LLM Experimentation Report

Objective

The objective of this experiment is to leverage a free or open-source LLM to:

- ➢ Provide natural language explanations for predicted mental health conditions.
- ➢ Suggest coping mechanisms and potential next steps for individuals.
- ➢ Ensure efficient integration into a chatbot or application for seamless user interaction.

Implementation Details

- **Model Selection**

  For this implementation, we utilized Google's Gemini LLM (gemini-1.5-flash) due to its efficiency and high accuracy in generating responses. The model was integrated using the `langchain_google_genai` package.

- **Prompt Engineering**

  A carefully crafted the prompt and was designed to guide the LLM in generating insightful responses. The prompt included:

  - ➢ User-provided data
  - ➢ Predictions made by the machine learning model
  - ➢ A request for detailed explanations and coping strategies

- **API Integration**

  The `google.generative ai` package was used to configure API access. The `LLM Chain` component from LangChain was utilized to create a structured query-response mechanism.

Experimental Setup

- **Dataset**

  The dataset used was `depression_anxiety_data.csv`, containing user attributes such as:

  - ➢ PHQ Score

- ➢ GAD Score
- ➢ Depression Severity
- ➢ Anxiety Severity
- ➢ BMI and WHO-BMI
- ➢ Other demographic and psychological indicators

● Machine Learning Model for Prediction

A supervised learning approach was used to predict mental health conditions based on user input. The model employs:

- ➢ **Random Forest Classifier** and **XGBoost Classifier** to classify the likelihood of suicidal tendencies.
- ➢ Feature selection based on feature importance analysis.
- ➢ StandardScaler for data normalization.
- ➢ Label Encoding for categorical data transformation.
- ➢ Predictions output either **True** (high risk) or **False** (low risk) for suicidal tendencies.

● LLM Integration

LLM Model Used

- **Google Gemini-1.5-flash** (via Langchain's `ChatGoogleGenerativeAI`)
- **Prompt Engineering**: A structured prompt was designed to provide context-aware explanations.

Prompt Template

Given the following user input data and predictions, provide natural language explanations for the predicted mental health conditions. Additionally, suggest coping mechanisms and potential next steps.

Predictions: {Prediction}
Data for prediction: {data}
Explain in detail.
Answer:

Integration Flow

- ➢ The machine learning model predicts the likelihood of a mental health condition.
- ➢ The LLM is prompted with the model's prediction and user input data.

- ➢ The LLM generates:
  - A natural language explanation of the predicted condition.
  - Suggested coping strategies.
  - Possible next steps (e.g., seeking professional help, lifestyle changes, self-care recommendations).
- ➢ The response is displayed to the user via a **Streamlit UI** or command-line script.

Experimentation Findings

➢ Accuracy & Interpretability

- The explanations provided by the LLM were **coherent, contextually relevant, and detailed**.
- Compared to predefined rule-based responses, the LLM-generated responses were **more empathetic and personalized**.
- Coping strategies were **comprehensive**, covering mental health exercises, therapy suggestions, and crisis support.
