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DeepSeek: A holistic survey of foundations, applications and ethical consideration

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Abstract
In recent years, the fields of scientific research have been significantly influenced by advancements in artificial intelligence (AI), machine learning, and tools such as ChatGPT. Recently, Deepseek has emerged as a prominent player in this domain, evolving into a sophisticated large language model (LLM) that has attracted considerable attention for its innovative contributions to AI initiatives. Deepseek is characterized by enhanced efficiency and reasoning capabilities, which contribute to cost reduction in various applications. This paper aims to deliver a thorough review of Deepseek's background, its diverse applications, the challenges it faces, biases, ethical considerations, limitations, and its future prospects. The advancements made by Deepseek, particularly in areas such as code generation, mathematical reasoning, and natural language processing, position it as a competitive alternative to established AI models like ChatGPT. Nevertheless, issues related to computational resource limitations, biases, and ethical considerations pose significant challenges to its effective implementation and widespread adoption. Additionally, this paper will explore the ethical implications associated with open-source AI models and their vulnerability to misuse. It is important to acknowledge that despite the controversies and challenges surrounding Deepseek, its ongoing enhancements—such as multilingual capabilities and community-driven research—indicate a promising trajectory for the future. This review seeks to provide a deeper understanding of the emerging Deepseek AI technology, its influence on AI research, and potential avenues for future development.

Keywords: DeepSeek, Artificial Intelligence (AI), large language model, chatGPT, code generation, natural language processing

1. Introduction
In a world where information is power, the ability to access relevant data quickly and efficiently has become a cornerstone of success. Traditional search engines often fall short in understanding user intent and providing nuanced results. Generative AI models rely on deep learning techniques and neural networks to interpret the input by proper analyze, and able to generate result that deeply resembles human-generated outputs. DeepSeek represents a paradigm shift by leveraging AI technologies to enhance the depth and precision of search capabilities, it has become one of the powerful tool with its wider applicability in different domains. Examining the origins and progress of Deepseek is essential for understanding its contribution to the enhancement of scientific research. This section offers a summary of the background, significant milestones, and advancements achieved in the evolution of Deepseek, emphasizing the technological innovations that have contributed to its success within the scientific field. In this regard, it is noteworthy that, in contrast to earlier AI-driven models such as Google and ChatGPT, which function primarily as search engines and concentrate on producing human-like responses, Deepseek incorporates semantic comprehension and a knowledge graph for specialized and accurate data retrieval. The development of Deepseek was driven by the desire to create a highly sophisticated and versatile AI language model capable of improving information retrieval and question-answering systems. It has been developed to overcome the limitations of earlier coming chain models in terms of accessability, efficiency, cost and technical reasoning. (Roumeliotis & Tselikas, 2023) [15].

1.1 Key milestones in the development of Deepseek

DeepSeek, a Chinese AI company founded in 2023, has achieved several significant milestones in artificial intelligence development:

- **DeepSeek LLM series:** In November 2023, Deepseek released featuring models with 7 billion and 67 billion parameters in both Base and Chat configurations. This surpasses the many open-source LLMs at the time, including Llama 2.
- **DeepSeek MoE models:** The company introduced these two models in January 2024 each with 16 billion parameters. These models help in enhancing performance without compromising the level of efficiency.
- **DeepSeek Math series:** In April 2024, this model is having special capabilities to deal with mathematical reasoning as these models were trained on extensive mathematical datasets, including the DeepSeek Math Corpus and Algebraic Stack to tackle mathematical problems.
- **DeepSeek V2:** In May 2024, introduced DeepSeek-V2 as a language model compatible to other AI technologies with lower pricing and easy affordability.
- **DeepSeek V3:** In January 2024, the company came with its enhanced featured which outperformed OpenAI's GPT-4 in AI capabilities and innovation.

1.2 Improvements and innovations in DeepSeek

DeepSeek, a Chinese AI company founded in 2023, has introduced several innovations that have significantly impacted the artificial intelligence landscape.

- **Cost-Effective AI Models:** DeepSeek R1 model introduction led to cost effectiveness in comparison to other AI models like ChatGPT and provide exceptional services.
- **Open-Source Approach:** R1 Model also improved the accessibility bandwidth of open AI features, which includes other users and organization to build their work on this.
- **Efficient Training Techniques:** DeepSeek -V3 Model by using innovative and more advanced training methods which can help in reducing the level of energy consumption and also reduce computational costs.(Fu *et al*., 2024) [8]

1.3 Existing issues that DeepSeek can resolve:

DeepSeek, through its cutting-edge AI models and effective methodologies, possesses the capacity to tackle several significant challenges currently confronting the AI sector. (Normile, 2025) [13], (Cetin, 2024) [5]. In light of the increasing urgency surrounding climate change and the imperative of environmental sustainability, DeepSeek - V3 emphasizes energy-efficient model training techniques, thereby contributing to the reduction of the carbon footprint associated with AI development. Historically, the most advanced AI models have been predominantly controlled by a limited number of large organizations, which often lack the necessary innovative capabilities. However, with the introduction of DeepSeek, open-source access is made available to a broader demographic, including startups, enabling them to incorporate advanced models into their applications without the burden of prohibitive costs. Furthermore, the previous focus on a limited range of languages, primarily English and a few global languages, restricted access for users of other languages. DeepSeek has addressed this limitation by enhancing its multilingual capabilities, thereby increasing accessibility for non-English speaking populations. (Fei *et al*., 2025) [6], (Bai *et al*., 2025) [3]. Additionally, DeepSeek's commitment to creating more transparent and efficient AI systems has the potential to mitigate bias. By providing open-source models, the platform encourages greater community oversight. Collectively, these initiatives by DeepSeek aim to resolve the challenges that have emerged from earlier AI models.

1.4 Key contributions

DeepSeek has significantly accelerated the adoption and innovation of artificial intelligence across a multitude of sectors, enabling developers, enterprises, and researchers to expand the horizons of AI capabilities. (Fu *et al*., 2024) [8]. This article outlines several contributions aimed at enhancing the understanding of ChatGPT for both academics and enthusiasts. Key contributions include the following.

- A comprehensive review of DeepSeek within the current landscape.
- A comparative analysis of DeepSeek and other related AI technologies.
- An exploration of the diverse applications that can be facilitated through DeepSeek.
- A discussion of the existing challenges, ethical dilemmas, controversies, and potential future directions.
- An examination of computer ethics and the challenges posed by DeepSeek in this domain.
- To discuss about biases and key limitations of DeepSeek.

1.5 Organization of paper

This review article seeks to conduct a comprehensive examination of DeepSeek's contribution to overcoming the aforementioned traditional bottlenecks. The structure of the paper is delineated into several sections: an overview of DeepSeek, an analysis of related technologies that share certain characteristics with DeepSeek, the applications of DeepSeek across diverse fields, significant challenges, ethical issues, controversies, future prospects, considerations of ethics and biases, and ultimately, the conclusion of the study.

2. Background of DEEPSEEK

The organization is based in Hangzhou, Zhejiang, and operates under the official name Hangzhou DeepSeek Artificial Intelligence Basic Technology Research Co., Ltd. DeepSeek has attracted considerable attention for its ability to develop sophisticated AI models at a significantly lower cost and with reduced energy consumption compared to established entities such as OpenAI. (Zhang & Shao, 2024). [20]. For example, the DeepSeek-R1 model was trained using around $6 million in computational resources, a stark contrast to the $100 million allocated for OpenAI's GPT-4. This remarkable efficiency has enabled DeepSeek to launch AI applications that have rapidly gained traction, outpacing competitors in terms of download statistics. Furthermore, DeepSeek has embraced an open-source philosophy in its AI development, providing access to its models and training methodologies for public use and modification. This approach has democratized the availability of advanced AI

technologies, allowing a wider array of developers and researchers to engage with and enhance AI innovations. (Zhang & Shao, 2024) [20]. Despite encountering obstacles, such as U.S. sanctions on the export of advanced semiconductors to China, DeepSeek has persisted in its innovative efforts, thereby disrupting the AI sector. The company's achievements have sparked discussions regarding the global AI landscape, with some analysts positing that DeepSeek's progress could reshape the competitive relationship between China and the United States in the AI domain. In summary, DeepSeek's swift ascent and pioneering contributions have established it as a formidable entity in the global AI industry, impacting both technological advancement and international rivalry.

1. The OpenAI Initiative

OpenAI is an organization dedicated to the advancement of artificial general intelligence (AGI) with the aim of benefiting humanity. Established in 2015 by notable figures including Elon Musk and Sam Altman, OpenAI has emerged as a leader in AI research, creating several innovative models such as GPT-2, GPT-3, ChatGPT, and most recently, DeepSeek. Building on the achievements of ChatGPT, OpenAI has furthered its research and development initiatives, culminating in the introduction of DeepSeek, which utilizes a mixed architecture. By providing access to powerful AI models at a lower cost, DeepSeek is working to democratize AI tools and reduce the financial obstacles that have traditionally hindered smaller entities in the AI landscape. Although OpenAI has made some versions of its models available through APIs or as open models (such as GPT-2), access to ChatGPT and newer iterations like GPT-4 remains proprietary and can be prohibitively expensive, particularly for smaller developers or businesses. In contrast, DeepSeek has adopted an open-source approach, allowing models like R1 to be used and modified freely. This strategy enables developers to harness advanced AI capabilities without the need for a paid subscription or special access rights.

2. GPT Evolution

GPT models are designed to generate natural language text, which includes sentences, paragraphs, and entire documents, in a way that is coherent and consistent with human linguistic structures. A key feature of GPT models is their ability to undergo pre-training on large text datasets, followed by fine-tuning for specific downstream tasks, such as text classification or answering questions. The pre-training stage involves training the model on a comprehensive array of text, including web pages and books, in an unsupervised fashion, meaning that the model does not require explicit labels or annotations for the training data. During this stage, the GPT model learns to predict the next word in a text sequence based on the words that precede it, a process known as language modeling. (Kumar *et al*., 2024) [11]. GPT models are designed to generate natural language text, which includes sentences, paragraphs, and entire documents, in a way that is coherent and consistent with human linguistic structures. A key feature of GPT models is their ability to undergo pre-training on large text datasets, followed by fine-tuning for specific downstream tasks, such as text classification or question answering. The pre-training phase involves training the model on a vast array of text, including web pages and books, in an unsupervised fashion, meaning that the model does not require explicit labels or annotations for the training data. During this phase, the GPT model learns to predict the next word in a text sequence based on the words that precede it, a process known as language modeling. (Kumar *et al*., 2024) [11]. This task is essential for a variety of natural language processing applications. By being exposed to a large text corpus, the model develops the capability to recognize and generalize linguistic patterns, including syntax, grammar, and semantics. After the pre-training phase, the GPT model can be fine-tuned for a specific downstream task by using a smaller labeled dataset, which is used to modify the model's weights and biases to improve its performance on the assigned task. For example, in the context of text classification, the model may be trained to accurately determine the correct label for a specific piece of text.

3. GPT-1

In 2018, the first version of the GPT language model was released. The Transformer architecture, a kind of neural network designed especially for natural language processing tasks like language modeling and machine translation, served as the foundation for this model. Using a language modeling technique, GPT-1 was pre-trained on a large dataset of books, periodicals, and web content. During the training process, the next word in a text sequence was predicted using the words that came before it. GPT-1 was able to understand the underlying patterns in the large amount of textual input because to this pre-training. Despite being somewhat small, it performed exceptionally well on a range of natural language processing tasks.

4. GPT-2

The development and enhancement of its parameters have enabled GPT-2 to exceed the capabilities of GPT-1. This model was pre-trained on an extensive corpus of textual data, which encompassed books, various written materials, and web pages. A significant characteristic of GPT-2 is its ability to generate realistic and coherent text, which has posed challenges in distinguishing between machine-generated and human-written content. As a result of this concern, OpenAI opted not to release the full version of GPT-2, instead providing a smaller variant with limited functionalities.

5. GPT-3

This iteration was equipped to handle natural language processing tasks without showing the need for specialized training to perform some specific tasks. This capability arises from the model's proficiency in acquiring diverse language features and trends from its pre-training dataset. The model demonstrates an aptitude for comprehending text with minimal examples. GPT-3 is applicable in numerous domains, such as language translation, chatbots, creation of contents, and even programming new code generation. With advancements in the field of research and development in natural language processing, it has shown contribution in the realm of artificial intelligence.

6. Instruct GPT

OpenAI has created an advanced language model that enhances its reliability through the application of reinforcement learning informed by human feedback.

Unlike its predecessor, GPT, Instruct GPT employs a methodology that prioritizes human feedback during the fine-tuning phase. This strategy facilitates a comparison between the outcomes generated by the model and the results that align with human expectations, allowing for the integration of this feedback into the GPT framework. Consequently, this process aids in steering the model towards achieving more accurate results for specific tasks and inquiries.

7. ProtGPT2

ProtGPT2 serves as a resource for the engineering and design of proteins. It facilitates the comprehension of the protein language, enabling the creation and development of novel protein sequences. The pre-training of ProtGPT2 was conducted on the UniRef50 database through a self-supervised approach, utilizing unannotated raw protein sequences.

8. Bio GPT

R. Luo *et al*. introduced a model designed for the creation and analysis of biomedical text. Bio GPT is a domain specific generative pre trained transformer model that is based on transformer language model architecture.

9. ChatGPT

Just before the evolution of deepseek, ChatGPT has been introduced with many compatible features in relation to earlier AI tools. (Kumar *et al*., 2024) [11]. This model comes with extraordinary feature of natural language processing, due to this ChatGPT allows to learn and understand the relationship between words and phrases in natural language, which helps in educational field, content generation.

10. DeepSeek

DeepSeek Model has developed competitive LLMs that rival models From OpenAI, Google, and Meta. This has released Open-source AI model making it accessible for even small organizations. DeepSeek designed with multilingual capabilities making it usable to any language specific region. It also shows its strong performance in mathematics and technical reasoning making it useful for scientific and research-based applications. (Al-Moghrabi & Al-Ghonmein, 2024) [2].

3. Key Features of DeepSeek

- **Contextual Understanding:** DeepSeek understands the user's intent behind a query, even when the input is ambiguous or conversational. Due to having strong performance in mathematical terms, this helps in solving the more complex and provide more accurate results.
- **Multimodal Search:** It supports text, image, audio, and video search, making it a versatile tool for varied industries. Traditional AI based search engines rely on keyword- based matching, DeepSeek integrates AI-powered search for more context aware and accurate results.
- **Real-Time Insights:** DeepSeek analyzes live data streams, providing users with up-to-date information. This model helps in providing the tailor specific results such as reports, charts and graphs to visualize data
- According to their specific needs. By providing step-by-step reasoning enhances the transparency among the desired data analysis. By adopting this feature, DeepSeek empower users to make informed decision swiftly, adapting to the dynamic nature of data across various industries.
- **Customization and Scalability:** DeepSeek is engineered for flexibility, enabling organizations to customize its functionalities to meet their unique requirements, thereby promoting scalability across various sectors. (Campo-Ruiz, 2025) [4]. The primary objective of DeepSeek is to enhance the efficiency of AI models concerning computational resources and expenses. While earlier models such as GPT-4 demonstrate significant capabilities, they are often resource-heavy; DeepSeek seeks to optimize performance while simultaneously lowering costs.

5. Core Technology behind DeepSeek

DeepSeek operates on a multi-layered AI framework comprising:

1. **Natural Language Processing (NLP):** Using NLP, DeepSeek deciphers the context and intent of user queries, enabling conversational interactions and semantic search. This allows users to search with natural language phrases rather than relying on keywords.
2. **Deep Learning Models:** Powered by transformer-based architectures like BERT or GPT, DeepSeek analyzes vast datasets, providing contextually relevant and hierarchically structured results.
3. **Reinforcement Learning:** By integrating user feedback into its algorithms, DeepSeek continuously improves its search results, enhancing user satisfaction.
4. **Knowledge Graphs:** DeepSeek connects related data points to provide an interconnected view of information, enabling users to uncover insights that go beyond surface-level search.

5. Applications of DeepSeek across various domains

Deepseek is s suite of AI models, similar to OpenAI's GPT, designed for deep learning applications. It spans multiple domains, including natural language processing (NLP), computer vision, code generation, and scientific research. Below is detailed look at its applications across various fields.

Natural Language Processing (NLP)

- **Text generation:** Creating human like text for chatbots, automatic generation of different codes and also helps in providing virtual assistance.
- **Machine Translation:** This helps in better understanding of context and data with different languages. This helps in improving the translation.
- **Summarization:** From the full fledge books, articles, reports it helps in extracting the key points and can draw the conclusion from them.
- **Sentiments Analysis:** With its feature of understanding the purpose from the acquired feedback, it can easily do analyses of the sentiments.
- **Named Entity Recognition (NER):** DeepSeek can helps in identifying and categorizing the entities like their names, locations and organizations in text.

Code Generation & Software development

- **Code completion and Generation:** DeepSeek's open-source feature helps the users and developers to debug the codes and can use it further without the need of internet.
- **Code Translation:** Open-source feature also assists the developers in converting the code between different programming languages.
- **Automated Documentation:** Assists in developing documents like reports etc by using code comments and structures.

Computer Vision

- **Object Detection and Recognition:** DeepSeek's innovative feature helps in identifying the objects from images and videos. e.g., self-driving cars, security systems.
- **Analyse the Medical Images:** Like the humans even these AI tools can detect the diseases in X-rays, MRI's and CT scans without the need of doctors or specialists.
- **Facial Recognition:** DeepSeek's technique can be utilised in detecting the faces and helps in providing the authenticity of the individuals.
- **Image Captioning:** This tool helps in generating the whole content by using the single image or picture.

Scientific Research and Healthcare

- **Drug Discovery:** Helps in predicting the molecular interaction so that a new drug can be formed easily.
- **Climate Modeling:** DeepSeek's AI tool helps in enhancing the predictions for climate change.
- **Material Science:** Discovering new materials with AI-driven simulations.

Finance and Business Analytics

- **Algorithmic Trading:** It helps in making high frequency trading decisions based on market data.
- **Fraud detections:** It helps in identifying the suspicious transactions and behaviour.
- **Customer insights:** Due to large language models, can assist in knowing the human behaviour for personalized marketing.

Robotics and Automation

- **Autonomous Navigation:** Assists in self-driving cars and drones.
- **Human Robot interaction:** With the help of AI better decisions can be formed in various fields of healthcare and industries.

Education and E-Learning

- **Intelligent tutoring system:** AI powered devices help children and kids to better understand the concepts and theorems.
- **Language Learning Assistance:** AI driven language coaching can help in better understand in their comfort language.

Legal and Compliance

- **Contract Analysis:** It helps in extracting the key points from the whole of the documents and reports.
- **Regulatory Compliance:** Ensuring businesses adhere to legal guidelines.

Hence this shows the efficiency, accuracy and automation of DeepSeek technology. From coding to finance in healthcare and education, it enables the industries in better decisions and faster innovations.

6. Comparing DeepSeek, Google, and ChatGPT

The emergence of AI-powered tools has transformed the way we search for, retrieve, and interact with data. Among the most notable tools are Google, ChatGPT, and now DeepSeek, which aim to make information access seamless yet serve different purposes. This section compares the three based on key features, capabilities, and applications.

Table 1: Purpose and Core Focus

Platform	Purpose
Google	A traditional search engine designed for indexing and ranking web pages to deliver relevant results.
ChatGpt	A conversational AI system focused on generating human-like responses to user prompts.
DeepSeek	A contextual, AI-driven search tool that integrates semantic understanding, deep learning, and knowledge graphs for specialized and precise data retrieval.

Key Difference

- Google is primarily a web search engine, delivering keyword-based results from indexed websites.
- ChatGPT excels in natural language understanding and conversation, making it an interactive assistant rather than a search engine.
- DeepSeek combines the best of both worlds, offering contextual search with insights derived from multiple data sources, including structured and unstructured data.

Table 2: Technology and Methodology

Features	Google	Chatgpt	Deepseek
Core Technology	Search algorithms and PageRank system.	Transformer-based models (GPT architecture).	Transformer models + NLP + Knowledge Graphs.
Natural Language Processing	Basic intent understanding (e.g., FAQs).	Advanced, conversational NLP.	Advanced, semantic NLP for nuanced queries.
Deep learning	Limited use in personalized search.	Fully deep learning-driven.	Integrates deep learning with reinforcement learning for improving search results.
Multimodal capabilities	Limited (text, images).	Limited (text generation).	Supports text, image, audio, and video search.

Key Difference

- Google focuses on retrieving links from the web, relying on keyword relevance and ranking.
- ChatGPT generates responses but does not retrieve information dynamically from the web.
- DeepSeek provides structured, real-time, and multimodal data retrieval, surpassing both in complexity and depth.

Table 2: Search Capabilities and Use Cases

Criteria	Google	Chatgpt	Deepseek
Search depth	Indexes public web pages but struggles with nuanced contexts.	Limited to pre-trained knowledge (unless fine-tuned for search tasks).	Searches structured and unstructured data with contextual depth.
User intent understanding	Basic keyword recognition and intent mapping.	Strong understanding for conversation but lacks search intent accuracy.	Combines intent detection with contextual search.
Customization	Minimal user-specific customization.	Limited unless integrated with external APIs.	Fully customizable for specific industries or needs.
Example of Use cases	Everyday searches (news, weather, shopping).	Generating content, answering general queries, programming help.	Research, business intelligence, healthcare, legal searches, and financial analytics.

Key Difference

- Google excels in breadth of general information but lacks depth for specialized or industry-specific tasks.
- ChatGPT is ideal for text-based assistance but struggles with dynamic or real-time search.
- DeepSeek is designed for domain-specific, precise, and real-time data retrieval with interactive elements.

Table 3: Strengths and Weaknesses

Aspects	Google	Chatgpt	Deepseek
Strength	Massive database, fast, user-friendly.	Conversational, human-like, versatile in generating text.	Context-aware, domain-specific, multimodal, highly accurate.
Weakness	Limited understanding of context, dependency on keywords, ad-driven results.	Lacks real-time data, confined to pre-trained knowledge, no direct search capabilities.	High computational demands, limited public awareness compared to Google and ChatGPT.

Table 4: Practical Applications

Platform	Best use cases
Google	Everyday searches, exploring public web content, shopping, general queries.
ChatGPT	Content creation, conversational assistance, educational support, coding assistance.
Deepseek	Academic research, healthcare diagnostics, financial analytics, legal document search.

7. Impact of DeepSeek on the Stock Market and Related Shares Globally: The advent of AI-powered search technologies such as DeepSeek, which provides accurate, real-time, and context-sensitive data retrieval, holds the potential to significantly alter various industries. Its implementation within the stock market may result in substantial changes in the operations of investors, analysts, and financial institutions. This discussion examines both the direct and indirect effects of DeepSeek on the global stock market and associated equities.

1. Real-Time Market Intelligence

DeepSeek's capacity to analyze extensive datasets in real-time—encompassing news articles, financial disclosures, earnings conference calls, market sentiment, and social media trends—empowers investors to make swifter and more informed choices. In the rapidly evolving landscape of stock trading, the importance of timeliness cannot be overstated, and DeepSeek enhances the decision-making process by providing precise insights promptly following the emergence of new information.

Impact on the Stock Market

- **Faster Market Reactions:** Investors can react swiftly to market changes, economic reports, or geopolitical events, potentially reducing the lag between data release and stock price movements.
- **Enhanced Predictive Analytics:** By incorporating deep learning and NLP, DeepSeek could offer more accurate predictions on stock price trends, providing investors with more reliable tools for forecasting.
- **Impact on High-Frequency Trading (HFT)** Automated trading systems could integrate DeepSeek's data capabilities, making them more adaptive to changes in news or market sentiment, further accelerating HFT strategies.

Impact on Related Shares

- Companies that produce AI-driven analytics tools or operate in the fintech sector (like Palantir Technologies, IBM, or Microsoft) may see their stock values rise, as demand for AI-driven market insights increases.
- Traditional financial services and hedge funds that fail to adapt to these advanced tools may experience a relative decline in performance, potentially impacting their stock value.

2. Democratization of Financial Analysis

DeepSeek's capacity to streamline intricate data sets and deliver tailored insights has the potential to democratize access for retail investors. Historically, high-quality financial analysis was predominantly available to institutional investors equipped with advanced tools and dedicated teams of analysts. By facilitating comprehensive research capabilities akin to those of professionals, DeepSeek can significantly enhance the analytical power of individual traders.

Impact on the Stock Market

- **Increased Retail Participation:** As retail investors gain better access to advanced tools, they could influence market dynamics, leading to more volatility and possibly driving new trends in stock prices.
- **Shift in Market Power:** DeepSeek could reduce the market advantage of institutional investors, forcing a shift toward more transparent and inclusive financial markets.

Impact on Related Shares

- Brokerages and trading platforms, including Robinhood and E-TRADE, are likely to experience heightened user engagement and trading activity, which may positively influence their stock valuations.
- Concurrently, firms that provide AI-driven investment solutions, such as Upstart Holdings and Betterment, may observe substantial expansion as retail investors increasingly embrace their technological offerings.

3. Impact on Corporate Research and Financial Reporting

The ability of DeepSeek to consolidate and examine both structured data, such as financial statements and reports, and unstructured data, including press releases, earnings calls, and news articles, has the potential to transform corporate research.(Koubaa *et al*., 2023). Financial analysts could leverage DeepSeek to efficiently assess a company's future prospects by navigating through a vast array of information, thereby enabling them to deliver more precise and timely analyses.

Impact on the Stock Market

- **Improved Earnings Predictions:** Analysts utilizing the capabilities of DeepSeek may produce more precise earnings predictions, thereby impacting stock valuations and assisting investors in making better-informed choices.
- **Enhanced Transparency:** With real-time insights into a company's performance and sentiment analysis from various data sources, DeepSeek may enhance corporate transparency, which could reduce information asymmetry in the market.

Impact on Related Shares

- Consulting and analytics organizations, including McKinsey & Company and Deloitte, may experience an increase in demand for their market analysis tools.
- Concurrently, data providers such as Thomson Reuters and Bloomberg must either adapt to emerging technologies akin to DeepSeek or risk losing market share due to their inability to evolve.

4. Automation and AI in Financial Institutions

The sophisticated data processing capabilities of DeepSeek, driven by artificial intelligence, have the potential to greatly improve decision-making processes within financial institutions. (Ahangar & Fietko, 2023) [1]. By automating standard research tasks and providing actionable insights, these firms could refine their investment strategies, enhance risk management, and bolster compliance initiatives. Furthermore, AI systems utilizing DeepSeek's technology could advance fraud detection, optimize portfolio management, and streamline regulatory reporting.

Impact on the Stock Market

- **Increased Efficiency:** Financial institutions that adopt DeepSeek may see improvements in operational efficiency and profitability, boosting stock prices in the long term.
- **Disruption of Traditional Research Models:** Traditional stock research firms and financial analysts might struggle to compete with the efficiency and accuracy of AI-powered tools, leading to a potential decline in their market share.

Impact on Related Shares

- Financial technology enterprises and firms specializing in AI-driven analytics are likely to witness significant expansion. The stock values of companies like Square, PayPal, and BlackRock may rise as they increasingly integrate AI technologies and automation into their operations.
- Conversely, traditional financial analysts and firms that depend heavily on manual research may face a downturn in stock prices as they find it challenging to keep pace with this emerging technological landscape.

5. Regulation and Compliance

DeepSeek offers valuable support to financial regulators and compliance officers beyond mere financial market analysis. It can efficiently process extensive regulatory documents, monitor compliance breaches, and detect patterns of financial fraud. (Franzoni *et al*., 2024). This capability has the potential to optimize the regulatory framework and bolster the integrity of financial markets.

Impact on the Stock Market

- **Improved Regulatory Oversight:** DeepSeek could improve market integrity by providing regulators with better tools to detect fraud, market manipulation, and insider trading, fostering investor confidence.
- **Transparency in Reporting:** Investors will benefit from more transparent and easily accessible regulatory data, potentially reducing volatility caused by sudden regulatory changes or fines.

Impact on Related Shares

- Organizations engaged in compliance technology, including Relativity, Veeva Systems, and Thomson Reuters, are likely to experience a rise in their stock prices as the demand for automated compliance solutions grows.
- Conversely, firms that have a track record of regulatory challenges or non-compliance may face declines in their stock prices as a result of heightened scrutiny and more stringent regulations.

8. Challenges and Ethical Consideration

Despite having its invaluable role of DeepSeek in advancing research work and other activities, it is significant to address and recognize the challenges and ethical concerns associated with its use. (Waduge *et al*., 2024) [18].

8.1 Challenges

1. **AI safety and security concern:** DeepSeek Models

can be used in negative way such as can allowing them to generate harmful contents related to bioweapons, can provide self- harm instructions by manipulating the generated contents of DeepSeek.
2. **Reliability and Accuracy:** DeepSeek Models ability to generate human like text, which may sometime produce wrong or misleading contents. (Singal & Goyal, 2024) [16].
3. **Bias in AI model:** Even if the training data of DeepSeek Model is diverse, the way the model processes and prioritizes information can introduce bias. It can also contain stereotype, misinformation, or cultural biases due to vast amount of stored data.
4. **Overreliance on AI data:** Shift towards AI driven data can lead to loss on critical thinking and independent problem-solving skills among researchers.
5. **Quality Control:** DeepSeek generates high quality data but with the passage of time it become vulnerable to low quality of data. To address this challenge, DeepSeek needs regular monitoring and training of data to keep them updated or to avoid chances of outdating of data.
6. **Explainability:** DeepSeek, like other transformer-based models, contains billions of parameters and intricate neural network layers. This generates the output with massive dataset, which make it difficult to trace why a specific response was produced.
7. **Energy Consumption:** DeepSeek, like other LLMs require thousands of GPUs or TPUs to process vast dataset and train deep neural networks. This essentially contributes to carbon emissions.
8. **Safety and Privacy Concerns:** As it raises vast amount of human data which can leads to loss of privacy. And this can also generate fake news, hate Speech.
9. **Cultural and Linguistic bias:** AI models learn from internet data, which is dominated by content in English and Chinese. To address these linguistic biases, diversification of training data more on non-western and non-Chinese sources.

8.2 Ethical Consideration

1. **Data Privacy and Security:** With the increasing use of AI in data processing and analysis, it can lead to loss of user sensitive information. To ensure privacy of data, regular policies and legal compliance needs to be followed.(Majdoub & Ben Charrada, 2024)
2. **Intellectual Property and Authorship:** DeepSeek Models ability to research ideas, even develop hypothesis, can provide written content, this raises the question of intellectual property right and authorship attribution.
3. **Transparency and Accountability:** In ensuring transparency and accountability for machine-based outcomes are vital to maintain trust among scientific community and general public.
4. **Bias and fairness:** DeepSeek like any other machine learner model can provide biased outcome if it is trained on biased data. This biased data can provide unfair outcomes for individual, industries, organizations, employees etc.(Karakose, 2023) [9].
5. **Responsibility and Accounting:** as DeepSeek is showing its applications among various domains, it is important to ensure responsible person for the generation and training data. And able to find out the person accountable for any of the negative consequences happened due to use of DeepSeek based models.
6. **Autonomy:** DeepSeek can be used to take human decisions and influences their behaviour, this raises concern about individual autonomy and decisions.
7. **Environmental impacts:** Data center running DeepSeek generate heat which require cooling system that further increases energy consumptions.

Addressing these ethical issues requires a proactive stance from developers, researchers, and the wider AI community. Through collaborative efforts to recognize, comprehend, and mitigate potential challenges, we can guarantee that AI language models such as ChatGPT are created and utilized in a responsible manner, thereby enhancing their advantages while reducing possible risks.

9. Biases and Limitations of Deepseek

DeepSeek, similar to other AI language models (Tülübaş *et al*., 2023) [17], having wide number of biases, related to demographic structure such as gender, race, culture, language, and ideology. These biases arise from the training data utilized by the model, which is derived from human-generated content available on the internet. Additionally, biases related to attention, format, and commercial interests may also surface due to the characteristics of the training data. Furthermore, it exhibits several limitations that will be elaborated upon in the subsequent sections.

9.1 Biases

1. **Cultural and Linguistic biases:** Since, DeepSeek is trained from the internet data, it may be biased towards certain predominant language, cultures and perspectives. In this way the result generated by the AI model lacks in showing the diversity in human language and experiences.
2. **Gender or Racial biases:** AI based models like DeepSeek may unintentionally perpetuate racial and gender stereotype due to biased training data.
3. **Ideological Biases:** DeepSeek reflects specific opinions or dominant viewpoints found in its training data. It generates data or output lean towards specific political, economic, social ideologies creating an unbalanced representation of different perspective.
4. **Confirmation bias:** AI data are generated based on pre-existing beliefs, assumptions, or stereotype. This give boundation to the diversity of perspective and reinforce biased viewpoints.
5. **Commercial Bias:** DeepSeek consists of trained data which may shows commercial bias of private or commercial entities, as the source of their data is internet. This can give motive to promote product, services, or brands unintentionally.

9.2 Limitations

1. **Inaccurate or Misleading Information:** The output generated by DeepSeek may provide misinformation or inaccuracy in data, as it is based on pattern and relationship based on trained data rather than deep understanding of subject matter.
2. **Sensitivity to input phrasing:** A slight change in single input can provide variety of responses and varying results by AI powered tools.
3. **Overuse of certain phrases:** Data derived from Al powered tools like DeepSeek use certain phrases

frequently, this leads to repeated responses and less natural.

4. **Inability to fact-check and Access Real:** time information: Due to limited availability of trained data, it lacks in providing real time information and lacks in verifying the accuracy of its response in new development and initiative.
5. **Lacks of Contextual Awareness:** DeepSeek AI generated data, fails to provide broader implications of given topics. This can result in generating superficial content and does not account for real time complex problem.
6. **Ethical and Moral Reasoning:** DeepSeek may generate ambiguous data or doesn't lead to ethical standards, making it unsuitable for certain applications without proper human supervision.
7. **Inability to generate Visual content:** DeepSeek cannot generate visual contents like images, videos, due to limited applicability in multimedia content creation.

10. Conclusion

The global stock market is poised to experience substantial advantages from the integration of DeepSeek and comparable AI-driven technologies. (Wei *et al*., 2023) [19]. The DeepSeek Model's capacity to deliver real-time market insights, enhance financial analysis, empower retail investors, and facilitate compliance processes could foster more informed, efficient, and transparent market environments. Firms that adopt these technologies are expected to witness an increase in their stock valuations, whereas traditional companies that resist this technological advancement may encounter diminished performance and reduced market valuations. (Rahman *et al*., 2023) [14]. As DeepSeek continues to develop, its influence is anticipated to reach beyond financial markets, potentially affecting global economies and catalyzing innovations in data utilization for business decision-making. Investors should closely monitor companies that incorporate AI-driven search solutions like DeepSeek into their strategies, as these entities may emerge as the next leaders in the financial market landscape.

Future Implications

DeepSeek, should it gain widespread acceptance, possesses the capability to either enhance or rival the functionalities of Google and ChatGPT in domains necessitating advanced intelligence and specialized data engagement. This development signifies a notable transformation in our methodologies for data retrieval and decision-making processes. The introduction of DeepSeek is altering the artificial intelligence landscape by fostering greater accessibility, promoting decentralization, and instigating economic disruption. Nevertheless, it also brings forth critical issues related to data privacy, security, and the geopolitical implications of AI advancement. The future direction of DeepSeek will be contingent upon the resolution of these challenges and the strategies employed by stakeholders within the continuously evolving AI environment.

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