Report: Enhancing Chatbot Capabilities with Function Calling and Multi-Model Support

Overview

This report details the implementation of new chatbot functionalities for Homework 9. The upgrades include:

1. **Function Calling**: Enabling the chatbot to retrieve real-time or dynamic data by utilizing external APIs.
2. **Multi-Model Support**: Integrating DALLE 3 to generate images in response to user requests.

Key integrations include:

- Pinecone for storing embeddings and enabling similarity-based retrieval.
- Azure OpenAI for advanced natural language processing capabilities.
- LangChain tools for generating contextually relevant responses.

Implementation

1. Function Calling

Goal

Enable dynamic response generation by fetching external information such as book prices, availability, or weather updates using API calls.

Steps

- **Book Price Retrieval**:
    - Integrated Google Books API to fetch book price and availability data.
    - The get_Book_Price function processes user queries to retrieve relevant pricing information and formats it into a user-friendly response.
- **Real-Time Integration**:
    - Function calls are dynamically triggered based on user query intent (e.g., "What's the price of 'Pride and Prejudice'?").

Challenges

- **API Response Variability**: Some books may lack pricing information, requiring robust error handling.
- **Rate Limits**: Addressed by optimizing API call frequency and caching previously queried results.

2. Multi-Model Support

Goal

Enable the chatbot to complement textual responses with generated visuals for enhanced interactivity.

Steps

- **DALLE Integration**:
  - Implemented a generate_image tool using DALLE 3 via Azure OpenAI's API.
  - Image generation prompts were tailored to guarantee high-quality and contextually relevant results.
- **Dynamic Response Formatting**:
  - Combined text and image URLs seamlessly into the chatbot's output. For instance:
    - Textual Response: "Here's an artistic depiction of Dracula's castle."
    - Image URL: Embedded directly into the response using markdown syntax.
- **Error Handling**: Ensured fallback text responses in case of image generation failures.

Challenges

- **Latency**: DALLE image generation can introduce delays, mitigated by prioritizing text output and appending the image URL when ready.
- **Image Prompt Design**: Fine-tuned prompts to balance user expectations and DALLE capabilities.

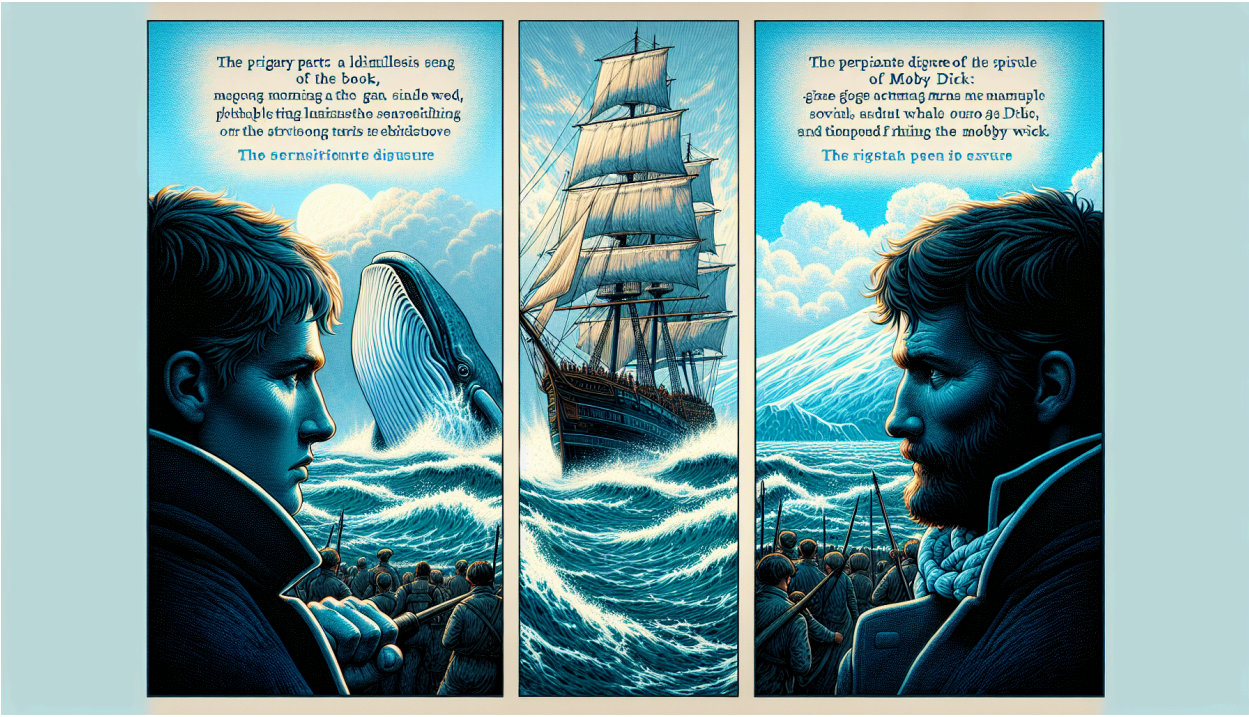
Sample Queries

Function Calling

1. **Book Price Query**:
    - **User**: "What's the price of Harry Potter?"
    - **Chatbot**: "The price of "Harry Potter" is 11.99 USD."

Image Generation

1. **Book-Inspired Art**:
    - **User**: "Explain the book via drawings"
    - **Chatbot**:



2. **Creative Request**:
    - **User**: "Generate an image of a futuristic city at night."

- **Chatbot**:

3. **Diagrammatic Art**:
   - **User**: "Create an artistic representation of time."
   - **Chatbot**:

Deployment

- **Hosting**: The chatbot is deployed on Azure Static Websites.
- **Public Link**: https://orange-ground-0d858280f.5.azurestaticapps.net/

Challenges and Resolutions

1. **Error Handling**: Implemented robust error-handling mechanisms for both API calls and image generation.
2. **Context Switching**: Ensured seamless handling of multi-turn conversations by retaining the context of previous queries.
3. **Performance Optimization**: Enhanced performance through asynchronous API calls and improved vector similarity search optimization.

Conclusion

The chatbot's functionality has been significantly improved by the incorporation of new features, resulting in a more dynamic and engaging experience. The chatbot provides a versatile and interactive user experience by combining real-time information retrieval with the ability to generate visuals.