

# Deep Learning Spring 2022

## Assignment 3 Report

Ali Khalid  
MSDS21001

May 29, 2022

# 1 Compare results of simple convolution block base architecture vs mobilenet block based architecture and report results with reasoning

Both models are trained for same number of epochs with same learning rate.

## 1.1 Mobilenet Block Architecture

```
Test Set Accuracy: 0.9472
Test Set Recall Score: 0.9472
Test Set F1 Score: 0.9477546579444083
```

Figure 1: Mobilenet Block Architecture results

## 1.2 Convolution Block Architecture

```
Test Set Accuracy: 0.972
Test Set Recall Score: 0.972
Test Set F1 Score: 0.972035690836449
```

Figure 2: Convolution Block Architecture results

## 1.3 reasoning

The accuracy, recall and f1 score are better for architecture having all convolution block. Both architectures have 4 blocks followed by average pooling and fully connected layer. Mobilenet architecture has 1 convolution block and 3 mobilenet blocks. Convolution architecture has 4 convolution blocks. both the architectures are trained for 10 epochs with learning rate equal to 0.0001 for fair comparison. As convolution architecture has more number of parameters, it has the tendency to learn better and hence the accuracy, f1 score and recall are higher for this architecture.

# 2 Use no of different conv block and mobileNet block and compare its accuracy

## 2.1 1 convolution block and 3 mobilenet blocks

```
Test Set Accuracy: 0.9472
Test Set Recall Score: 0.9472
Test Set F1 Score: 0.9477546579444083
```

Figure 3: 1 convolution block and 3 mobilenet blocks results

## 2.2 4 convolution block

```
Test Set Accuracy: 0.972
Test Set Recall Score: 0.972
Test Set F1 Score: 0.972035690836449
```

Figure 4: 4 convolution block results

## 2.3 Comparison

It can be observed from the results above that for an architecture having same number of blocks, the one with more number of convolution blocks will have higher accuracy.

## 3 Confusion matrices, Recall, and Accuracy for the testing set.

### 3.1 Mobilenet Block Architecture

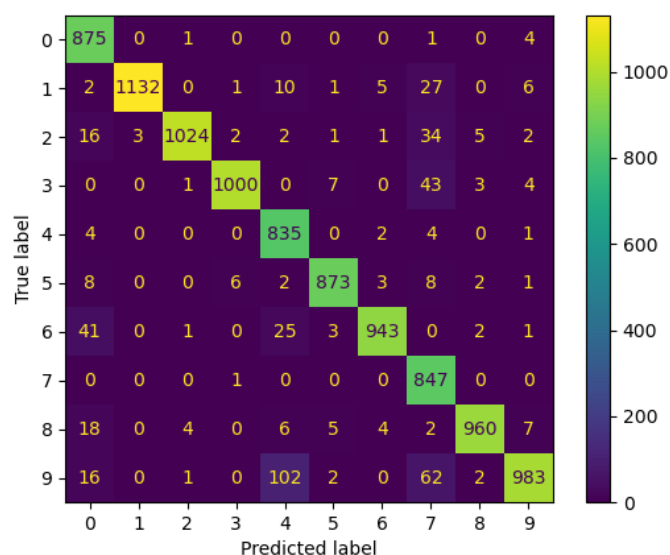


Figure 5: Mobilenet Block Architecture Confusion Matrix

```
Test Set Accuracy: 0.9472
Test Set Recall Score: 0.9472
Test Set F1 Score: 0.9477546579444083
```

Figure 6: Mobilenet Block Architecture Recall, Accuracy and F1 score

### 3.2 Convolution Block Architecture

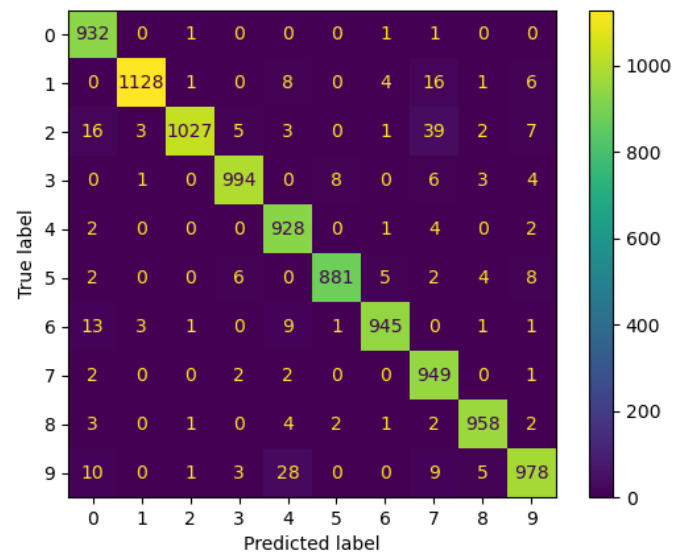


Figure 7: Convolution Block Architecture Confusion Matrix

```
Test Set Accuracy: 0.972
Test Set Recall Score: 0.972
Test Set F1 Score: 0.972035690836449
```

Figure 8: Convolution Block Architecture Recall, Accuracy and F1 score

## 4 Figures along with labels for correct predictions and wrong ones.

### 4.1 Mobilenet Block Architecture

right predictions

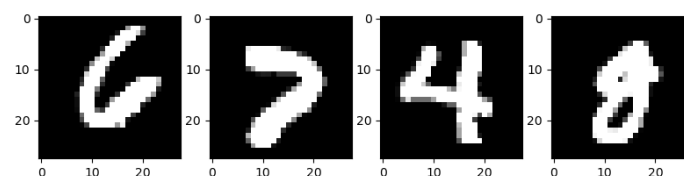


Figure 9: correct prediction images

```
labels : [tensor(6), tensor(7), tensor(4), tensor(8)]
prediction : [tensor(6), tensor(7), tensor(4), tensor(8)]
```

Figure 10: correct predictions and true labels.

wrong predictions

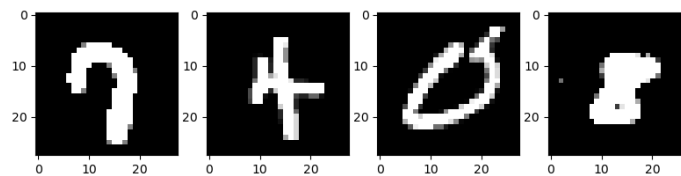


Figure 11: wrong predictions images

```
labels : [tensor(7), tensor(4), tensor(0), tensor(8)]
prediction : [tensor(9), tensor(5), tensor(6), tensor(5)]
```

Figure 12: Wrong predictions and true labels

## 4.2 Convolution Block Architecture

right predictions

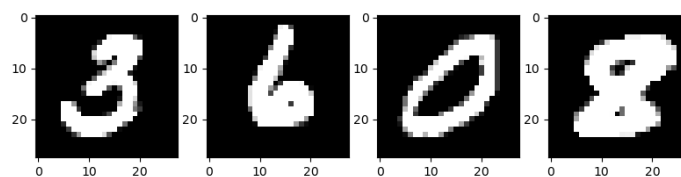


Figure 13: correct prediction images

```
labels : [tensor(3), tensor(6), tensor(0), tensor(8)]
prediction : [tensor(3), tensor(6), tensor(0), tensor(8)]
```

Figure 14: correct predictions and true labels.

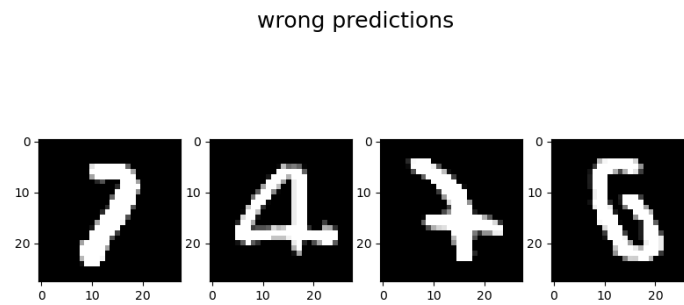


Figure 15: wrong predictions images

```
labels : [tensor(7), tensor(4), tensor(7), tensor(6)]
prediction : [tensor(1), tensor(2), tensor(2), tensor(5)]
```

Figure 16: Wrong predictions and true labels

## 5 Plot learned filters of your last convolution layer using matplotlib.

### 5.1 Mobilenet Block Architecture

As the mobilenet has 1x1 convolutions as a last convolution filter, all the filter below shows the same color. This is because the filters are plot independently from each other on separate scale.

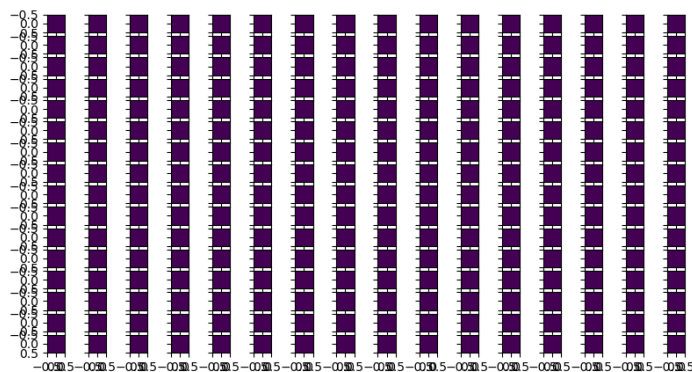


Figure 17: Last layer filters

## 5.2 Convolution Block Architecture

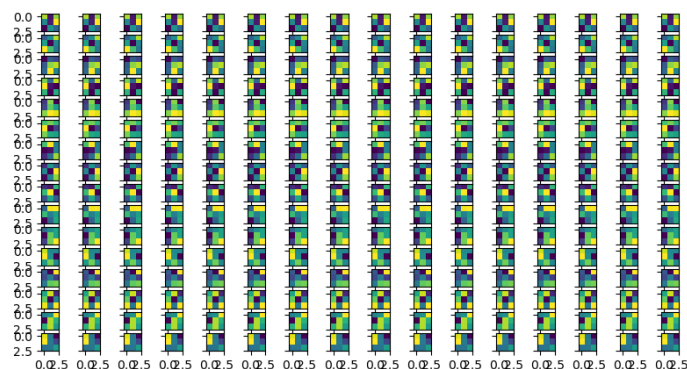


Figure 18: last layer filters

6 Show what happens when we do not use MobileNet block and when we use MobileNet block in your architecture. Show ROC curves, accuracy/loss curve, confusion matrix, and tsne plot.

### 6.1 Mobilenet Block Architecture

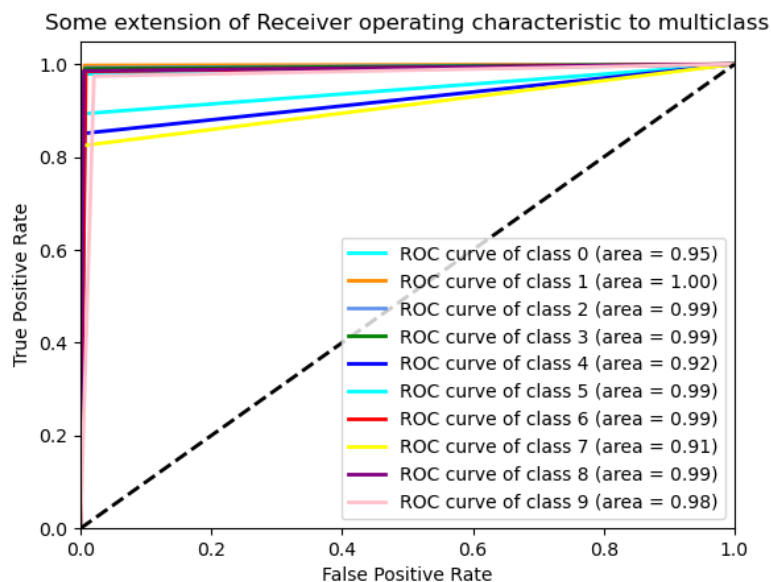


Figure 19: Mobilenet Block Architecture ROC

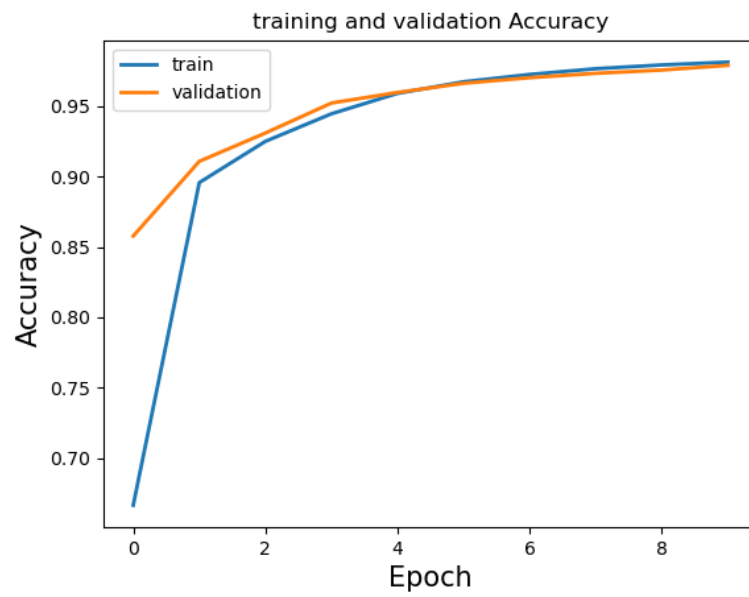


Figure 20: Mobilenet Block Architecture Traing and Validation accuracy

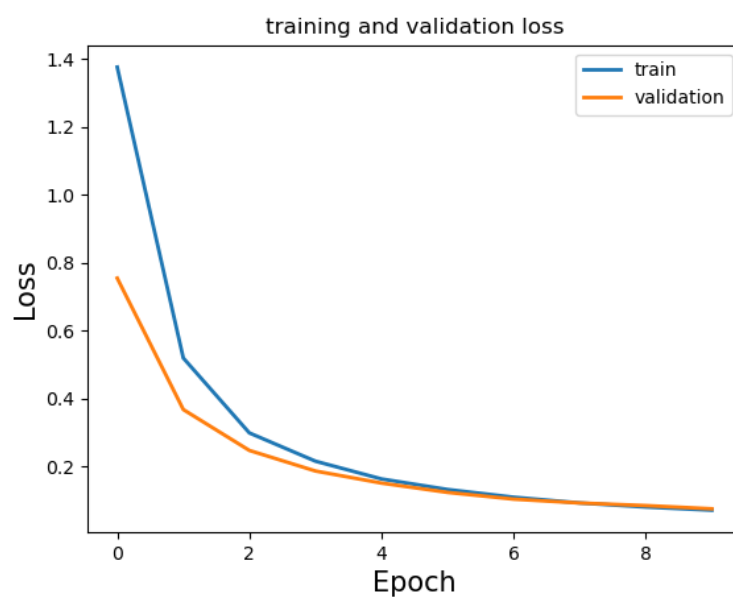


Figure 21: Mobilenet Block Architecture Traing and Validation loss



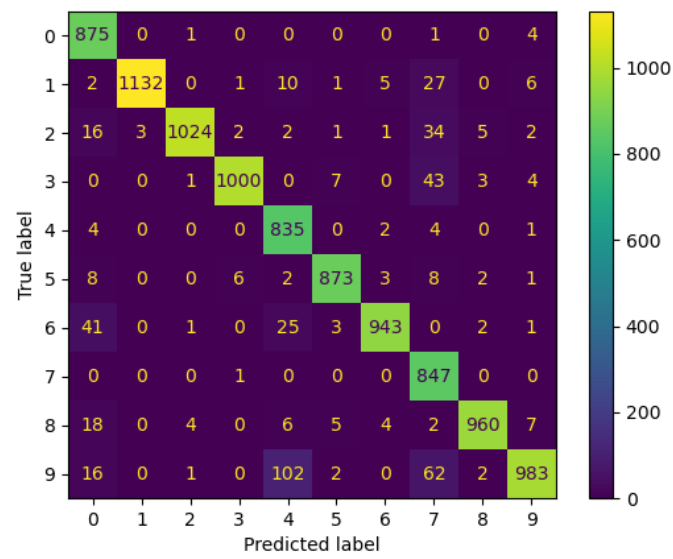


Figure 22: Mobilenet Block Architecture Confusion Matrix

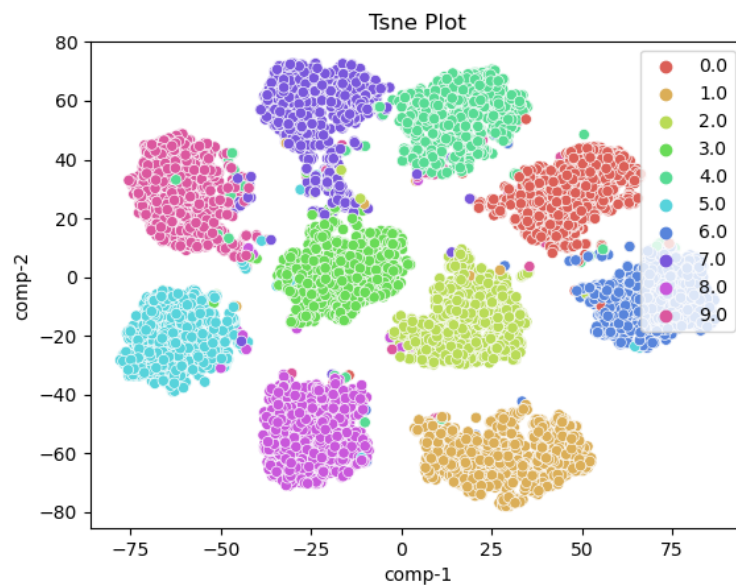


Figure 23: Mobilenet Block Architecture t-SNE plot

## 6.2 Convolution Block Architecture

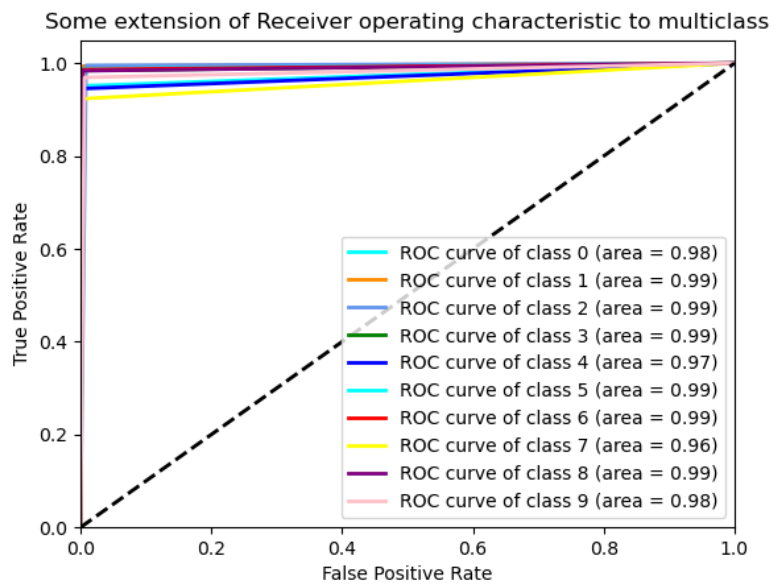


Figure 24: Convolution Block Architecture ROC

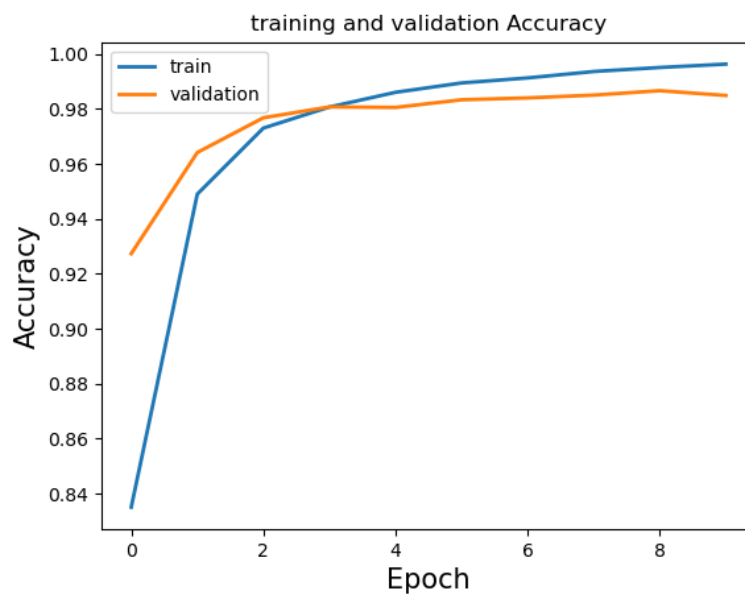


Figure 25: Convolution Block Architecture Traing and Validation accuracy

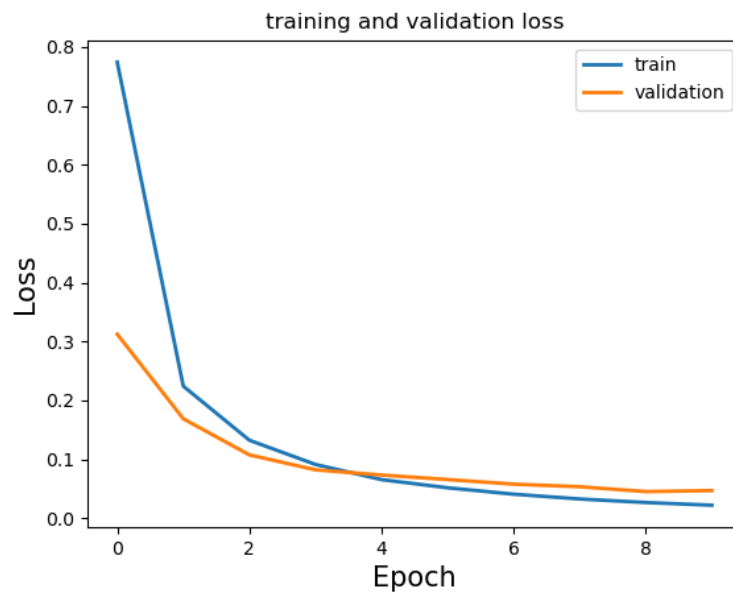


Figure 26: Convolution Block Architecture Traing and Validation loss

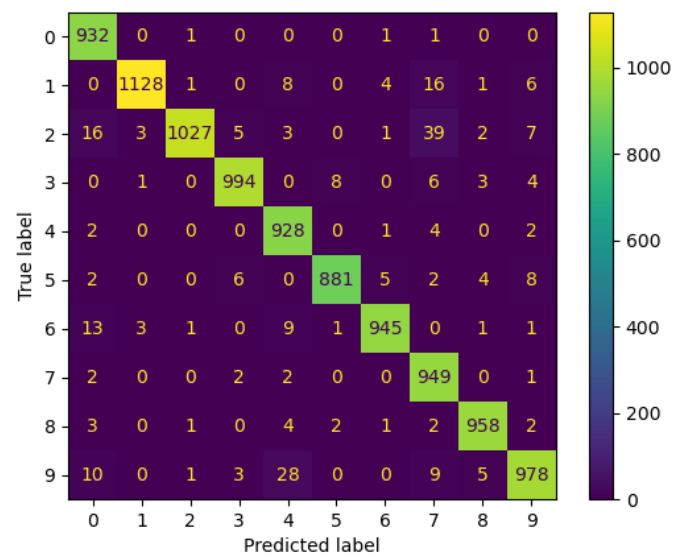


Figure 27: Convolution Block Architecture Confusion Matrix

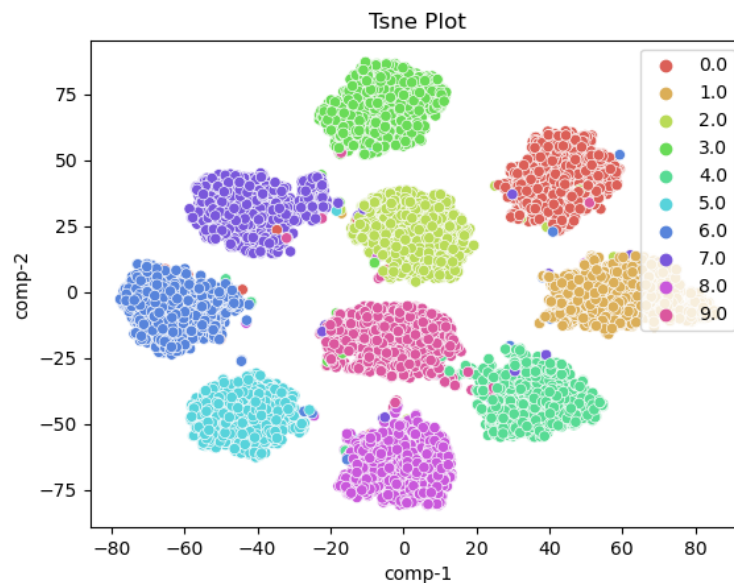


Figure 28: Convolution Block Architecture t-SNE plot

## 7 Report what you learned from this assignment, your analysis, and if you find something innovative or interesting in the conclusion section.

- Depth wise separable convolution filters have less parameters as compared to normal convolution filters.
- Mobilenet uses depth wise separable convolution filters in its architecture.
- Mobilenet achieves almost the same accuracy as compared to normal convolution filters but has very less parameters.
- The relatively less number of parameters in mobile net make it useful for deploying in edge devices which have limited computing power.

## 8 Report the accuracy by changing loss functions, batch size, learning rate, epochs, and the ratio of training and testing data, etc.

### 8.1 Mobilenet Block Architecture

Test Set Accuracy: 0.5997

Figure 29: Test Accuracy for Epoch = 1, Learning rate = 0.0001

Test Set Recall Score: 0.5997  
Test Set F1 Score: 0.6911575995518724

Figure 30: Recall and F1 score for Epoch = 1, Learning rate = 0.0001

```
Test Set Accuracy: 0.9472  
Test Set Recall Score: 0.9472  
Test Set F1 Score: 0.9477546579444083
```

Figure 31: Test Accuracy, Recall and F1 score for Epoch =10, and learning rate = 0.0001

## 8.2 Convolution Block Architecture

```
Test Set Accuracy: 0.6857
```

Figure 32: Test Accuracy for Epoch = 1, Learning rate = 0.0001

```
Test Set Recall Score: 0.6857  
Test Set F1 Score: 0.7796530103398593
```

Figure 33: Recall and F1 score for Epoch = 1, Learning rate = 0.0001

```
Test Set Accuracy: 0.972  
Test Set Recall Score: 0.972  
Test Set F1 Score: 0.972035690836449
```

Figure 34: Test Accuracy, Recall and F1 score for Epoch =10, and learning rate = 0.0001