

ResNet Models Utilization for Tomato Leaf Disease Classification

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problem statement

Tomato crop diseases significantly reduce yield.

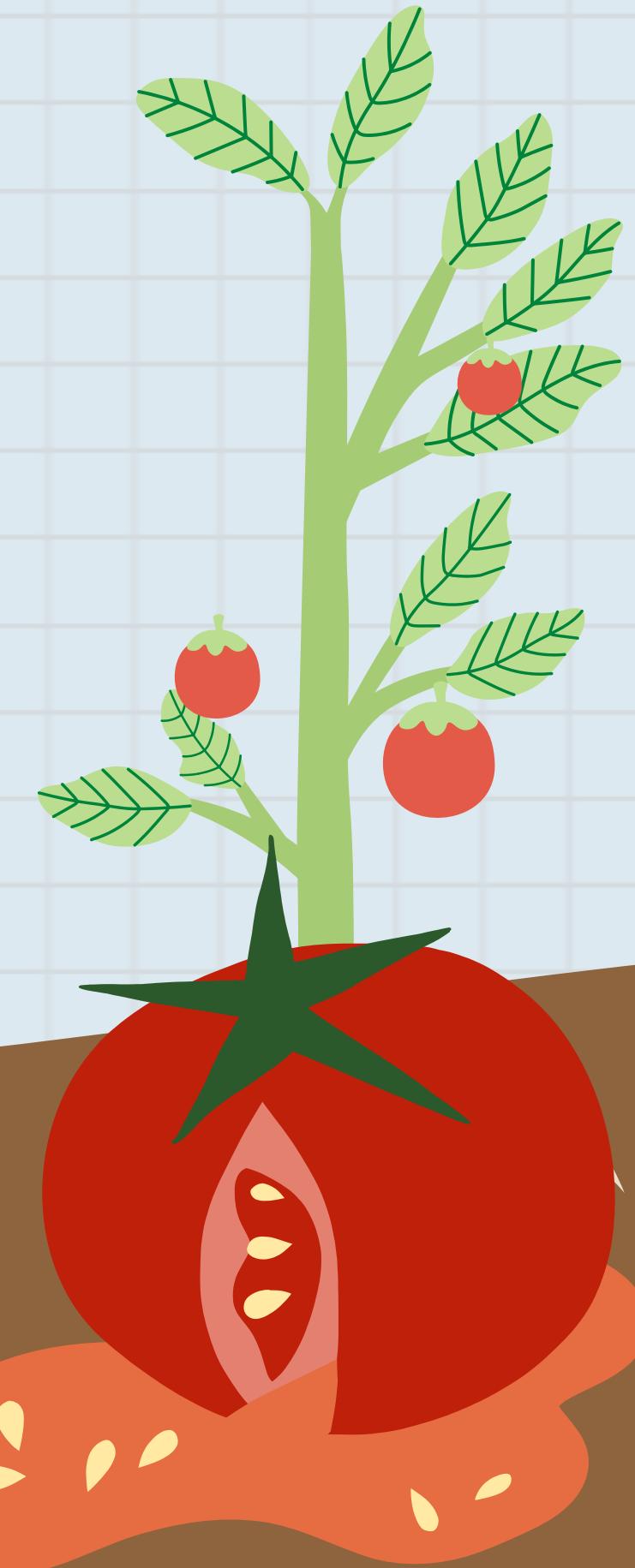
Two main disease types: infectious(microorganisms) and non-infectious (environmental/nutritional).

Manual detection is slow and costly.

A tomato leaf disease image dataset containing 11,000 images categorized into 10 classes (including healthy) with a balanced distribution of 1100 images per class.

A multi-Class Classification problem.

Need of automated system capable of detecting tomato leaf disease efficiently



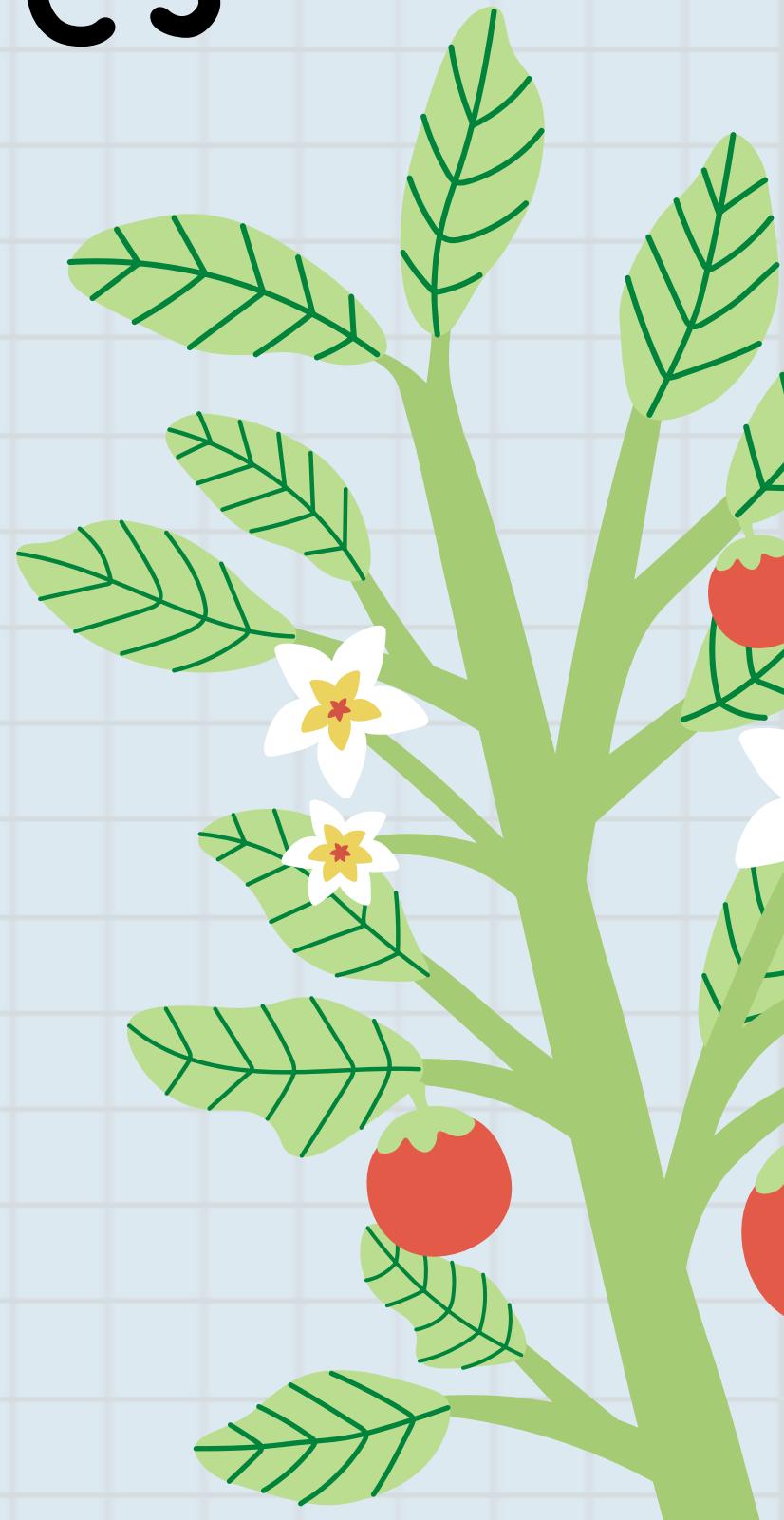


11, 000 Instances

9 type of diseases

early blight, late blight,
leaf mold, spider mites,
yellow leaf curl virus, mosaic virus
bacterial spot, Septoria leaf spot, targeted spot

1 healthy class



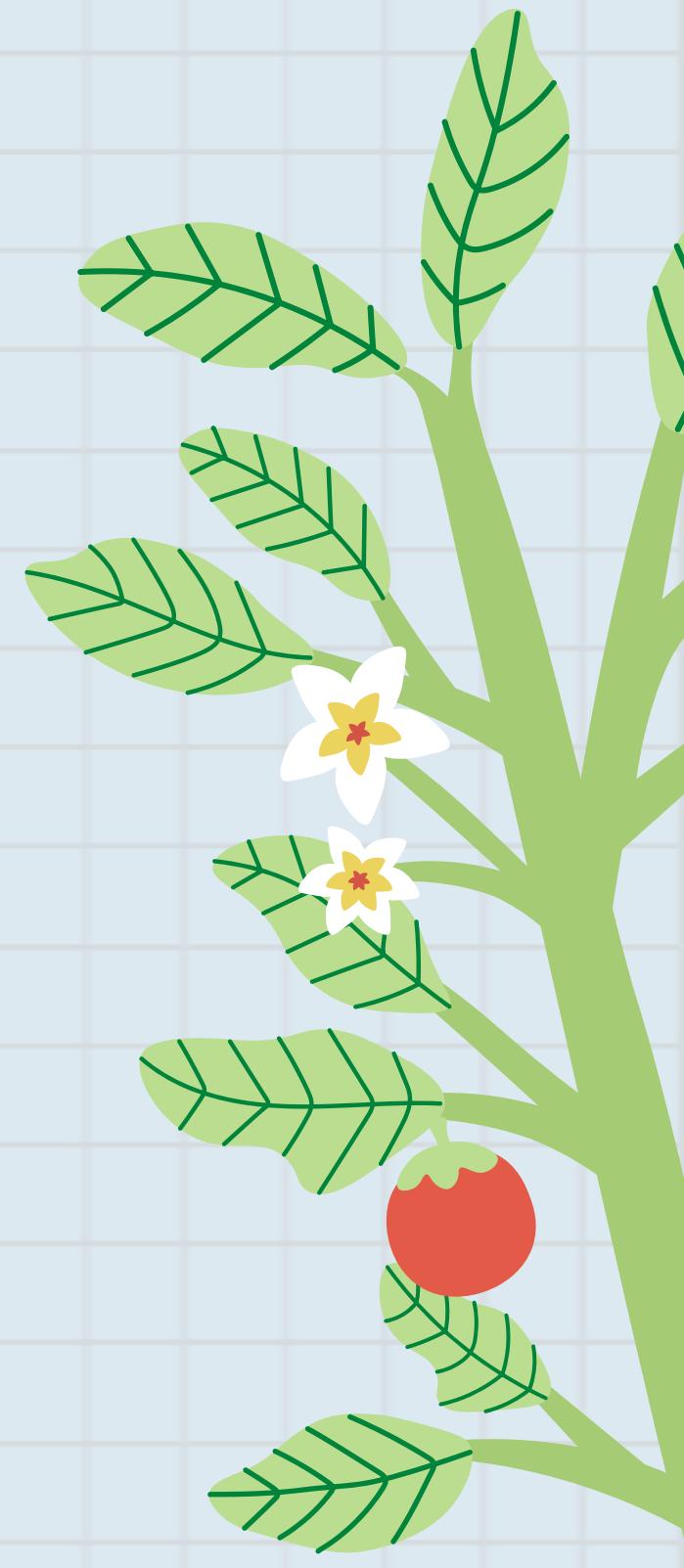


Each tomato instance Have:

256 × 256 Size

3 Channels (**RGB**)

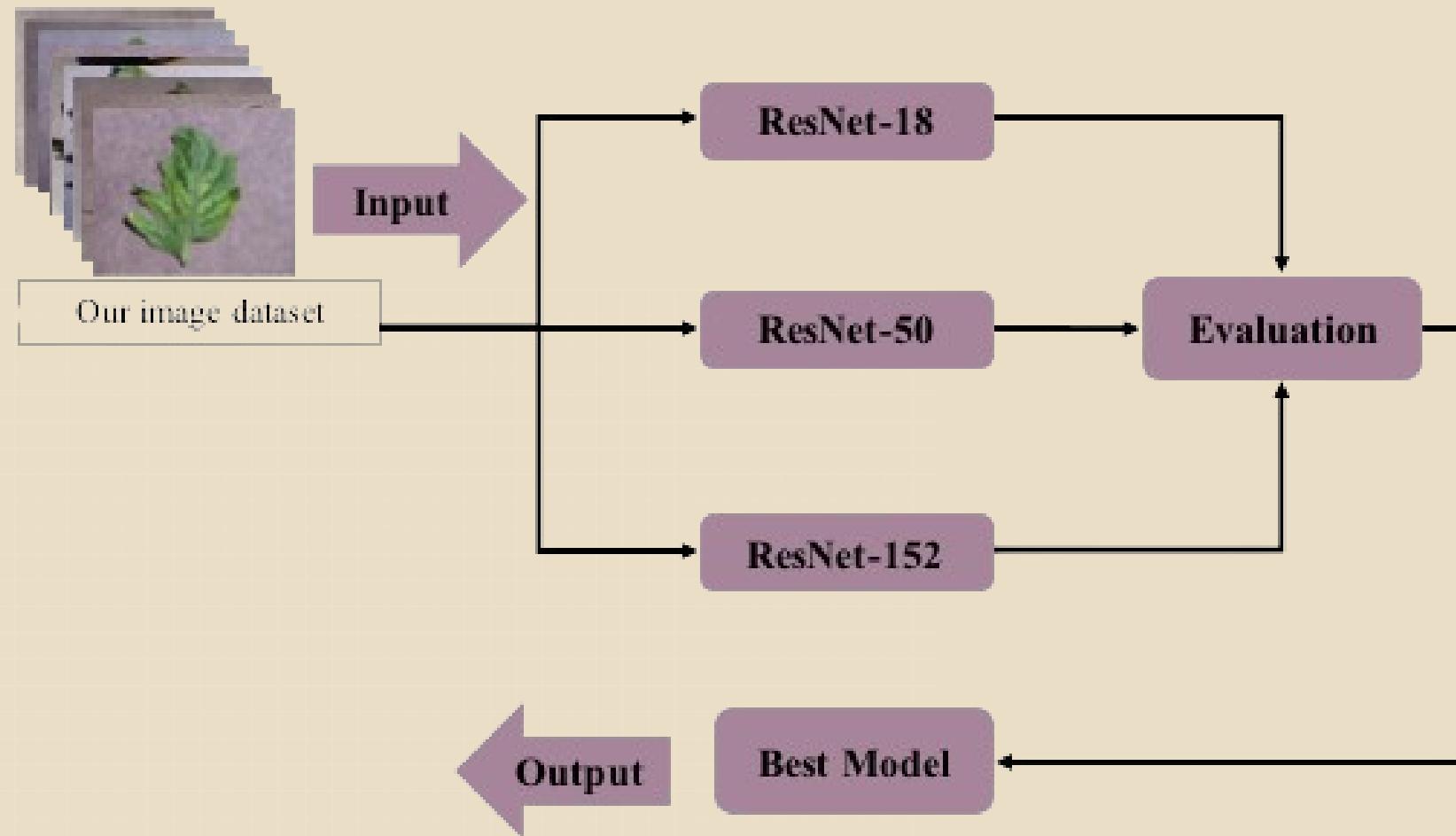
JPG Format



Methodology

Model Selection

- ResNet-18: 18 layers, optimized for speed and lower complexity.
- ResNet-50: 50 layers, captures more detailed features.
- ResNet-152: 152 layers, best for in-depth analysis.



Hyperparameters

learning rates, batch sizes, and number of epochs.

Evaluation Metrics

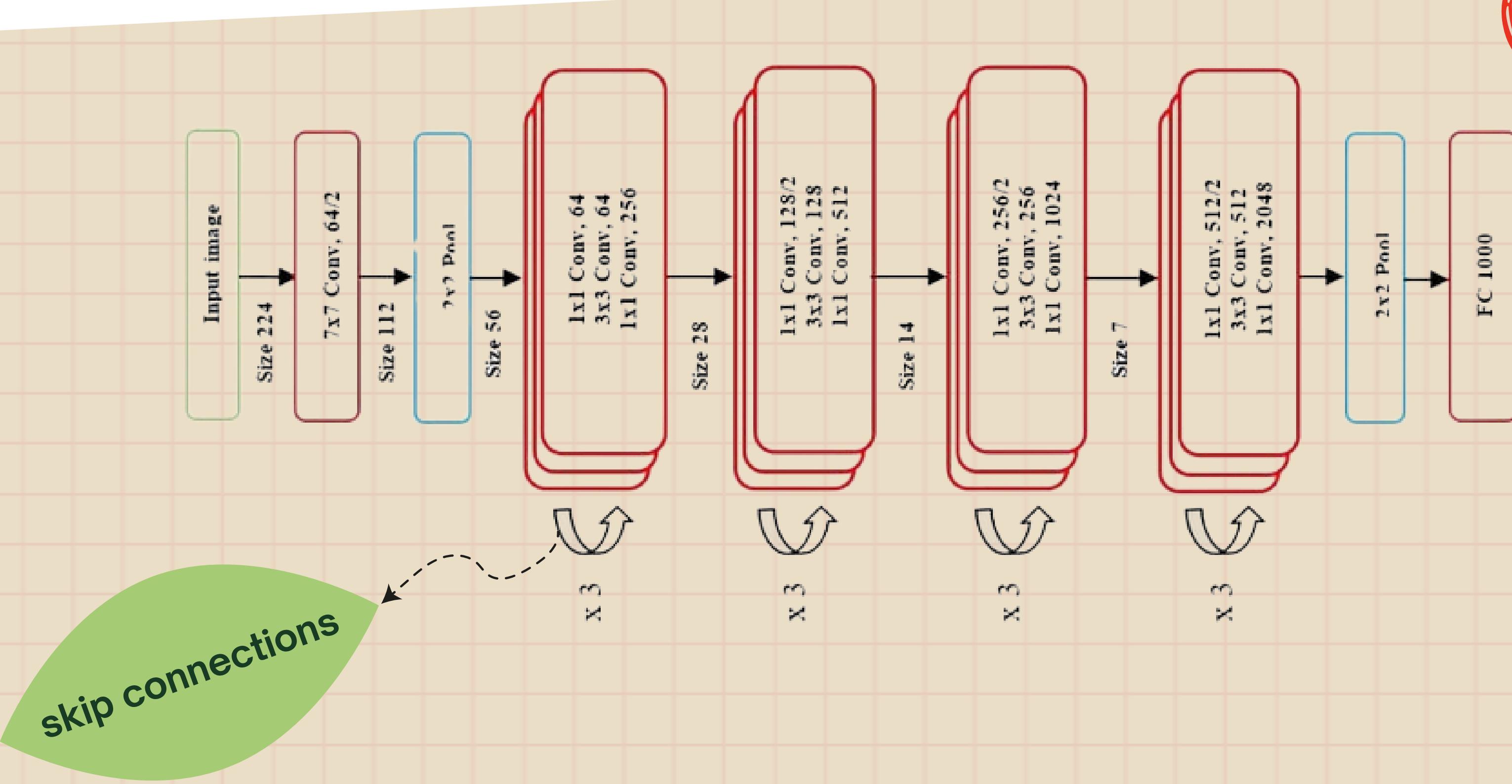
accuracy, precision, recall, and F1-score.

Implementation Platform

python™ colab

PyTorch

Architecture Overview



Results

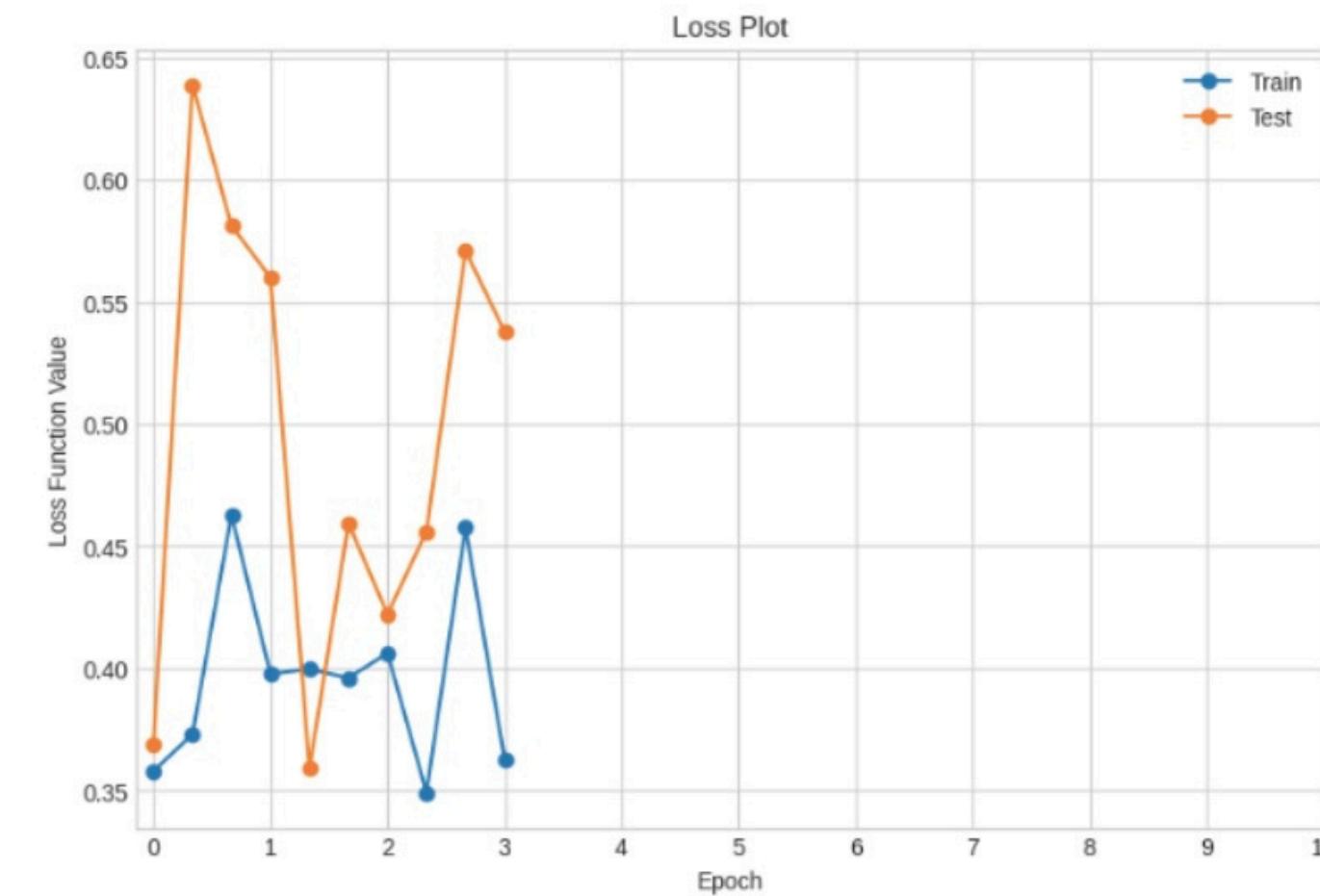
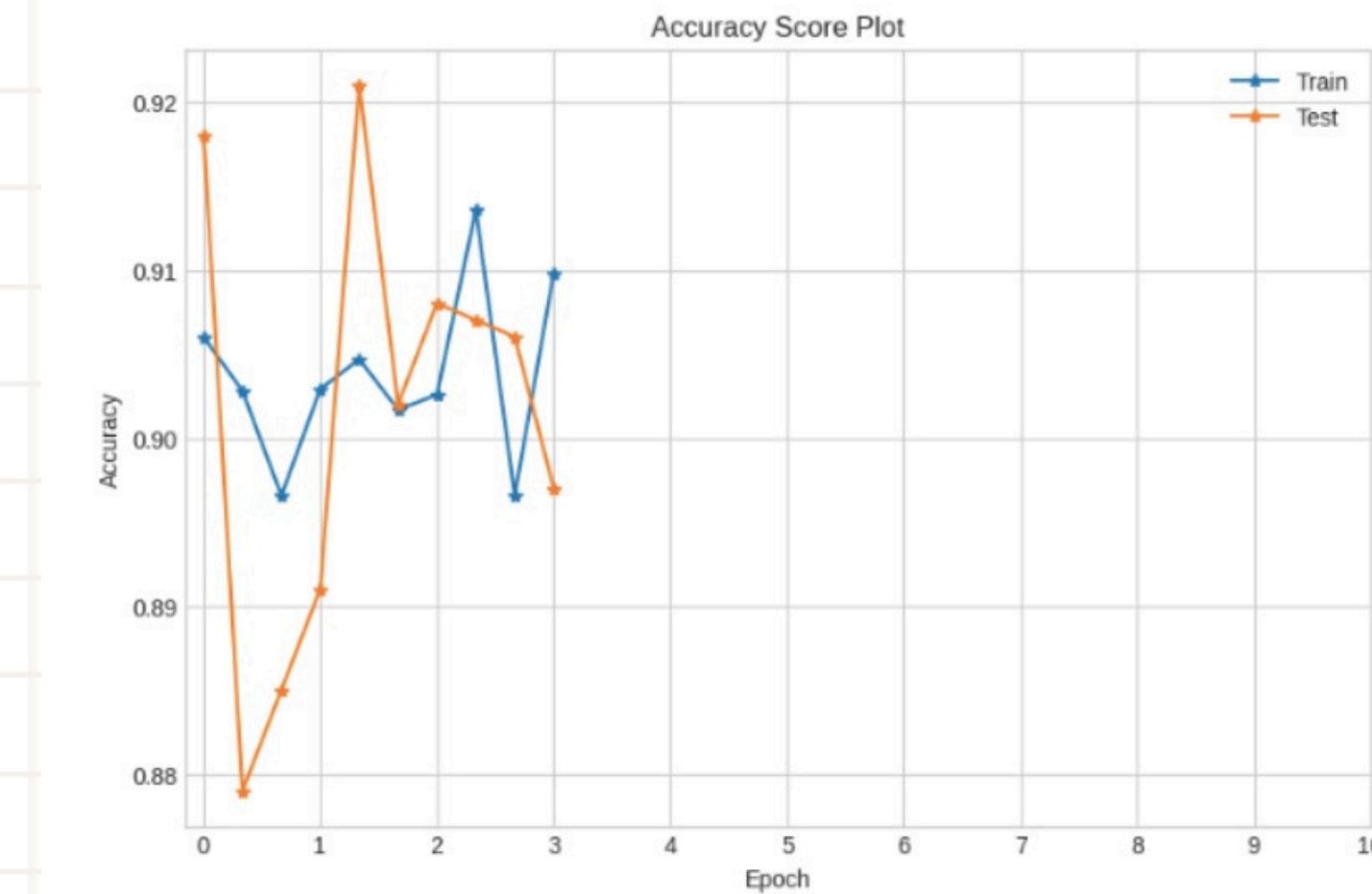
- First Model: Resnet-18

	Optimizer	Learning Rate	Batch Size	Epochs	Augmentation
Configuration 1	Adam	0.01	32	10	Random Horizontal Flip
Configuration 2	Adam	0.001	32	10	Random Horizontal Flip
Configuration 3	Adam	0.0001	32	10	Random Horizontal Flip

ResNet18 Configuration set

Results

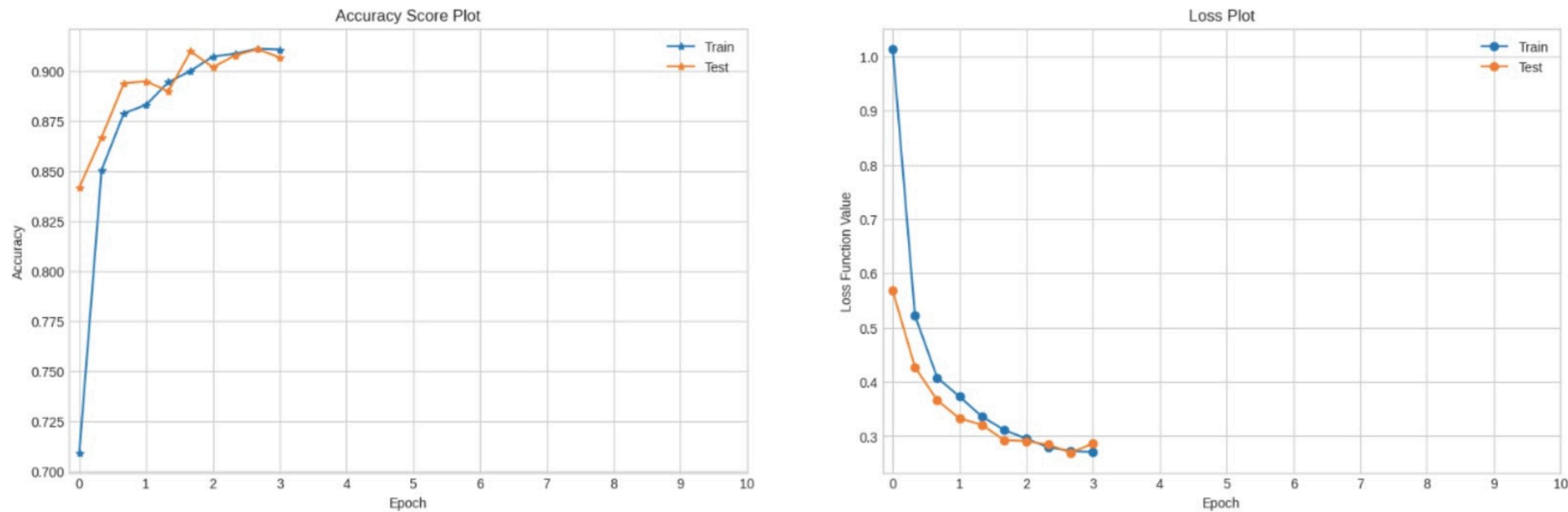
- First Model: Resnet-18



ResNet18 model accuracy, and loss with Lr = 0.01, Epoch = 10

Results

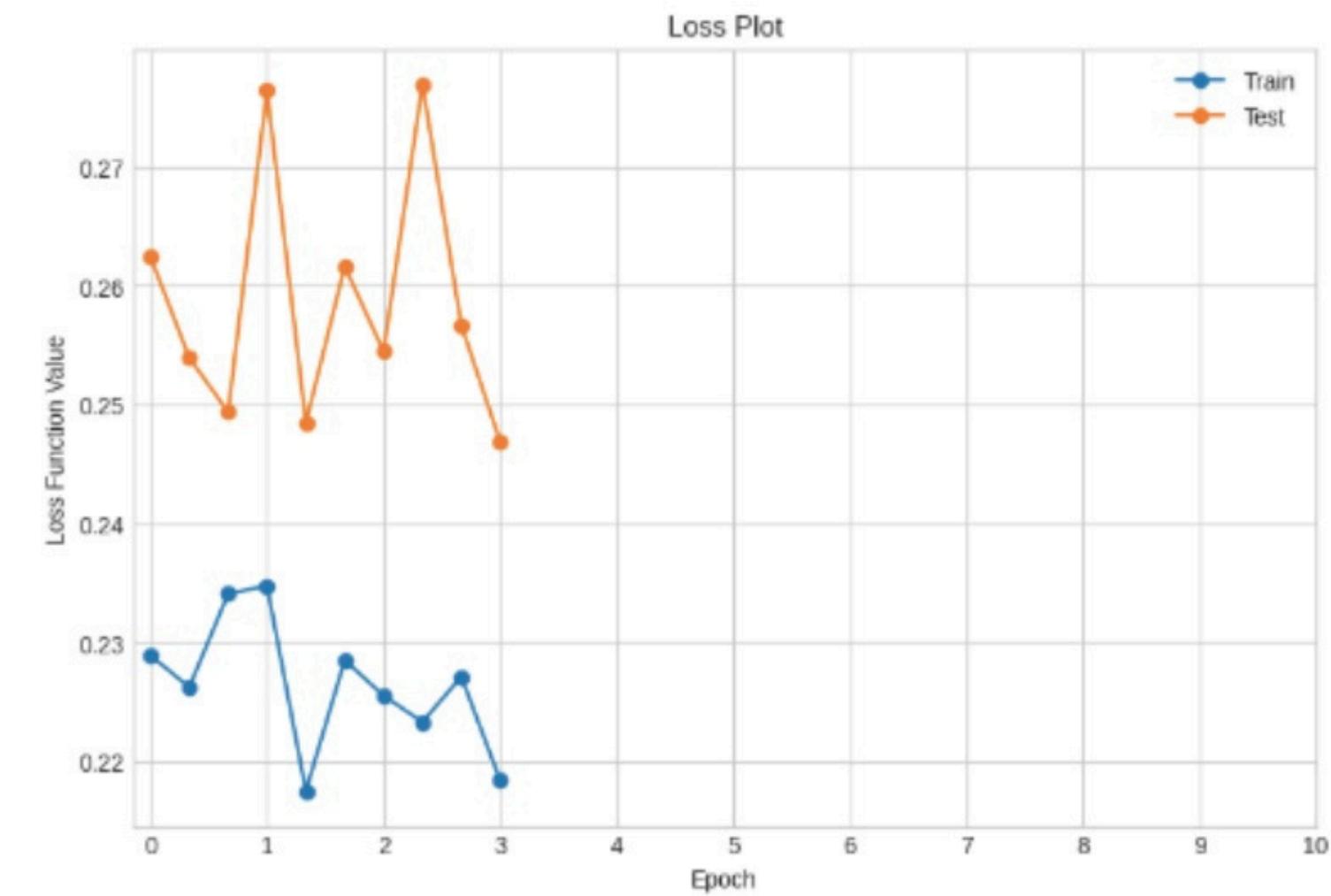
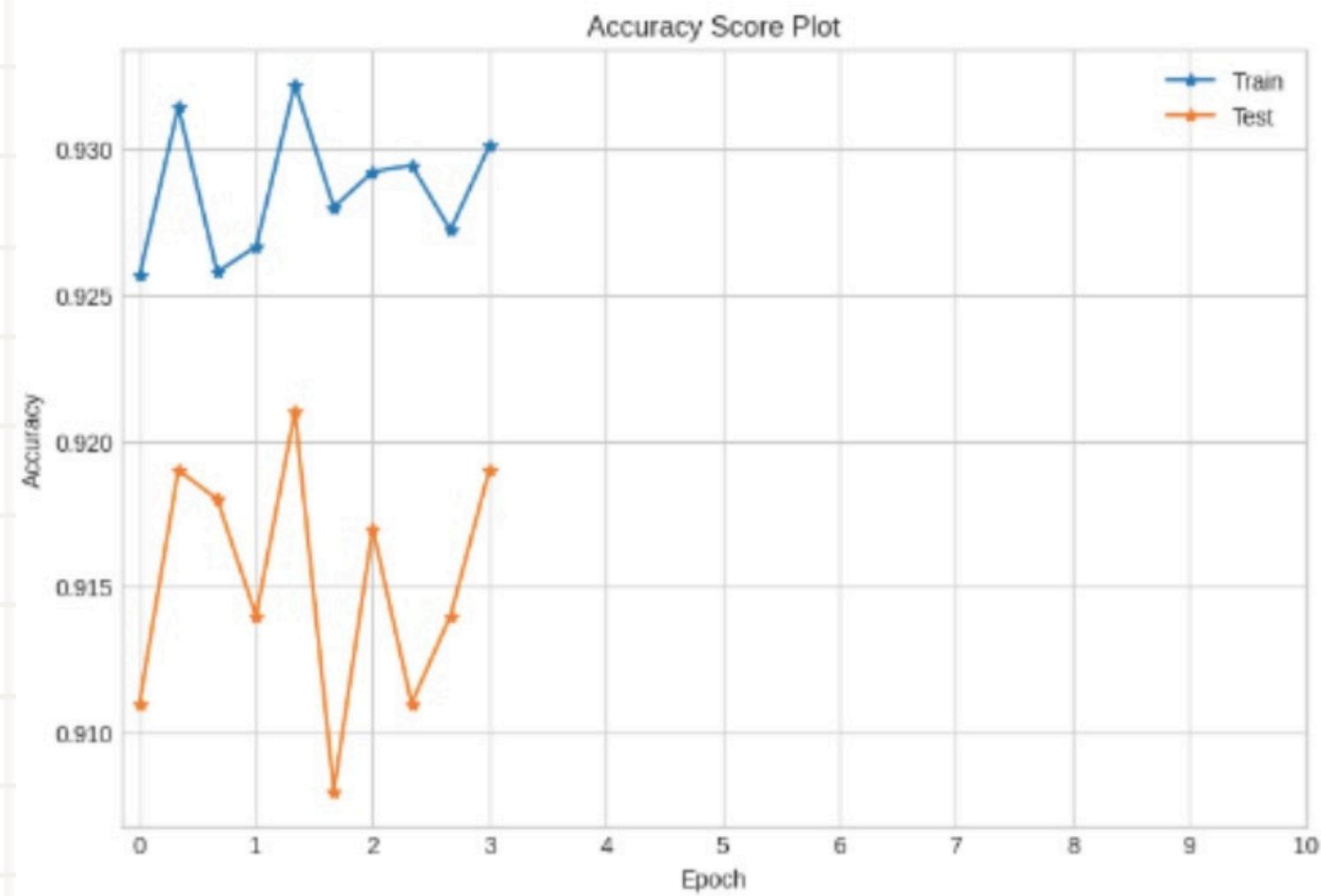
- First Model: Resnet-18



ResNet18 model accuracy, and loss with Lr = 0.001, Epoch = 10

Results

- First Model: Resnet-18



ResNet18 model accuracy, and loss with Lr = 0.0001, Epoch = 10.

Results

- First Model: Resnet-18

Configuration	Accuracy	Recall	Precision	F1-Score
1	0.89%	0.89%	0.89%	0.88%
2	0.90%	0.90%	0.90%	0.90%
3	0.91%	0.91%	0.91%	0.91%

Evaluation metrics used to assess the ResNet18 performance on unseen data.

Results

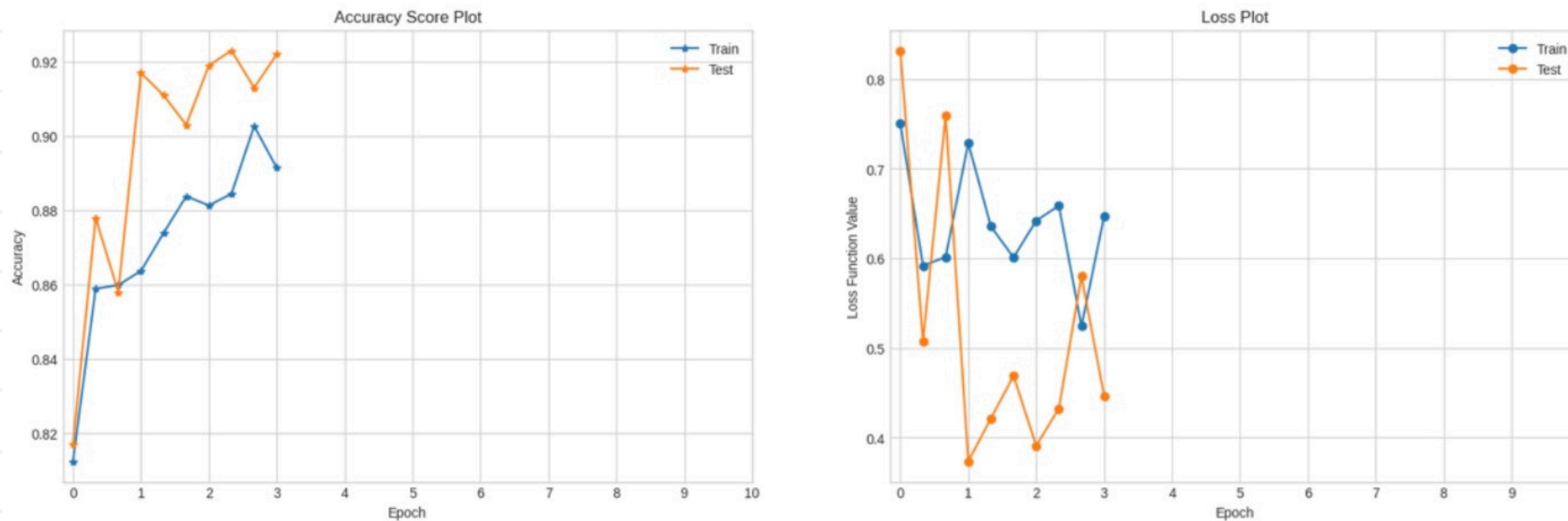
- Second Model: Resnet-50

	Optimizer	Learning Rate	Batch Size	Epochs	Augmentation
Configuration 1	Adam	0.01	32	10	Random Horizontal Flip
Configuration 2	Adam	0.001	32	10	Random Horizontal Flip
Configuration 3	Adam	0.0001	32	10	Random Horizontal Flip

ResNet50 Configuration set

Results

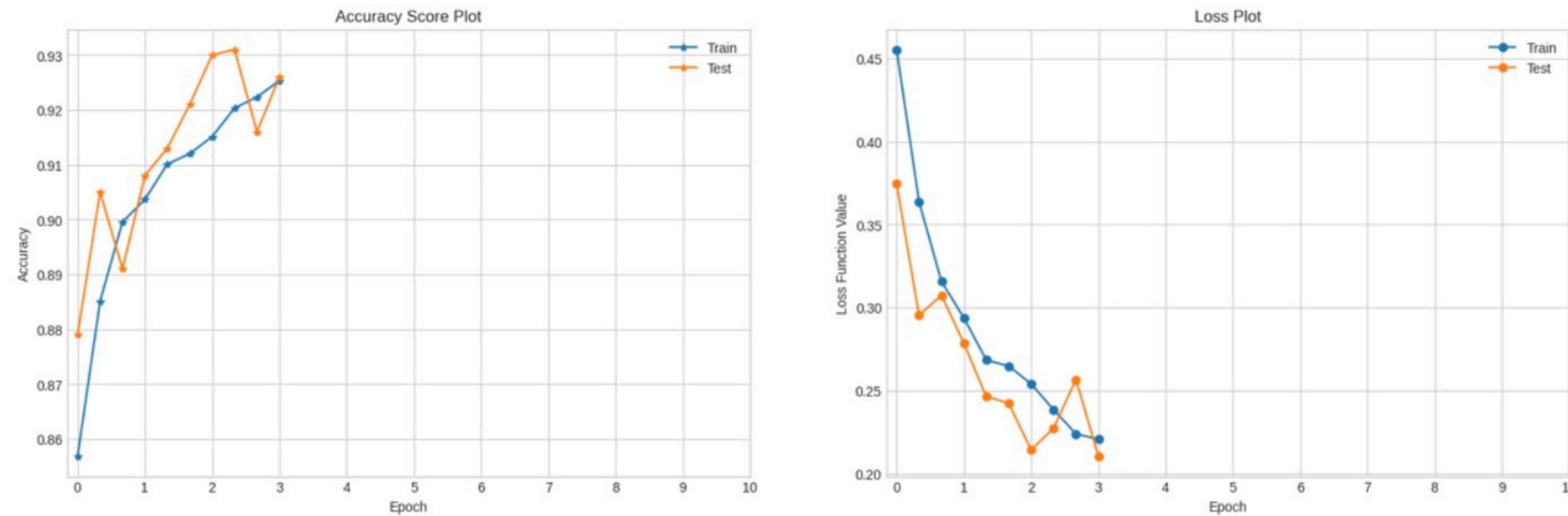
- Second Model: Resnet-50



ResNet50 model accuracy, and loss with Lr = 0.01, Epoch = 10

Results

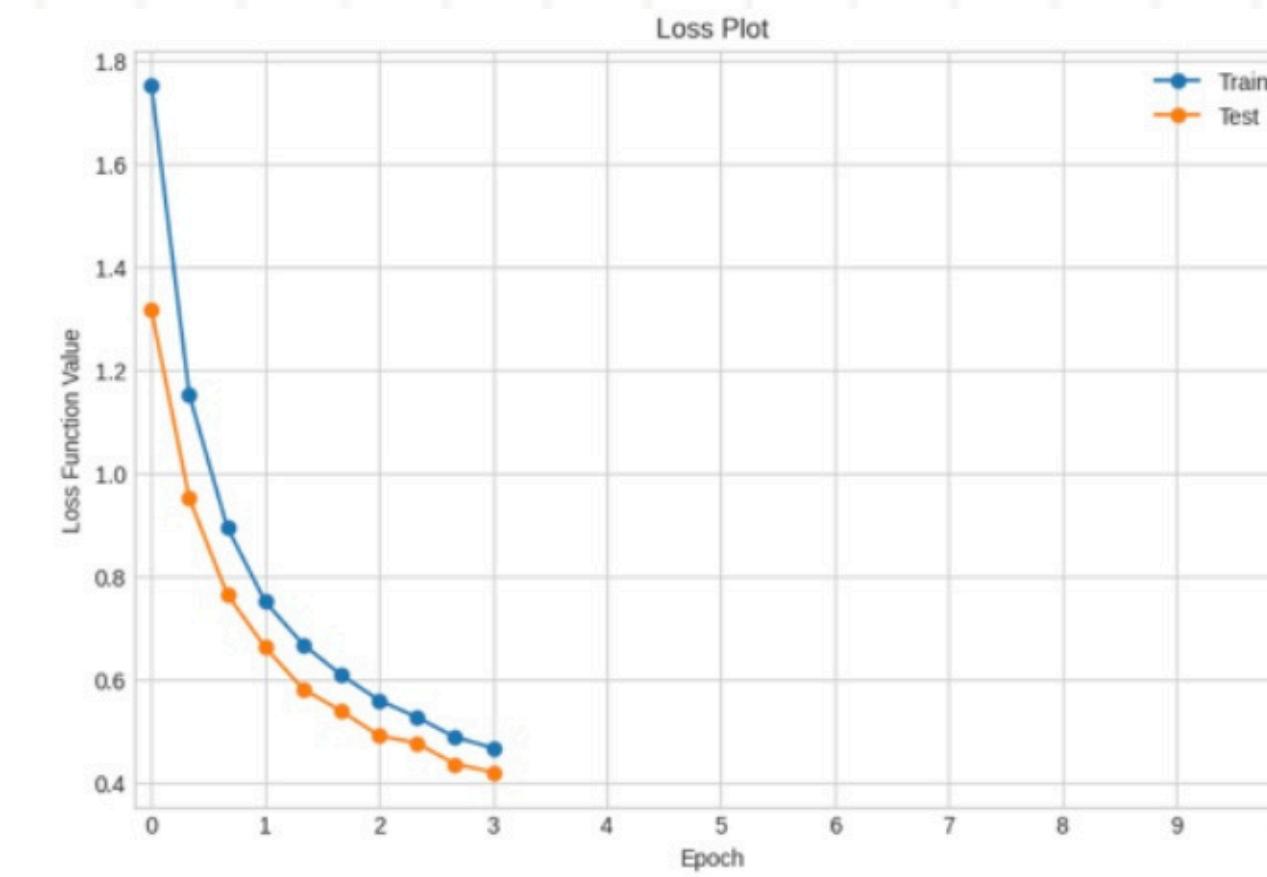
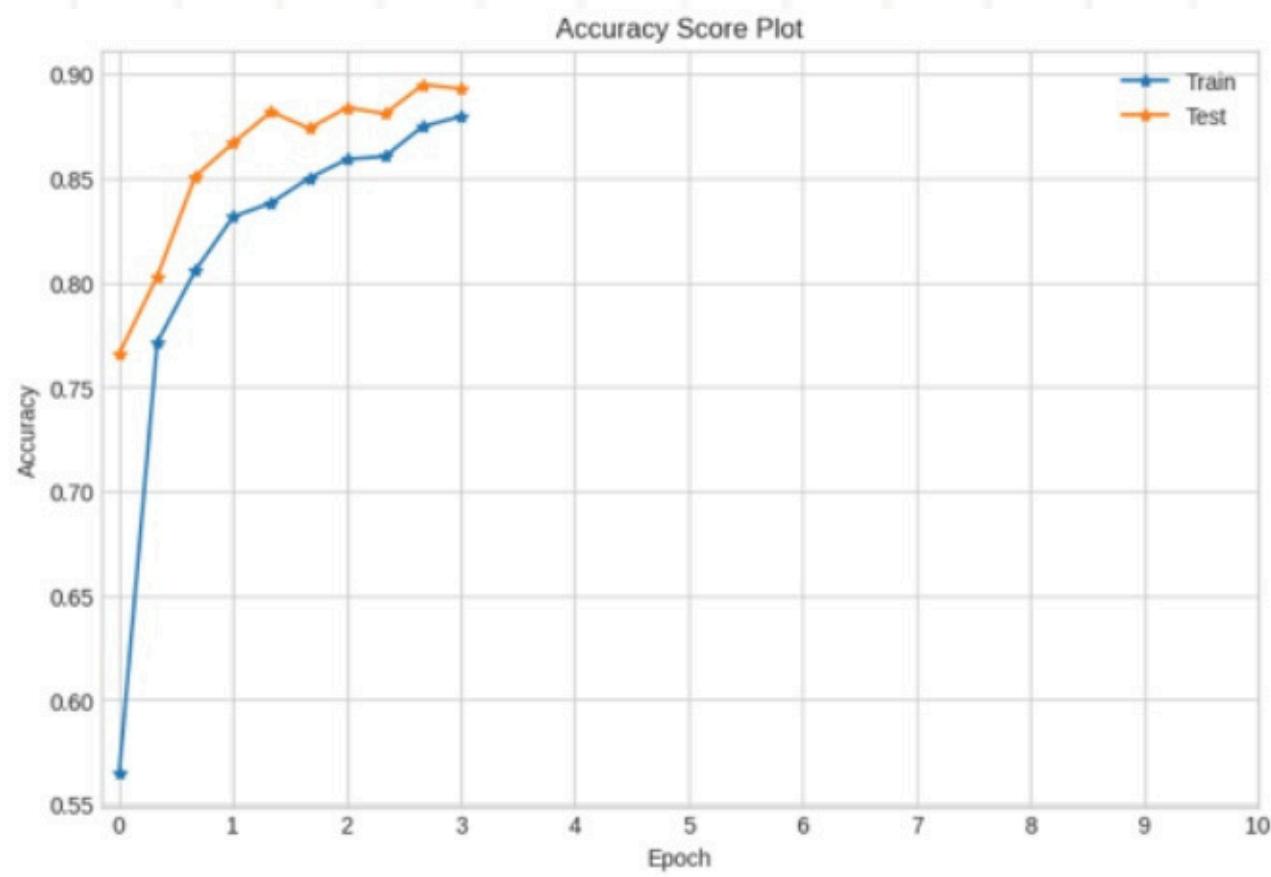
- Second Model: Resnet-50



ResNet50 model accuracy, and loss with Lr = 0.001, Epoch = 10

Results

- Second Model: Resnet-50



ResNet50 model accuracy, and loss with Lr = 0.0001, Epoch = 10.

Results

- Second Model: Resnet-50

Configuration	Accuracy	Recall	Precision	F1-Score
1	90%	90%	91%	89%
2	91%	91%	91%	91%
3	87%	87%	87%	87%

Evaluation metrics used to assess the ResNet50 performance on unseen data.

Results

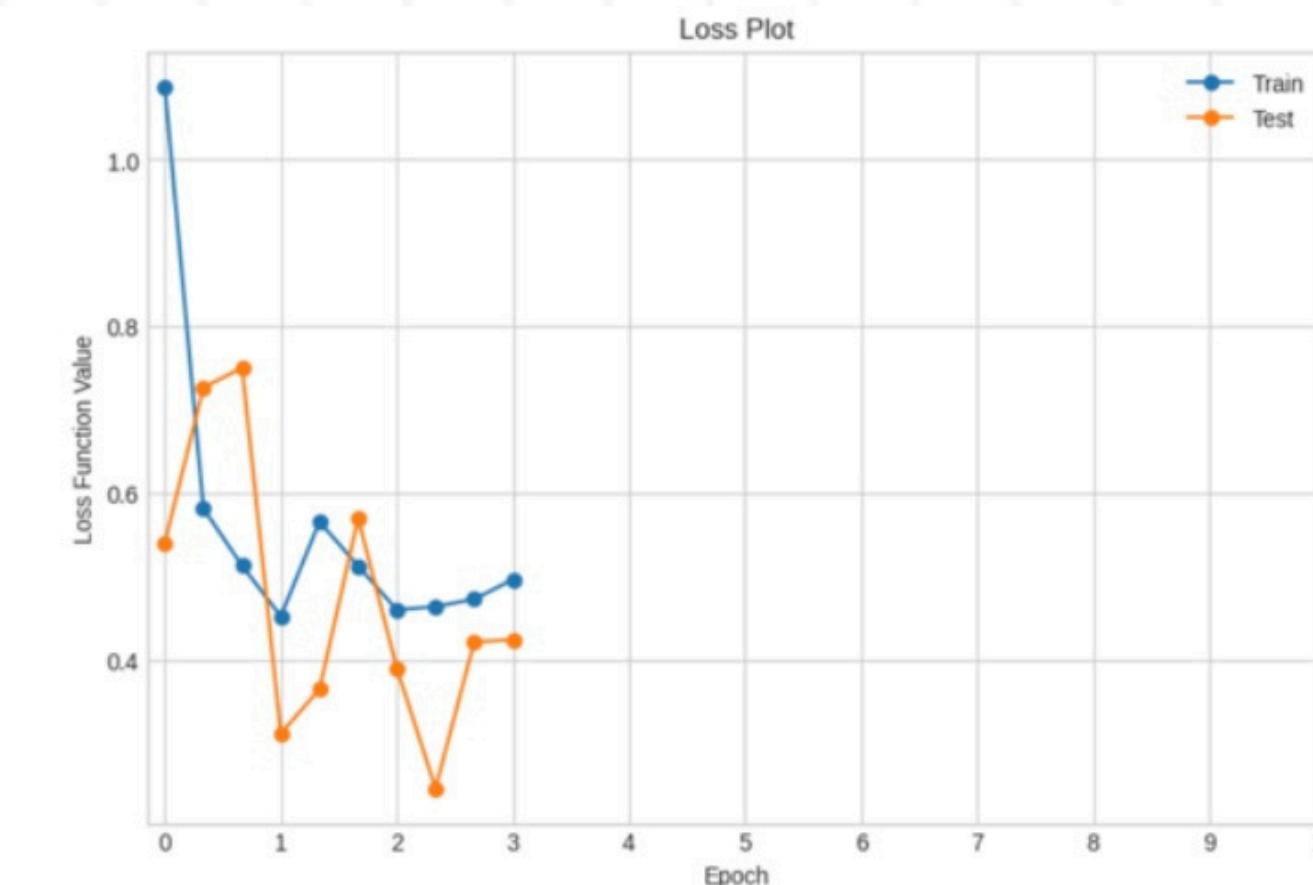
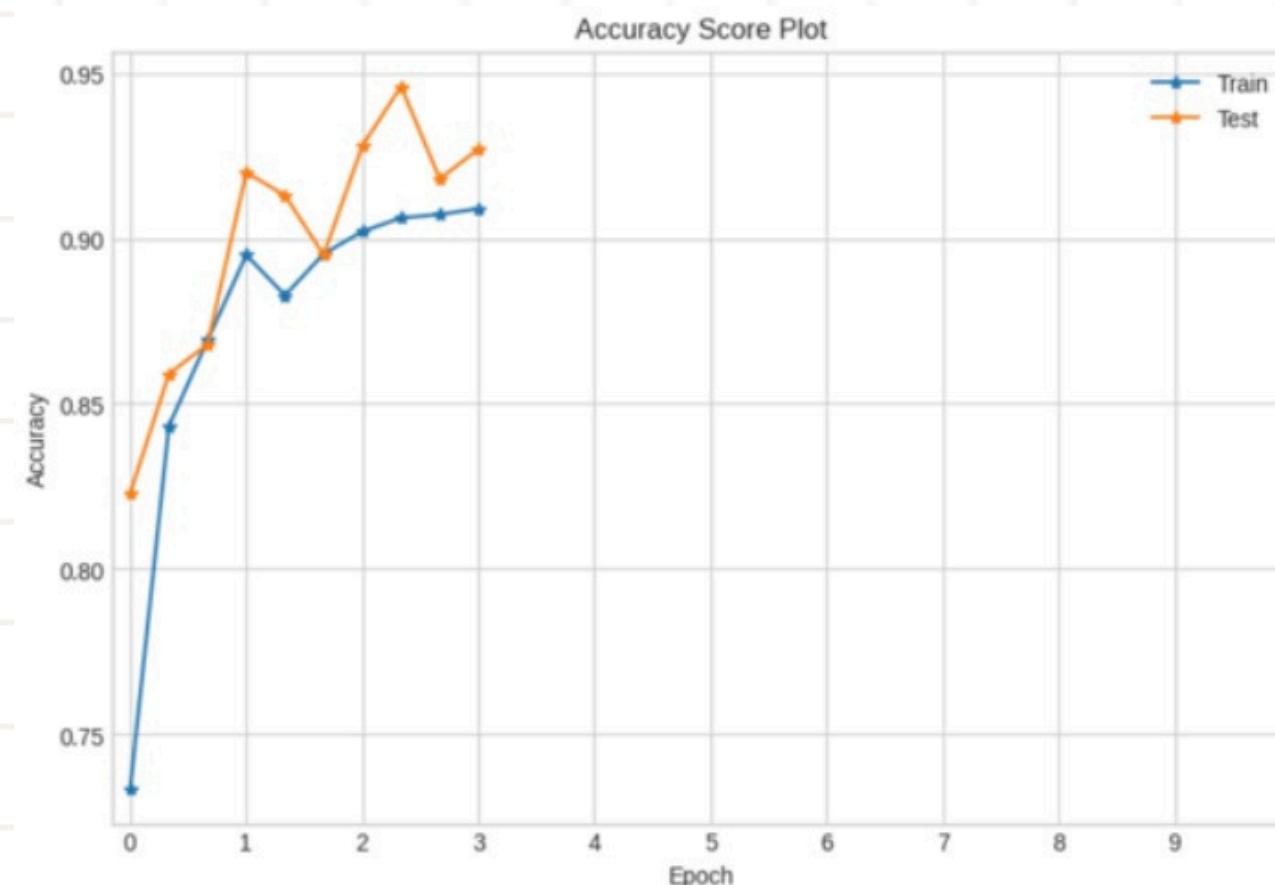
- Third Model: Resnet-152

	Optimizer	Learning Rate	Batch size	Num of Epochs	Augmentation
Configuration 1	Adam	0.01	32	10	Random Horizontal Flip
Configuration 2	Adam	0.001	32	10	Random Horizontal Flip
Configuration 3	Adam	0.0001	32	10	Random Horizontal Flip

ResNet152 Configuration set

Results

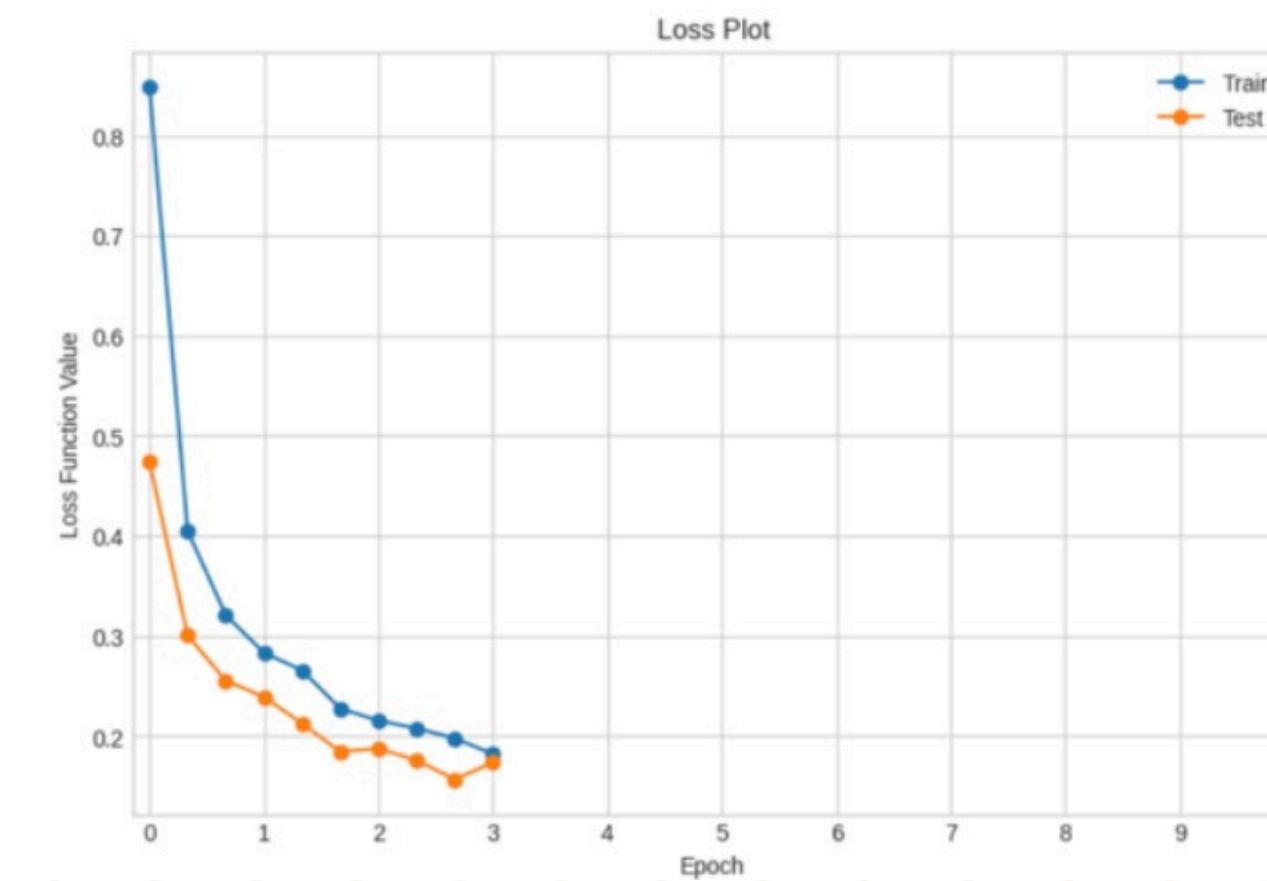
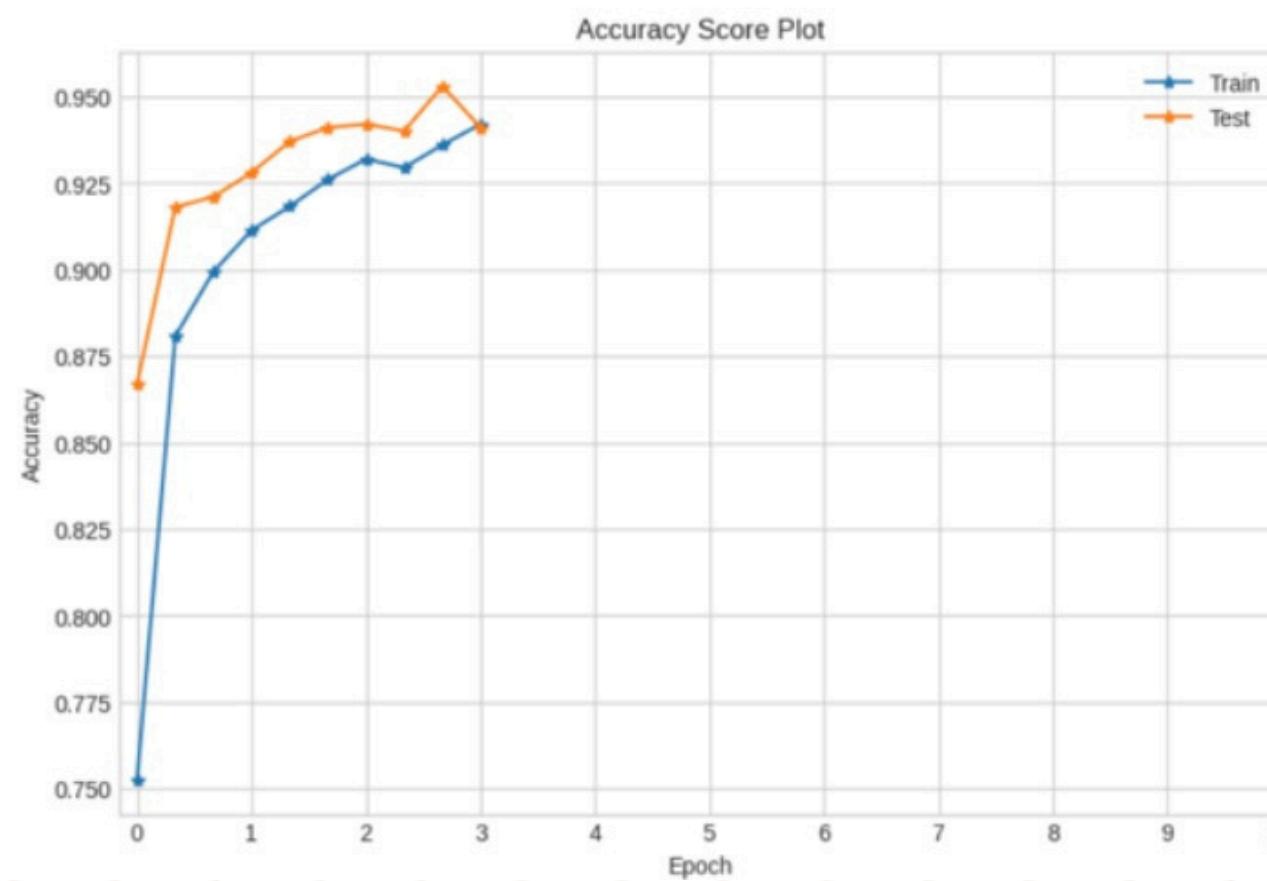
- Third Model: Resnet-152



ResNet152 model accuracy, and loss with Lr = 0.01, Epoch = 10

Results

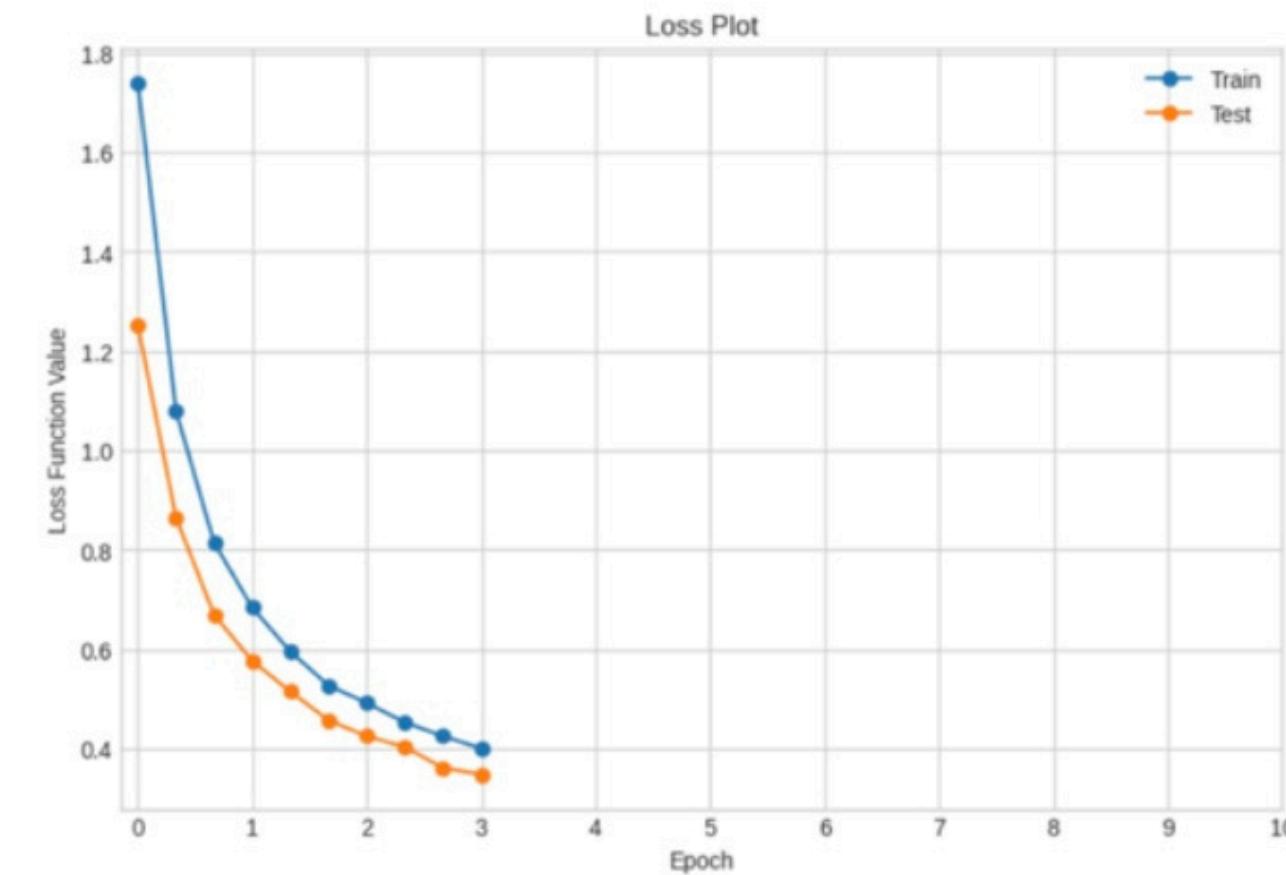
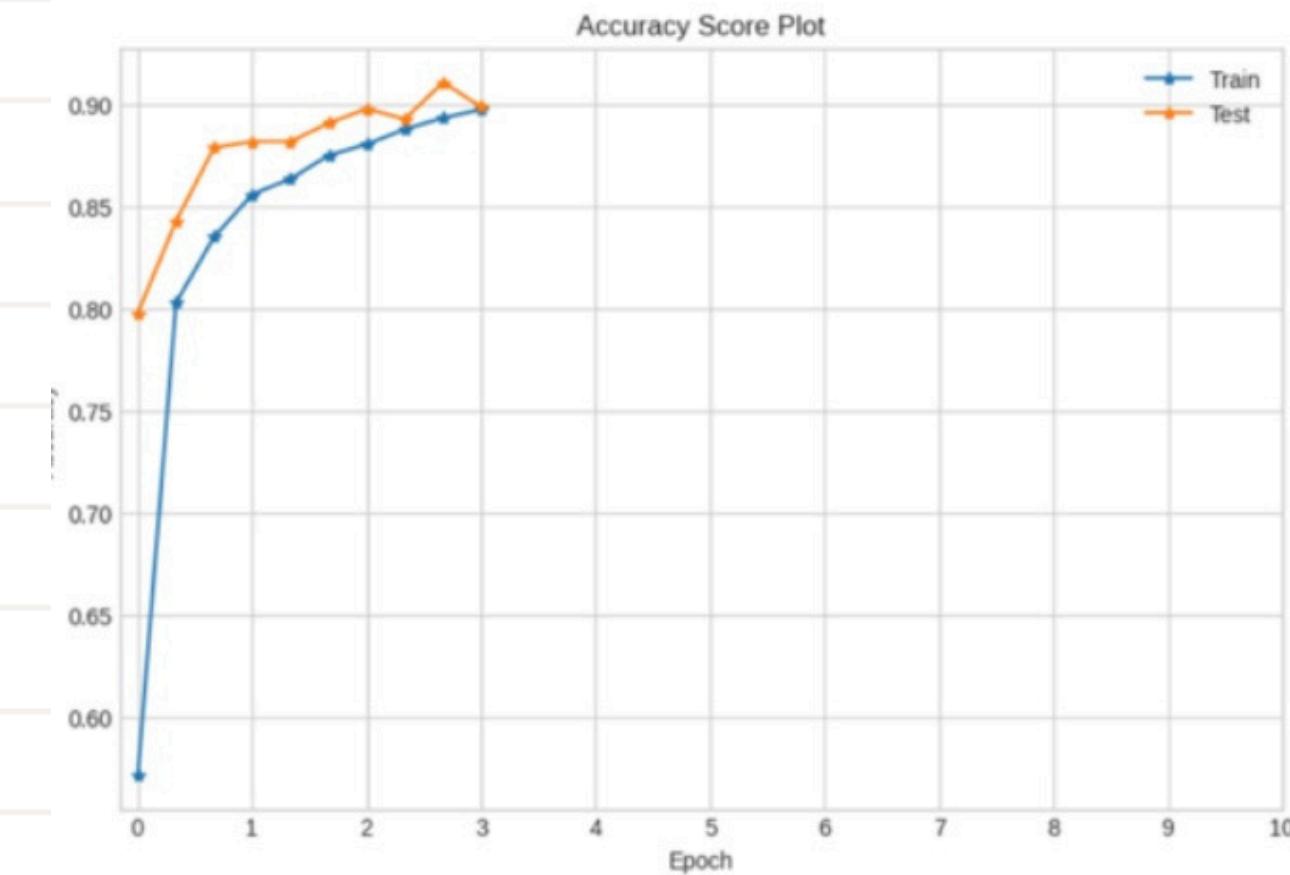
- Third Model: Resnet-152



ResNet152 model accuracy, and loss with Lr = 0.001, Epoch = 10

Results

- Third Model: Resnet-152



ResNet152 model accuracy, and loss with Lr = 0.0001, Epoch = 10.

Results

- Third Model: Resnet-152

Configuration	Accuracy	Recall	Precision	F1-Score
1	92%	92%	92%	92%
2	92%	92%	92%	92%
3	88%	88%	88%	88%

Evaluation metrics used to assess the ResNet152 performance on unseen data.

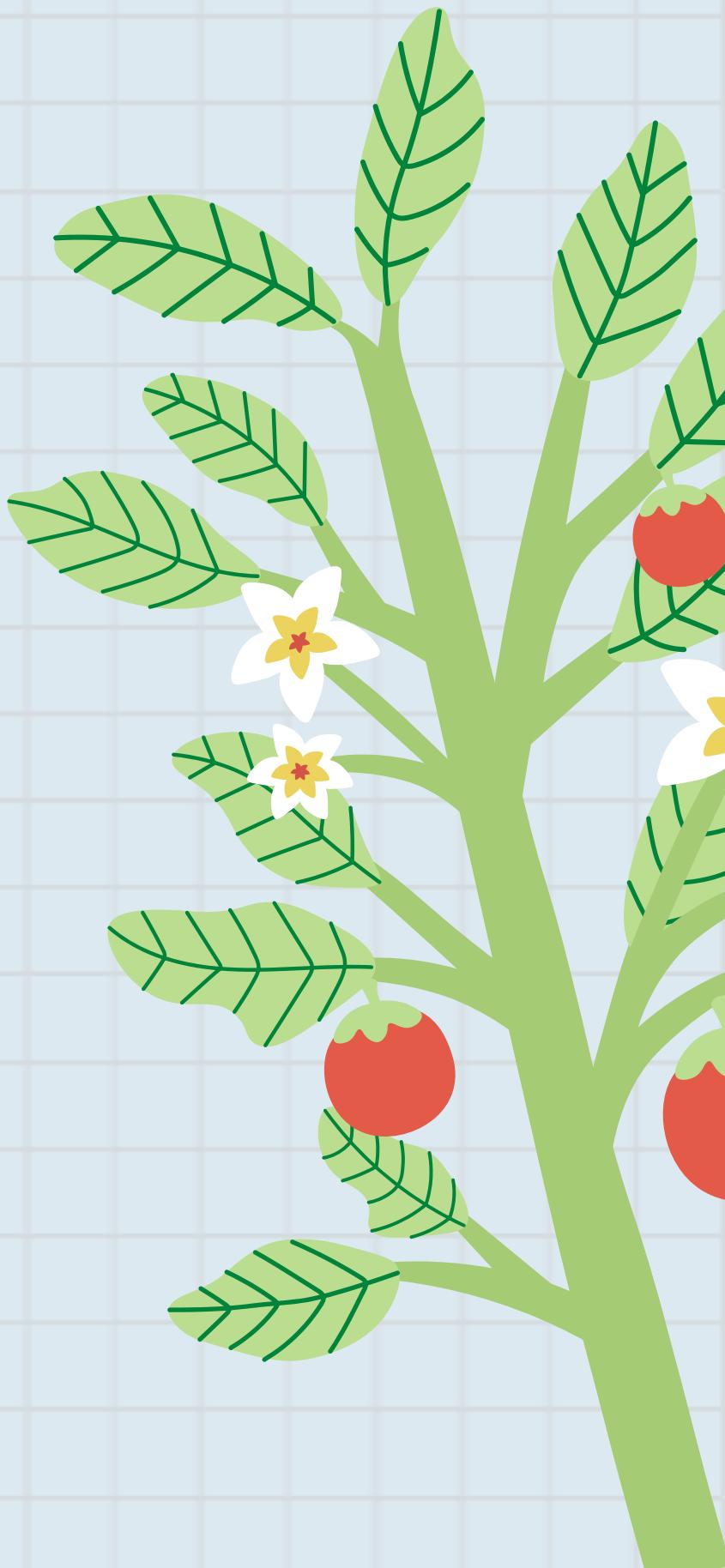
Performance Analysis

- **ResNet-18:** Achieved highest accuracy (91%) at lowest learning rate (0.0001), indicating preference for gradual learning.
- **ResNet-50:** Peaked at 91% accuracy with learning rate of 0.001, showing a balance between model complexity and learning rate efficiency.
- **ResNet-152:** Outperformed others with 92% accuracy at both 0.01 and 0.001 learning rates, leveraging deeper architectures for detailed feature extraction.

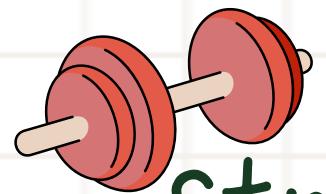
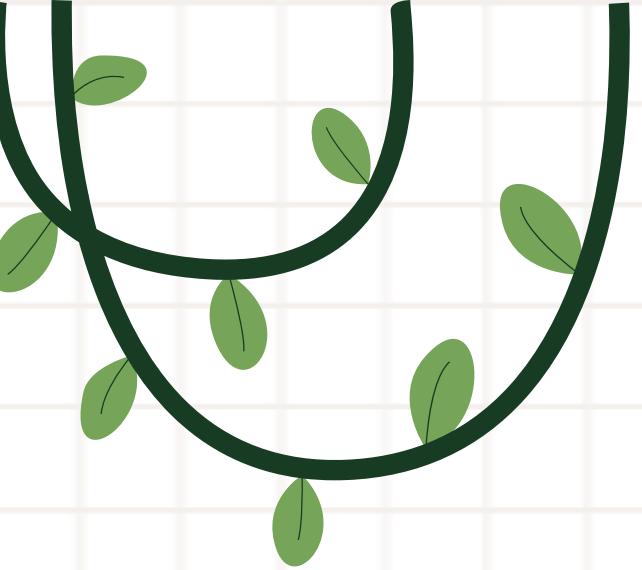


Performance Analysis

- 1 Optimization
- 2 Enhancements
- 3 Comparison
- 4 Recommendation



Discussion and Future Work



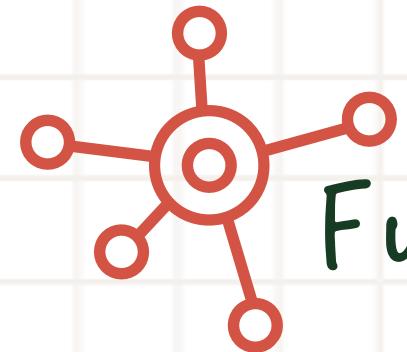
Strength

- pre-trained models
- Google Colab Pro



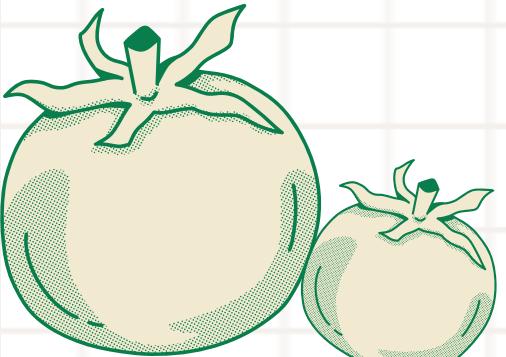
limitation

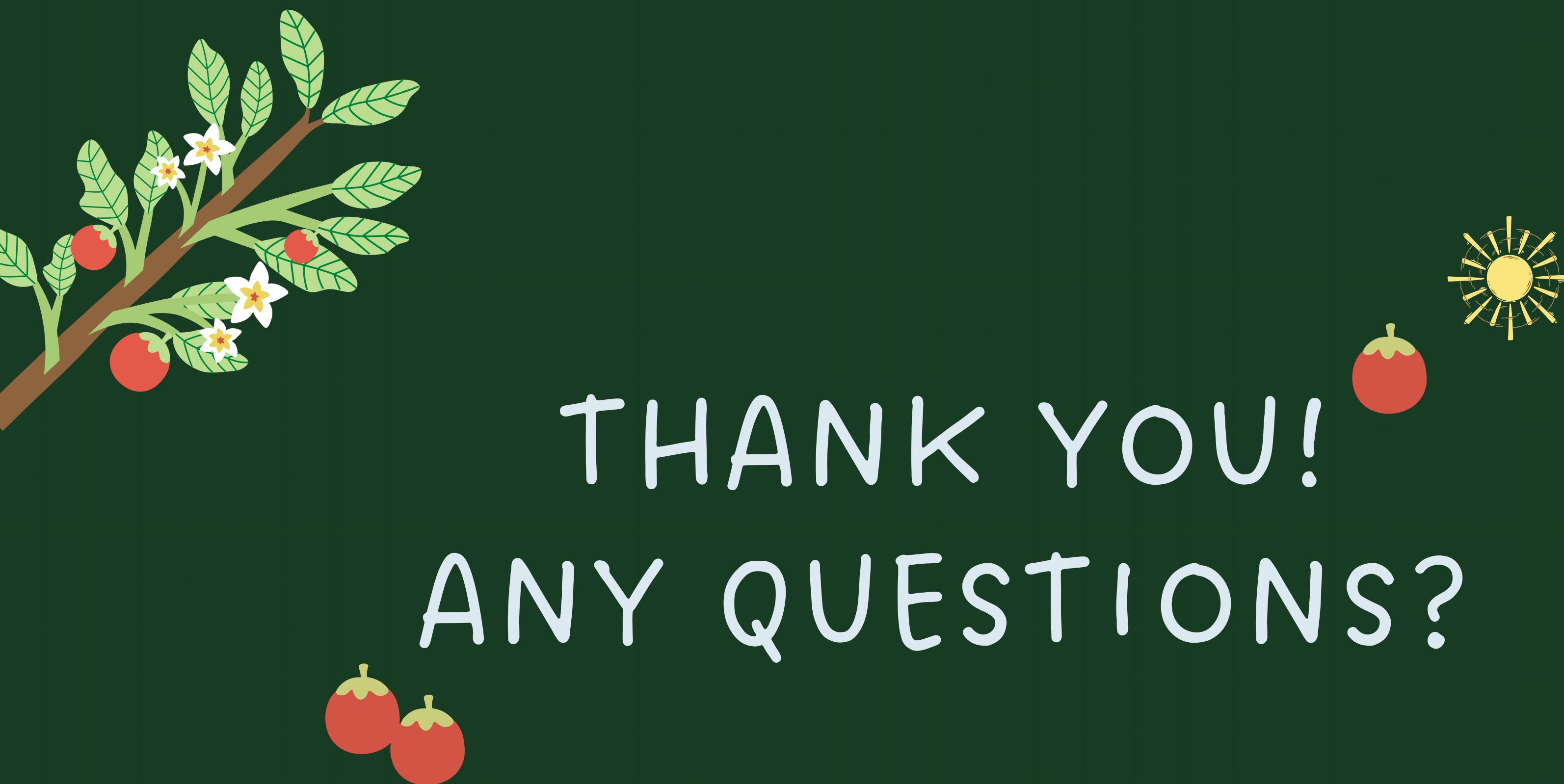
- Google Colab
- knowledge in image classification



Future work

- experimenting with different architectures, hyperparameters, deeper architectures





THANK YOU!
ANY QUESTIONS?