



Offline-03 Report

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October 19, 2024

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Chapter 1

Introduction

This report presents the results of training three different deep learning models with four different learning rates. For each learning rate, four figures are generated, resulting in a total of 48 figures. Each page contains four figures.

Chapter 2

Running the Code for Testing

This chapter provides instructions for running the code to test the models using the provided IPython Notebook (‘.ipynb’ file).

2.1 Requirements

You can install the required packages using the following command:

```
pip install -r requirements.txt
```

2.2 Testing the Model

To test the best model (model_1905072.pickle), execute all the cells above the training section. We will skip the training section since we don’t want to train. Then execute the testing section, and the model’s performance on the test set will be displayed.

Chapter 3

Model Architectures

3.1 Model 1

```
[
    Flatten((28,28)),
    Dense(784, 256), BN(256), ReLU(), Dropout(0.2),
    Dense(256, 10), Softmax()
]
```

3.2 Model 2

```
[
    Flatten((28,28)),
    Dense(784, 180), BN(180), ReLU(), Dropout(0.2),
    Dense(180, 80), BN(80), ReLU(), Dropout(0.2),
    Dense(80, 10), Softmax()
]
```

3.3 Model 3

```
[
    Flatten((28,28)),
    Dense(784, 150), BN(150), ReLU(), Dropout(0.2),
    Dense(150, 100), BN(100), ReLU(), Dropout(0.2),
    Dense(100, 50), BN(50), ReLU(), Dropout(0.2),
    Dense(50, 10), Softmax()
]
```

Chapter 4

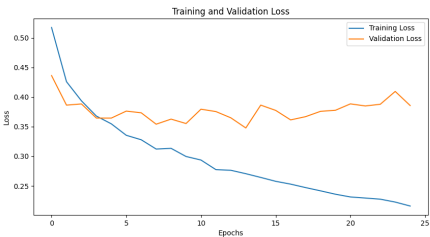
Results

4.1 Model 1

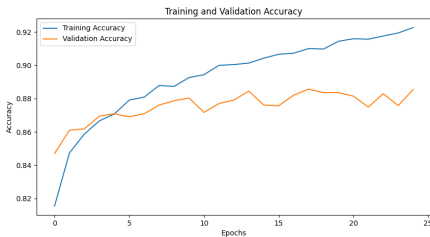
4.1.1 Learning Rate 0.005

Validation Macro F1: 0.8864245142748702

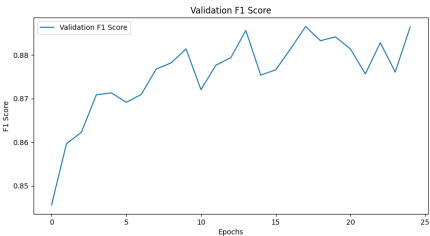
Test Accuracy F1: 0.8884



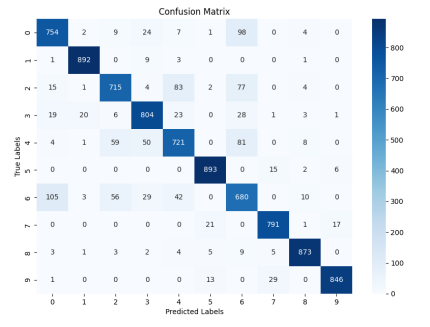
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.1: Results for Model 1 with Learning Rate 0.005

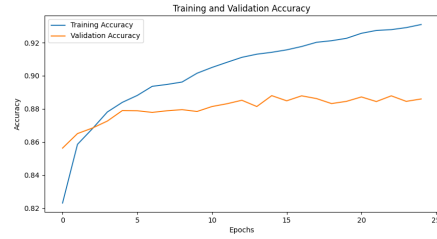
4.1.2 Learning Rate 0.001

Validation Macro F1: 0.88624269319234

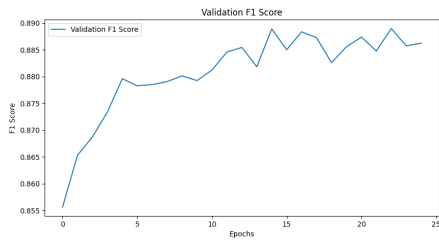
Test Accuracy F1: 0.8874



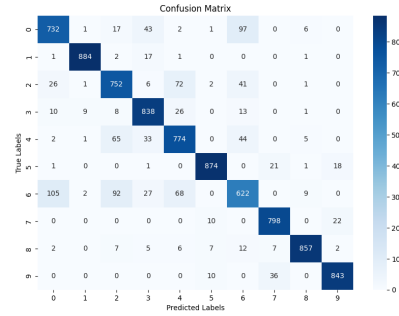
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.2: Results for Model 1 with Learning Rate 0.001

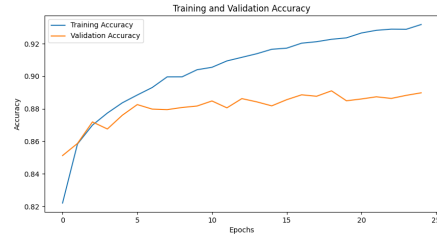
4.1.3 Learning Rate 0.0005

Validation Macro F1: 0.8906490850647055

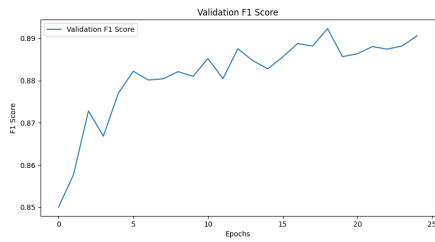
Test Accuracy F1: 0.8924



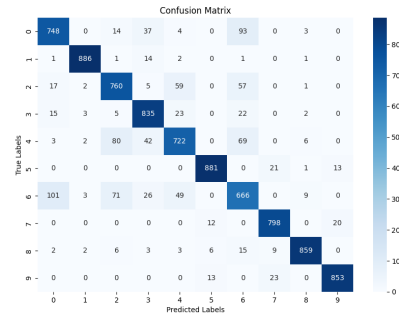
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.3: Results for Model 1 with Learning Rate 0.0005

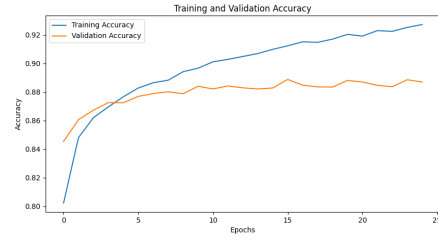
4.1.4 Learning Rate 0.0001

Validation Macro F1: 0.8876554145603317

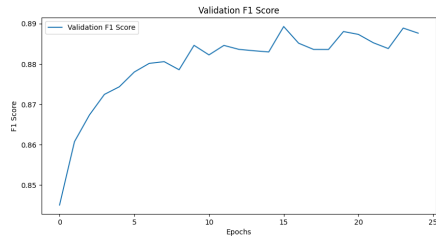
Test Accuracy F1: 0.886



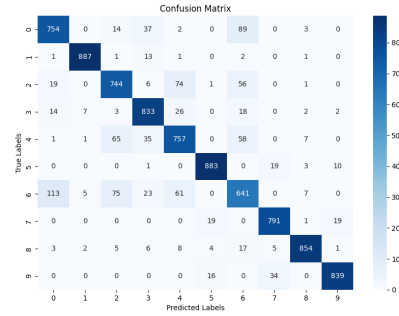
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.4: Results for Model 1 with Learning Rate 0.0001

4.2 Model 2

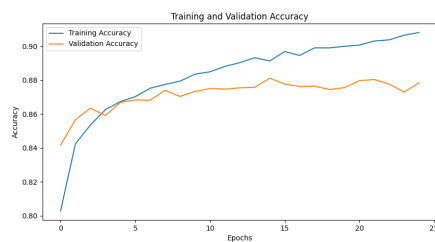
4.2.1 Learning Rate 0.005

Validation Macro F1: 0.8787974897971365

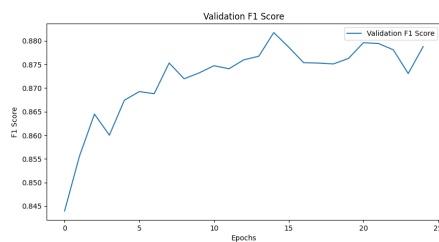
Test Accuracy F1: 0.8898



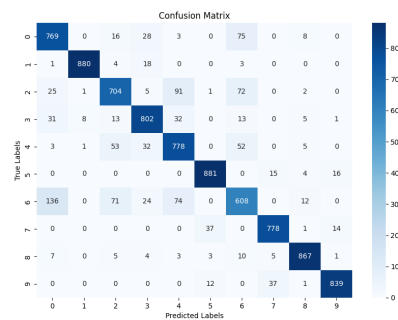
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.5: Results for Model 2 with Learning Rate 0.005

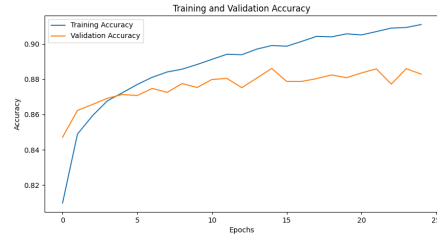
4.2.2 Learning Rate 0.001

Validation Macro F1: 0.8832774164110841

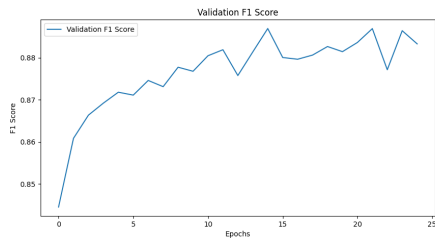
Test Accuracy F1: 0.8897



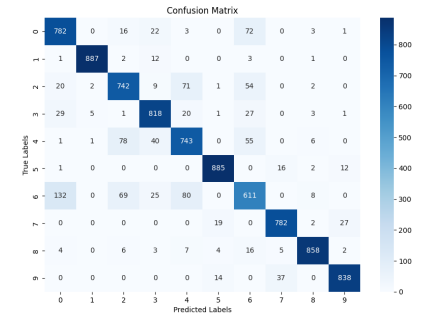
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



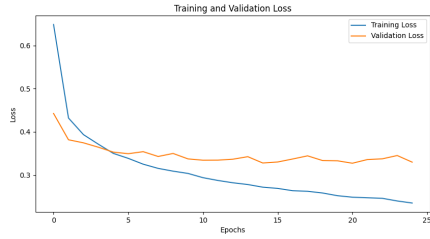
(d) Confusion Matrix

Figure 4.6: Results for Model 2 with Learning Rate 0.001

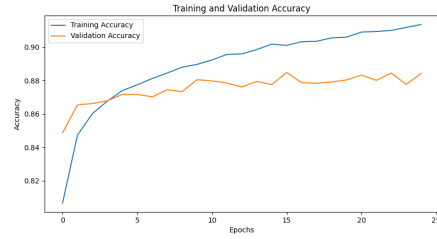
4.2.3 Learning Rate 0.0005

Validation Macro F1: 0.8851833832069353

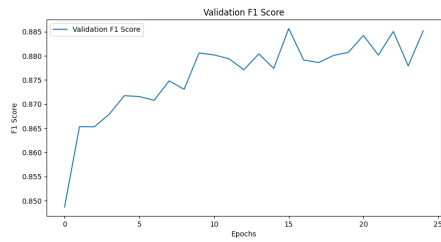
Test Accuracy F1: 0.8892



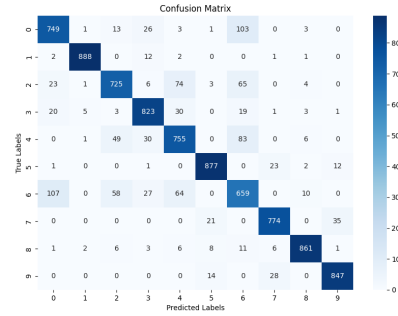
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



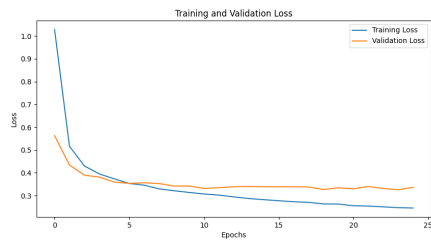
(d) Confusion Matrix

Figure 4.7: Results for Model 2 with Learning Rate 0.0005

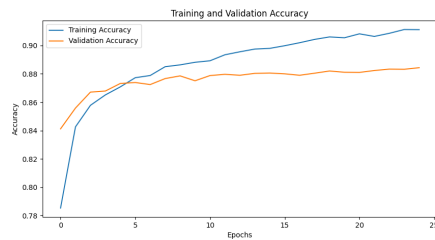
4.2.4 Learning Rate 0.0001

Validation Macro F1: 0.8848096291513313

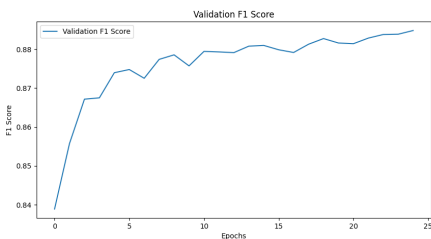
Test Accuracy F1: 0.8924



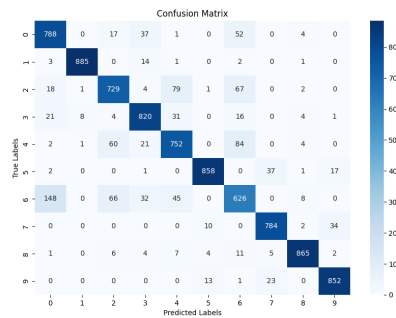
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

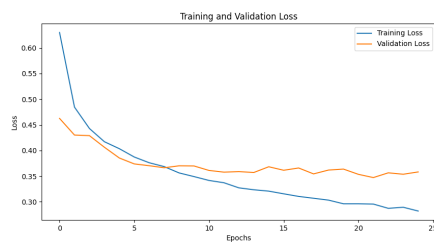
Figure 4.8: Results for Model 2 with Learning Rate 0.0001

4.3 Model 3

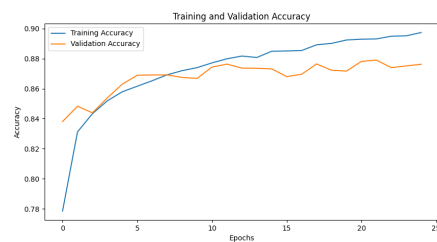
4.3.1 Learning Rate 0.005

Validation Macro F1: 0.8747083763582907

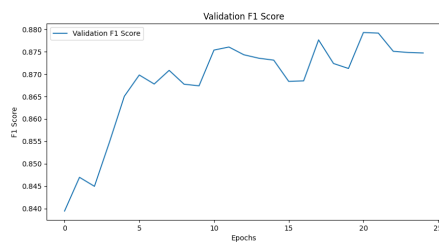
Test Accuracy F1: 0.885



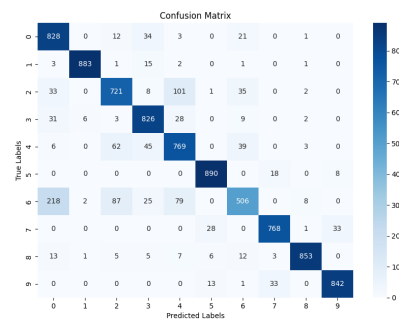
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.9: Results for Model 3 with Learning Rate 0.005

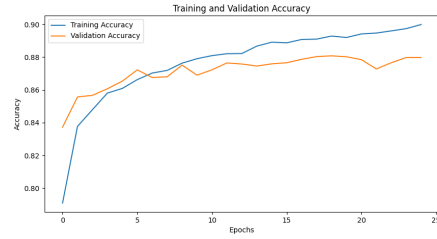
4.3.2 Learning Rate 0.001

Validation Macro F1: 0.8792131651389061

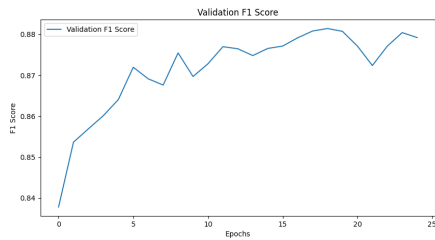
Test Accuracy F1: 0.8893



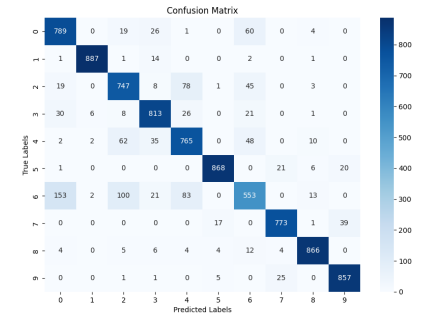
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.10: Results for Model 3 with Learning Rate 0.001

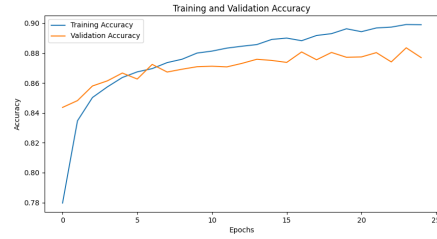
4.3.3 Learning Rate 0.0005

Validation Macro F1: 0.8769000025009104

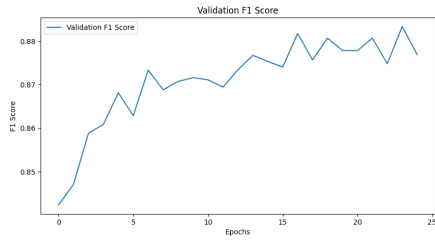
Test Accuracy F1: 0.8848



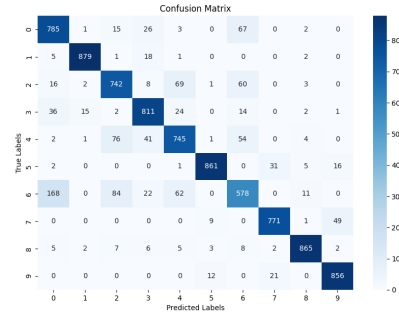
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



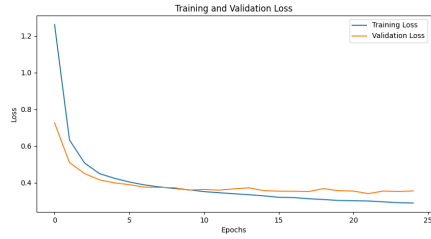
(d) Confusion Matrix

Figure 4.11: Results for Model 3 with Learning Rate 0.0005

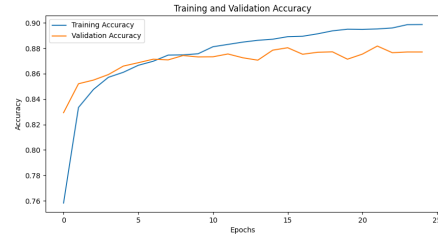
4.3.4 Learning Rate 0.0001

Validation Macro F1: 0.8774710502825878

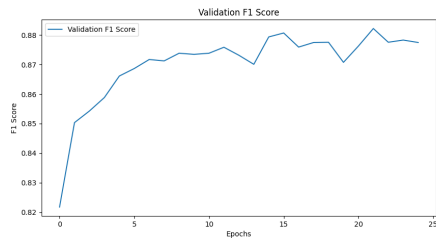
Test Accuracy F1: 0.8886



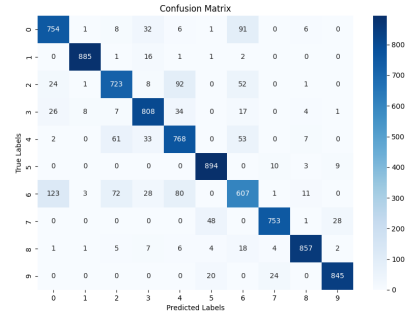
(a) Training Validation Loss



(b) Training Validation Accuracy



(c) Validation F1 Macro Score



(d) Confusion Matrix

Figure 4.12: Results for Model 3 with Learning Rate 0.0001

Chapter 5

Conclusion

Best Model: 1, Learning Rate: 0.0005, Validation F1 Score: 0.8906, Test Accuracy: 0.8924