PLANT DISEASE DETECTION

SEVDA SAYAN
21527305

FATMANUR TURHAN
21527429

İSMET SEYHAN
21693431

What is our goal?

Identify plant and diseases pair accurately and practically

Definition of the Problem

Which plant does this leaf belong to?

Is this leaf diseased?

If yes, what is the disease?

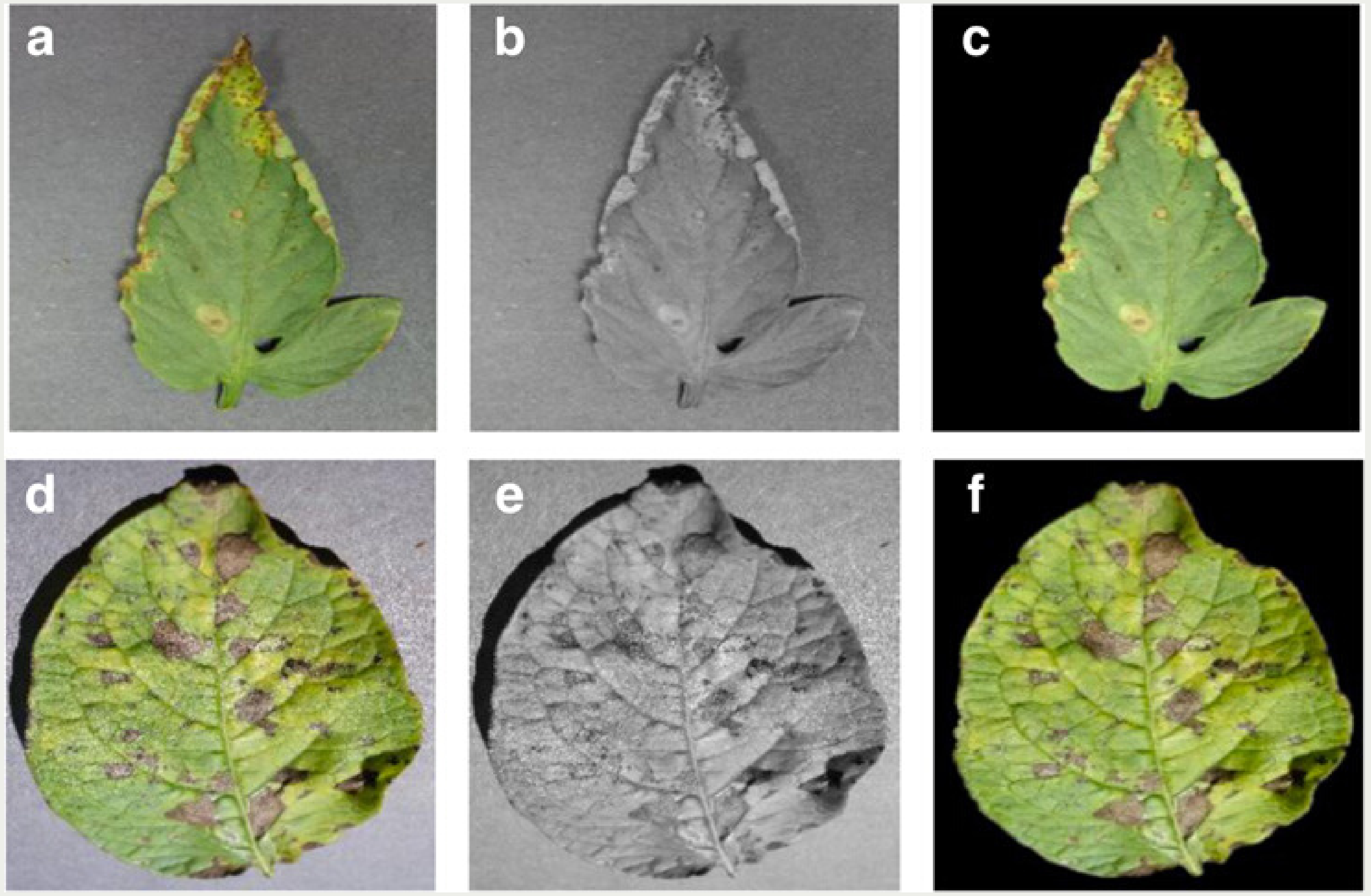
Overview of the Paper

Our reference article is “Using Deep Learning for Image-Based Plant Disease Detection” written by M. S. Sharada P. Mohanty, David P. Hughes in 22 September 2016.

This article used"PlantVillage" dataset that containing about 54 thousand images and categorized into 38 different classes.

Each class label is a plant - disease pair and predicts from the given image of the plant leaf.

Three different versions are used for the whole PlantVillage dataset.



Firstly, colored version as in the PlantVillage dataset,

Secondly, grayscale version of the Plant Village dataset,

Finally, removed all the extra background information for the segmented version of the Plant Village dataset.

According to our reference paper, observed that the best results in the classification of plant diseases are obtained by AlexNet and GoogleNet architectures.

	AlexNet		GoogleNet	
	Transfer learning	Training from scratch	Transfer learning	Training from scratch
TRAIN: 200%, TEST: 80%				
Color	0.9736 (0.9742, 0.9737, 0.9738)	0.9118 (0.9137, 0.9132, 0.9130)	**0.9820** (0.9824, 0.9821, 0.9821)	0.9430 (0.9440, 0.9431, 0.9429)
Grayscale	0.9361 (0.9368, 0.9369, 0.9371)	0.8524 (0.8539, 0.8555, 0.8553)	**0.9563** (0.9570, 0.9564, 0.9564)	0.8828 (0.8842, 0.6835, 0.8841)
Segmented	0.9724 (0.9727, 0.9727, 0.9726)	0.8945 (0.8956, 0.8963, 0.8969)	**0.9808** (0.9810, 0.9808, 0.9808)	0.9377 (0.9388, 0.9380, 0.9380)
TRAIN: 400%, TEST: 60%				
Color	0.9860 (0.9861, 0.9861, 0.9860)	0.9555 (0.9557, 0.9558, 0.9558)	**0.9914** (0.9914, 0.9914, 0.9914)	0.9729 (0.9731, 0.9729, 0.9729)
Grayscale	0.9584 (0.9588, 0.9589, 0.9588)	0.9088 (0.9090, 0.9101, 0.9100)	**0.9714** (0.9717, 0.9716, 0.9716)	0.9361 (0.9364, 0.9363, 0.9364)
Segmented	0.9812 (0.9814, 0.9813, 0.9813)	0.9404 (0.9409, 0.9408, 0.9408)	**0.9896** (0.9896, 0.9896, 0.9898)	0.9643 (0.9647, 0.9642, 0.9642)
TRAIN: 50%, TEST: 50%				
Color	0.9896 (0.9897, 0.9896, 0.9897)	0.9644 (0.9647, 0.9647, 0.9647)	**0.9916** (0.9916, 0.9916, 0.9916)	0.9772 (0.9774, 0.9773, 0.9773)
Grayscale	0.9661 (0.9663, 0.9663, 0.9663)	0.9312 (0.9315, 0.9318, 0.9319)	**0.9788** (0.9789, 0.9788, 0.9788)	0.9507 (0.9510, 0.9507, 0.9509)
Segmented	0.9867 (0.9868, 0.9868, 0.9869)	0.9551 (0.9552, 0.9555, 0.9556)	**0.9909** (0.9910, 0.9910, 0.9910)	0.9720 (0.9721, 0.9721, 0.9722)
TRAIN: 600%, TEST: 40%				
Color	0.9907 (0.9908, 0.9908, 0.9907)	0.9724 (0.9725, 0.9725, 0.9725)	**0.9924** (0.9924, 0.9924, 0.9924)	0.9824 (0.9825, 0.9824, 0.9824)
Grayscale	0.9686 (0.9689, 0.9688, 0.9688)	0.9388 (0.9396, 0.9395, 0.9391)	**0.9785** (0.9789, 0.9786, 0.9787)	0.9547 (0.9554, 0.9548, 0.9551)
Segmented	0.9855 (0.9856, 0.9856, 0.9856)	0.9595 (0.9597, 0.9597, 0.9596)	**0.9905** (0.9906, 0.9906, 0.9906)	0.9740 (0.9743, 0.9740, 0.9745)
TRAIN: 80%, TEST: 20%				
Color	**0.9927** (0.9928, 0.9927, 0.9928)	**0.9782** (0.9786, 0.9782, 0.9782)	**0.9934** (0.9935, 0.9935, 0.9935)	**0.9836** (0.9839, 0.9837, 0.9837)
Grayscale	**0.9726** (0.9728.0.9727, 0.9725)	**0.9449** (0.9451, 0.9454, 0.9452)	**0.9800** (0.9804, 0.9801, 0.9798)	**0.9621** (0.9624, 0.9621, 0.9621)
Segmented	**0.9891** (0.9893, 0.9891, 0.9892)	**0.9722** (0.9725, 0.9724, 0.9723)	**0.9925** (0.9925, 0.9925, 0.9924)	**0.9824** (0.9827, 0.9824, 0.9822)

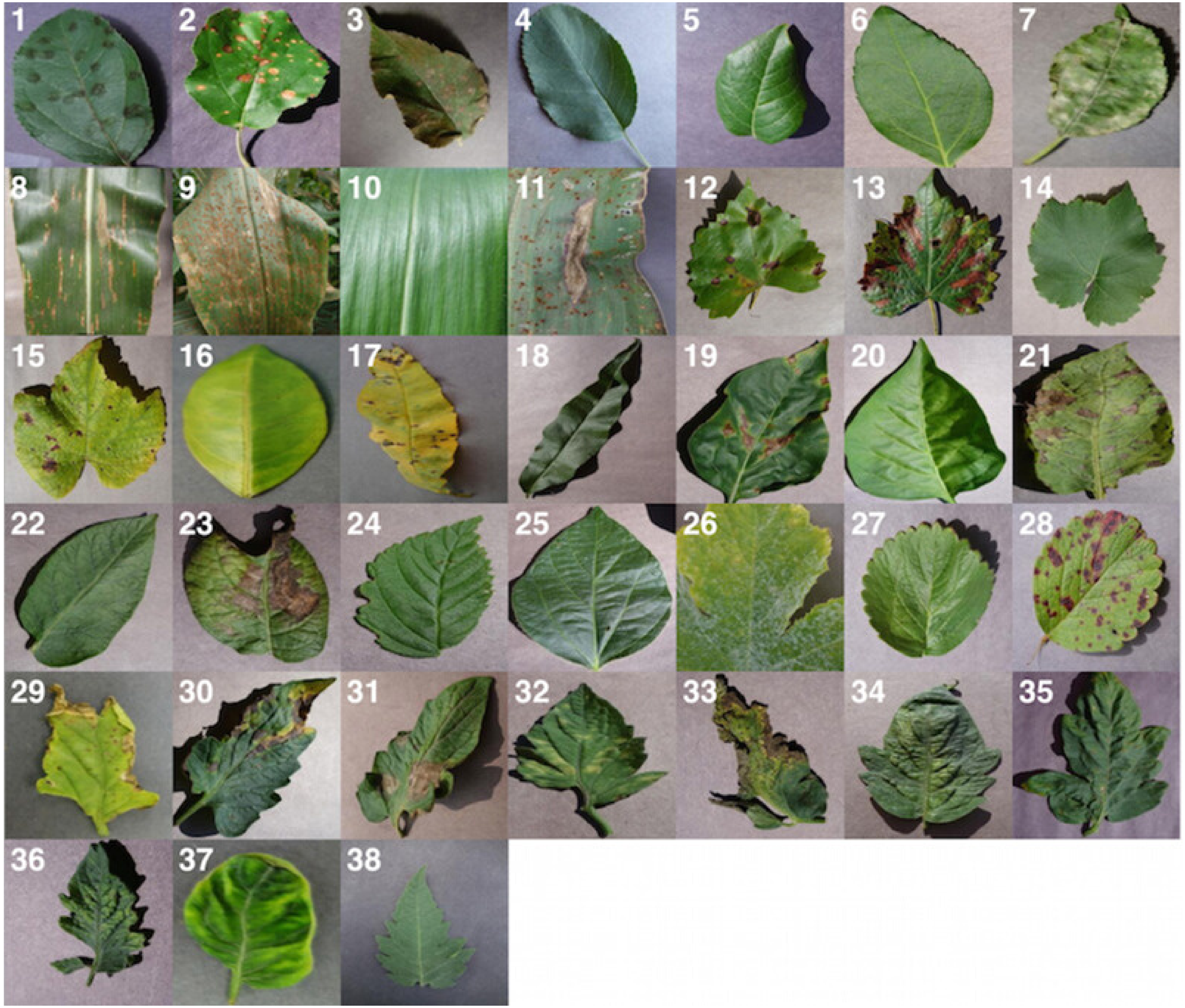
Plant Disease Dataset

Consists of about 87K rgb images
Healthy and diseased crop leaves
Categorized into 38 different classes.

Our minimized dataset

Consists of about 14K rgb images

300 train images,
50 validation images ,
50 test images


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38

Methodology

Configurations About Architecture

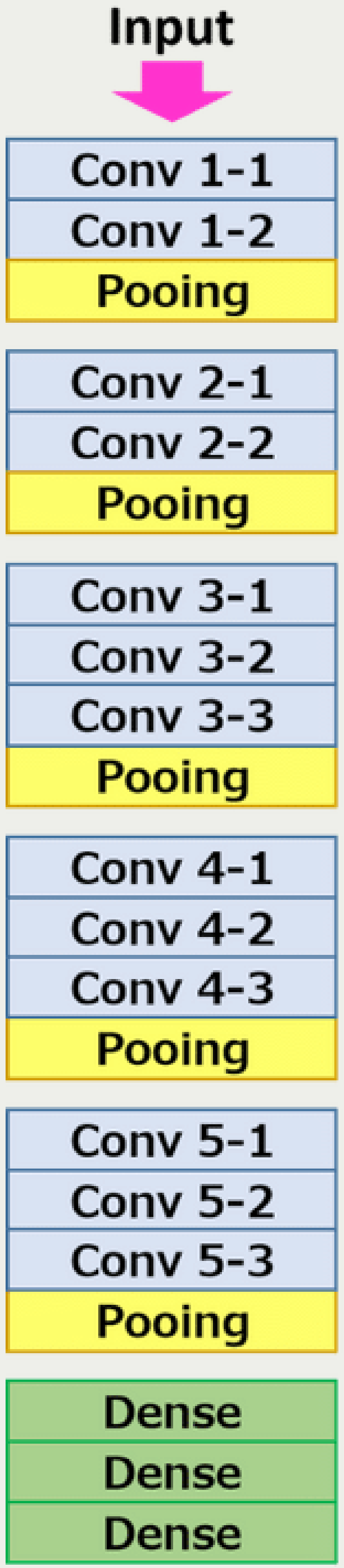
VGG16

Resnet50

Configurations About Training Mechanism

Transfer Learning

Training from Scratch

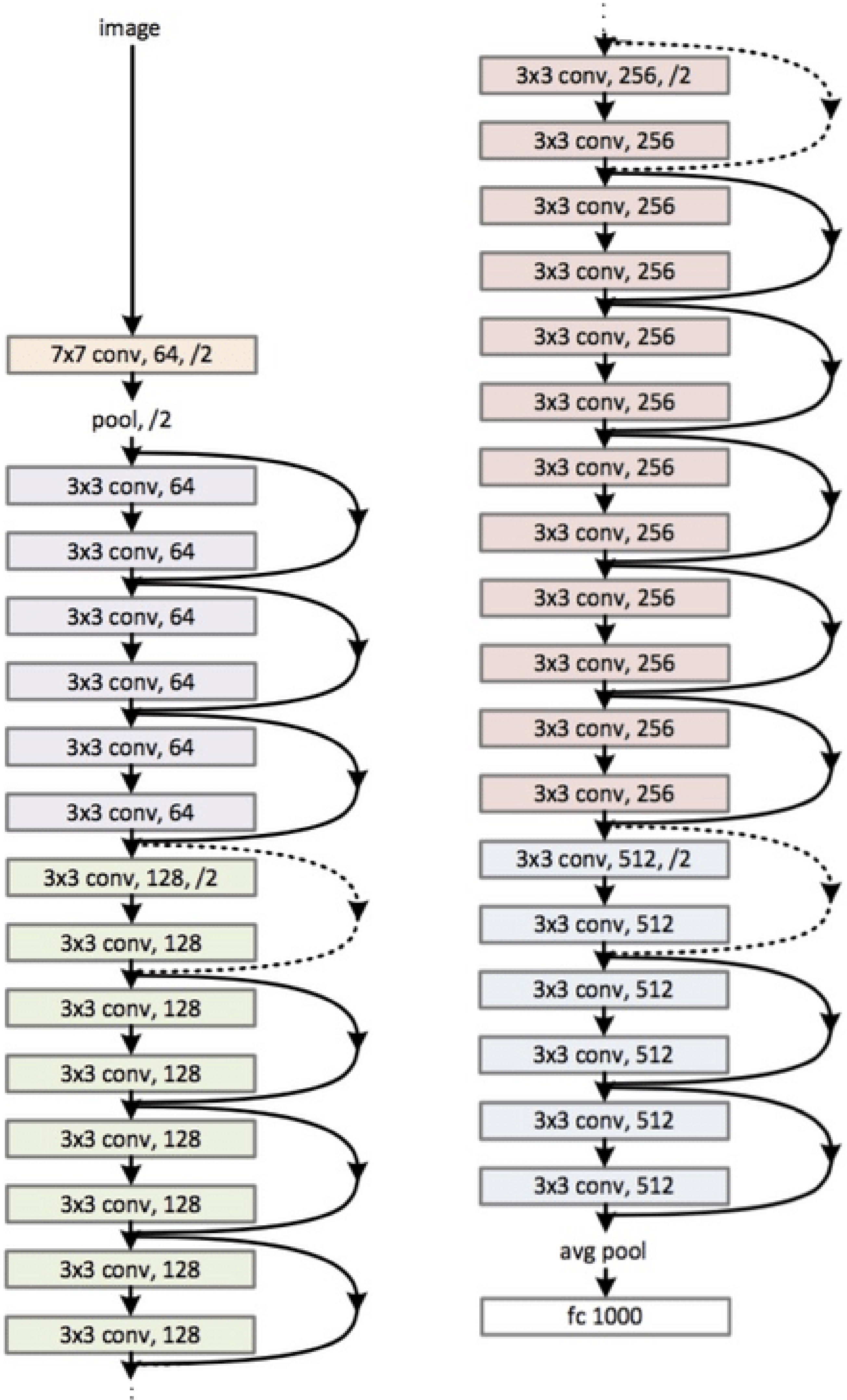


VGG16

Visual Geometry Group (VGG), which achieved very good performance on the ImageNet dataset.

Convolutions layers (used only 3*3 size)
Max pooling layers (used only 2*2 size)
Fully connected layers at end

Total 16 layers



ResNet50

Deep convolutional networks have led to number of breakthroughs for image classification.

50 layer Residual Network

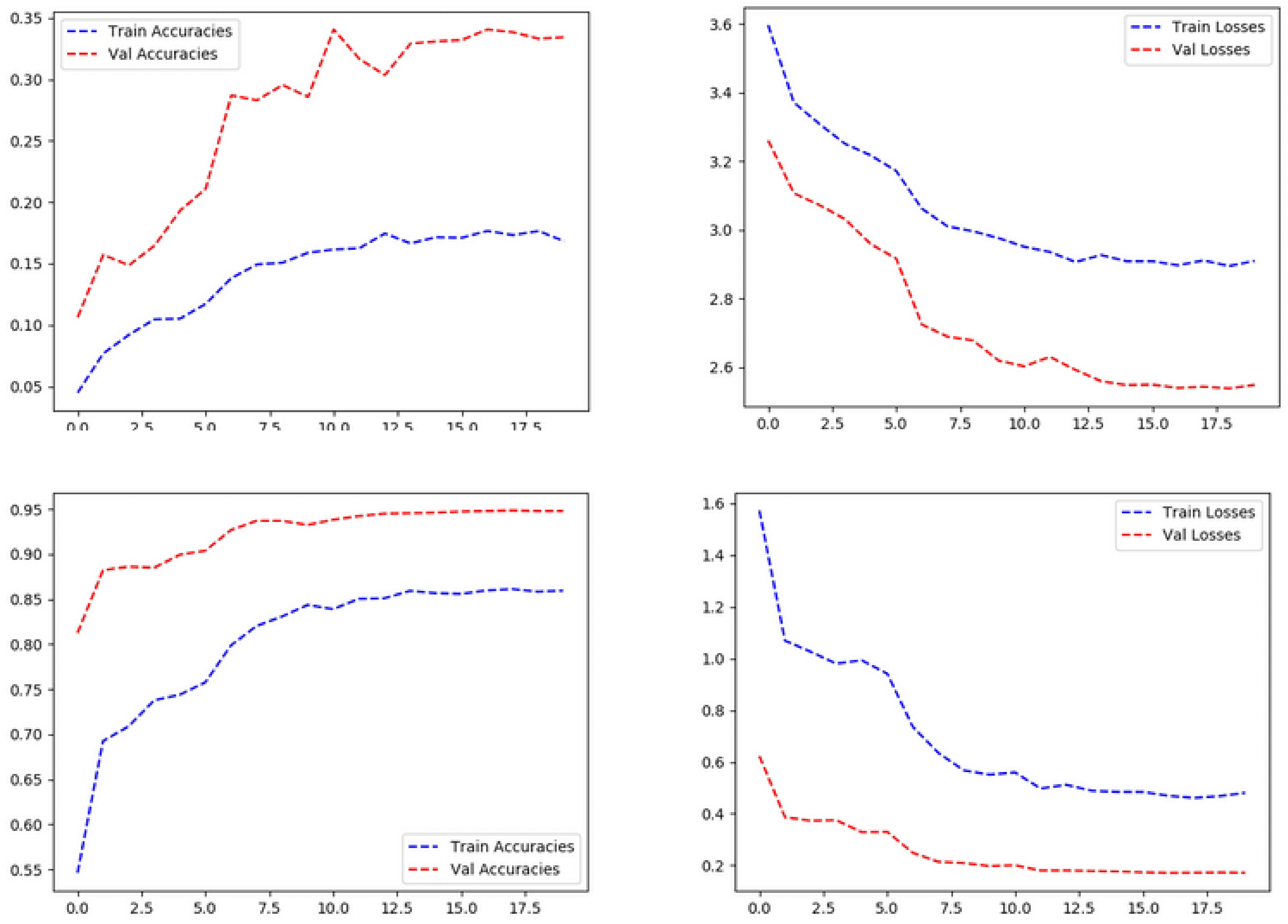
When we go deeper with the neural networks the accuracy starts saturating and then degrades also.Residual training tries to solve this problem.

Transfer Learning

It is a research problem in machine
learning
that focuses on storing the
information obtained while solving a
problem
and then applying it to a different but
relevant problem.

Evaluation Metrics

- Loss & Accuracies
- Confusion Matrix
- Weight Visualization

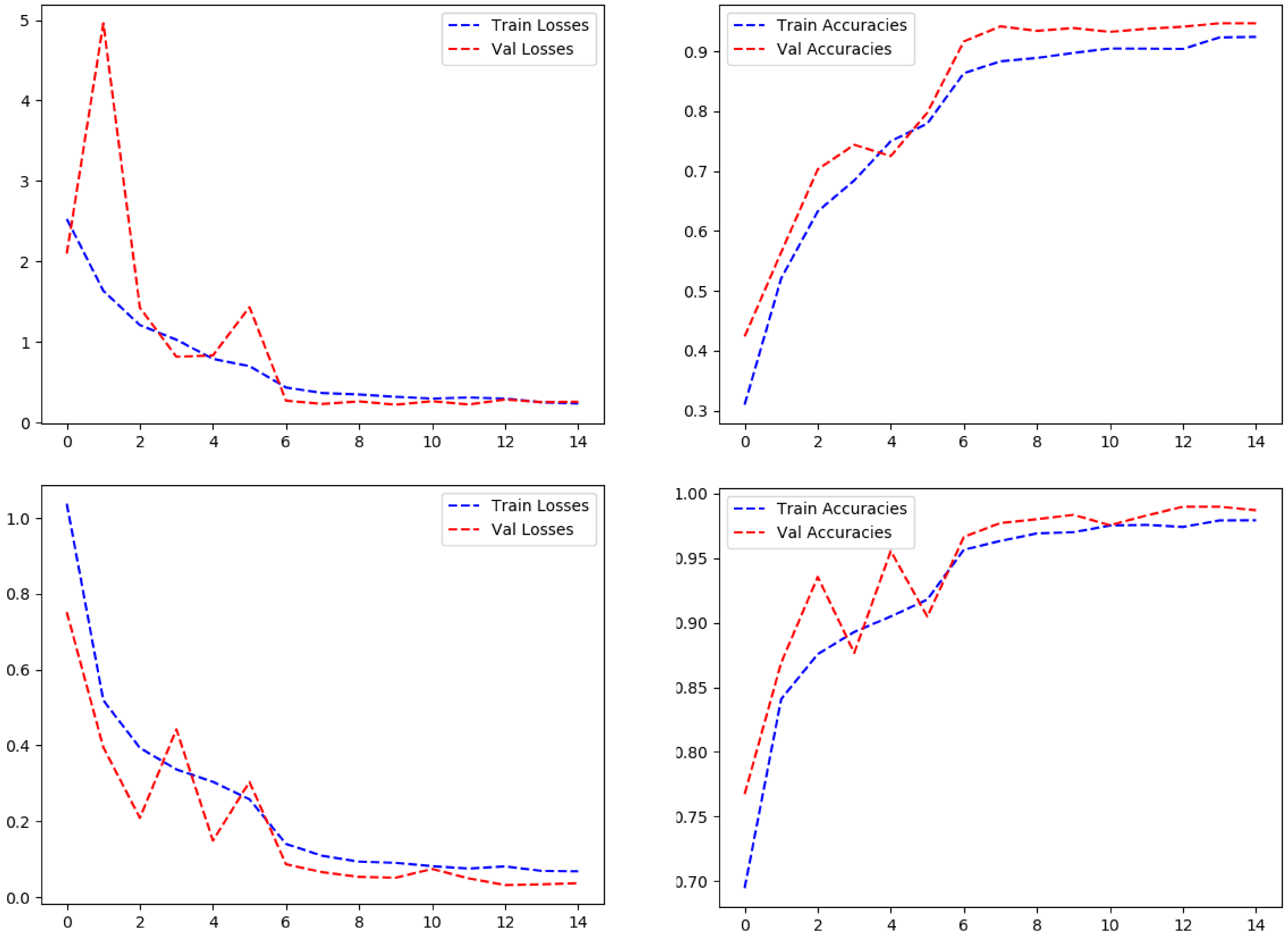


VGG16 From Scratch

VGG16 Transfer Learning

ResNet50 From Scratch

ResNet50 Transfer Learning

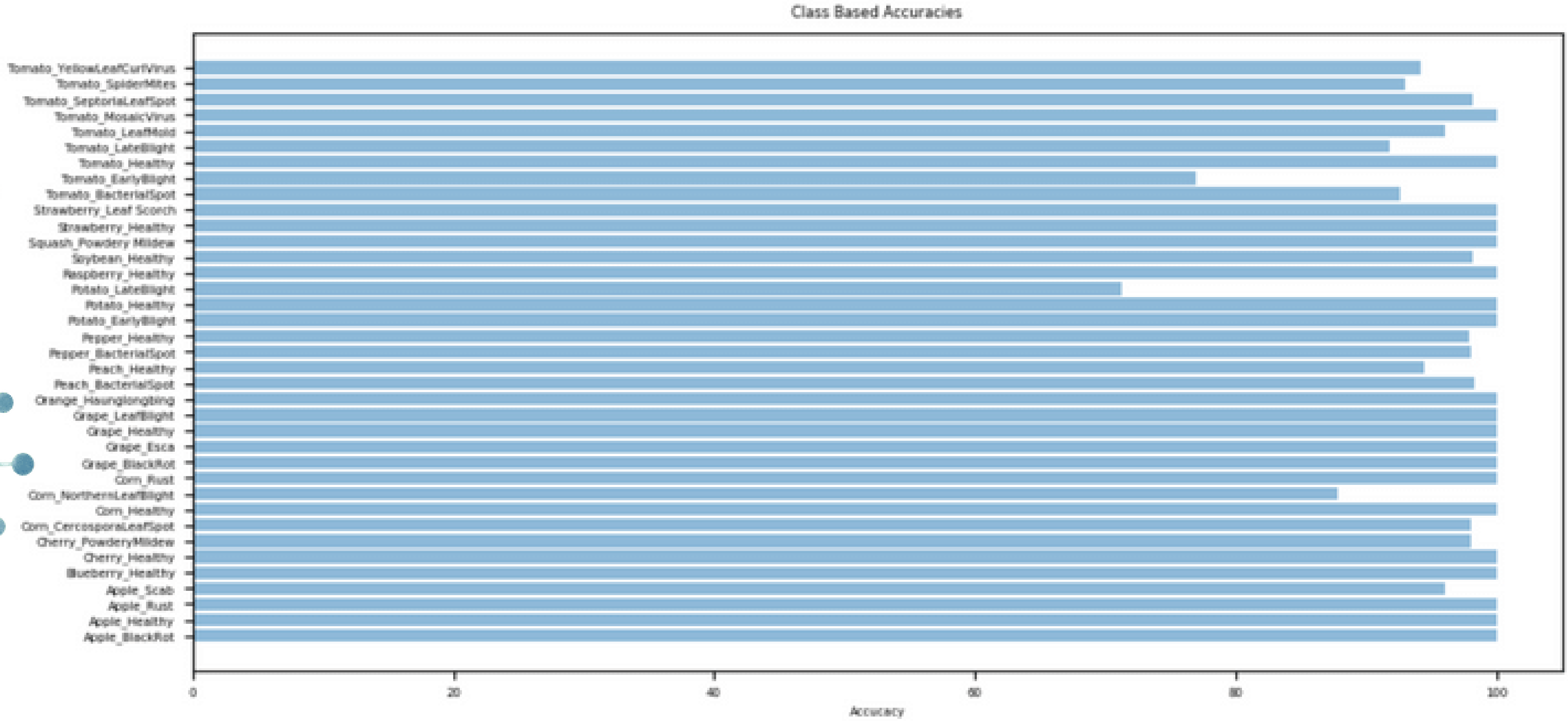


Training RESNET50 TRANSFER LEARNING				
Epoch	Train Loss	Accurancy	Validation Loss	Accurancy
0	1,0379	0,6947	0,7517	0,7674
1	0,5191	0,8409	0,3951	0,8691
2	0,3937	0,8757	0,2091	0,9354
3	0,3371	0,8928	0,4427	0,8766
4	0,3043	0,9048	0,1493	0,9554
5	0,2583	0,9179	0,3041	0,9046
6	0,1406	0,9564	0,0869	0,9663
7	0,109	0,9632	0,0658	0,9771
8	0,0939	0,969	0,0537	0,98
9	0,0906	0,97	0,0514	0,9834
10	0,0819	0,9751	0,0745	0,9754
11	0,0757	0,9756	0,0497	0,9829
12	0,0813	0,974	0,0321	0,9897
13	0,0694	0,9791	0,0341	0,9897
14	0,0683	0,9792	0,0371	0,9869

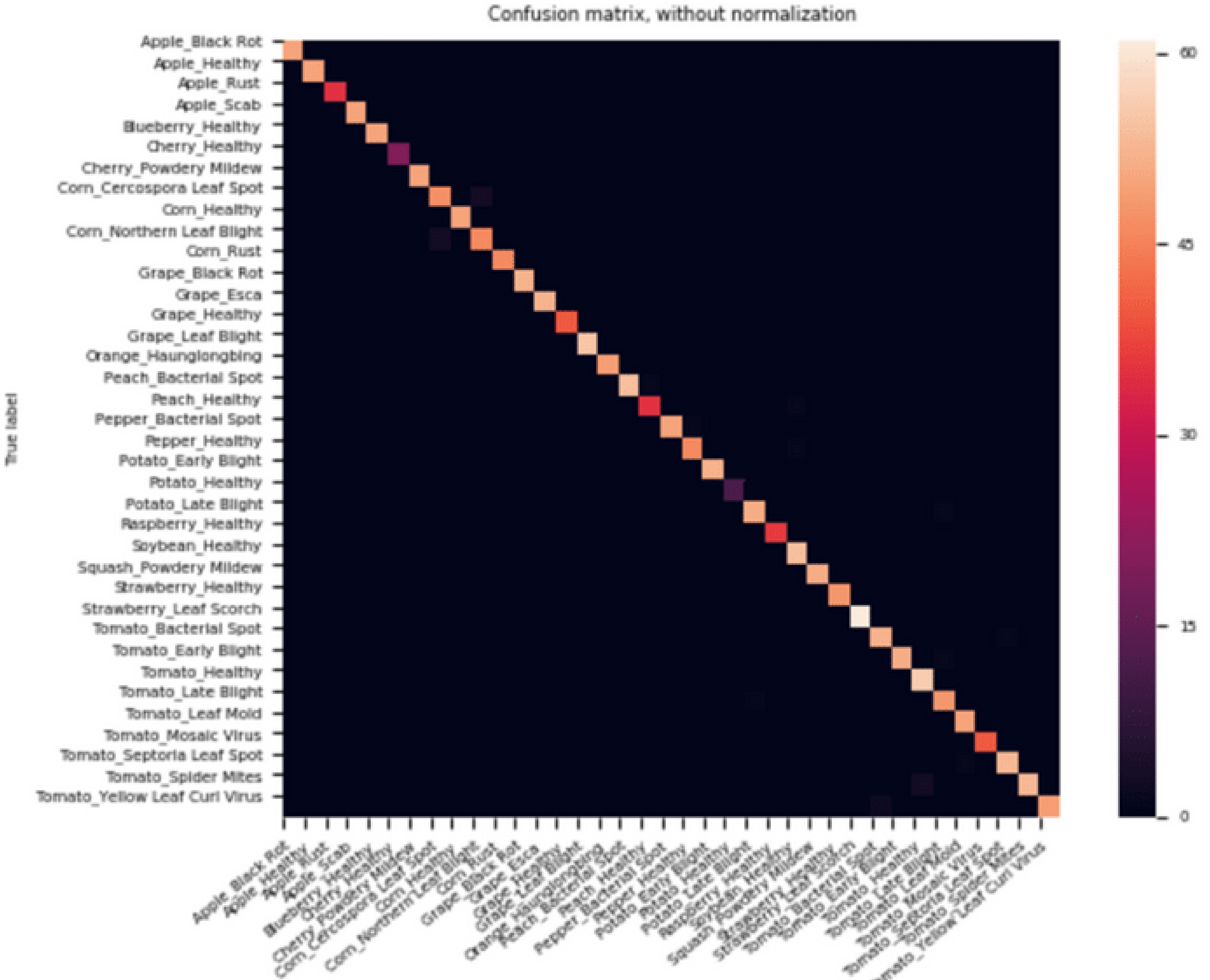
Loss & Accuracies

	Loss	Accuracy
VGG16 From Scratch	0.0416	0.3209
VGG16 Transfer Learning	0.0030	0.9342
ResNet50 From Scratch	0.0027	0.9461
ResNet50 Transfer Leaning	0.0005	0.9887

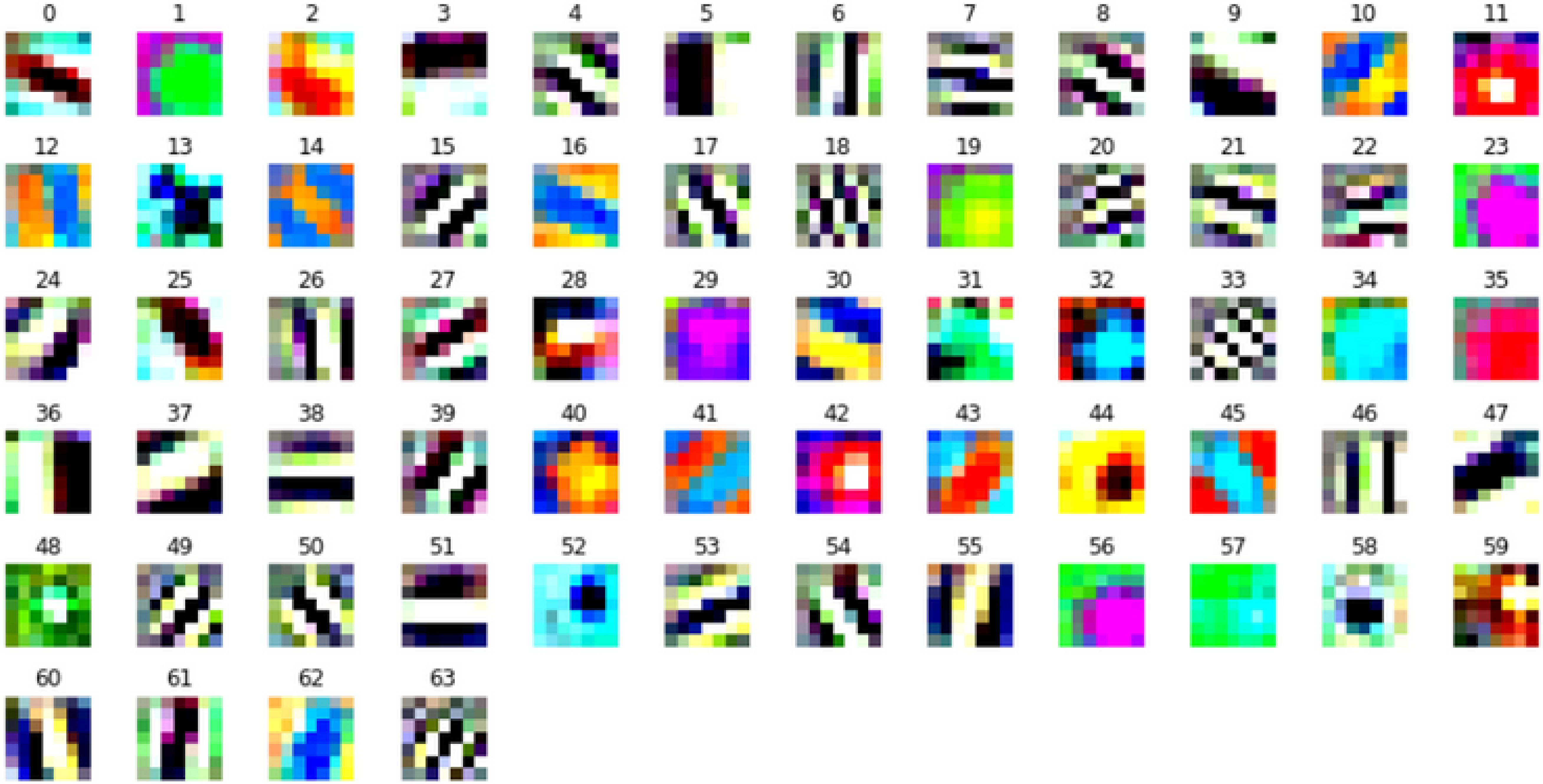
Class Based Accuracies



Confusion Matrix



Weight Visualization



Strength

Grape Ecsa

Grape Black Rot

Durable even for very similar leafs

Weakness

Tomato Late Blight

Potato Late Blight

Predict disease true but confuse plant type

Connections with Other Work

When we investigate the current studies, we see similar studies. The dataset used by the reference article, we refer to is one of the dataset we use. However, unlike the reference article, we combined two datasets and reduced the size. We divided into train, test and validation the newly created dataset.

Another difference is that we used Vgg16 and ResNet50 architectures, other study used AlexNet and GoogleNet architectures

Conclusion

Combined two dataset and it is reduced.

Tried two architecture which Vgg16 and Resnet50.

Compared results for two architecture and selected Resnet50 as best model.

Obtained very high accuracy.

Future Work