**Model Optimization and Tuning Phase Template**

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| Date | 4 July 2025 |
| Team ID | SWTID1749727925 |
| Project Title | E-Adapt: Predicting Student Adaptability in Online Classes |
| 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):

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| **Model** | **Tuned Hyperparameters** | **Optimal Values** |
| Tuned Catboost | 'iterations', 'depth', 'learning\_rate', 'random\_strength', 'bagging\_temperature', 'od\_type', 'od\_wait' | 'iterations': 570, 'depth': 9, 'learning\_rate': 0.04829016967980194, 'random\_strength': 63, 'bagging\_temperature': 1.9644230050947629, 'od\_type': 'IncToDec', 'od\_wait': 26 |
| Tuned XGboost | 'n\_estimators', 'max\_depth', 'reg\_alpha', 'reg\_lambda', 'min\_child\_weight', 'gamma', 'learning\_rate''colsample\_bytree' | 'n\_estimators': 185, 'max\_depth': 13, 'reg\_alpha': 0, 'reg\_lambda': 5, 'min\_child\_weight': 0, 'gamma': 0.008549680342959925, 'learning\_rate': 0.07330077783044628, 'colsample\_bytree': 0.7549889063579746 |

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

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| **Model** | **Baseline Metric** | **Optimized Metric** |
| Tuned XGboost | 0.8414938 | 0.9128630705394192 |
| Tuned Catboost | 0.8174274 | 0.9136929460580914 |

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

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| --- | --- |
| **Final Model** | **Reasoning** |
| Tuned Catboost | The tuned CatBoostClassifier was selected based on its superior performance, achieving the highest cross-validated accuracy of approximately 91.37% after optimization. Its native support for categorical variables further enhanced its suitability for the dataset's structure and feature types. |