Vidyayāmruthamashnuthe

B.N.M. Institute of Technology

An Autonomous college under VTU

Hybrid NLP-Based Document Classifier

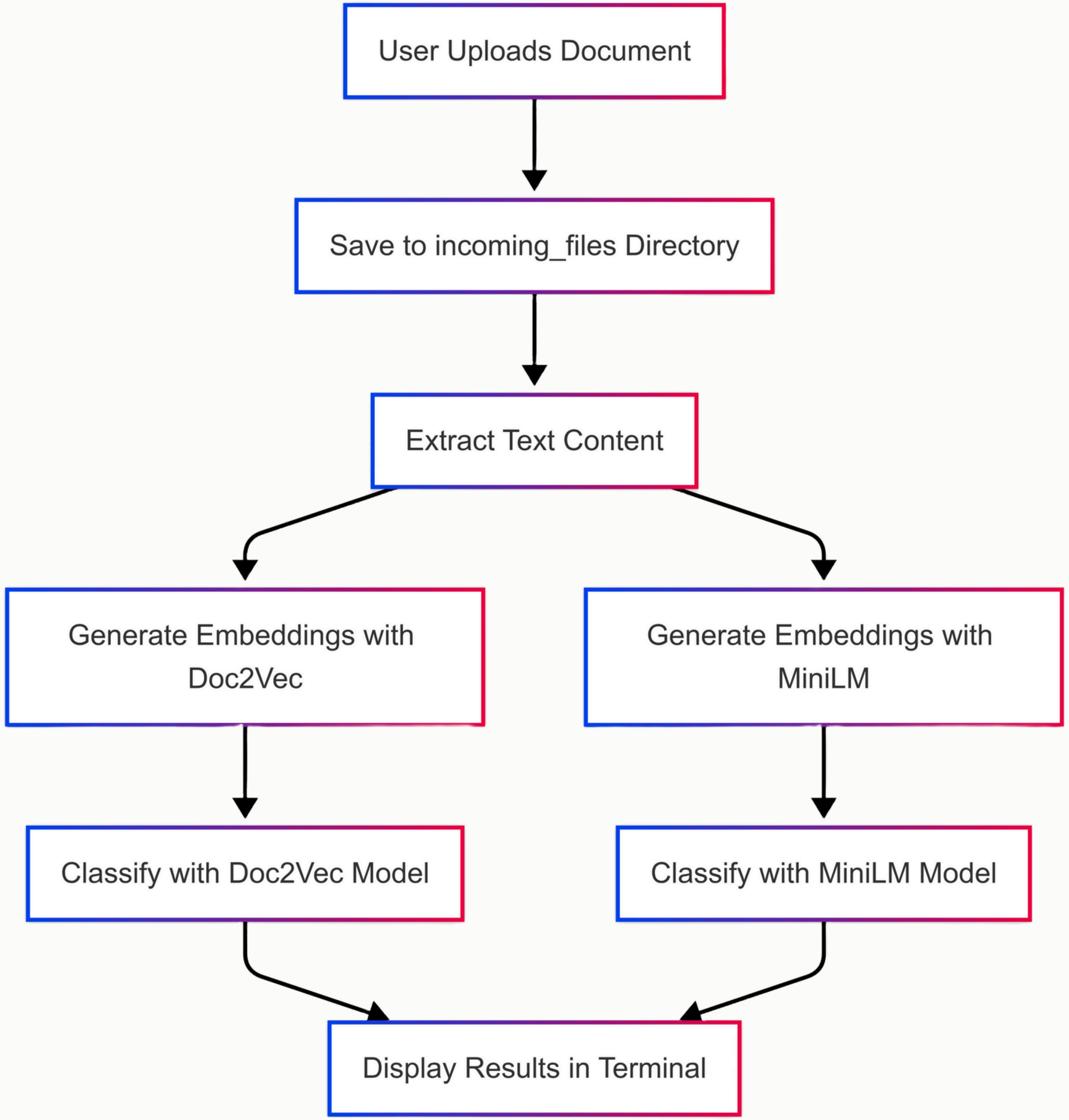
Team Members:

Abhay S	1BG23CS002
Abhiram H	1BG23CS004
Achintya K J	1BG23CS005

Objective

- To develop an intuitive and efficient workflow that classifies text based documents of various formats into clusters.
- To compare the performance of two NLP models — Doc2Vec and all-MiniLM-L6-v2 — on real-world text classification tasks.
- To enable efficient document classification via a command-line tool, allowing users to input files, trigger external model scripts, and evaluate model predictions and agreement.

Methodology and Workflow



User Uploads Document

Save to incoming_files Directory

Extract Text Content

Generate Embeddings with Doc2Vec

Generate Embeddings with MiniLM

Classify with Doc2Vec Model

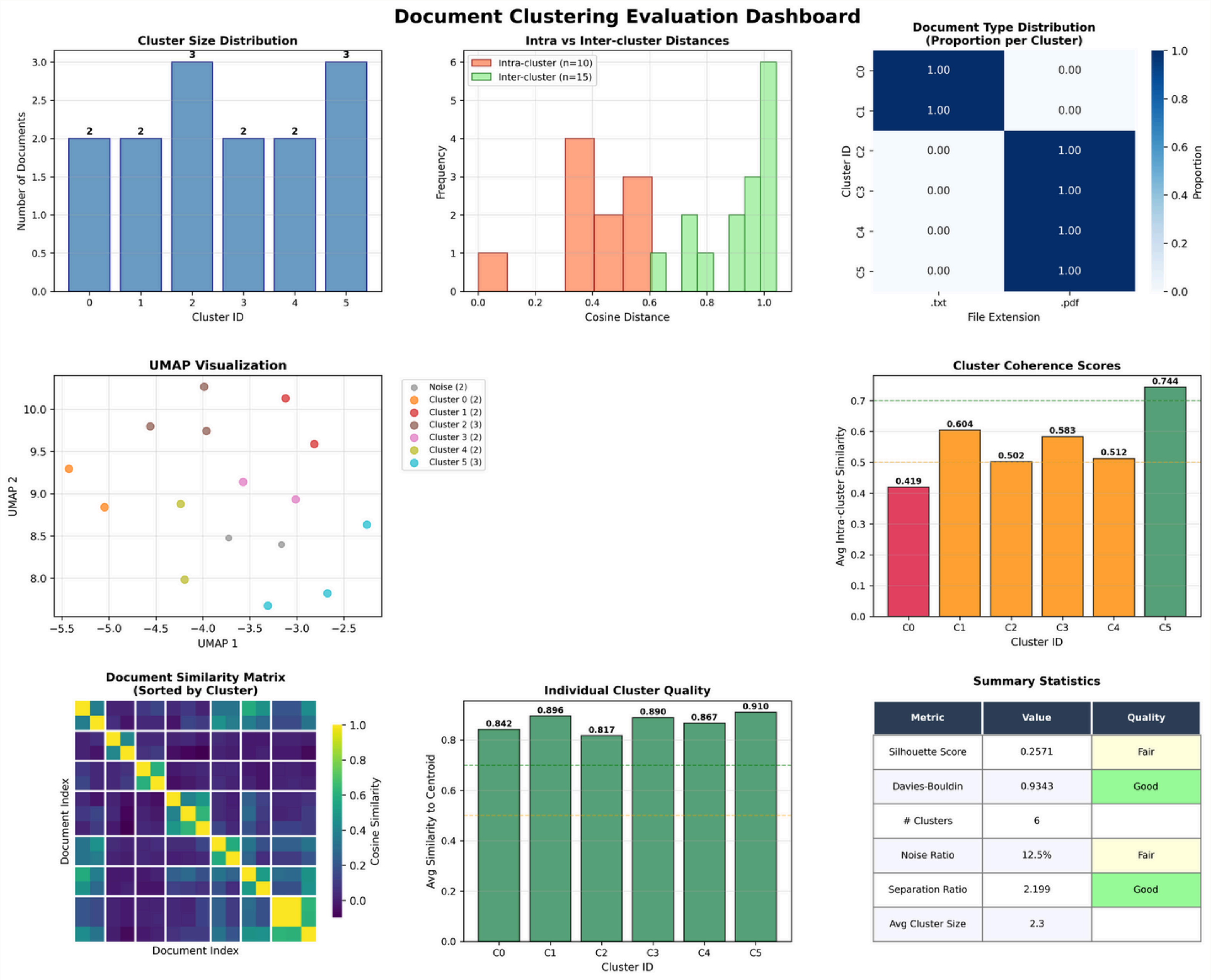
Classify with MiniLM Model

Display Results in Terminal

Key Assumptions

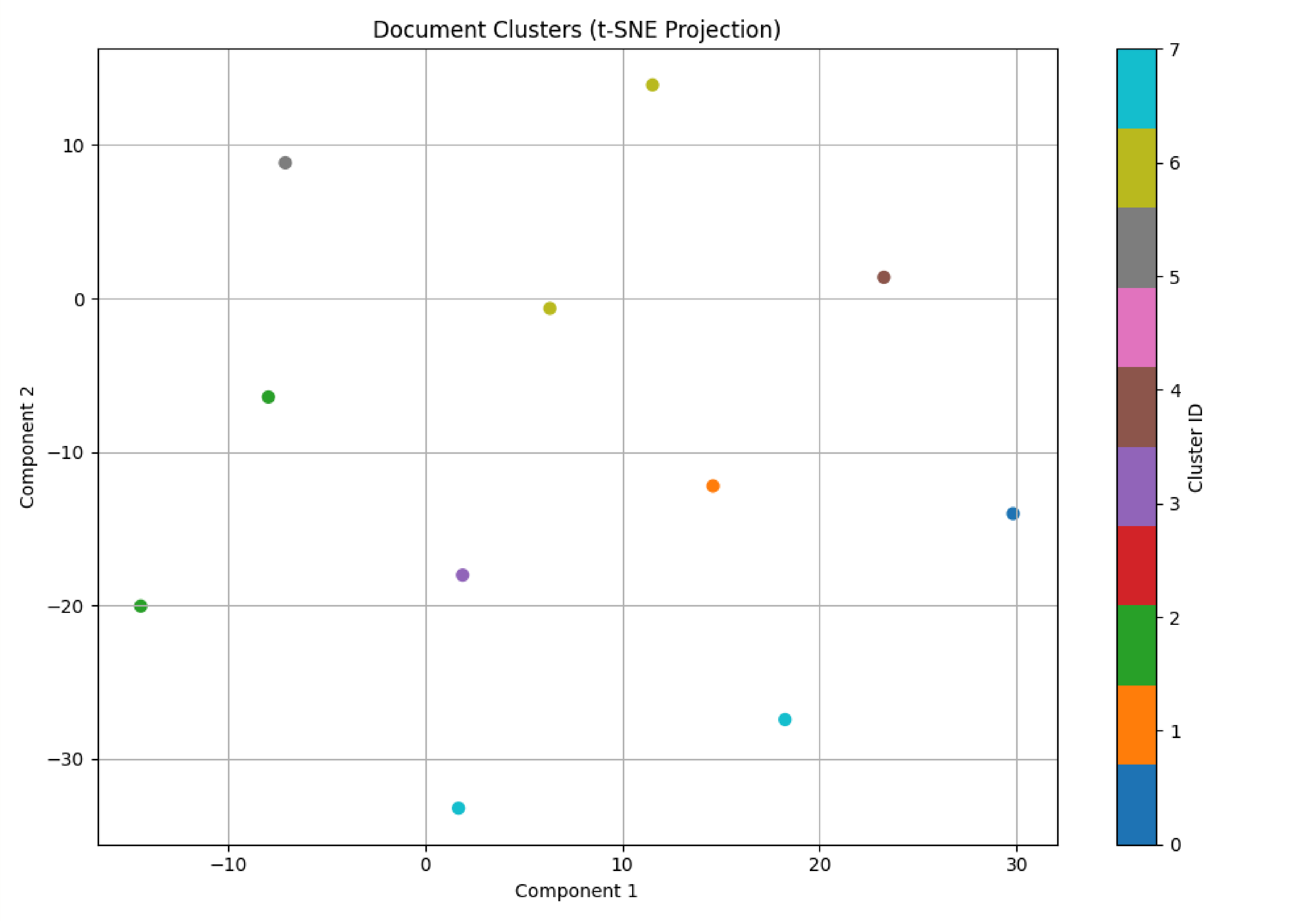
- Users will upload documents that are semantically rich and contain sufficient textual content for accurate classification.
- The pre-trained embeddings (Doc2Vec and MiniLM) are assumed to generalize well to the types of documents being uploaded.
- The uploaded files are free from significant noise, errors, or language inconsistencies that might degrade embedding quality.
- Both models (Doc2Vec and MiniLM) assume language is English and embeddings are aligned to English text semantics.

Model Evaluation and Analysis



Summary Statistics

Metric	Value	Quality
Silhouette Score	0.2571	Fair
Davies-Bouldin	0.9343	Good
# Clusters	6	
Noise Ratio	12.5%	Fair
Separation Ratio	2.199	Good
Avg Cluster Size	2.3	



Project Summary and Outcomes

Project Summary

- Built a document classifier for txt, pdf and other file types using Doc2Vec and all-MiniLM-L6-v2 embeddings.
- Enabled document classification via CLI with support for external model execution and side-by-side prediction comparison from independent scripts.

Project Outcomes

- Successfully deployed a CLI-based prototype for real-time document classification with necessary metrics.
- Validated the semantic effectiveness of embedding-based models (Doc2Vec and MiniLM) for categorizing varied document types.
- Established a foundation for future multi-model NLP systems, with extensibility for broader classification tasks.

Future Improvements and Extensions

- Add support for multi-label classification for documents spanning multiple categories.
- Add a user-friendly frontend using streamlit for drag and drop upload.
- Integrate OCR to handle scanned or image-based PDFs.
- Incorporate Google's Universal Sentence Encoder or BERT variants for deeper contextual understanding.
- Enable model training from uploaded data to adapt to domain-specific documents.
- Develop a feedback loop where user corrections improve model accuracy over time.
- Add analytics dashboard for tracking document types, prediction trends, and model performance.

Reflections and Learning Outcomes

- Gained hands-on experience in end-to-end NLP pipeline design using pre-trained embedding models and training a model.
- Understood trade-offs between different word embedding techniques like Doc2Vec and MiniLM.
- Identified challenges in text extraction, formatting inconsistencies, and model generalization.
- Recognized the importance of clear evaluation metrics and cross-model comparisons for trust.