**Model Optimization and Tuning Phase Template**

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| Date | 20 July 2025 |
| Team ID | SWTID1750360304 |
| Project Title | Power consumption analysis for households |
| 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** |
| **Logistic Regression** | C, penalty, solver, max\_iter, class\_weight | C: 0.5, penalty: 'l2', solver: 'saga', max\_iter: 500, class\_weight: 'balanced' |

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

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| --- | --- | --- | --- | --- |
| **Model** | **Baseline Accuracy** | **Optimized Accuracy** | **F1-Score (Optimized)** | **Training Time** |
| **Logistic Regression** | 82.3% | 86.2% | 0.84 | 28 seconds |

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

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| --- | --- |
| **Final Model** | **Reasoning** |
| Logistic Regression | The tuned Logistic Regression was selected for its **optimal balance of accuracy (86.2%), speed (28s training), and interpretability**. While Random Forest had slightly higher accuracy (91%), Logistic Regression's 5x faster predictions and clear feature importance (via coefficients) better suit real-time energy monitoring. Its balanced class weighting also improved detection of peak usage events. This aligns with our goals of actionable insights and scalable deployment. |