**Model Optimization and Tuning Phase Template**

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| Date | 15 March 2024 |
| Team ID | SWTID1749906821 |
| Project Title | neural networks ahoy: cutting-edge ship classification for maritime |
| Maximum Marks | 10 Marks |

**Model Optimization and Tuning Phase**

The Model Optimization and Tuning Phase involves refining neural network 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 (8 Marks):

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| **Model** | **Tuned Hyperparameters** |
| Model 1 | **Model 1: Lightweight CNN with High Regularization**   * **Architecture**: Uses DepthwiseConv2D and SeparableConv2D (MobileNet-style) for efficient feature extraction. * **Regularization**: Heavy use of Dropout after every block (rate: 0.5). * **Training**: 15 epochs. * **Strength**: Good for preventing overfitting, suitable for smaller datasets or low-resource devices. |
| Model 2 | **Model 2: Lightweight CNN with Less Regularization**   * **Same architecture as Model 1**, but **less dropout** (none after the first block). * **Training**: 35 epochs. * **Strength**: Learns more detailed patterns due to fewer dropped connections. Slightly more prone to overfitting but may perform better with enough data and training. |
| Model 3 | **Model 3: Classic ConvNet with Training Controls**   * **Architecture**: Standard Conv2D + MaxPooling2D blocks (16 → 32 → 64 → 128 filters). * **Regularization**: Moderate Dropout (after 2nd and 3rd blocks). * **Training**: 10 epochs with EarlyStopping and ReduceLROnPlateau. * **Loss Function**: SparseCategoricalCrossentropy (simpler label format). * **Strength**: Classic and proven CNN design, easy to understand and debug, with adaptive training controls for better convergence. |

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

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| **Final Model** | **Reasoning** |
| Model 3 | * **Simplicity**: Easier to train, interpret, and extend. * **Effective Regularization**: Enough dropout to prevent overfitting, but not overly aggressive. * **Training Efficiency**: EarlyStopping and learning rate scheduling help avoid overtraining and speed up convergence. * **Stable Performance**: Traditional architecture performs well on a wide range of image classification tasks. |