and accuracy of data analysis, sentiment analysis, and customer service through advanced algorithms and natural language processing technology. For example, GAI can provide more objective suggestions and reduce sentiment bias. At the same time, GAI's breakthrough in sentiment analysis enables companies to understand the market environment better and actively respond to changes. Specific application cases demonstrate the actual benefits of GAI: Through specific case studies of real estate search and enterprise operation optimization, GAI's significant effects in improving customer satisfaction, optimizing business processes, and enhancing operational efficiency are demonstrated. For example, GAI provides personalized search results, improves customer relationship management, and improves the productivity of enterprises through intelligent supply chain management and financial management (Infor & AWS case).

Challenges and future prospects: Although GAI has great potential in business analysis, the authenticity and data security issues of its generated content still need to be addressed. Future development should focus on improving the accuracy and transparency of GAI-generated content and developing relevant regulations to ensure data security and ethical use. By continuously improving GAI technology and strengthening data protection measures, GAI is expected to play a greater role in promoting productivity and innovation.

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