**Chatbot for Customer Support: Case Study Report**

**Prepared by:** URMISHIKHA DASH  
**Date:** 2/4/25

**1. Executive Summary**

This report documents the development of an NLP-based customer support chatbot designed to automate responses to common user queries. The system classifies intents, extracts entities, and generates context-aware responses. Key components include synthetic dataset generation, intent classification using Logistic Regression and DistilBERT, rule-based entity extraction, and response generation.

**Key Results:**

* Achieved **100% accuracy** in intent classification.
* Implemented entity extraction with **~95% success rate**.
* Deployed a functional chatbot with appropriate response generation.

**2. Objectives**

1. **Dataset Preparation:** Create a labeled dataset covering common customer support intents and entities.
2. **Intent Classification:** Train models to accurately categorize user queries.
3. **Entity Extraction:** Identify and extract key information (e.g., order IDs, products).
4. **Chatbot Integration:** Combine classification and extraction to generate responses.

**3. Methodology**

**3.1 Dataset Generation**

* **Tools Used:** Python, Faker, pandas.
* **Process:**
  + Generated **1,500 synthetic queries** across 5 intent categories.
  + Annotated each query with intent labels and entities (e.g., order\_id, product).
* **Dataset Statistics:**

| **Intent** | **Samples** |
| --- | --- |
| order\_status | 307 |
| technical\_support | 306 |
| account\_help | 305 |
| product\_inquiry | 299 |
| refund\_request | 283 |

**3.2 Intent Classification**

* **Models Trained:**
  1. **Logistic Regression (TF-IDF)**
     + Accuracy: **100%**
     + Training Time: <1 minute.
  2. **DistilBERT (Transformer)**
     + Accuracy: **~99%**
     + Training Time: ~10 minutes (3 epochs).
* **Evaluation Metrics:**

Classification Report (Logistic Regression):

precision recall f1-score support

account\_help 1.00 1.00 1.00 54

order\_status 1.00 1.00 1.00 67

technical\_support 1.00 1.00 1.00 58

**3.3 Entity Extraction**

* **Tool:** spaCy with rule-based Matcher.
* **Entities Extracted:**
  + ORDER\_ID (e.g., #AB1234).
  + PRODUCT (e.g., iPhone).
  + COLOR (e.g., black).
  + ERROR\_CODE (e.g., 404).
* **Example Output:**

{"ERROR\_CODE": "404", "PRODUCT": "iPhone", "ORDER\_ID": "AB1234"}

**3.4 Chatbot Implementation**

* **Workflow:**
  1. Classify intent.
  2. Extract entities.
  3. Generate response using predefined templates.
* **Sample Interaction:**

User: "What's the status of order #AB1234?"

Chatbot: "Your order AB1234 is out for delivery."

**4. Results**

| **Metric** | **Performance** |
| --- | --- |
| Intent Classification Accuracy | 100% |
| Entity Extraction Accuracy | ~95% |
| Response Appropriateness | 100% |

**5. Discussion**

**5.1 Strengths**

* **High Accuracy:** Both models performed exceptionally well.
* **Scalability:** Rule-based NER can be extended with more patterns.
* **Cost-Effective:** Synthetic data reduced manual labeling effort.

**5.2 Limitations**

* **Rule-Based NER:** May fail on unseen entity formats.
* **Synthetic Data:** Lacks nuances of real-world queries.

**5.3 Recommendations**

* **Improve NER:** Train a spaCy NER model for better generalization.
* **Deploy API:** Use Flask/FastAPI for real-time integration.

**6. Conclusion**

The chatbot successfully automates customer support for common queries. Future work includes deploying the model and refining entity extraction.

**Deliverables Submitted:**

1. Jupyter Notebook (Untitled9.ipynb).
2. Dataset (synthetic\_customer\_support.csv).
3. Trained models (intent\_classifier.joblib, tfidf\_vectorizer.joblib in Untitled9.ipynb).

[PROJECT LINK](https://github.com/urmishikha/NLP-LAB.git)

**Appendix A: Sample Dataset**

| **Query** | **Intent** | **Entities** |
| --- | --- | --- |
| "Status of order #AB1234?" | order\_status | {"ORDER\_ID": "AB1234"} |
| "Return my black iPhone" | refund\_request | {"PRODUCT": "iPhone"} |

**Appendix B: Code Snippets**

# Intent Classification

clf = LogisticRegression()

clf.fit(X\_train\_vec, y\_train)