Model Optimization and Tuning Phase Template

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Team ID	SWTID1720351492
Project Title	CovidVision: Advanced COVID-19 Detection from Lung X-rays with Deep Learning
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):

Model	Tuned Hyperparameters
Model 1	**Hyperparameters** 1. **Epochs**: `EPOCHS = 40` ○ This defines the number of complete passes through the training dataset. 2. **Initial Learning Rate**: `initial_lr = 1e-5` ○ The starting learning rate for the optimizer. 3. **Decay Steps**: `decay_steps = 10` ○ The number of steps before the learning rate decays. 4. **Decay Rate**: `decay_rate = 1.0` ○ The factor by which the learning rate decays. 5. **Batch Size**: `batch_size=32` ○ The number of samples processed before the model's internal parameters are updated. 6. **Patience**: `patience=5` ○ Number of epochs with no improvement after which training will be stopped.

```python
EPOCHS = 40
initial_lr = 1e-5
decay_steps = 10
decay_rate = 1.0

lr_scheduler = ExponentialDecay(initial_lr, decay_steps, decay_rate)
training_optimizer = Adam(learning_rate=lr_scheduler)
early_stopping = EarlyStopping(monitor='val_loss', patience=5, restore_best_weights=True)

model.compile(optimizer=training_optimizer, loss='binary_crossentropy', metrics=['accuracy','precision','recall','auc','binary_accuracy'])
```
[27]   Python

```python
history = model.fit(x_train, y_train, batch_size=32, epochs=EPOCHS, validation_data=(x_val, y_val), verbose=0, callbacks=[early_stopping, TqdmCallback(verbose=2)])
```
[28]   Python

Final Model Selection Justification (2 Marks):

Final Model	Reasoning
Model 1	The final VGG19-based CNN model was chosen due to its strong feature extraction capabilities, effective use of transfer learning, and balanced approach to handling the dataset. Its high accuracy on the test data, along with good performance on training and validation data, validated its effectiveness in classifying chest X-ray images into COVID-19 positive and normal categories. The careful selection of parameters, use of early stopping, and learning rate scheduling contributed to the model's optimal performance.