

Intelligent Agents for Natural Language Interaction

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Abstract - *This research study explores the use of ai agents for decision making, and problem solving. They leverage advanced natural language processing techniques of large language models to analyze user inputs and determine which external tool to call. The use of agentic technology is called tool calling to perform complex tasks. Tool calling is the agent's ability to invoke external functions or API's as it was their own built command. Using these ai agents users can get insights from data without technical knowledge.*

Keywords - *Agentic AI, Function Calling, Large Language Models, Natural Language Interaction.*

INTRODUCTION

An agent is an artificial intelligence (AI) system capable of perceiving its environment, reasoning about potential actions, and making autonomous decisions [1]. In today's data-driven world, accessing and analyzing data often require technical expertise that many non-technical users lack. As a result, these users are unable to independently extract data and generate insights.

This research study explores the use of agentic AI technology to bridge that gap. By leveraging tools such as OpenAI's models, APIs, and SDKs, the project implements a conversational AI chatbot that acts as an intelligent agent. The chatbot enables non-technical users to get insights of their data through natural language interaction, eliminating the need for traditional programming skills.

Social Learning

Albert Bandura was one of the most influential psychologists in the history of psychology [2]. Its most famous work is the development of social learning theory; social learning theory suggests that people learn by observing others. Albert Bandura

emphasizes observing, modeling, and imitating behaviors, attitudes, and emotional reaction of others is of the utmost importance [3].

The foundation of the concept of Agentic Artificial Intelligence derives from psychology. This means that artificial intelligence systems can be developed using the foundation of social learning. As a result of this, it enables Artificial Intelligence systems to learn human interaction in social contexts [4].

In an agentic system, this idea can be reflected in how the model learns patterns of communication from training data, and how it selects actions based on what it has observed in similar contexts. Even though the agent is not a human, the process of learning from examples and adapting behavior is conceptually aligned with the idea of learning by observation.

Machine Learning

Machine learning is a research area of artificial intelligence that allows AI systems to learn from large datasets without being programmed explicitly [5]. Due to this, it allows ai systems to analyze patterns in datasets that in turn generate models for certain tasks [5].

In this project, machine learning is used in a practical way: after the dataset is cleaned, the system trains a regression model that can produce predictions. The key point is that the user does not have to implement the training pipeline manually, because the agent can trigger the correct steps through tool calling.

Generative AI

Generative artificial intelligence is ai that can create text, images, videos, audio, among others in response to a user's prompt [6]. It relies on models

that are generated by machine learning algorithms [6]. These models simulate the learning and decision-making part of the human brain [6]. The models then learn from huge amounts of data and in turn use that information to understand a user's natural language prompt request.

For this research, generative AI is important because it enables natural language understanding and response generation. Instead of the user writing SQL or python code, the user communicates through prompts, and the model generates structured actions in the form of tool calls.

Agentic Technology Case Studies

Cyber Security: Darktrace is a cyber security company that is leveraging artificial intelligence to autonomously detect cyber threats. They have developed a sophisticated AI framework that simulates the human body's immune system [7].

Health Care: HealthAI is a healthcare technology company that develops ai technology that helps improve chronic disease management [5]. They have developed a mobile application based on their ai technology. This mobile application uses algorithms that analyze patient data to predict potential health risks [5].

PROPOSED ARCHITECTURE

This research study proposes modular and scalable architecture that integrates OpenAI's language models, and a modern front-end interface to enable natural language interactions with csv files. The goal is to empower non-technical users to extract data using a chatbot that abstracts the complexity of data analysis.

IMPLEMENTATION

The implementation of this project involved integrating four main components: a front-end chatbot interface, OpenAI's GPT-based language model with function calling for decision making, and a set of python frameworks as seen in Figure 1. The goal of this implementation is to define what each

module does so that the figure and the system can be understood by people who are not experts in the area.

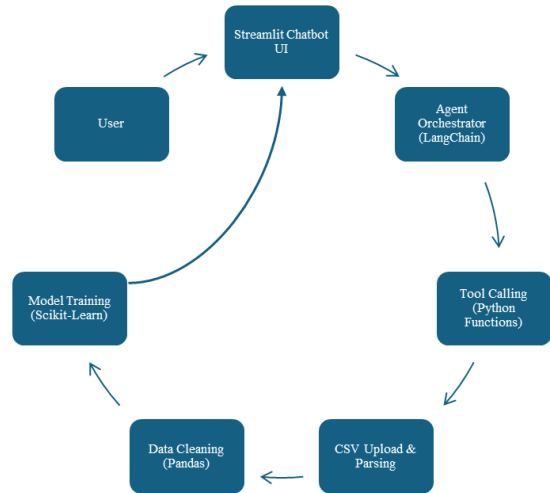


Figure 1
Proposed Architecture [1]

Module 1 - Front-End Chatbot Interface

The front-end module provides the user experience through a chat box interface that works similarly to Open ai's ChatGPT. In this module, the user uploads a csv file, asks questions about the dataset, and receives answers in natural language. This module also displays charts and basic visualizations so the user can quickly understand the results. The interface is responsible for validating that a file was uploaded and sending the user prompt to the agent.

Module 2 - Agent Orchestration and Decision Making

The agent module is responsible for interpreting the user's prompt and deciding what action should be executed. This is done by leveraging GPT models with function calling. The model analyzes the prompt and selects the correct tool to use (for example: loading the csv, cleaning the data, training the model, or generating predictions). This module keeps the conversation context and makes sure the answer matches what the user requested.

Module 3 - Tool Calling Functions (Back-End)

In this implementation, the tools are python functions that execute the work needed for data analytics. The tools are designed as separate

modules so the system is easier to maintain and extend. The main tools implemented are: (1) csv ingestion and parsing, (2) data cleaning with pandas, (3) feature preparation, (4) regression model training with scikit-learn, and (5) prediction generation and summarization of results.

For data cleaning, the system checks missing values, handles incorrect data types, removes duplicates when needed, and normalizes column formats so the dataset can be used consistently. After cleaning, the system prepares the dataset into features and targets based on the prediction task selected by the user. This makes it possible for the user to perform predictive analytics without knowledge of statistics or data science.

Module 4 - Results Delivery and Visualization

Once the tool finishes running, the results are returned to the chatbot interface as natural language summaries. The system also generates plots (for example, prediction vs actual values, distributions, and trend charts) to help users interpret the outputs. In essence, this project can successfully use agentic technology with artificial intelligence models, python programming language and vast frameworks to develop this project.

Open ai's GPT-4 Model

GPT stands for generative pre-trained transformers that are based on neural network architecture. GPT-4 can translate languages, has the creativity to generate specific text formats, and answer questions in a communicative way. One of the core capabilities of this model is that it can reference information from earlier conversations. This capability helps the agent keep context during the interaction and produce answers that follow the user's request.

Python Programming Language

Python is an object-oriented language that is known for its ease of use, built-in security, and its open-source nature that makes it easy for other people to contribute to. In the case of our project, it maximizes the use of frameworks for agentic

technology, graphical user interface development, and data science.

Frameworks

The following frameworks mentioned below are being used to implement our agentic project using the workflow shown in Figure 2.

- Lang chain – Lang chain is an open-source framework that assist in the development of LLM applications. Lang chain's main purpose is to manage complex workflows to integrate LLM into applications.
- Lang chain community – It's open-source nature makes it easier for third party to create tools for Lang chain.
- Open AI API – Open AI's API allows developers to integrate and leverages ChatGPT models into applications.
- Pandas – It's an easy-to-use data analysis and manipulation tool.
- Scikit-Learn – It's a popular open-source library for machine learning. It provides an interface for a range of supervised and unsupervised models.
- Streamlit – It's an open-source framework for AI/LM engineers to easily developed interactive applications.

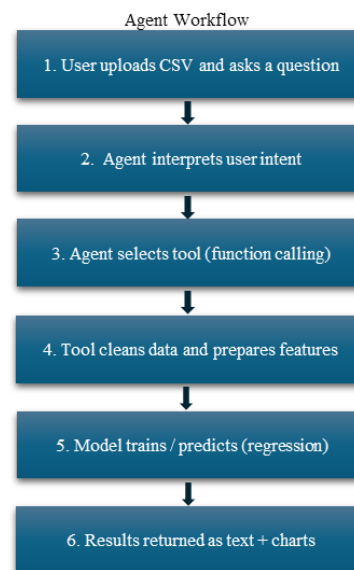


Figure 2

Implementation Workflow [2]

High-level workflow showing how the agent interprets the user prompt, selects tools, and returns results through the interface.

OUTCOMES

The implementation of AI agents demonstrated the feasibility and effectiveness of agentic technology in combination with AI models, machine learning models, and an interactive interface. The system was able to clean data, train predictive regression models, and generate insights with minimal human intervention as shown in Figure 3.

The final prototype focuses on three key outcomes:

- The AI agent went through the complete process of cleaning data, training, and performing predictions on that data. This reduces manual intervention or knowledge of data science and statistics.
- Interaction through natural language with the integration of GPT models and lang chain framework allows users with little technological knowledge to have their data analyzed.
- The project provides an easy-to-use interface that allows users to upload data in csv files and have that data analyze and visualize with the help of streamlit framework.

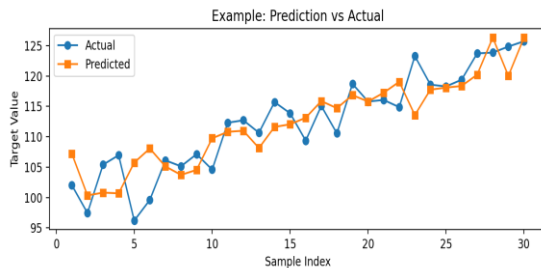


Figure 3
Example Results Visualization [3]

These outcomes show a practical and accessible approach in the Artificial Intelligence field, where users can focus on decision making rather than technical implementation.

RESULTS AND DISCUSSION

The results of the prototype show that the agent can guide the user through a complete analytics pipeline without requiring the user to understand the internal steps. When a csv file is uploaded, the agent

can identify the dataset structure, detect basic issues such as missing values, and apply cleaning steps before training the model. This is relevant because real datasets are rarely perfect, and non-technical users typically do not know how to prepare data for modeling.

For model training, the system uses regression methods as an initial baseline. The agent selects the training tool, prepares the feature matrix, and evaluates the output. Even when the final model is simple, the most valuable contribution is that the full workflow becomes accessible through natural language. This makes the system useful for quick insights and early decision making in data-driven environments.

In addition, the conversational interface reduces friction in the workflow. Instead of switching between tools, scripts, and notebooks, the user interacts with one interface. This supports the main objective of the project: to reduce technical barriers and improve accessibility to data analytics for non-technical users.

A limitation of the current prototype is that the quality of the answers depends on correct tool selection and consistent dataset structure. This is why future work should focus on validation steps, error handling, and expanding the set of tools so that the system can handle a wider variety of database.

System Evaluation and Analysis

The system was evaluated using multiple CSV datasets with different sizes and structures. The main goal of this evaluation was not to measure model accuracy in a statistical sense, but rather to evaluate whether the system could successfully guide the user through the complete data analysis process without requiring technical knowledge.

In most cases, the agent was able to correctly interpret the user's intent and select the appropriate tool. For example, when the user asked for predictions, the agent selected the model training function, prepared the dataset, trained the regression model, and returned the results without requiring any manual intervention. When the user requested

descriptive statistics or trends, the agent selected the appropriate analysis functions instead.

This shows that the agentic approach is effective for orchestrating complex workflows through natural language interaction. The most important result is not the specific numerical output, but the fact that the system reduces the complexity of data analysis into a conversational process that any user can follow.

Scalability Considerations

The modular design of the system allows it to scale as new features are added. Each tool is implemented as a separate function, which means that new tools can be added without modifying the entire system.

Reliability and Limitations

The agent depends on the structure and quality of the input data. If a csv file contains missing columns or incorrect values, the system may fail or return incorrect results.

Ethical Considerations and User Trust

The system should explain what tools are used and what assumptions are made so users can trust the results.

Summary of Extended Analysis

In summary, the system demonstrates that agentic AI can orchestrate data analytics workflows through natural language.

CONCLUSION

This project demonstrated the design and implementation of an AI-powered chatbot system that enables non-technical users to extract data in natural language. By integrating OpenAI's GPT-4 through their API service and using function calling, the ai system can make decisions based on user input. With a modern front-end interface, the system provides an intuitive alternative to traditional data analysis methods that typically require technical expertise.

The use of agentic AI technology allowed the chatbot to not only understand user intent but also autonomously decide which backend functions to trigger in order to clean data, prepare features, train models, and generate predictions. This is important because the user does not need to know which step comes first or how to code it; the agent takes responsibility for choosing the correct sequence of actions. In this sense, tool calling becomes a bridge between natural language and technical execution.

In addition, the modular architecture makes the system easier to extend. For example, the csv tools can later be replaced with database tools, and new analytics tools can be added without changing the user interaction. This makes the proposed system scalable for more advanced use cases, including larger datasets and different types of predictions.

Agentic technology is at the forefront of Artificial Intelligence development. With this Artificial Intelligence technology gets closer to emulating how a human being interacts, learns, socializes, and solves problems. In conclusion, the results of this project support that agentic systems can reduce barriers for data access and help users obtain insights in a practical and effective way.

FUTURE WORK

Future work will focus on expanding the system beyond csv files and integrating relational databases, such as Supabase or PostgreSQL, so that users can query structured data at scale. Additional work includes improving the agent's reliability with better tool selection, adding validation steps for safer execution, and supporting multiple agents that collaborate for complex tasks.

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