Intent Classification System for Natural Language Understanding

Introduction

In this project, we aimed to develop a simple yet effective Natural Language Understanding (NLU) system capable of classifying intents from textual inputs. The system's primary function is to discern the intent behind a text query and respond appropriately, either with the detected intent and a confidence score or with a fallback response if the confidence is insufficient.

Data Preparation

The dataset was manually constructed to include a variety of intents that are typical in conversational systems. Each intent is represented by multiple text examples to provide a broad spectrum of expressions. The current dataset includes the following intents:

- Greet: Friendly salutations.
- Farewell: Expressions for saying goodbye.
- Inquiry: Questions about information.
- Request Assistance: Requests for help or support.
- Provide Information: Demands for specific details about services or products.

We expanded the dataset to enhance model performance and its ability to generalize across different phrasings and contexts. This extension ensures a more robust training outcome and reduces the potential for overfitting.

Model Selection and Preprocessing

The choice of model and preprocessing techniques is crucial for the success of any text classification task. For this project, we opted for the Support Vector Machine (SVM) model implemented within the scikit-learn library. SVM was selected due to its effectiveness in high-dimensional spaces and its suitability for binary and multiclass classification tasks.

For preprocessing, we employed the TF-IDF (Term Frequency-Inverse Document Frequency) vectorization technique. TF-IDF converts text data into a numeric form the model can process, emphasizing words that are more unique to a document across the dataset. This method helps in reducing the impact of frequently appearing words that might otherwise dominate the feature set.

Confidence Threshold and Fallback Mechanism

Setting a confidence threshold is a critical step in deploying a practical NLU system. For this system, a threshold of 0.7 was chosen. This value means that if the model's confidence in its prediction is above 70%, the system considers the prediction reliable enough to act upon. Conversely, if the confidence score is below this threshold, the system triggers a fallback response. This threshold balances between avoiding false positives (acting on incorrect predictions) and ensuring the user receives a response even when the system is less certain.
The fallback mechanism is a simple yet crucial component of our system. It enhances the system's reliability by providing a generic response ("NLU fallback: Intent could not be confidently determined") when the prediction confidence is low. This feature ensures that the system remains user-friendly and helpful even in cases of uncertainty.

Conclusion

The intent classification system developed for this project represents a foundational step towards building more sophisticated NLU systems. By utilizing a robust machine learning model, effective preprocessing methods, and a thoughtful fallback mechanism, the system can reliably interpret and respond to user inputs across a variety of domains. Future enhancements could include expanding the dataset, incorporating more complex models, and fine-tuning the confidence thresholds based on real-world usage data to further refine its performance.