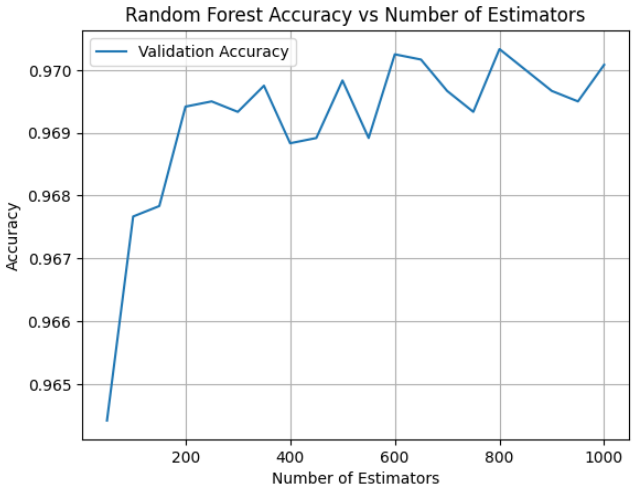
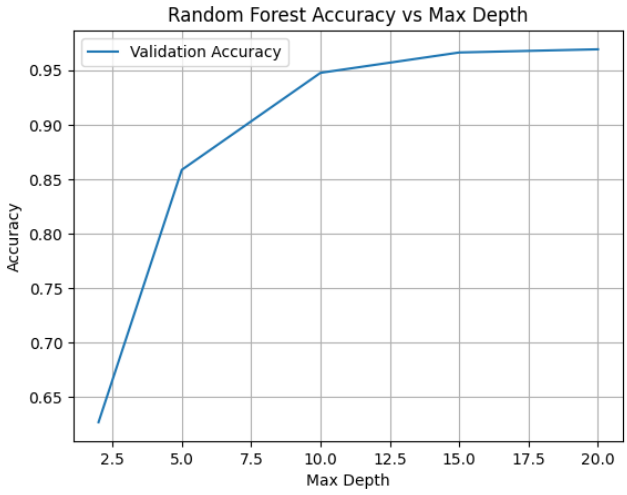
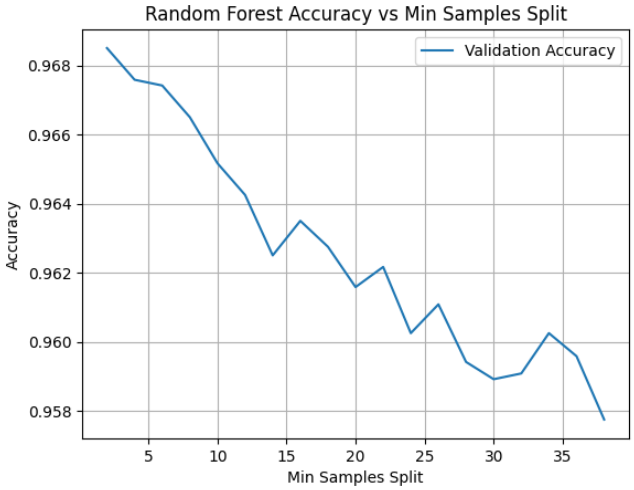
Evaluating model's performance for SVM, RF and LSTM using MNIST dataset

Random Forest

```
{
  "n_estimators": range(50, 1050, 50),
  "max_depth": {2, 5, 10, 15, 20, None},
  "min_samples_split": range(2, 42, 2)
}
```







Seeing that the best number of `estimators` is 650, best number of `max_depth` is 20 and best number of `min_samples_split` is 2. In combination, the resulting test accuracies yields

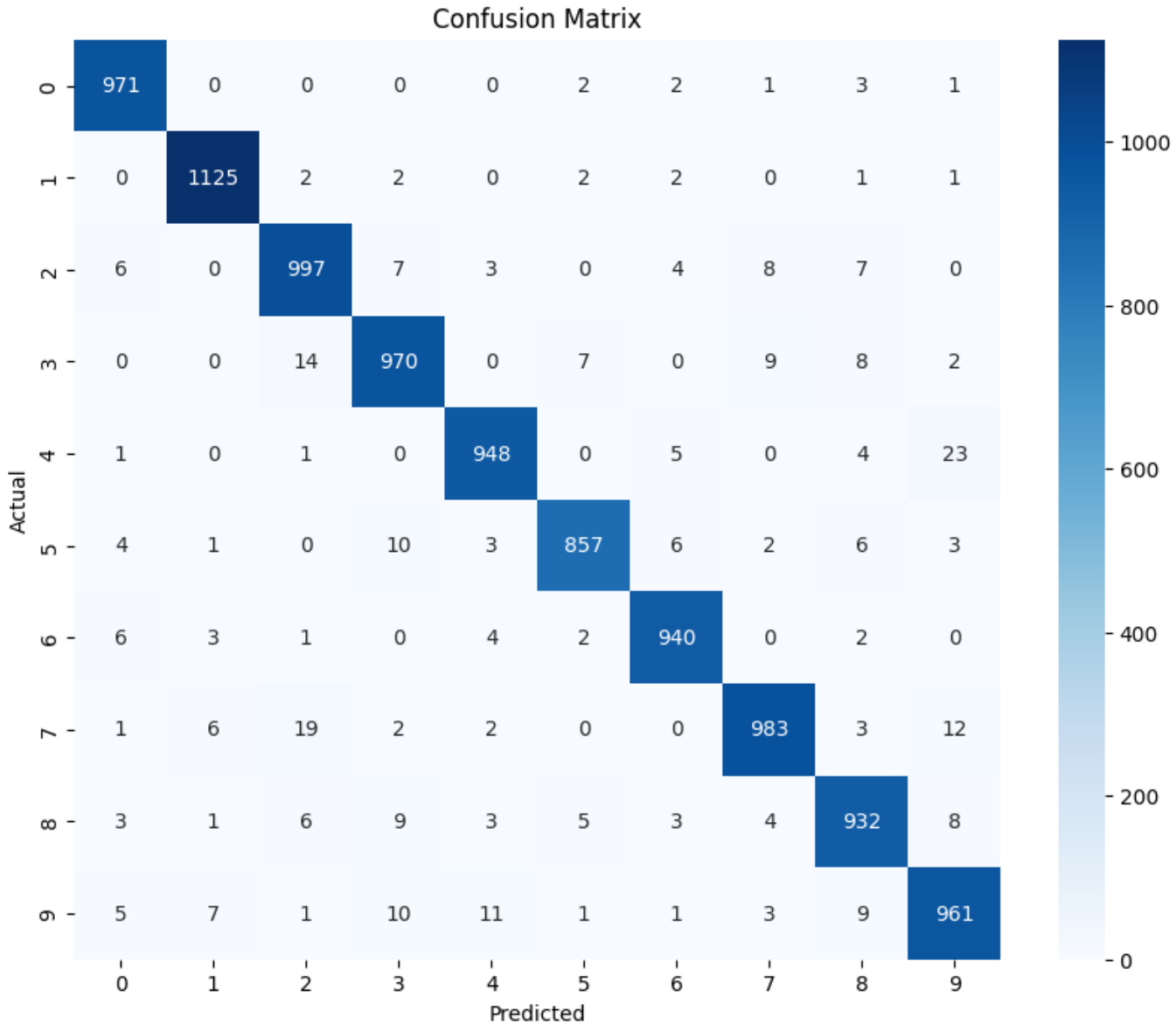
```
Validation accuracy: 0.971
Validation Precision: 0.9710116403292254
Validation Recall: 0.971
Validation F1 Score: 0.9709933654164185
```

```
Cross Validation Scores: [0.96866667 0.96708333 0.96533333 0.96525
0.97183333]
Mean Cross Validation Score: 0.9676333333333333
```

As the number of estimators of `650` is quite high, and may result in higher computational cost with diminishing returns, I choose `150` to be the best combination of accuracy and efficiency. Indeed, the test yields

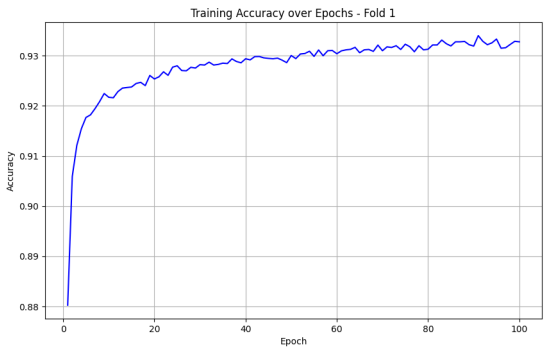
```
Validation accuracy: 0.9696
Validation Precision: 0.9695990508409351
Validation Recall: 0.9696
Validation F1 Score: 0.9695861419399533
Cross Validation Scores: [0.96675    0.96475    0.9635     0.96316667
0.971     ]
Mean Cross Validation Score: 0.9658333333333333
```

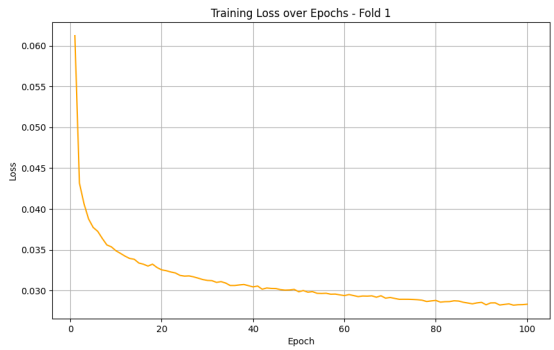
which only differs a mere `.002` percentage point (this could be amount to the noise in the progress of training, but after 10 experiments, the results seems consistent)

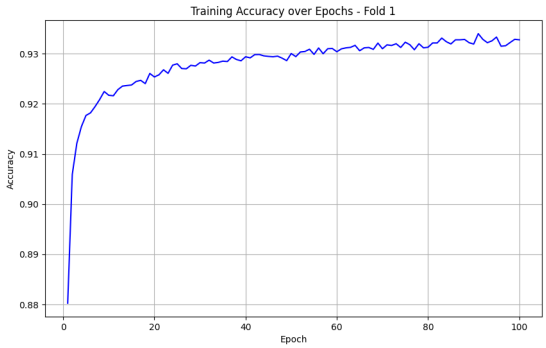


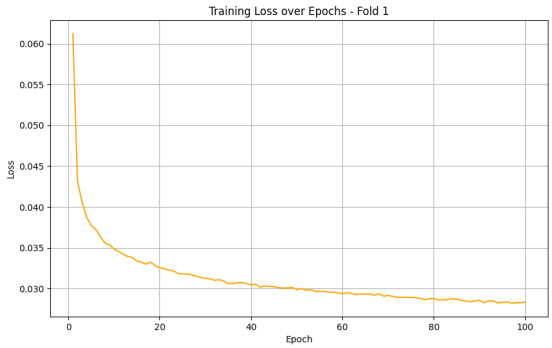
SVM

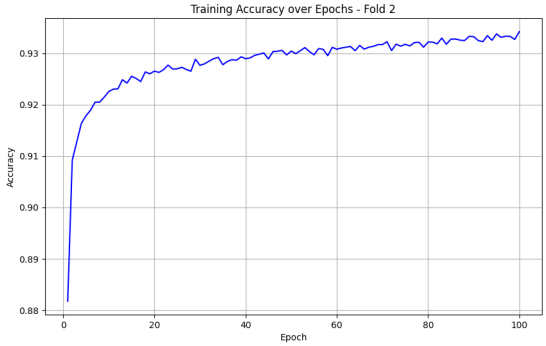
```
{
  "n_epochs": 100
}
```

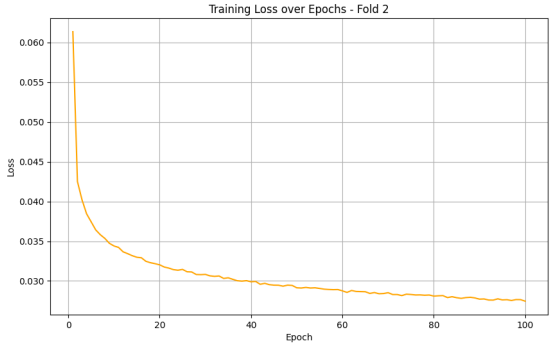


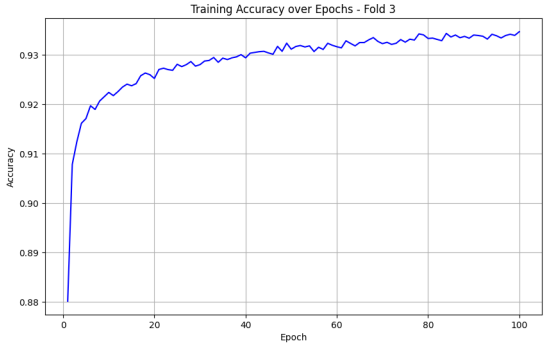


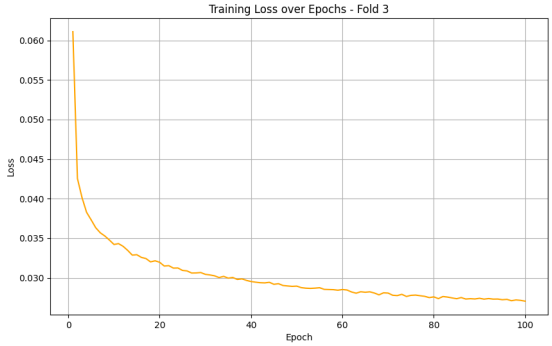






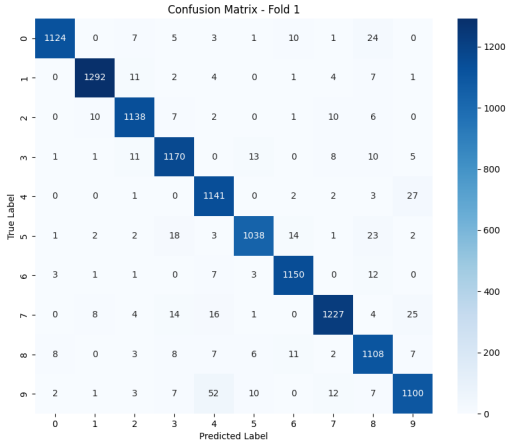


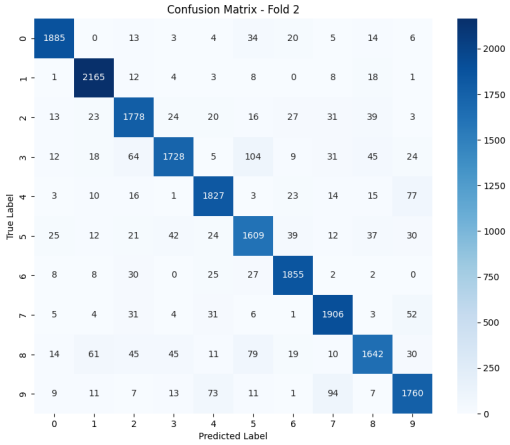


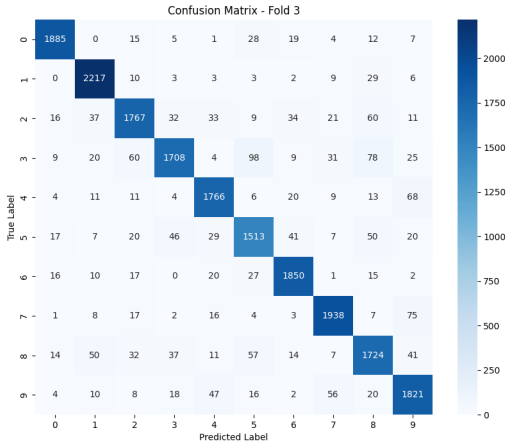



```
Fold 1 Results:
  Accuracy: 0.9107
  Precision: 0.9113
  Recall: 0.9107
  F1 Score: 0.9108

Fold 2 Results:
  Accuracy: 0.9077
  Precision: 0.9079
  Recall: 0.9077
  F1 Score: 0.9074

Fold 3 Results:
  Accuracy: 0.9094
  Precision: 0.9096
  Recall: 0.9094
  F1 Score: 0.9092

Average Results across all folds:
```

```
Accuracy: 0.9093
Precision: 0.9096
Recall: 0.9093
F1 Score: 0.9092
```



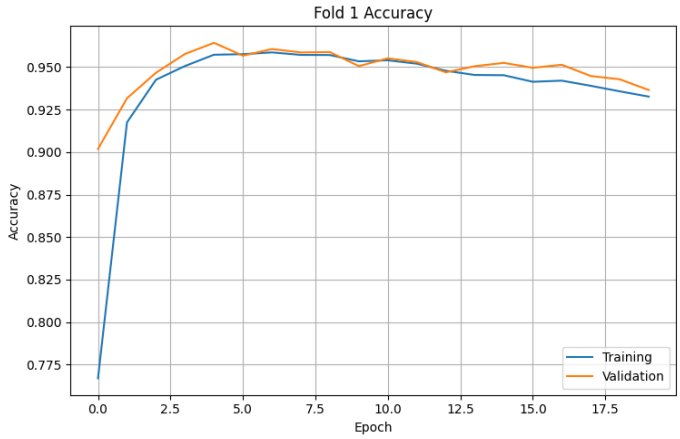


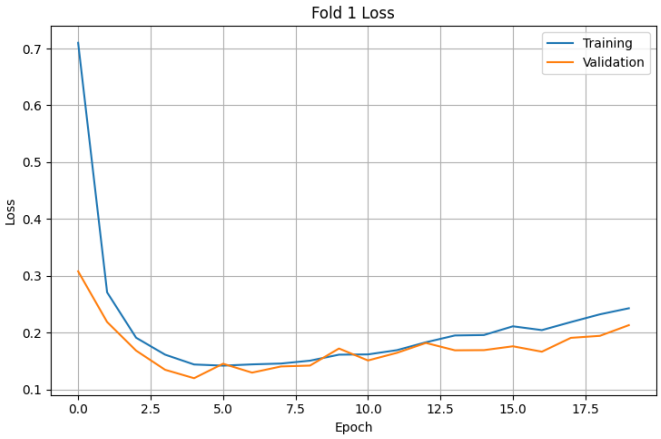


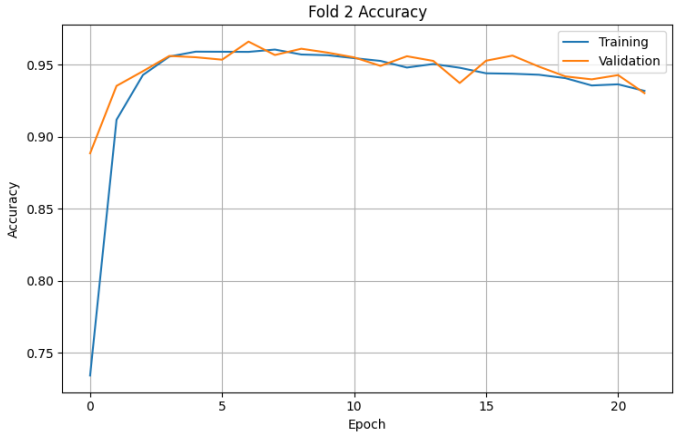
LSTM

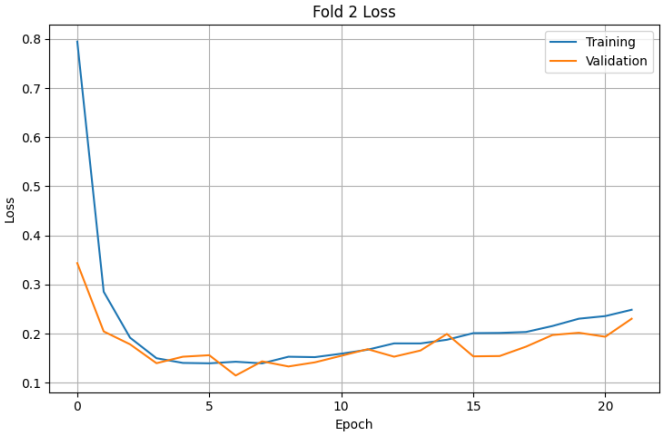
```
{
  "n_epochs": 100
}
```

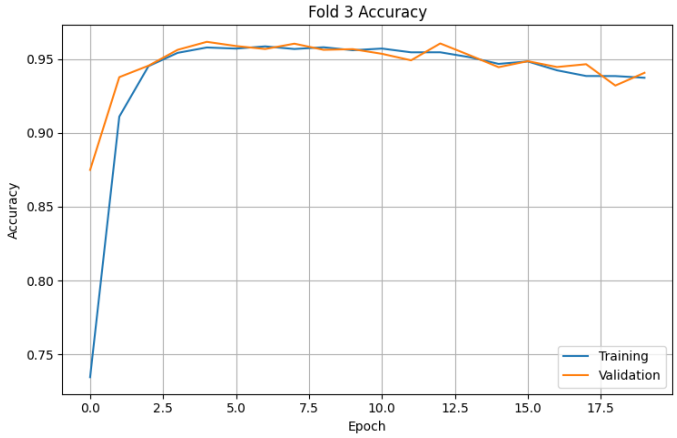
Below is the result of training v validation accuracy through each of the 100 epochs of LSTM

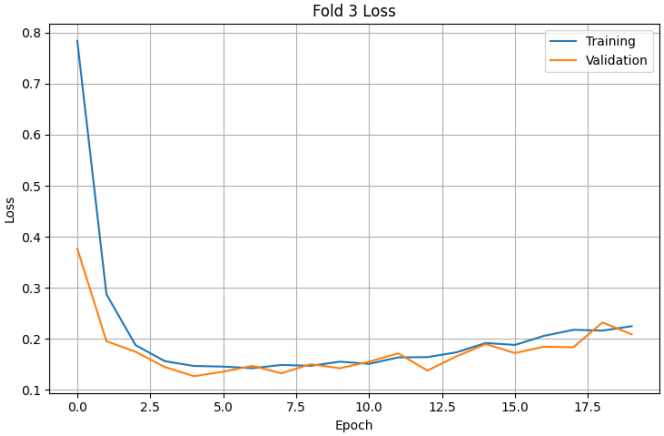

Fold 1 Accuracy
Accuracy
Epoch
Training
Validation

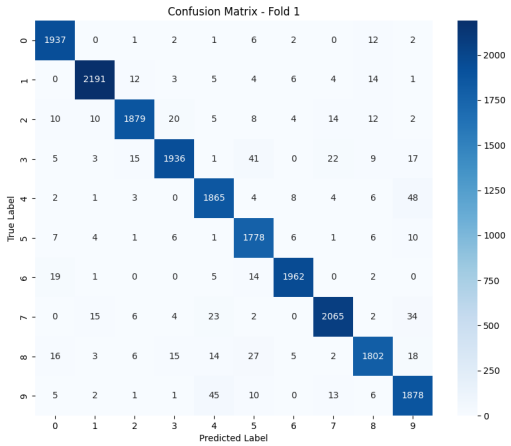

Fold 1 Loss
Loss
Epoch
Training
Validation

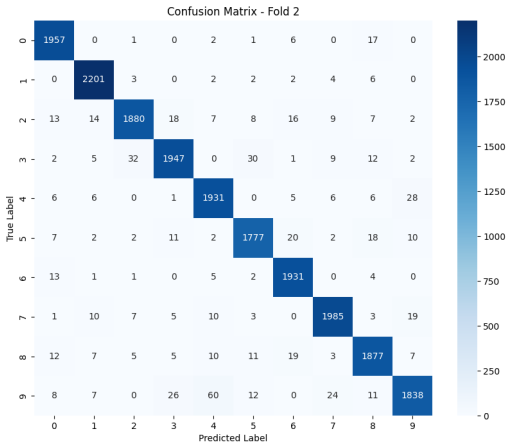

Fold 2 Accuracy
Accuracy
Epoch
Training
Validation

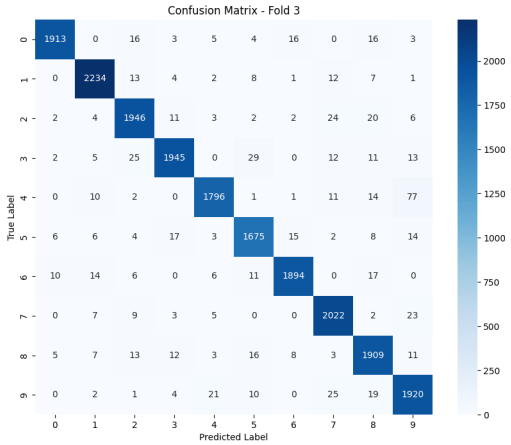

Fold 2 Loss
Loss
Epoch
Training
Validation


Fold 3 Accuracy
Accuracy
Epoch
Training
Validation


Fold 3 Loss
Loss
Epoch
Training
Validation


Confusion Matrix - Fold 1
True Label
Predicted Label


Confusion Matrix - Fold 2
True Label
Predicted Label




```
Early stopping triggered after epoch 20

Fold 1 Final Results:
  Accuracy: 0.9647
  Precision: 0.9649
  Recall: 0.9647
  F1 Score: 0.9647

Early stopping triggered after epoch 22

Fold 2 Final Results:
  Accuracy: 0.9662
  Precision: 0.9662
  Recall: 0.9662
  F1 Score: 0.9661

Early stopping triggered after epoch 20

Fold 3 Final Results:
  Accuracy: 0.9627
  Precision: 0.9630
  Recall: 0.9627
  F1 Score: 0.9627

Average Results across all folds:
  Accuracy: 0.9645
  Precision: 0.9647
  Recall: 0.9645
  F1: 0.9645
```