ARI3129 – Transfer Learning and Fine-Tuning

Note: There was no use of Generative AI whilst carrying out all the below tasks.

Task 1: Varying the learning rate

Comparison of learning rates:

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| Learning Rate | Initial Training Results | Second Training Results | Final Test Results |
| 0.0001 | Accuracy = 91%  Loss = 0.216  Validation Set Accuracy = 96.2%  Validation Loss = 0.133 | Accuracy = 95.55%  Loss = 0.109  Validation Set Accuracy = 98.5%  Validation Loss = 0.047 | Test Accuracy = 99.48%  Test Loss = 0.0235 |
| 0.001 | Accuracy = 95.2%  Loss = 0.119  Validation Set Accuracy = 98.5%  Validation Loss = 0.051 | Accuracy = 98.6%  Loss = 0.0286  Validation Set Accuracy = 98.4%  Validation Loss = 0.0936 | Test Accuracy = 99%  Test Loss = 0.043 |
| 0.01 | Accuracy = 95.2%  Loss = 0.148  Validation Set Accuracy = 97.5%  Validation Loss = 0.632 | Accuracy = 97.4%  Loss = 0.111  Validation Set Accuracy = 51.1%  Validation Loss = 0.0629 | Test Accuracy = 53.3%  Test Loss = 0.0663 |
| 0.1 | Accuracy = 95.9%  Loss = 0.954  Validation Set Accuracy = 97.7%  Validation Loss = 0.516 | Accuracy = 92.8%  Loss = 0.1615  Validation Set Accuracy = 49.9%  Validation Loss = 110.922 | Test Accuracy = 49.4%  Test Loss = 112.178 |

Summary: Increasing the learning rate of the model does not lead to much change in both accuracy and loss before the model is fine-tuned. However, after fine-tuning, the model suffers from a decrease in accuracy and an increase in loss whenever the learning rate decreases. This is especially true when the learning rate is equal to 0.1, causing the model to have just a 49.9% validation accuracy, a 49.4% test accuracy, and both a validation and test loss of over 110. This shows that the learning rate is not sufficient for this model.

Task 2: Fine-Tuning

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| Optimizer | Initial Training Results | Second Training Results | Final Test Results |
| RMSprop | Accuracy = 91%  Loss = 0.216  Validation Set Accuracy = 96.2%  Validation Loss = 0.133 | Accuracy = 95.55%  Loss = 0.109  Validation Set Accuracy = 98.5%  Validation Loss = 0.047 | Test Accuracy = 99.48%  Test Loss = 0.0235 |
| Adam | Accuracy = 91%  Loss = 0.216  Validation Set Accuracy = 96.2%  Validation Loss = 0.133 | Accuracy = 94.2%  Loss = 0.1476  Validation Set Accuracy = 98.4%  Validation Loss = 0.0439 | Test Accuracy = 97.9%  Test Loss = 0.0508 |

Task 3: Trying a different architecture

Note: Before creating the models using each architecture, care was taken to ensure that the input images were rescaled using the preprocessing method provided by the architecture model.

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| Architecture | Initial Training Results | Second Training Results | Final Test Results |
| MobileNetv2 | Accuracy = 91%  Loss = 0.216  Validation Set Accuracy = 96.2%  Validation Loss = 0.133 | Accuracy = 95.55%  Loss = 0.109  Validation Set Accuracy = 98.5%  Validation Loss = 0.047 | Test Accuracy = 99.48%  Test Loss = 0.0235 |
| Inceptionv3 | Accuracy = 90.3%  Loss = 0.2433  Validation Set Accuracy = 96.3%  Validation Loss = 0.0989 | Accuracy = 93.6%  Loss = 0.1590  Validation Set Accuracy = 94.7%  Validation Loss = 0.1278 | Test Accuracy = 93.75%  Test Loss = 0.1336 |
| VGG-16 | Accuracy = 76%  Loss = 1.0020  Validation Set Accuracy = 84.3%  Validation Loss = 0.5894 | Accuracy = 80.9%  Loss = 0.7850  Validation Set Accuracy = 85.6%  Validation Loss = 0.5198 | Test Accuracy = 79.167%  Test Loss = 0.7381 |
| ResNet50 | Accuracy = 92.65%  Loss = 0.1698  Validation Set Accuracy = 98.27%  Validation Loss = 0.0756 | Accuracy = 98.84%  Loss = 0.0439  Validation Set Accuracy = 98.64%  Validation Loss = 0.0405 | Test Accuracy = 97.9%  Test Loss = 0.0534 |