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LARGE LANGUAGE MODELS: BUSINESS APPLICATIONS AND DEVELOPMENT PROSPECTS

Abstract. The article explores the potential of large language models (LLMs) in business. The main areas of their use are identified, including customer service, marketing and sales, internal operations, product development and innovation. The benefits of implementing LLMs are analyzed, such as increasing efficiency, reducing costs, improving service quality and stimulating innovation. The challenges and limitations associated with the use of LLMs are considered, in particular, issues of data quality, cost, security, ethics and the need for human control. The prospects for the development of LLMs and their impact on the future business environment are outlined, including hyper-personalization, automated decision-making, employee empowerment, the creation of new business models and multimodality. The conclusion is made about the significant potential of LLMs for business transformation and the importance of further research in this area.

Keywords: large language models, artificial intelligence, business, efficiency, innovation, automation, development prospects.

Introduction

The rapid development of artificial intelligence technologies, in particular large language models (LLMs), opens up broad prospects for their application in various areas of public life, including business. LLMs demonstrate impressive capabilities in understanding and generating natural language, which stimulates the emergence of innovative business models based on automation, personalization and intelligent data analysis. At the same time, there is a need to understand the potential benefits and risks associated with the implementation of LLMs, their impact on the labor market and the economy as a whole. Insufficient understanding of the limits of applicability of these technologies can lead to ineffective investments and potential losses. Large Language Models (LLM) are of great importance to large businesses, providing a wide range of opportunities to optimize processes, improve customer interactions, and make informed decisions. This article discusses the main benefits and use cases of LLM for large businesses.

Analysis of recent research and publications. The idea of creating artificial intelligence originated in the middle of the 20th century. The fundamental article in this direction was Alan Turing's "Computing Machinery and Intelligence" (1950), where the concept of thinking machines was first proposed and the Turing test was formulated. Further development of the field is associated with the work of Arthur Samuel "Some Studies in Machine Learning Using the Game of Checkers" (1959), in which the term "machine learning" was introduced and a checkers program capable of learning from its own experience was described. A revolutionary step was the creation of the first mathematical model of a neural network in the article "A Logical Calculus of the Ideas Immanent in Nervous Activity" (1943) by Warren McCulloch and Walter Pitts.

The development of reinforcement learning is associated with the work of Richard Sutton "Learning to Predict by the Methods of Temporal Differences" (1988), which introduced the temporal difference method, which became one of the main algorithms for reinforcement learning. The Transformer architecture, presented in the article "Attention is All You Need" (2017) [1], revolutionized the field of natural language processing and became the basis for most modern LLMs.

Recently, much attention has been paid to the development of models capable of "reasoning" such as ChatGPT o1-preview from OpenAI, which can generate a chain of thoughts before issuing a response, which significantly improves their performance[2][3].

Modern scientific research pays considerable attention to studying the potential of LLMs in various business sectors, as well as analyzing the challenges that arise in the process of their integration.[4][5][6][7][8] Separately, the economic feasibility of implementing these technologies is investigated, including an assessment of the costs and benefits that accompany their deployment, and a proposal, CEBench (Fig. 1) is introduced as a method for assessing [9]. In addition, considerable attention is paid to the issues of overcoming existing limitations of LLMs, in particular, improving their productivity, adaptability and efficiency in specific business scenarios [10]. Since LLMs are systems that operate with large amounts of data, the safety of their use remains a critically important aspect. In this regard, threats associated with possible vulnerabilities of models and risks of confidential data leakage, as well as measures to minimize the impact of these risks on information security are considered [11].

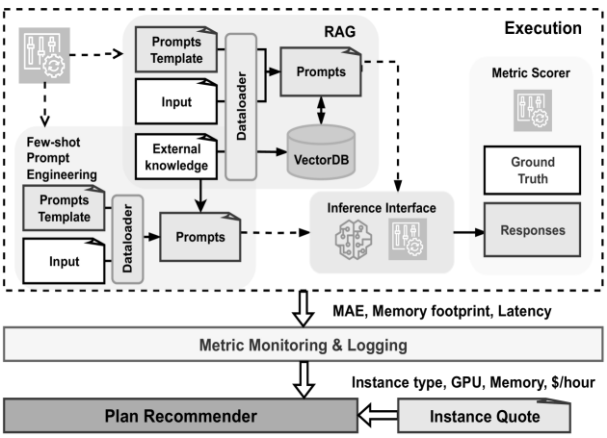

Fig. 1. Workflow of benchmarking LLM pipelines using CEBench

Research objective. The purpose of this study is to analyze the potential applications of large language models (LLMs) in business, identify the main areas of their use, as well as determine the advantages, challenges and limitations associated with their implementation. In addition, the work aims to outline the prospects for the development of LLMs and their impact on the future business environment.

Presentation of the main material

Main areas of application of LLMs in business. LLMs are increasingly being used in various aspects of business, transforming traditional approaches and opening up new opportunities for process optimization and efficiency improvement. It is useful to consider the application of LLMs in the context of key business functions.

Customer service. LLMs are revolutionizing the customer service industry by automating and personalizing interactions at various stages.

Chatbots and virtual assistants. The use of LLMs allows you to create intelligent chatbots and virtual assistants capable of conducting meaningful dialogues with customers, simulating a live conversation. These systems can not only provide reference information, but also solve complex problems, provide qualified support, place orders and perform other operations 24/7. This approach allows you to significantly reduce the load on contact center operators, optimize service costs and increase its availability and efficiency.

Feedback analysis. LLMs provide the ability to effectively analyze large amounts of text data containing customer feedback collected from a variety of sources: social networks, surveys, e-mail, forums, etc. Through deep semantic analysis, LLMs identify key topics, detect trends, determine the emotional coloring of statements (positive, negative, neutral) and isolate problematic aspects that concern customers. This allows companies to obtain valuable information for improving products and services, increasing the quality of service and responding promptly to complaints.

Personalization of offers. Based on the analysis of customer data (purchase history, views, behavioral factors, demographics, preferences), LLLs generate personalized recommendations for products, services, and special offers. This approach takes into account the individual needs and interests of each customer, which contributes to increased conversion, increased average transaction value, and strengthened brand loyalty.

Marketing and sales. LLMs open up new opportunities for automating and optimizing marketing activities and sales processes.

Content generation. LLMs are able to automatically create a variety of high-quality marketing texts: product and service descriptions, articles for blogs and websites, posts for social networks, advertisements, video scripts, email newsletters, etc. This allows content marketers to significantly save time and resources, automate routine tasks, and focus their efforts on solving strategic issues, developing creative concepts, and analyzing content effectiveness.

SEO optimization. LLMs help optimize content for search engines. They analyze current search queries, the semantic core, and create text content that is as relevant as possible to these queries, which improves the website's ranking in search results, increases organic traffic, and, as a result, increases the company's visibility in the online environment.

Market and competitor analysis. LLMs are able to analyze large amounts of data about the market, the competitive environment, the target audience, and consumer trends. They identify new market niches, determine promising development directions, identify the strengths and weaknesses of competitors, and also form forecasts about future trends. Such analytics allow companies to make strategically sound decisions regarding product development, pricing, positioning, promotion, and other aspects of marketing activities.

Internal operations. LLMs help optimize internal business processes, automate routine operations, and increase employee efficiency.

Document workflow automation. LLMs allow you to automate the processing of various documents, such as invoices, contracts, acts, reports, etc. They are able to recognize text, extract structured data from it (for example, names of counterparties, dates, amounts, product nomenclature), classify documents, automatically fill in the corresponding fields in information systems and databases, and detect errors and discrepancies. This speeds up the document processing process, minimizes the number of manual operations, and reduces the likelihood of errors associated with the human error.

Knowledge management. LLMs can serve as the basis for creating corporate knowledge bases that aggregate information from various internal sources. Thanks to semantic search capabilities, LLMs allow employees to quickly find the necessary information, instructions, regulations, answers to frequently asked questions, as well as share experience and best practices. This helps to increase productivity, reduce the time for adapting new employees and ensure the effective use of the company's accumulated experience.

Decision support. LLMs are capable of analyzing large volumes of internal company data and providing analytical insights that can be used by managers to make more informed and effective decisions. For example, LLMs can detect hidden patterns in financial indicators, predict risks, identify potential problems, and suggest solutions.

Product development and innovation. LLMs stimulate innovative activities of companies and contribute to the development of new products and services.

Idea generation. LLMs can generate new ideas for products, services, business models, marketing campaigns, etc. Using machine learning methods and analyzing large amounts of data about the market, competitors, consumer trends, and technological innovations, LLMs offer creative and unconventional solutions that can become the basis for breakthrough innovations and help companies stay ahead of their competitors.

Prototyping. LLMs can be used to speed up the prototyping process. For example, in the field of software development, LLMs are able to generate parts of code or even entire software modules based on a textual description of their functionality. In the field of design, LLMs can create sketches, mockups, and other visual elements. This allows you to reduce the time and cost of the prototype development phase and move faster to testing and implementing new products.

Testing and feedback. LLMs can be involved in the testing process of new products. They can generate test scenarios, analyze test results, and collect and process user feedback in the early stages of development. This allows them to identify potential problems and shortcomings of the product before it is released to the market, as well as take into account user wishes for its improvement.

Examples of practical application of LLMs. *Business Process Management*. Research shows that LLMs can extract imperative and declarative business process models from textual descriptions with accuracy that surpasses traditional approaches, opening up new opportunities for automating business process analysis and optimization.[12]

Financial analysis. Models like GPT-4 demonstrate high performance in predicting changes in company profitability based on standardized financial statements, even outperforming professional financial analysts in forecast accuracy.

Fig. 2 compares the forecasting performance of GPT and human analysts. The naive model is based on extrapolating the change in previous earnings to the current change in earnings. Analyst 1m (3m, 6m) denotes the median analyst forecast issued one (three, six) months after the earnings release. GPT (without CoT) denotes GPT forecasts without any chain-of-thought prompts.

In this case, the model is provided with only structured and anonymized financial statement information. GPT (with CoT) denotes the model with financial statement information and detailed chain-of-thought prompts. Accuracy (percentage of correct forecasts out of total forecasts) for each method (left) and F1 score (right) [13].

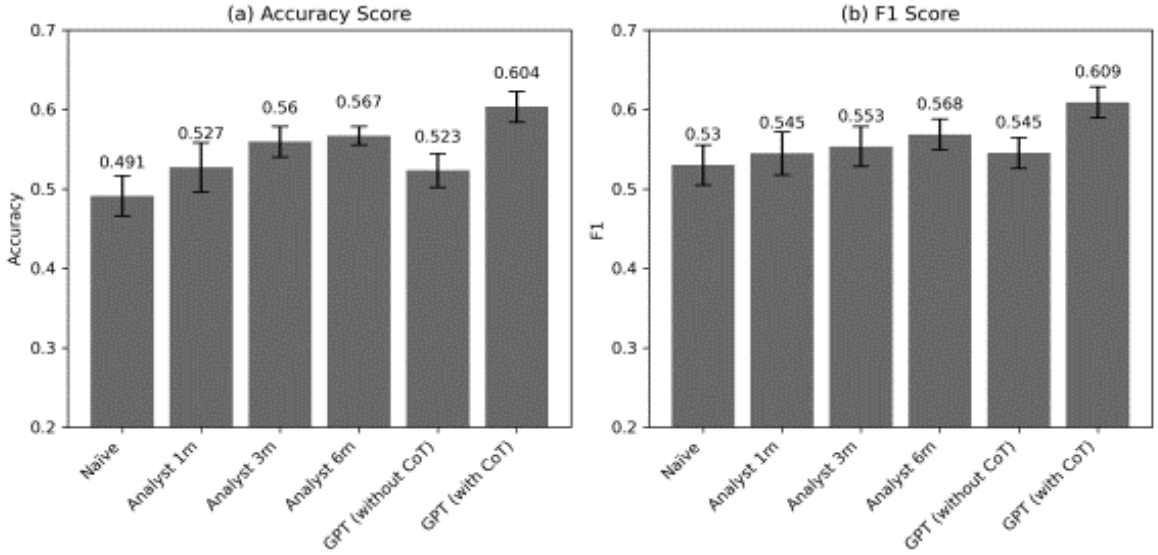

Fig. 2. GPT vs. Human Analysts

Text analysis. LLMs such as ChatGPT are effectively used for sentiment analysis in texts, for example, in customer reviews, as well as for automatic summarization of large amounts of text information and content generation [14]

Translation. LLMs provide high quality and naturalness of text translation, which is critically important for companies operating in global markets, outperforming traditional machine translation tools in these indicators.

Code generation. LLMs significantly simplify and accelerate the software development process by automating code generation and allowing you to obtain analytical data from databases using SQL queries.

Data analysis. LLM's ability to identify patterns, trends, and anomalies in large data sets opens up vast opportunities for in-depth data analysis, which contributes to making informed business decisions.

Productivity improvement. Research confirms that using LLM in consulting allows you to complete 12.2% more tasks, and do it 25.1% faster. The quality of task performance increased by more than 40% compared to the control group (Fig. 3). [15]

Benefits of Using an LLMs in Business. *Improving efficiency*. Automating routine and time-consuming tasks, such as document processing, responding to customer inquiries, and generating content, allows employees to focus on more complex, creative, and strategically important tasks, which contributes to overall productivity growth.

Cost reduction. Process automation and resource optimization using LLMs lead to a reduction in operational costs associated with manual information processing, maintaining a large staff of employees, and other cost items.

Improving customer service quality. LLMs provide fast and accurate information to customers, personalized support 24/7, which leads to increased customer satisfaction and strengthening their loyalty to the company.

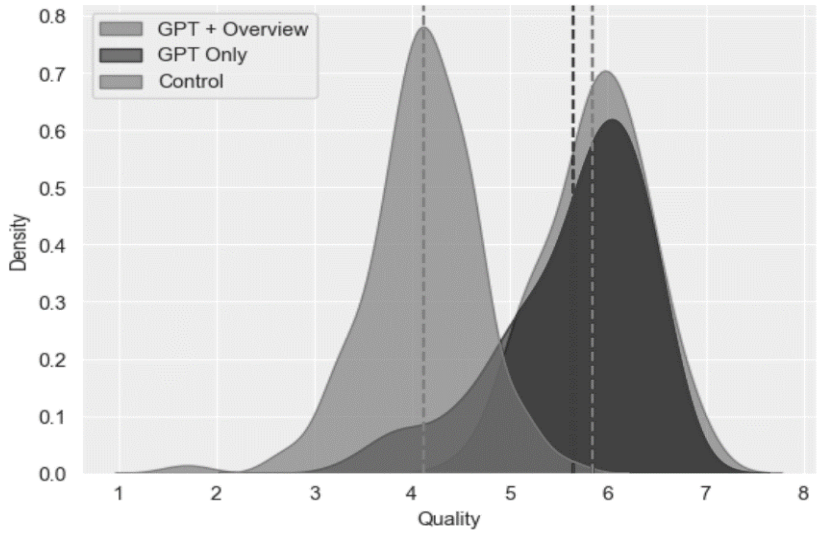

Fig. 3. Performance distribution

Stimulating innovation. Thanks to the ability to generate new ideas, accelerate the process of product development and testing, LLMs contribute to the creation of innovative solutions, which allows companies to remain competitive in a dynamic market environment.

Making more informed decisions. The analytical capabilities of LLMs, their ability to process and interpret large volumes of data, allow managers to gain a deeper understanding of the business environment, identify hidden patterns, and make decisions based on objective data rather than intuition.

Challenges and limitations. *Data quality.* The effectiveness and accuracy of LLMs is directly dependent on the quality of the data they are trained on. Using poor-quality, incomplete, outdated, or biased data can lead to inaccurate results, erroneous conclusions, and poor decision-making. Therefore, it is critical to pay attention to the quality of the data used to train and operate LLMs.

Cost. Developing, implementing, and maintaining LLMs can require significant financial investments, especially for small and medium-sized businesses. This is due to the costs of computing resources, developing and training models, attracting qualified specialists, etc.

Security and privacy issues. The use of LLMs is associated with risks of leakage of confidential information and cyberattacks. Comprehensive measures must be taken to ensure the security of data processed by LLMs and to protect systems from unauthorized access.

The need for human control. Despite the high level of automation, LLMs still require human control and oversight to ensure the accuracy, relevance, and consistency of their work results with their intended objectives. Relying entirely on LLMs to make important decisions is unacceptable.

Ethical aspects. The use of LLMs raises a number of ethical issues related to algorithmic bias, decision-making transparency, responsibility for consequences, possible misuse of technology, etc. These issues require careful consideration and regulation.

The Future of LLMs in Business. The role of LLMs in business will steadily grow in the coming years. This will be facilitated by the development of technology, the reduction in the cost of computing resources, and the accumulation of experience in the application of LLMs in various fields.

Promising directions of development and application of LLMs. *Hyperpersonalization.* LLMs will allow for even more personalized customer experiences, taking into account not only their past preferences, but also real-time contextual information such as location, mood, current needs, and intentions.

Automated decision-making. LLMs will play an increasingly important role in business decision-making, automating not only the analysis of data, but also the process of formulating recommendations and, in some cases, even taking certain actions based on those recommendations.

Employee empowerment. LLMs will become indispensable assistants for employees, providing them with quick access to the necessary information, automating routine tasks, helping to solve complex problems, and contributing to increased productivity.

Creating new business models. LLMs will open up opportunities for creating fundamentally new business models based on automation, artificial intelligence, and deep personalization, which will lead to the emergence of new markets and the transformation of existing industries.

Multimodal LLMs. Further development of LLMs will be related to the ability to process not only textual information, but also other types of data, such as images, audio and video. This will allow LLMs to understand context even better, provide more accurate and relevant results, and expand the scope of its applications.

Impact on the labor market. The introduction of LLMs will undoubtedly have a significant impact on the labor market. Some professions related to the performance of routine, repetitive tasks may be partially or fully automated. This primarily applies to professions related to the processing of large volumes of text

information, simple data analysis, providing basic customer support, etc.

However, at the same time, new professions related to the development, implementation, maintenance, and monitoring of LLMs will emerge. Machine learning specialists, data analysts, prompting engineers, AI ethicists, and other professionals with the knowledge and skills necessary to work with LLMs will be needed. Additionally, LLMs are likely to transform many existing professions, requiring workers to acquire new skills related to the use of AI tools in their work. Thus, the impact of LLMs on the labor market will be ambiguous, and it is important to prepare for these changes now by investing in education and retraining of personnel.

Conclusions

This paper analyzes the possibilities and prospects for the application of large language models in business. The application of LLMs in the following areas is considered: customer service, marketing and sales, internal operations, product development and innovation, and outlines the methods of application. Examples of practical application are also given and promising areas of development and implementation of LLMs are investigated. The speed of development of artificial intelligence necessitates continuous scientific research aimed at analyzing its functional capabilities and potential areas of application.

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Великі мовні моделі: бизнес-застосування та перспективи розвитку

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Анотація. У статті досліджено потенціал застосування великих мовних моделей (LLM) у бізнесі. Визначено основні сфери їх використання, серед яких обслуговування клієнтів, маркетинг та продажі, внутрішні операції, розробка продуктів та інновації. Проаналізовано переваги впровадження LLM, такі як підвищення ефективності, зниження витрат, покращення якості обслуговування та стимулювання інновацій. Розглянуто виклики та обмеження, пов'язані з використанням LLM, зокрема питання якості даних, вартості, безпеки, етики та необхідності людського контролю. Окреслено перспективи розвитку LLM та їх вплив на майбутнє бізнес-середовища, включаючи гіперперсоналізацію, автоматизоване прийняття рішень, розширення можливостей співробітників, створення нових бізнес-моделей та мультимодальність. Зроблено висновок про значний потенціал LLM для трансформації бізнесу та наголошено на важливості подальших досліджень у цій галузі.

Ключові слова: великі мовні моделі, штучний інтелект, бізнес, ефективність, інновації, автоматизація, перспективи розвитку.