**Report: Training and Validation Performance of Image Classification Models**

**Objective**

The project aimed to evaluate and compare the performance of various convolutional neural network (CNN) architectures, including:

• A basic CNN model,

• VGG19,

• ResNet50,

• InceptionNet,

• MobileNet.

The primary goal was to assess their training and validation performance while mitigating overfitting and ensuring generalization on unseen data.

**Challenges and Adjustments**

• **Limited Computational Resources**: Due to constraints with GPU availability and time, training was limited to fewer epochs for some models.

• **Partial Results**: Training results were collected for:

• CNN (20 epochs),

• VGG19 (20 epochs),

• ResNet (5 epochs),

• InceptionNet (5 epochs),

• MobileNet (5 epochs).

**Basic CNN**

• **Performance**:

• Training Accuracy: 44.9%.

• Validation Accuracy: 65.5%.

• Loss: The training and validation loss decreased steadily, with the validation loss reaching 0.9193.

• **Insights**:

• The CNN showed improvement with a reduced learning rate and regularization but required deeper architecture for better generalization.

**VGG19**

• **Performance**:

• Training Accuracy: 84.6%.

• Validation Accuracy: 93.5%.

• Loss: Validation loss decreased to 0.1930, showing consistent improvement across epochs.

• **Insights**:

• VGG19 demonstrated excellent generalization and consistent performance, leveraging transfer learning effectively.

**ResNet50**

• **Performance**:

• Training Accuracy: 40.4%.

• Validation Accuracy: 60.6%.

• Loss: Validation loss decreased to 1.1567 over 5 epochs.

• **Insights**:

• ResNet50 showed promise but required more training epochs to reach optimal performance.

**InceptionNet**

• **Performance**:

• Training Accuracy: 66.6%.

• Validation Accuracy: 82.0%.

• Loss: Validation loss decreased to 0.4844 over 5 epochs.

• **Insights**:

• InceptionNet achieved balanced performance with moderate validation loss, indicating potential with extended training.

**MobileNet**

• **Performance**:

• Training Accuracy: 64.7%.

• Validation Accuracy: 77.4%.

• Loss: Validation loss reached 0.6256, indicating steady improvement.

• **Insights**:

• MobileNet performed efficiently and demonstrated strong potential for lightweight applications.

**Epoch Progression Details**

1. **Basic CNN**: Gradual improvement in validation accuracy, reaching 65.5% with a reduction in validation loss from 2.1088 to 0.9193.

2. **VGG19**: Outstanding performance with validation accuracy reaching 93.5% and validation loss reducing to 0.1930.

3. **ResNet50**: Achieved 60.6% validation accuracy within 5 epochs, with validation loss reducing to 1.1567.

4. **InceptionNet**: Balanced learning with validation accuracy of 82.0% and validation loss of 0.4844.

5. **MobileNet**: Consistently improved validation accuracy to 77.4% and validation loss to 0.6256.

**Potential Performance with Full Training**

Given sufficient computational resources, it is expected that the performance of ResNet50, InceptionNet, and MobileNet would have significantly improved with full training. Extended training epochs could have further minimized loss and increased validation accuracy, potentially matching or exceeding the performance of VGG19.

**Conclusion**

• **VGG19** outperformed others with its excellent generalization and high accuracy.

• **ResNet50** and **InceptionNet** showed potential but required more training epochs.

• **MobileNet** demonstrated efficiency and good potential for resource-constrained scenarios.

• **Basic CNN** served as a baseline but struggled to match the performance of advanced architectures.

Future work should focus on utilizing extended computational resources to fully train the models, enabling a more comprehensive evaluation.