**Model Optimization and Tuning Phase Report**

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| **Date** | 17 June 2025 |
| **Team ID** | SWTID1749876754 |
| **Project Title** | SynapseScan: AI Driven Classification of Ovarian Cancer Variants |
| **Maximum Marks** | 10 Marks |

**Model Optimization and Tuning Phase**

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

**Hyperparameter Tuning Documentation**

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| **Model** | **Tuned Hyperparameters** | **Optimal Values** |
| **InceptionV3 + Attention** | Learning Rate Batch Size Epochs Dropout Rate Dense Layer Size Attention Heads Gaussian Noise Early Stopping Patience | 0.0001 32 20 0.25 512 8 0.25 5 |
| **InceptionV3 + Attention + Fine-tuning** | Fine-tune Learning Rate Fine-tune Epochs Unfreeze Layers Count Early Stopping Patience LR Reduction Factor LR Reduction Patience Minimum Learning Rate | 1e-5 25 60 3 0.5 2 1e-7 |

**Performance Metrics Comparison Report**

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| **Model** | **Optimized Metric** |
| **InceptionV3 + Attention** | **Test Accuracy:** 77.34% **Test Loss:** 0.33% **Precision:** 78.39% **Recall:** 77.31% **F1-Score:** 77.62% |
| **InceptionV3 + Attention + Fine-tuning** | **Test Accuracy:** 93.84% **Test Loss:** 0.12% **Precision:** 93.91% **Recall:** 93.84% **F1-Score:** 93.87% |

**Final Model Selection Justification**

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| **Final Model** | **Reasoning** |
| **InceptionV3 + Attention + Fine-tuning** | The fine-tuned InceptionV3 with Custom Differential Attention was selected for its superior performance over the base model. The fine-tuning process with selective layer unfreezing (last 60 layers) and reduced learning rate (1e-5) allowed the model to adapt better to the specific dataset characteristics. The incorporation of advanced callbacks including ReduceLROnPlateau and optimized early stopping (patience=3) prevented overfitting while maximizing performance. The custom attention mechanism enhances feature focus, and the fine-tuning approach leverages pre-trained ImageNet weights while adapting to domain-specific patterns, resulting in improved accuracy and generalization capability for loan approval prediction tasks. |