Model Optimization and Tuning Phase Template

Date	16 Dec 2025
Team ID	RT
Project Title	Restaurant Recommendation System
Maximum Marks	10 Marks

Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining machine learning models for peak performance. It includes optimized model code, fine-tuning hyperparameters, comparing performance metrics, and justifying the final model selection for enhanced predictive accuracy and efficiency.

Hyperparameter Tuning Documentation (6 Marks):

Model	Tuned Hyperparameters	Optimal Values
TF-IDF Content-Based	max_features, ngram_range, min_df, max_df	Best: {'max_df': 0.95, 'max_features': 2000, 'min_df': 5, 'ngram_range': (1, 1)} (Sim: 0.715)

```
Saved: tuning_results.csv
Best: {'max_df': 0.95, 'max_features': 2000, 'min_df': 5, 'ngram_range': (1, 1)} (Sim: 0.715)
```

Performance Metrics Comparison Report (2 Marks):

Model	Baseline Metric	Optimized Metric
TF-IDF Content-Based	FULL METRICS: Success Rate: 85.7% (12/14) Avg Similarity: 0.450 Avg Diversity: 6.4 unique chains/10 Avg Latency: 5.9ms/query 95th Percentile: 9.8ms Model saved: ../model/tfidf_model.pkl	FULL METRICS: Success Rate: 85.7% (12/14) Avg Similarity: 0.601 Avg Diversity: 6.1 unique chains/10 Avg Latency: 5.5ms/query 95th Percentile: 7.6ms Model saved: ../model/tfidf_model.pkl

Final Model Selection Justification (2 Marks):

Final Model	Reasoning
TF-IDF (max_features=2000, min_df=5, max_df=0.95, ngram_range=(1,1))	GridSearch optimal from 120 combinations: +35% similarity (0.446→0.601) while maintaining 85.7% success; min_df=5 prunes rare noise, max_df=0.95 removes generics; 6.0ms latency production-ready for Flask real-time queries; unigrams prioritize speed/accuracy for cuisine matching.