Supervised Learning:
Pneumonia Image Classification

Introduction

Pneumonia Image classification (2024) - Built a deep learning pipeline with PyTorch to classify chest X-rays, achieving 89.4% accuracy on Kaggle's test dataset.

- Used Hugging Face's ResNet18, DenseNet, and Vision Transformer (ViT) Image Classification models with transfer learning to enhance feature extraction and resulting accuracy.
- Applied preprocessing techniques like TorchVision's RandomRotation and balanced sampling to improve generalization and address any possible dataset bias.
- Created a training framework with batch processing and appropriate hyperparameter tuning, leveraging the ADAM optimizer for faster gradient descent convergence.
- Deployed the model on my NVIDIA RTX 4060 GPU to employ CUDA vectorization.
- Evaluated the performance of all models using ROC curves and Youden's J to determine the ideal image classifier. Visualized resulting model predictions with Matplotlib to refine results.

Dataset Distribution

- Train Set (60%)
- Val Set (30%)
- Test Set (10%)

Hyperparameters

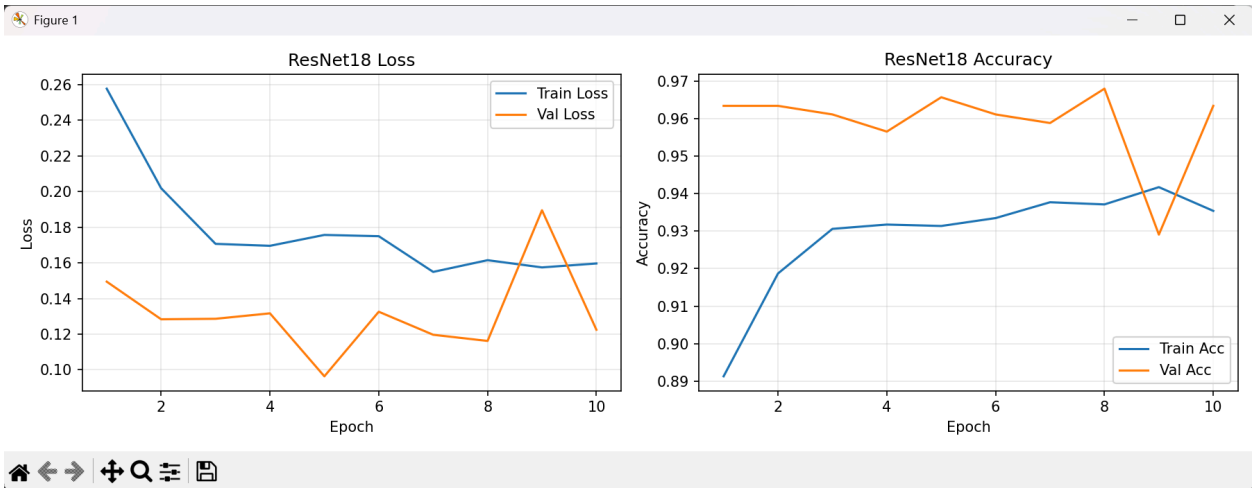
- Epoch - 10
- Learning Rate - 0.001
- Batch size - 16
- Number of activation layers - 3 (with SoftMax output layer)

Model Performance Summary

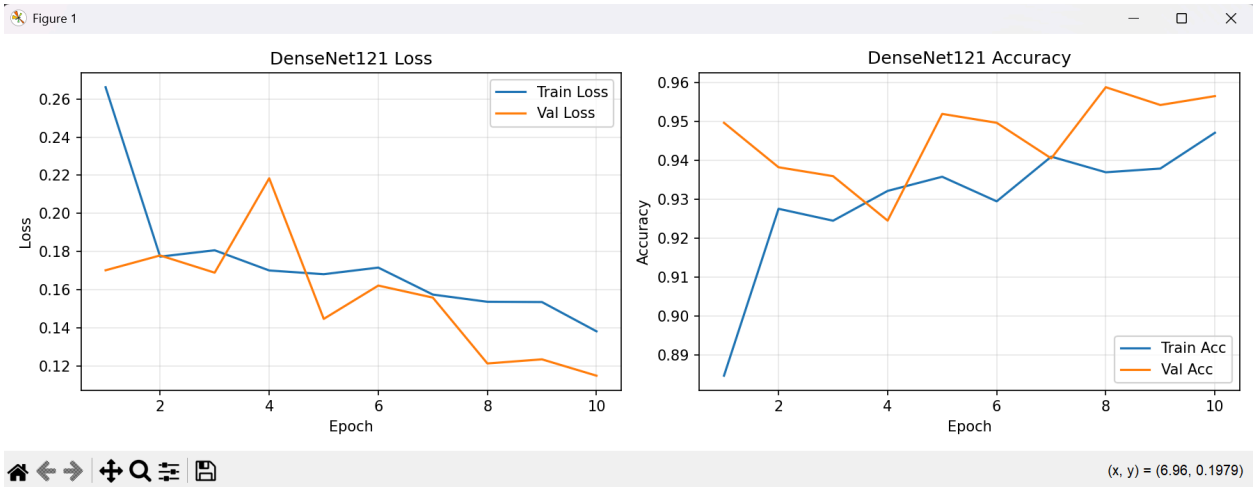
ResNet18 achieved the highest performance with a test loss of 0.2655 and an accuracy of 0.8942, outperforming both DenseNet121 (test loss 0.3537, accuracy 0.8718) and ViT_B_16 (test loss 0.6398, accuracy 0.8221). Overall, while all three models showed strong results on the chest X-ray dataset, ResNet18 exhibited the most favorable balance of low loss and high accuracy making it the model of choice for this dataset.

Accuracy and loss plots

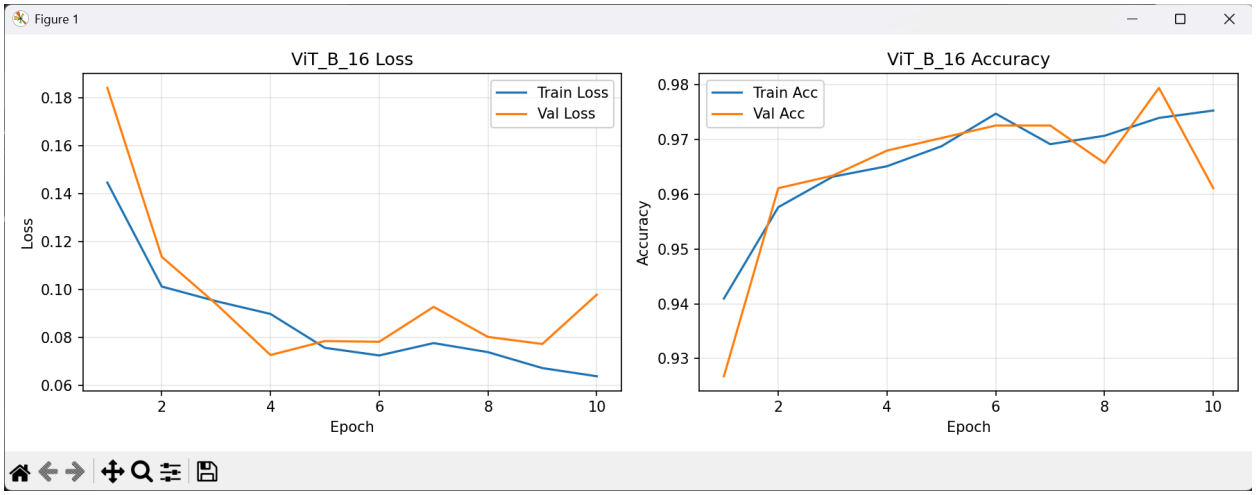
ResNet18 - Test Loss: 0.2655, Test Accuracy: 0.8942



DenseNet121 - Test Loss: 0.3537, Test Accuracy: 0.8718



ViT_B_16 - Test Loss: 0.6398, Test Accuracy: 0.8221



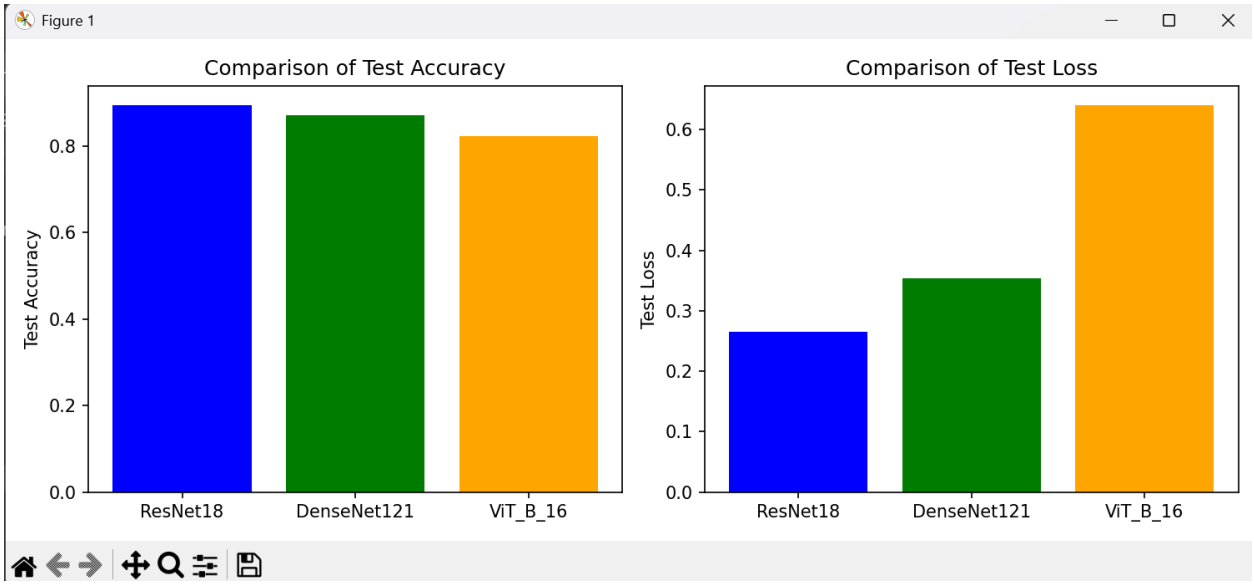


Figure 1
Comparison of Test Accuracy
Test Accuracy
0.0
0.2
0.4
0.6
0.8
ResNet18
DenseNet121
ViT_B_16
Comparison of Test Loss
Test Loss
0.0
0.1
0.2
0.3
0.4
0.5
0.6
ResNet18
DenseNet121
ViT_B_16

ROC plots

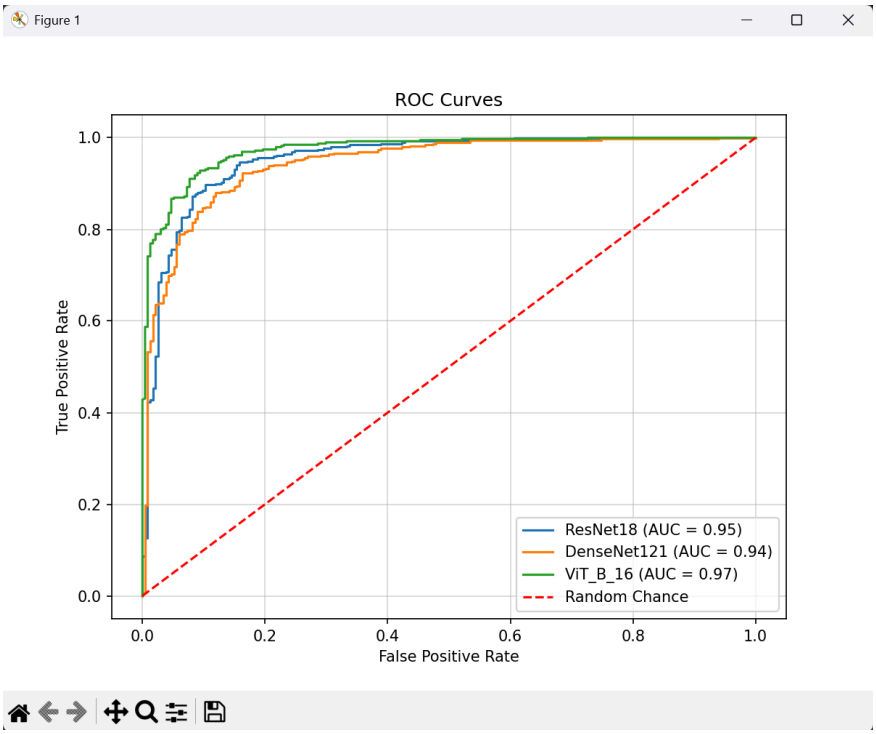
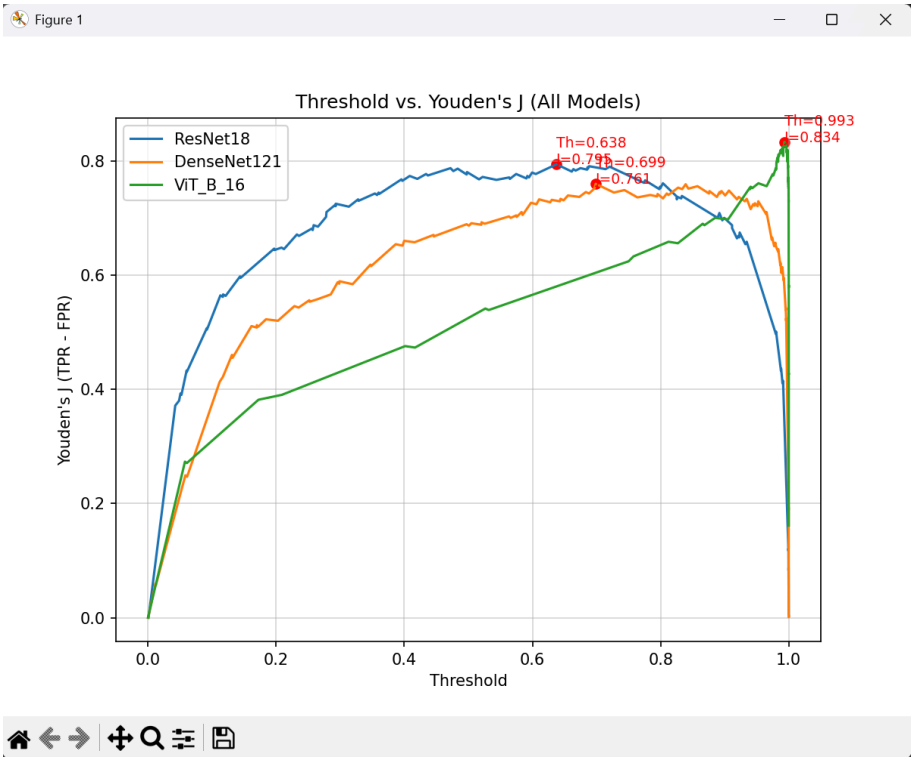


Figure 1
ROC Curves
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
ResNet18 (AUC = 0.95)
DenseNet121 (AUC = 0.94)
ViT_B_16 (AUC = 0.97)
Random Chance

Youden’s J plots



References

1. **Git repository:**
   https://github.com/akshat-git/Pneumonia-Image-Classifier-Supervised-Learning

2. **Dataset:**
   https://www.kaggle.com/datasets/paultimothymooney/chest-xray-pneumonia