**Model Optimization and Tuning Phase Template**

| Date | 15 March 2024 |
| --- | --- |
| Team ID | xxxxxx |
| Project Title | xxxxxx |
| 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** |
| --- | --- | --- |
| **Decision Tree** | max\_depth, min\_samples\_split, criterion | max\_depth=7, min\_samples\_split=5, criterion='entropy' |
| **Logistic Regression** | penalty, C, solver | penalty='l2', C=0.1, solver='liblinear' |
| **Naive Bayes** | var\_smoothing | var\_smoothing=1e-8 |

### CODE SNIPPET:

### Performance Metrics Comparison Report (2 Marks):

| **Model** | **Baseline Metric** | **Optimized Metric** |
| --- | --- | --- |
| **Decision Tree** | 0.93 | **0.96** |
| **Logistic Regression** | 0.86 | 0.88 |
| **Naive Bayes** | 0.78 | 0.80 |

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### Final Model Selection Justification (2 Marks):

| **Final Model** | **Reasoning** |
| --- | --- |
| **Optimized Decision Tree** | 1. **Highest F1 (0.96)** for fraud class (balances precision/recall).  2. **Interpretable rules**: Critical for fraud investigation teams (e.g., amount > $50K + oldbalanceOrg == 0).  3. **Low computational cost**: Predicts in 2ms/transaction vs. 5ms (Logistic Regression). |