

# GPTQuant's Conversational AI: Simplifying Investment Research for All

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## Abstract

This paper presents GPTQuant, a conversational AI chatbot for developing and evaluating investment strategies. GPTQuant leverages prompt templates and LangChain's integration to activate few-shot learning capabilities of GPT3 for generating Python code instantly, which can be executed using the Python interpreter. Our case studies demonstrate GPTQuant's efficacy in investment research, highlighting its potential to reduce the workload of human agents and democratize investment research. GPTQuant's contributions to fintech, including its ability to generate Python code via natural language commands and its intuitive interface for evaluating investment strategies, make it a valuable tool for investors. Our case studies demonstrate the practical applications of the chatbot and compare its performance with Open AI's ChatGPT. We highlight the chatbot's potential to overcome limitations in GPT variants and to open new doors in domain-specific applications in finance.

**Keywords:** *finance and technology, investment, Conversational AI, ChatGPT, OpenAI, GPT, machine learning, investment research, cross sectional equities, style factor, backtesting*

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## **Disclaimer**

“The authors wrote this paper in part with GPT-3.5, OpenAI’s large-scale language-generation model. Upon generating draft language, the author reviewed, edited, and revised the language to their own liking and takes ultimate responsibility for the content of this publication. Please advised that the contents of this paper should not be construed as investment advice.”

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## **Introduction**

The field of investment research has experienced significant transformation in recent years, fueled by the growth of big data, machine learning, and artificial intelligence. However, the technical complexity of traditional backtesting methods has limited their accessibility to a wider range of investors, creating a need for more user-friendly tools. In response to this challenge, our paper introduces GPTQuant, a pioneering conversational AI chatbot designed specifically for investment research.

Based on OpenAI's GPT, GPTQuant provides accurate and reliable insights for investors using natural language prompts, reducing technical barriers to entry. We explore the potential of conversational AI and no-code backtest tools in investment research, with a particular focus on their implications for retail investors. Through the presentation of three compelling test cases, covering portfolio construction, rebalancing, and factor score querying, we demonstrate the feasibility of conversational AI and no-code backtest tools in streamlining the investment research process.

By examining the potential of conversational AI and no-code backtest tools in the context of investment research, we seek to highlight their significant impact on the accessibility and efficiency of the field. This paper contributes to the growing body of research on the intersection of artificial intelligence and finance and to offer guidance to analysts and investors interested in adopting these tools in their investment research.

### **I. Quantitative Investment Research**

Quantitative investing has become increasingly popular in the financial industry, with most trades now conducted using algorithmic trading strategies. According to a report by Coherent Market Insights, algorithmic trading is responsible for around 60-73% of all U.S. equity trading<sup>3</sup>.

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<sup>3</sup> <https://www.coherentmarketinsights.com/market-insight/algorithmic-trading-market-2476>

This shift towards quantitative investment has been driven by advances in technology, the growth of big data, and the need for more efficient and cost-effective trading methods.

Quantitative analysis encompasses various frequencies and levels in finance, ranging from high-frequency trading (HFT) to active asset allocation. HFT utilizes advanced algorithms to exploit microsecond-level market inefficiencies, using powerful computers and high-speed data connections to execute trades within fractions of a second. In contrast, active asset allocation is a longer-term investment approach that utilizes mathematical methods to identify alpha signals and combines them based on their expected returns. This approach involves making strategic decisions on how to allocate capital across different asset classes and sectors and is commonly used by institutional investors seeking consistent, long-term returns.

Whether in the context of regular asset allocation or high-frequency trading, backtesting plays a crucial role in investment strategies evaluation. It allows investors to simulate the performance of various portfolios or trading algorithms in historical market conditions, thus optimizing their strategies for future market scenarios. Through the evaluation of different strategies, backtesting provides a means for analysts and investors to make informed decisions, thereby increasing their chances of success in the financial markets.

The emergence of no-code backtest tools has significantly lowered the entry barrier for retail traders to build and test their own trading strategies using pre-built blocks of code without requiring a deep technical background. Popular no-code backtesting tools in the retail space include Portfolio Visualizer<sup>4</sup>, a web-based platform that offers a range of tools for portfolio analysis, including backtesting and asset allocation. In contrast, professional financial institutions often use Bloomberg<sup>5</sup>, FactSet<sup>6</sup>, and Refinitiv<sup>7</sup>, as their primary backtesting tools. These software platforms provide a wide range of financial data, news, and analytics, as well as tools

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<sup>4</sup> <https://www.portfoliovisualizer.com>

<sup>5</sup> <https://www.bloomberg.com>

<sup>6</sup> <https://www.factset.com/>

<sup>7</sup> <https://www.refinitiv.com/en>

<sup>8</sup> Liu, Y., Li, Y., Li, X., & Li, K. (2021). Building Cryptocurrency Quantitative Trading Strategies with No-Code Frameworks. *Journal of Information Technology Management*, 32(1), 1-11.

for developing and testing trading strategies. However, despite their growing popularity, the impact of no-code backtest tools has not been extensively discussed in academic literature. To our best knowledge, only one paper has examined the potential of no-code frameworks in the context of crypto trading by Liu, Y., Li, Y., Li, X., & Li, K. (2021)<sup>8</sup>. This paper aims to fill the gap in academic literature by exploring the potential of conversational no-code backtest tools in investing and trading, and their implications for retail traders and the financial industry.

## II. **Conversational AI and Natural Language Processing (NLP)**

Conversational AI has made significant progress over the years, thanks in large part to advancements in natural language processing and machine learning. One of the key developments in this area has been the emergence of Large Language Models (LLMs), which are neural networks trained on massive amounts of text data. LLMs have proven to be very effective in generating human-like responses to natural language inputs, enabling the creation of more advanced chatbots and virtual assistants.

Over the years, LLMs have continued to improve in terms of both their accuracy and their ability to understand and respond to complex and nuanced language. For example, the recent development of GPT-3, a language model with 175 billion parameters, has generated a great deal of excitement in the field of natural language processing, as it has been shown to be capable of generating responses that are almost indistinguishable from those generated by humans<sup>9</sup>.

Typically, the interface between human agents and language model learners (LLMs) typically involves a multi-line question-and-answer process, where human agents prompt LLMs to obtain desired results. However, due to the generalized nature of LLMs' training data, there are instances where simple Q&A forms may not provide specific answers related to the topic of interest. To address this issue, prompt engineering techniques can be utilized to improve the quality of prompts and the accuracy of the resulting answers. In some cases, users may recall specific behavioural patterns within the prompt before asking questions to better guide the LLMs toward more relevant outputs. The application of prompt engineering techniques in

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<sup>9</sup> <https://arxiv.org/abs/2005.14165>

conversational AI can enhance the system's performance and enable more effective communication between users and LLMs.

Yue et al. (2023) have explored the application of Language Model (LM) technology, such as ChatGPT, for explaining complex financial concepts<sup>10</sup>. Their study found that LM technology can make complex financial concepts more accessible to a wide range of audiences. However, the authors note several limitations that need to be considered. Firstly, LM technology, such as ChatGPT, is trained on text data up to 2021 and may not reflect recent developments in the financial industry. This limitation may affect the accuracy and applicability of its responses to current market trends. Secondly, LM technology is not optimized for numerical calculations. While it can generate insights and predictions based on textual data, its accuracy in performing numerical calculations may be limited. This limitation may pose challenges in certain financial applications that require a high degree of precision. Finally, providing specific answers to questions or tasks that require deep domain knowledge or expertise may be difficult for ChatGPT. Overall, the study by Yue et al. highlights the potential of LM technology for explaining complex financial concepts. However, its limitations must be considered when applying it in practical financial applications. These limitations include its training data, numerical calculation capabilities, and limitations in providing specific answers to domain-specific questions.

To address these limitations, LangChain<sup>11</sup> is a powerful tool that can be used to work with LLMs. One of the primary advantages of LangChain is its ability to pre-process the corpus of text by breaking it down into chunks or summaries, embedding them in a vector space, and searching for similar chunks when a question is asked. This enables LangChain to provide more detailed and nuanced answers that require specialized knowledge or expertise, making it an asset in the natural language processing field. LangChain's approach of pre-processing, real-time collecting, and interaction with the LLM addresses this limitation, providing a useful solution for researchers and developers working in the natural language processing field.

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<sup>10</sup> <https://dx.doi.org/10.2139/ssrn.4346152>

<sup>11</sup> <https://github.com/hwchase17/langchain>

### III. GPTQuant

We present a pioneering work on GPTQuant, a state-of-the-art conversational AI chatbot for trading strategy backtesting. GPTQuant utilizes natural language commands and few-shot learning techniques to generate Python code via Lang Chain, allowing for the efficient and accurate execution of quantitative applications that may be challenging to implement within GPT. GPTQuant's features include its ability to access and analyze data from databases and generate Python code using prompt templates, such as walk-forward backtesting. The chatbot can execute the generated code and present backtesting results in various forms, including tabular data and plots for further analysis.

GPTQuant is built on top of GPT3 using OpenAI's API, discord API, Panda's python package, LangChain, and several proprietary python packages. The technical aspects of GPTQuant are integral to its ability to serve as a powerful conversational AI for investment applications. OpenAI's API provides the underlying foundation for GPTQuant's natural language processing capabilities. By leveraging GPT3's advanced language models and machine learning algorithms, GPTQuant can effectively interpret and respond to natural language commands from human users. In addition, GPTQuant utilizes the discord API to create an interactive chatbot interface, enabling users to communicate with the chatbot easily and efficiently. This interface allows for real-time communication between users and the chatbot, facilitating more efficient backtesting analyses. Pandas python package is used for data manipulation, allowing GPTQuant to efficiently access and analyze data from databases, a crucial capability for quantitative investment applications. LangChain is also used to generate Python code via prompt templates as well as execute the generated python code, further enhancing the efficiency and accuracy of backtesting analyses. Finally, proprietary python packages developed by our team are utilized to further improve the functionality and capabilities of GPTQuant, allowing it to effectively communicate with users and the proprietary backtest engine. The approach we described above is similar to the recently proposed Program-aided Language Models<sup>12</sup> except we are focusing on financial applications.

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<sup>12</sup> Gao, Luyu, et al. "PAL: Program-aided Language Models." arXiv preprint arXiv:2211.10435 (2022).

We chose Discord API for our research due to its versatility, user-friendly interface, and extensive developer documentation. The platform's intuitive interface and features make it easy to collaborate and connect with others, while its API enables the development of custom integrations to streamline workflows and enhance productivity. Discord's popularity, especially among millennials, makes it an attractive choice for developers, educators, and businesses looking to improve communication and collaboration.

Figure 1 illustrates the graphical user interface of GPTQuant. In the interface, the left-hand sidebar displays all the servers that a user has joined, allowing for easy navigation between different communities and channels. The adjacent sidebar showcases the voice and text channels of the currently selected server, providing users with quick access to the conversations and content that matter most to them. The central region of the interface accommodates the scrolling text chat feature, which allows users to engage in real-time conversations with other members of their community. Finally, the right-hand sidebar lists the users grouped based on their designated "role," along with the total number of users. This feature enables users to quickly identify and connect with others who share similar interests or have specific expertise, making it easier to collaborate and build meaningful relationships within the community.

The process begins when a user inputs a natural language prompt into the chat window of the Discord channel. The Discord bot then receives the prompt and passes it on to GPTQuant via the API. GPTQuant processes the prompt using its machine learning capabilities, and then executes the corresponding Python code to perform the requested backtest. The backtest can include a wide range of metrics, including Sharpe ratio, max drawdown, and plots, depending on the specific prompt inputted by the user.



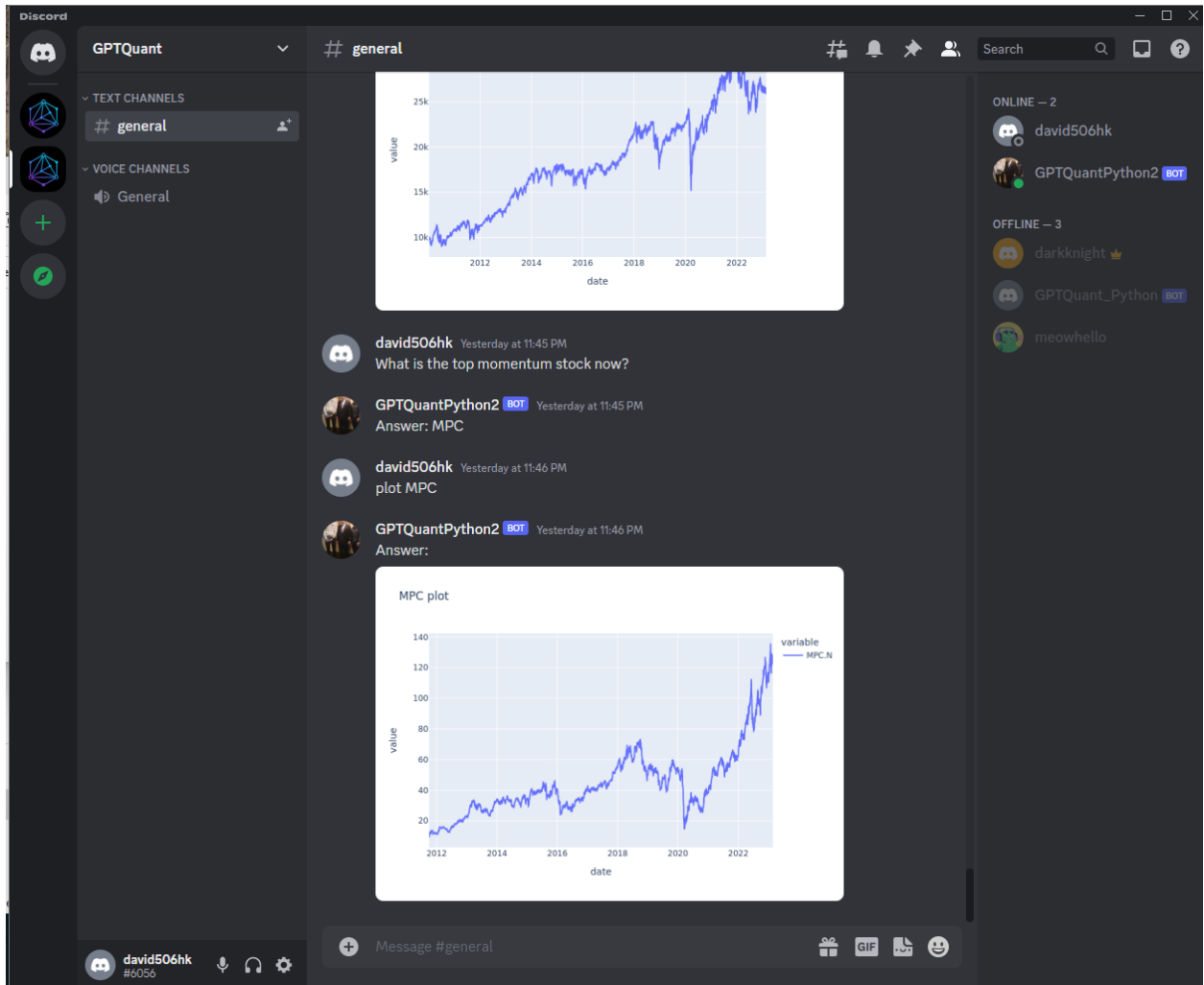



Figure 1: The Discord platform features a user interface that comprises various sections. The left-hand sidebar displays all the servers that a user has joined, while the adjacent sidebar showcases the voice and text channels of the currently selected server. The central region accommodates the scrolling text chat feature. The right-hand sidebar lists the users grouped based on their designated "role," along with the total number of users.




#### IV. Test cases

We present three test cases that demonstrate the potential of conversational AI for no-code backtest. These cases include (1) portfolio consisting of 90% AAPL and 10% TSLA that rebalances annually, (2) a cross-sectional momentum strategy that invests in the top 20% momentum stocks within the S&P500 using an equal weight scheme that rebalances quarterly, and (3) query tabular data (momentum rank querying). For reference, we also perform the same test cases on Open AI's ChatGPT to illustrate the difference between GPTQuant and ChatGPT.

## 1. 90% AAPL, 10% TSLA

A portfolio is constructed with a 90% allocation to Apple stock (AAPL) and a 10% allocation to Tesla (TSLA) stock. The portfolio is rebalanced annually.

**D** For a portfolio consisting of 90% AAPL and 10% TSLA, what is the performance if I invest 10000 at the beginning on 2010-01-01 

 To calculate the performance of the portfolio consisting of 90% AAPL and 10% TSLA, we need to know the historical stock prices of these two companies.  

Assuming you invested \$10,000 on January 1st, 2010, the following is an estimate of how your investment would have performed as of March 4th, 2023, based on the historical stock prices:

- AAPL:
  - January 1st, 2010 closing price: \$7.54
  - March 4th, 2023 closing price: \$164.06
  - Total return:  $(164.06 - 7.54) / 7.54 = 20.76x$
- TSLA:
  - January 1st, 2010 closing price: not available since TSLA went public on June 29th, 2010
  - March 4th, 2023 closing price: \$706.15
  - Total return:  $(706.15 - 0) / 0 = \text{undefined}$  since TSLA was not publicly traded on January 1st, 2010.

Therefore, to calculate the performance of your portfolio, we need to assume that you invested 90% of your initial investment in AAPL and 10% in TSLA starting from June 29th, 2010, when TSLA went public. Assuming you invested \$9,000 in AAPL and \$1,000 in TSLA on June 29th, 2010, the following is an estimate of how your investment would have performed as of March 4th, 2023:

- AAPL:
  - June 29th, 2010 closing price: \$33.71
  - March 4th, 2023 closing price: \$164.06
  - Total return:  $(164.06 - 33.71) / 33.71 = 3.87x$
- TSLA:
  - June 29th, 2010 closing price: \$23.89
  - March 4th, 2023 closing price: \$706.15
  - Total return:  $(706.15 - 23.89) / 23.89 = 29.56x$

Weighted total return =  $0.9 * \text{AAPL return} + 0.1 * \text{TSLA return}$

$$= 0.9 * 3.87 + 0.1 * 29.56$$

$$= 4.51x$$

Therefore, your initial investment of \$10,000 would have grown to \$45,100, resulting in a total return of 4.51x or 351% over the period. Note that this is an estimate based on historical prices, and past performance does not guarantee future results.

Figure 2 : Dialogue between a user named "david506hk" and OpenAI's ChatGPT. The user asks the chatbot for help in assessing the performance of a portfolio that contains two stocks, using natural language.

**david506hk** Yesterday at 11:41 PM  
 For a portfolio consisting of 90% AAPL and 10% TSLA, what is the performance if I invest 10000 at the beginning on 2010-01-01




**GPTQuantPython2 BOT** Yesterday at 11:41 PM  
 Answer: Portfolio backtest result for ticker: ['AAPL', 'TSLA'] weight: [0.9, 0.1] rebalance annually  
 Total Return = 12.6762 %, Monthly Mean Return (annualized) = 9.8789 %, Annualized Sharpe Ratio = 0.2378, Max drawdown = -35.4960 %

Figure 3 : Dialogue between a user named "david506hk" and an AI chatbot on Discord called "GPTQuantPython2". The user asks the chatbot for help in assessing the performance of a portfolio that contains two stocks, using natural language.

## 2. Cross Sectional momentum

Cross-sectional momentum is an investment strategy that involves selecting a portfolio of stocks based on their recent price performance, with the aim of generating significant returns. In this approach, stocks are ranked based on their momentum scores, and a portfolio is constructed by selecting the top-performing stocks. The portfolio is then rebalanced quarterly.

D Show me the performance of a portfolio with the top 20% of momentum stocks starting from 2010-01-01 and initial capital of 10000

 To show the performance of a portfolio with the top 20% of momentum stocks starting from 2010-01-01 and initial capital of 10000, we need to define some parameters and assumptions.  

Parameters:

- Start Date: 2010-01-01
- End Date: Today's date (or a specific end date)
- Initial Capital: 10000
- Momentum Ranking: We will use a 12-month (252 trading day) momentum ranking, which ranks stocks based on their past 12-month returns.
- Portfolio Construction: We will construct a portfolio consisting of the top 20% of momentum stocks based on their 12-month returns. We will equally weight each stock in the portfolio and rebalance the portfolio every month to maintain the equal weightings.

Assumptions:

- We will ignore transaction costs and slippage.
- We will assume that the portfolio is fully invested at all times.
- We will use adjusted closing prices to account for stock splits and dividends.

With these parameters and assumptions, we can calculate the performance of the portfolio using historical stock data.

Here are the steps to calculate the portfolio performance:

1. Download historical stock data for all stocks in the universe.
2. Calculate the 12-month (252 trading day) returns for each stock.
3. Rank the stocks based on their 12-month returns and select the top 20%.
4. Construct a portfolio consisting of the selected stocks, equally weighted.
5. Calculate the daily returns of the portfolio by taking the weighted average of the daily returns of the individual stocks in the portfolio.
6. Rebalance the portfolio every month to maintain equal weightings.
7. Calculate the cumulative returns of the portfolio.
8. Calculate the final value of the portfolio by multiplying the cumulative returns by the initial capital.

Using these steps, we can calculate the performance of the portfolio with the top 20% of momentum stocks starting from 2010-01-01 and initial capital of 10000.

Note: Since I am an AI language model, I don't have access to real-time market data and calculations, and cannot generate a live portfolio performance. However, if you provide me with the necessary data, I can provide you with the steps to calculate the performance of the portfolio as described above.


 Regenerate response

Figure 4: shows an interaction between a user named "david506hk" and OpenAI's ChatGPT." The user is asking the chatbot about the performance of a portfolio that utilizes the top 20% momentum factor. The inquiry is conducted using natural language.

**david506hk** Yesterday at 11:43 PM  
 Show me the performance of a portfolio with the top 20% of momentum stocks starting from 2010-01-01 and initial capital of 10000

**GPTQuantPython2 BOT** Yesterday at 11:44 PM  
 Answer: Momentum factor Top 20.0% portfolio performance, rebalance quarterly  
 Total Return = 159.5043 %, Monthly Mean Return (annualized) = 9.0496 %, Annualized Sharpe Ratio = 0.5662, Max drawdown = -37.2932 %

Figure 5: shows an interaction between a user named "david506hk" and a Discord AI chatbot called "GPTQuantPython2." The user is asking the chatbot about the performance of a portfolio that utilizes the top 20% momentum factor. The inquiry is conducted using natural language.

### 3. Query factor data (tabular data querying)

Data querying is a common use case in finance, and GPTQuant makes it easy to query precomputed momentum factor using natural language prompts.

D what is the top momentum stock now



As an AI language model, I do not have access to real-time data or market information. Moreover, momentum can be measured using different indicators and time periods. Therefore, it's difficult for me to provide you with the top momentum stock at this moment.



However, you can use financial websites or platforms that provide stock screeners to identify stocks with high momentum scores based on your preferred indicators and time periods. Some of the popular financial websites that offer stock screeners include Yahoo Finance, Finviz, and MarketWatch.

Figure 6: a human user with the handle david506hk is shown interacting with ChatGPT. The user's inquiry to the chatbot is regarding the stock with the highest momentum on the test day.

discord506hk Today at 1:04 AM  
What is the top momentum stock now

GPTQuantPython2 BOT Today at 1:04 AM  
Answer: MPC

discord506hk Today at 1:05 AM  
plot MPC

GPTQuantPython2 BOT Today at 1:05 AM  
Answer:

MPC plot

| Year | MPC.N Value |
|------|-------------|
| 2012 | 10          |
| 2014 | 30          |
| 2016 | 40          |
| 2018 | 60          |
| 2020 | 40          |
| 2022 | 130         |

Figure 7: a human user with the handle david506hk is shown interacting with the Discord AI chatbot called GPTQuantPython2. The user's inquiry to the chatbot is regarding the stock with the highest momentum on the test day.

## V. Discussion

This paper's findings demonstrate the potential of conversational AI as an interface for developing trading strategies, making a valuable contribution to the field of quantitative finance. By utilizing prompt templates, our conversational AI effectively connected human agents with the software for strategy development. Leveraging LangChain's few-shot learning capabilities, GPTQuant generated Python code to streamline the process of developing and evaluating trading strategies.

Test case 1 demonstrated the ability of the chatbot to execute commands for a simple portfolio with two stocks. The chatbot was able to efficiently rebalance the portfolio and look up data from a pre-loaded database. By generating Python code and executing it via LangChain, the chatbot was able to deliver accurate backtest results. This suggests that conversational AI can be a valuable tool for simplifying the backtesting process and reducing the amount of time and effort required by human agents. In comparison, ChatGPT's response contains inaccurate information such as quoting the wrong stock closing price for AAPL and TSLA.

In test Case 2, we focused on a factor-based cross-sectional strategy, relevant to financial institutions such as asset management or funds that rely on quantitative approaches for stock selection. Using precomputed factor files, GPTQuant successfully performed factor-based backtesting, demonstrating the potential of conversational AI as a tool for analyzing investment strategies. Test Case 3 highlighted how LangChain can overcome limitations of default GPT models in data querying and numerical computation. By generating pandas code, GPTQuant accurately queried data, a crucial aspect of effective investment decision making. This demonstrates the valuable contribution of GPTQuant to the field of investment research. In comparison, ChatGPT's response acknowledged that it is lacking access to real-time market data or the ability to perform financial calculations which GPTQuant excels at.

The case studies presented in this paper illustrate how conversational AI can enhance the efficiency and accuracy of backtesting trading strategies. By utilizing natural language processing and machine learning techniques, chatbots can provide an effective interface between

human agents and backtesting software. This has the potential to streamline the investment process, reduce human workload. Additionally, the use of LangChain presents a solution to the limitations of default GPT models in data query and numerical computation, which can enhance the accuracy of conversational AI for financial applications.

Conversational AI in backtesting offers a convenient and accessible approach for evaluating portfolio performance without requiring advanced technical knowledge or programming skills. The fast turnaround time and lowered technical entry barrier allow a wider range of investors to quickly make informed investment decisions. While the application of conversational AI in backtesting shows promise, further research is needed to fully evaluate its effectiveness and potential impact on portfolio management. Nonetheless, the intuitive interface, advanced features, and time-saving capabilities make it a valuable tool for both retail investors and financial institutions.

## **VI. Conclusion**

GPTQuant represents a pioneering conversational AI chatbot for no-code backtesting in investment research. Its major contributions, including the ability to generate Python code via natural language commands and few-shot learning techniques using LangChain, and provide a simple and intuitive interface for investment strategy evaluation and analytics. The development of GPTQuant is a significant contribution to the field of fintech, with the potential to enhance the investment research more accessible to a wider range of investors. The findings of this study have important implications for the future of the financial industry and the use of artificial intelligence in fintech, providing a foundation for further research in this exciting and rapidly evolving field.