DATA ANALYSIS WITH CHATGPT

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Abstract

OpenAI created and published ChatGPT, an AI chatbot, in November 2022. It was produced using supervised and reinforcement learning approaches and is built on top of OpenAI's GPT-3.5 and GPT-4 families of big language models. With the creation of artificial intelligence, a new era in computer science has dawned. The sigmoid curve is frequently used to analyze innovative technology, with a sluggish take off when a new technology is invented, followed by a quick speed of development dependent on how advantageous it is. This is true despite the fact that artificial intelligence was created in 1950 by John McCarthy, who is now regarded as its founder, and earlier by Alan Turning, who examined its mathematical implications. As a result, technology develops as more people use it. We believe that AI will mark the beginning of an entirely novel sigmoid curve. Following the maturity of ChatGPT, computational intelligence has now achieved a new height. AI is now growing at a 21% annual rate, establishing an entirely novel market in this extremely competitive sector. The ChatGPT characteristics, paradigm, and data analysis procedure were all represented in this work.

Keywords

ChatGPT, OpenAI, Reinforcement Learning, Data analysis

I. Introduction

Open AI is a mathematical intelligence (AI) research facility established in the United States that originated with two companies: the nonprofit OpenAI Incorporation and the for-profit OpenAI consortia Ltd Partner. Open AI now owns the world's fifth largest supercomputer. Following their debut, AI specialists named Chat GPT to be one of the finest three AI facilities in the world. It wants to conduct Intelligence investigations in order to develop and establish a friendly Intelligence.

Space X's Musk, along with Y Combinator's Sam Altman, previously Stripe-Chief Chief Technological Officer Greg Brockman, PayPal founding member Peter Thiel, LinkedIn as well founder Reid Hoffman, Infosys Corporation Amazon's Web Services, and YC Research announced the launch of OpenAI in December and invested over $1 billion in the newly established venture. Musk's vision, however, did not align with the firm's, during the time he felt that AI might endanger humanity, and he withdrew from OpenAI's board of trustees in 2018 and presently has no shareholding in the company.

OpenAI completely shifted their focus from nonprofit to for-profit business model in 2019, four years after it was founded. On 22nd July, 2019, Microsoft announced that they would be investing 1 billion dollars in Open AI for building artificial intelligence that can tackle more complex tasks. This investment provided Open AI with cloud computing services exclusively from Microsoft. OpenAI is a very valuable for-profit company, expertly using hype cycles to maximise the value of its shares.

On 30th November, 2022, OpenAI gained recognition after launching a free preview of ChatGPT (Chat Generative Pre-trained Transformer), their first AI language based chatbot based on the GPT-3.5 model. It is a large language model that has undergone extensive training using a vast collection of text data. As a result, it has the ability to comprehend and answer a diverse array of topics and inquiries. The primary aim of ChatGPT is to aid in human-machine communication by promoting more seamless and productive interactions through natural language. The model uses reinforcement learning and supervised learning to debug programs, compose and write lyrics to music, summarise documents, etc. It is regarded as the most advanced chatbot to exist thus far.

The API release of GPT-4 became available to both ChatGPT + customers and the wider community on March 14, 2023. GPT-4 is a large multimodal model that receives picture and text input and generates text. While GPT-4 is less successful than individuals in many real-world scenarios, it performs at a human level on a range of professional and academic standards. For example, it passes a simulated bar examination with an outcome in the top ten percent of applicants, as contrasted to GPT-3.5, which has a score in the bottom 10%. GPT4's artificial intelligence stack has been overhauled over the last two years, and a powerful machine has been co-designed from the ground up for workload with Azure. The GPT-4 training run was consequently unprecedentedly steady, making it the first large model whose training performance had been precisely forecast in advance.

II. Literature survey

ChatGPT has proven to be useful in a variety of disciplines, including broad and narrow question answering, code generation after generation, and the production of specific to the subject text templates. ChatGPT, a chatbot released by OpenAI in November 2022-2023, heralded a slew of novel opportunities for the software's application of computational intelligence (AI) to the generation as well as processing of textual resources, including their use in foreign language instruction and study across all age ranges and academic disciplines. [2] ChatGPT, developed by OpenAI in 2022, is an NLP framework for free-form talks. It makes use of OpenAI's cutting-edge GPT-3.5 linguistic processing model. ChatGPT can fuel conversational AI applications such as artificially intelligent assistants and chatbots. [3] However, many students argue that ChatGPT's responses are not always right and that its use requires a high degree of prior knowledge since technology cannot replace human intellect. [4]. ChatGPT, OpenAI's most recent chatbot, has received a lot of media coverage lately. The authority that it might possess and the consequences it may have on many industries have been thoroughly investigated. Incorporating ChatGPT into interactions between humans and machine systems has the potential to significantly affect the development of smart cars. [5]. While testing revealed that ChatGPT's data may be updated and rectified in bulk, modifications may not be reflected immediately in ChatGPT's replies, implying that it might not always contain the most up-to-date information on a particular topic. [6]. The current ChatGPT phenomena has ushered a new age in computational intelligence, one in which the barrier between real and virtual, human and machine, grows thinner and thinner in the framework of online, real-time interactions. [7]. While ChatGPT's greater intelligence has aided in the advancement and improvement of CSS in a variety of ways, it has also introduced new risks to online confidentiality and security, as well as concerns of responsibility for society and sustainability on an ecological scale [8].

Educators and trainers may use ChatGPT's capabilities to better prepare the next generation of construction employees to assure protection, encourage environmental responsibility, and achieve other industry goals. [9]. ChatGPT, a leading AI language model, may have an impact on the future of medical research, including clinical decision-making, medical education, pharmaceutical development, and enhanced research outcomes. [10]. This tool employs computational intelligence and deep learning technologies that process large amounts of data, remain flexible in the face of changing circumstances when interacting with humans, and so on in order to supply users with precise answers, explanations, and solutions on a wide range of topics [11]. The current assessment practices

and educational policies need to be revised immediately. To mitigate ChatGPT's negative effects on the classroom, it's crucial to train teachers and inform students. [12].
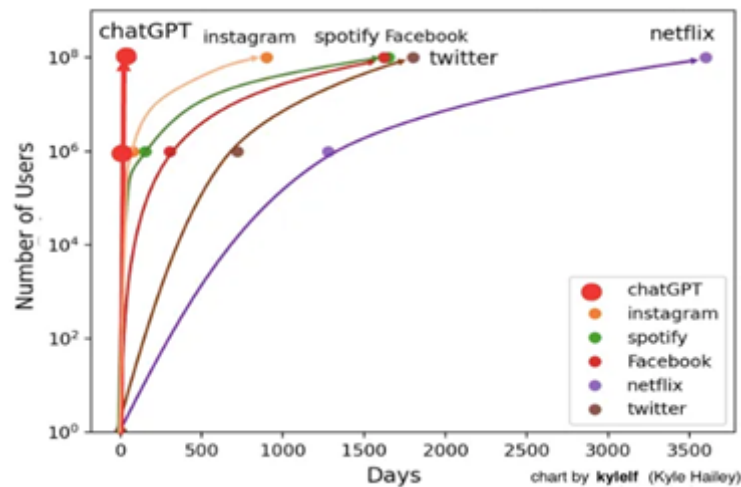

Figure. 1: Technology user analysis

The above figure 1 represents the Number of days to 1 M and 100 M users by technology. Here the diagram shows the increase rate of Generative Pre-trained Transformer user.

III. Working of ChatGPT

The working of ChatGPT is based on Generative Pre-trained Transformer (GPT), which is a type of deep learning algorithm that is capable of generating human-like language, rather than analyzing or acting on existing data. It follows an advanced instruction following approach, where the user provides a single request and the model outputs a response. A more engaging back-and-forth dialogue between messages is possible with Chat GPT thanks to the model's ability to remember and use context from previous exchanges.

The GPT-3 and 4 software is trained using a massive amount of text data from various sources. The only difference between GPT 4 and 3 is that GPT 4 uses plugins. There are three main stages of training the model:

3.1 Generative Pre-training

ChatGPT has been pre-trained on a vast corpus of text data, allowing it to understand linguistic patterns and structures. The framework receives instruction to anticipate the subsequent word in a series of words given the prior words during pre-training. This aids the model's learning of language syntax and semantics.

It employs a Self-regressive Sequential Model, which is a time sequence model that predicts the value at the next time step by using data from prior stages of time as input to a regression equation. The model learns to predict the next element in a series during training by modifying its variables (theta) to optimize the likelihood of the true next element (xt+1), given the sequence's history. This next step forecasting paradigm has been used in a variety of fields, including audio waveforms and molecular graphs. The Auto-regression Sequence Model's formula is as follows:

Next element history

$$P_\theta (X_{-t+1} = x_{t+1} | x_1 , \dots , x_t)$$

Example, when a language model is given the first four words of a sentence, it predicts the next word by assigning probabilities to all the words in its vocabulary. It selects a few words that are most likely to come next and generates a probability distribution for them. The model then randomly selects a word from this distribution and repeats the process until it selects a special stop token.

3.2 Supervised Fine tuning

In the second stage, the model is adjusted further using supervised learning. Human contractors simulate conversations between a user and an ideal chatbot, both sides played by a human. These conversations are then aggregated into a data set where each example consists of a particular

conversation history paired with the next response of the human acting as the chat bot. So the objective is to maximize the probability that the model assigns to the sequence of tokens in the corresponding response. There is evidence to support the claim that supervised learning models are significantly more effective than raw language models at responding to human requests. The below figure 2 represents the comparing Supervised learning model with regular language model.
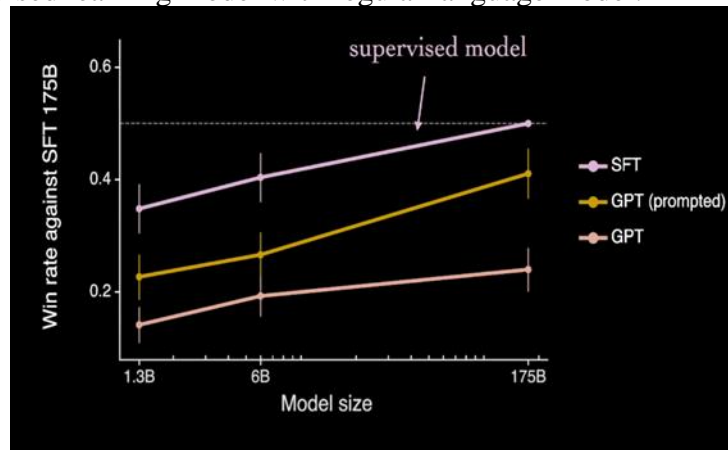

Figure 2. Graph comparing Supervised learning model with regular language model

3.3 Reinforcement Learning from Human Feedback, or, RLHF

The developers of Chat GPT use a reward function based on human preferences. AI trainers converse with the current model and sample alternative responses for each model response. Human labelers rank the responses from most to least preferred.

To distil this information into a scalar reward suitable for reinforcement learning, a separate reward model initialized with weights from the supervised model is trained on these rankings. (RLHF) is a subdivision of reinforcement learning that focuses on how humans can teach machines to learn from their feedback. Human input from ratings, preferences, and criticisms is used by RLHF algorithms to enhance decision-making in reinforcement learning.

By enabling non-experts to offer input to the learning process, which can subsequently be employed to alter the agent's policy, RLHF aims to make reinforcement learning more approachable to non-experts. This is especially helpful in fields where it is challenging to define a reward function that accurately captures the intricate goals of the work or when the agent's choices could have moral repercussions.

Open AI employs a moderation system called the moderation API to let developers flag content that violates their content policy, such as illegal or dangerous information, in order to prevent racial and political bias.

IV. Stages of ChatGPT

ChatGPT is based on a generative pre-trained transformer-architecture. It was solely created to complete chats, hence, if a prompt is provided to it, it will complete the same. The transformer architecture is designed to process sequences of inputs, such as words in a sentence or characters in a document, and to capture the relationships between them.

Table 1: Stages of ChatGPT

Stage 1	Stage 2	Stage 3
Collect demonstration data and train a supervised policy	Collect comparison data and train a reward model	Optimize a policy against the reward model using the PPO reinforcement learning algorithm

ChatGPT is also auto-regressive in nature, meaning it predicts an outcome purely based on previously observed outcomes in the same sequence. LLM essentially stands for Large Language Model. These are used in the ChatGPT framework. Any portion of text be it punctuation or a word or a phrase can

be classified as a token. These tokens are available in vast amounts in public due to human generated texts. The generative LLM uses these available tokens. When any question is asked, the model simply completes the thought by statistical distribution of the tokens and checks which fits best in the given sequence. We are fundamentally asking the ChatBot "for the given sequence of words/thoughts, what token would best complete it". The above Table 1 shows the Stages of ChatGPT.

Large language models (LLMs) are a type of artificial intelligence (AI) model that is capable of processing and generating human-like language at a large scale. They are designed using deep learning techniques, such as neural networks, and are trained on massive amounts of data, such as text corpora, to learn patterns and relationships in language. They are used for a variety of language-related tasks, such as natural language processing, text classification, sentiment analysis, language translation, and text generation.

In simple terms the architecture works as follows, an input sequence of tokens is provided, these could be words, phrases or characters. Based on the relationship of a token with regards to other tokens, a vector relationship is calculated for each token. This is done using self-attention, which allows the model to selectively focus on different parts of the input sequence.

After training on a huge corpus of text data, the model may be fine-tuned for a specific purpose, such as interpreting languages or question answering. ChatGPT has been customized on a conversational data dataset to give users with human-like replies to their questions.

4.1 Pros:

Language Understanding: Chat GPT is designed to understand natural language and can comprehend the implications of human communication. It can understand different accents, dialects, and even slang.

High Accuracy: Chat GPT's accuracy in producing human-like responses has increased as a result of training on a vast amount of text data.

24/7 Availability: Chat GPT can be available to users 24/7, providing an instant response to their queries at any time of the day.

Continual Learning: As Chat GPT follows the RLHF model for training, it can continue to learn and improve its responses based on user feedback. As more data is fed into the system, it becomes more intelligent and accurate.

Free: Currently, Chat GPT 3 is available to the public for no cost.

4.2 Cons:

Reliance on Data Quality: Chat GPT's accuracy and performance depend on the quality of the data it has been trained on. Poor quality data can lead to inaccurate or inappropriate responses.

Limited Creativity: Chat GPT is designed to generate responses based on the input it has received. While it can generate a wide range of responses, it may not be able to come up with creative or original responses that require more than just data-based reasoning.

Paid: To perform advanced data analysis on chatgpt, we need to get the latest version, GPT 4, which is not free.

Ethical issues: People could be victims of generative AI through deep fake videos, explicit content or propaganda, questioning user privacy.

Layoffs: Generative AI can cause people to lose their jobs. Example, Chat GPT's ability to generate human-like written text could see the beginning of the end of journalism.

Lack of interpretability: Not all answers are correct as there is no source in the data they use to train their model. Sometimes Chat GPT's complex and detailed answers can be misleading. It is also difficult for humans to understand how the model arrived at a particular decision or prediction.

4.3 Why ChatGPT required?

In the fast paced world that we live in, time is of utmost importance. ChatGPT reduces workload on users by helping with everyday tasks that range from drafting a mail to an employer to making grocery

lists. One of the key benefits of ChatGPT is its ability to understand the context of the conversation and generate responses that take into account the previous messages. This makes the conversation more natural and fluid, and enables more complex interactions between humans and machines. Additionally, OpenAI has made the pre-trained model and associated tools and APIs available to developers, researchers, and businesses, enabling them to build their own applications and customize the model to suit their needs. It reduces the burden on us humans and provides an efficient way of accomplishing our goals. ChatGPT can be used for various tasks such as the following:

1. Answering questions, proposal writing, for completion of repetitive tasks, writing scripts for YouTube videos, writing poems and songs
2. Writing reports and requests, writing essays and other productivity based applications
3. Analysis of large data sets and extraction of useful data.
4. Explaining different concepts in simple terms and also elaborating on topics.
5. Coding, analyzing codes and understanding them
6. Using ChatGPT in companies reduces labor and man force and helps in automation of tasks. Repetitive labor oriented tasks can be replaced by integrating ChatGPT in their algorithms.

V. ChatGPT for Data Analysis

Data analysis refers to the process of inspecting, cleaning, transforming, and modelling data in order to find relevant information, reach conclusions, and support decision-making. Regardless of the size, structure, numerical content, or text content of the data sets being analyzed, a number of statistical and computational techniques must be applied to extract relevant insights from the datasets.

A vast variety of sectors and domains, including business, finance, healthcare, education, social sciences, engineering, and many others, can benefit from data analysis. It is essential for spotting data patterns, trends, and correlations that can guide strategic planning, boost efficiency, and enhance results. Data analysis also aids in detecting oddities and flaws in data sets, which may then be corrected to enhance the reliability and accuracy of the data. ChatGPT: Applications: Conversational AI, Text Generation, Question Answering, Text Summarization, Text Classification, Dialogue Management. As a language model, ChatGPT can be used for data analysis using plugins, like code interpreter and notable, by following the below steps:

1. **Data Cleaning and Preprocessing**: Data cleaning involves removing or fixing any errors or inconsistencies in the data to improve its quality. This might include handling missing values, removing duplicates, and correcting errors. With textual data, this process can be extensive, given issues like different naming conventions, typos, or varying date formats. An advanced model like GPT could recognize patterns and anomalies in the data to suggest corrections.

2. **Exploratory Data Analysis (EDA)**: EDA is an initial investigation of the data to discover patterns, anomalies, and potential insights. It often involves visualization techniques. While GPT is primarily text-based, it can guide users on what visualizations to create or describe statistical patterns it identifies.

3. **Feature Engineering**: Features are the variables that a model uses to make predictions. Good feature engineering can significantly improve a model's performance. GPT could, for instance, recognize that from a date, we can extract features like the day of the week, month, or year, from the given data set, which might be relevant for some analyses.

4**. Interpreting Results**: Data analysis often produces complex results, and interpreting them correctly is crucial. GPT could provide explanations for statistical tests, helping users understand.

5. **Generating Hypotheses**: Hypotheses drive many scientific and business analyses. Given a dataset, GPT can suggest potential hypotheses based on patterns in the data or related studies it's aware of. For instance, if it sees sales spiking in December, it might hypothesise that holiday shopping affects sales.

6. **Natural Language Queries**: This is about altering data. A non-technical person might not know SQL or how to use a BI tool, but they can ask GPT questions about the data in natural language, and get back understandable answers, graphs, or insights without needing to write a single line of code.

7. **Anomaly Detection**: Anomalies are data points that deviate significantly from the norm. They might be errors, but they might also be significant events or breaks from the usual trend. GPT can assist by identifying these anomalies based on patterns and offering explanations or potential causes.

8. **Integration with Other Tools**: This would involve using the OpenAI API or other methods to combine GPT's capabilities with tools like Tableau, Power BI, or database systems. For instance, GPT might generate SQL queries based on natural language questions or guide a user in creating a visualization in a BI tool.

9. **Automated Report Writing**: Once you have insights, you often need to communicate them. GPT can help generate clear, concise reports or summaries, taking raw data or analysis results and turning them into understandable prose.

10. **Trend Analysis**: Trends are long-term movements in data. Identifying them can be vital for forecasting. While specialized statistical tools are best for in-depth trend analysis, GPT can provide initial insights or validate findings, ensuring that analysts haven't overlooked crucial information.

4.4 Practical use of ChatGPT 4 in data analysis

Step 1: Data Collection

This step involves gathering relevant data. This can come from databases, APIs, external sources, or manual data entry. For this report, we will be using the free data set provided by Kaggle. We can also automatically import the dataset from online sources by linking the dataset to external plugins like notable in chat gpt 4.

Step 2: Web scraping and checking data quality

In ChatGPT 4, we can use external plugins, such as notable or code interpreter, for data analysis and visualization purposes. In this step, we will be uploading the data set onto ChatGPT in HTML format and ask the bot to help us understand the data and look for data quality issues like duplicate data and missing information. The bot immediately identifies what the dataset is about and describes the variables in terms of rows and columns and gives explanations for each variable. It can also arrange the data in a tabular format. It then proceeds to highlight the key calls in the dataset with the description. It also gives us examples on how analytics can be conducted on that particular dataset.

Step 3: Exploratory Data Analysis (EDA)

In this step, we are asking chat gpt to perform exploratory data analysis. It proceeds to perform the analysis in 5 major steps. First it shows the data types of the variables. Then it proceeds to identity the missing values with a summary clarifying which columns have significant missing values. Next it provides summary statistics about the numerical column.

We can also expand on the statistics step by asking the bot to calculate the descriptive statistics (like mean, median, standard deviation) to the dataset provided. The bot gives us a description for the data types for each column, in terms of binary variable, identifier variable, ordinal variable, discrete variable, etc. It also gives us functions in python for the user to be able to obtain the same statistical information and also provides examples for how the python function can be used in practice. We can also ask the bot to give an explanation for each line of the code.

Step 4: Visualization

The plugins help create codes based on the dataset on the backend and provide data visualization in terms of charts and graphs on the front end. In this step, we can ask chat GPT to create a graph for the statistical information provided by the bot. The bot provides a bar graph (or any other specified graph) and gives us a basic insight about the data. We can also make changes to this graph by accessing the code in the backend of the code interpreter plugin. We can customize the prompt based on our requirement and get desired results.

Step 5: Exporting

The plugins help us save the report in several different formats, such as, PDF format. It also allows us to export the code in ipymd format, which can be accessed in Jupiter notebook and google collab, where you can edit and customize the codes.

VI. Conclusion

Technology has been rapidly improving since the early 19's, from telephones to fax machines to cellular hand phones to the internet to email. Every technology has gone through massive improvement and got better and better every passing year. As the Integrated Circuits chips got stronger and the processing speeds of the GPU got progressively faster, the AI field took off. The most common question asked is will ChatGPT be able to replace data analysts. Fortunately, the answer for now is no. Currently, GPT 4 has a limitation of accepting only 512 mb of data, which is much smaller than what the companies usually work with. Chat gpt is used as an assistant used by data analysts to optimise their performance. A person working on a VBA macro spends a lot of time to write 100 lines of code. Chat gpt can help write the same 100 lines of code in less than 5 minutes. It also helps us understand what the code does. Another reason that's stopping companies from using these tools for their job is security issues. These chatbots take these prompts and data that is given, to build on and improve themselves (machine learning). Confidential data uploaded could be seen by the reviewers of these chat bots or can be fed back into these chatbot and can be prompted by another user. These concerns are so major that google has forbidden their employees from uploading confidential data onto their chat bot bard. We believe the era of Artificial Intelligence has just begun and with time, it will only get progressively better and no one can predict how far along the technology would advance. Generative AI will change how we interact with the internet. The world is about to change, and for better or for worse, only time will tell.

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