Homework 1

Name: A K M Salman Hosain

ID: 801402112

1.a: https://github.com/salman2826/ECGR-5106/blob/main/HW_1_1a.ipynb

1.b: https://github.com/salman2826/ECGR-5106/blob/main/HW_1_1b.ipynb

2.a: https://github.com/salman2826/ECGR-5106/blob/main/HW_1_2a.ipynb

2.b: https://github.com/salman2826/ECGR-5106/blob/main/HW_1_2b.ipynb

2.c: https://github.com/salman2826/ECGR-5106/blob/main/HW_1_2c.ipynb

1.a

From the training loss over epochs curve, it is evident that the loss has not yet plateaued and needs more training to converge.
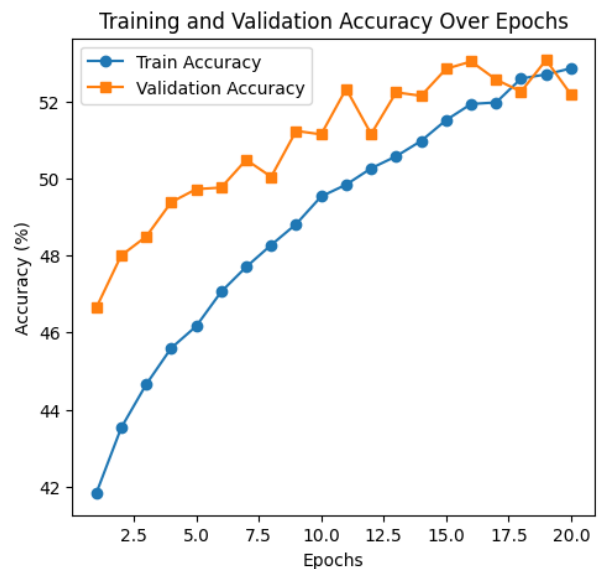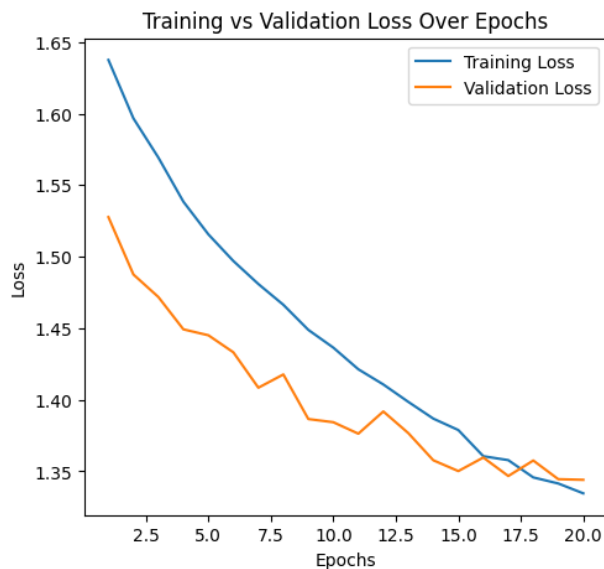
I do not observe significant overfitting in the model as the gap between training and validation loss is not increasing. Although there might be slight overfitting as the training loss is still decreasing and validation loss seems to reach plateau.

After 20 epochs, Train loss: 1.3346, Val Loss: 1.3441, Train Acc: 52.85%, Val Acc: 52.17%.

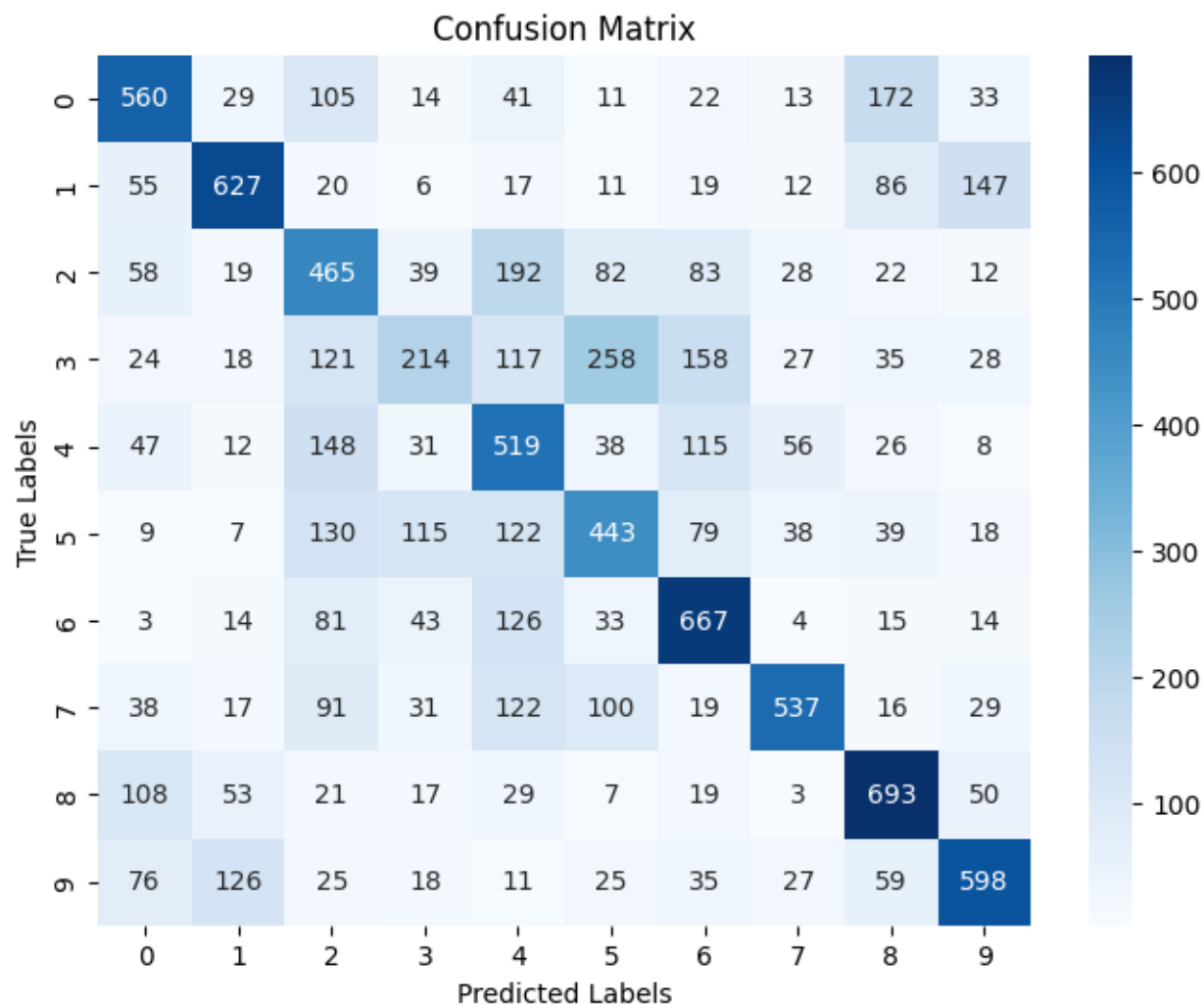Precision: 0.5387

Recall: 0.5323

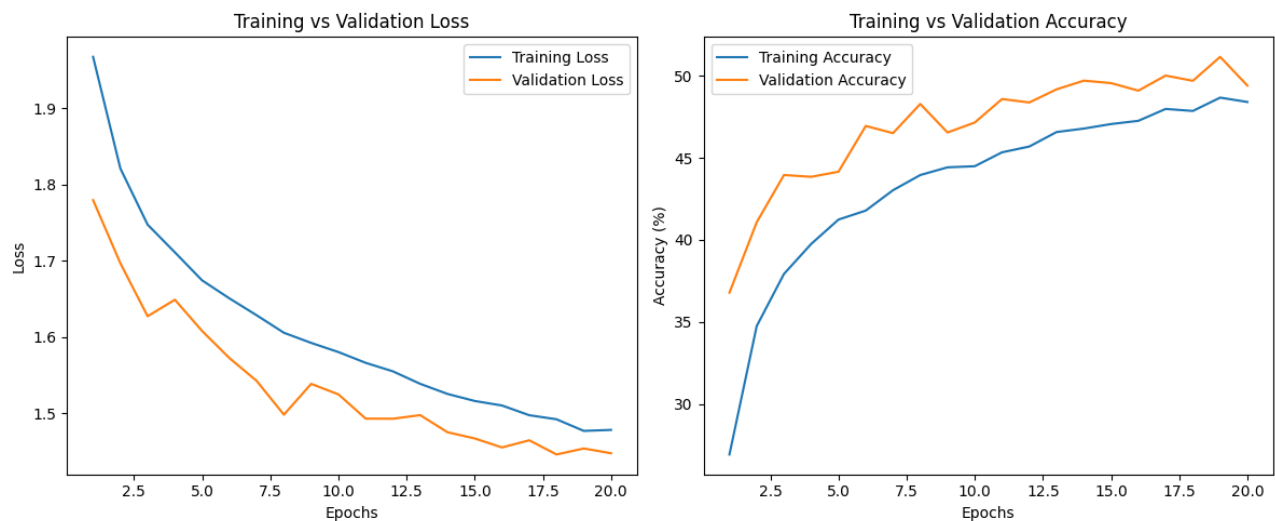F1 Score: 0.5289

Fig.: Confusion Matrix

1.b

I have changed the model from three hidden layers with 512, 256, and 128 neurons to five hidden layers with 1024, 512, 256, 128, 64 neurons. The training and validation results in the new model after 20 epochs: Train Loss: 1.4782, Val Loss: 1.4476, Train Acc: 48.40%, Val Acc: 49.40% which were previously Train loss: 1.3346, Val Loss: 1.3441, Train Acc: 52.85%, Val Acc: 52.17%. It seems although they are almost the same, in the new model the accuracy decreases slightly and losses increases slightly.
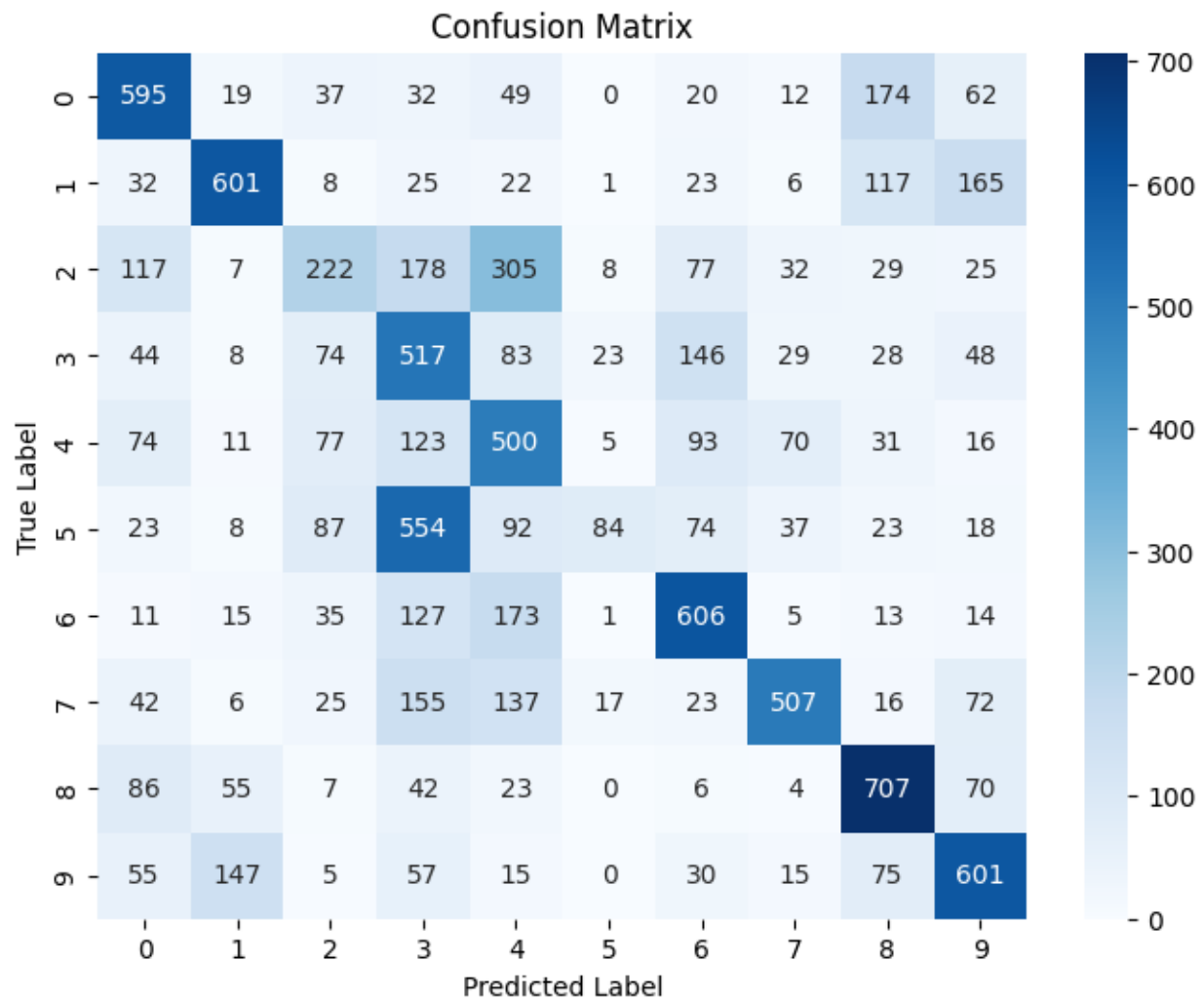
Overall Precision (Macro Average): 0.5262
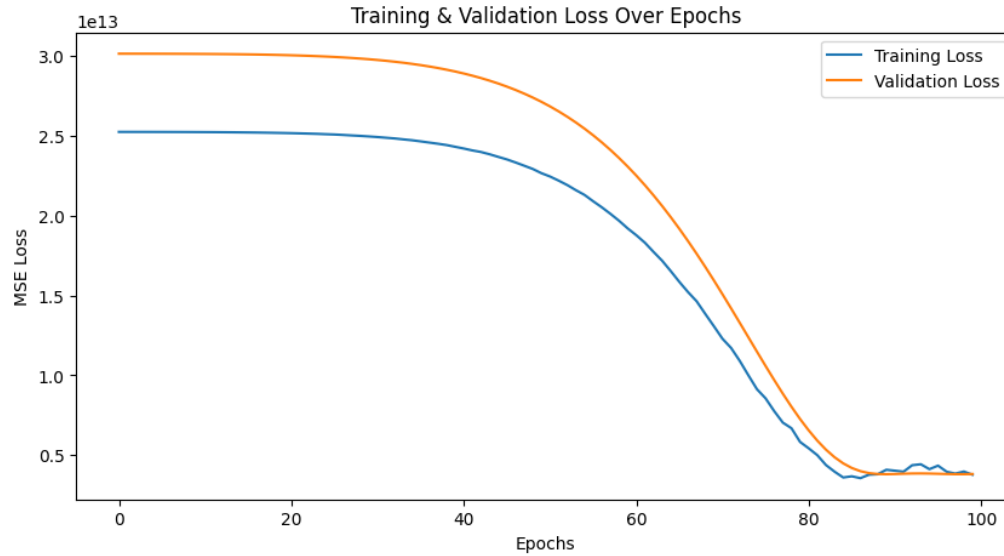
Overall Recall (Macro Average): 0.4940

Overall F1 Score (Macro Average): 0.4809

I don't see any significant overfitting in the new model from the loss and accuracy curves.

Confusion Matrix

	0	1	2	3	4	5	6	7	8	9
0	595	19	37	32	49	0	20	12	174	62
1	32	601	8	25	22	1	23	6	117	165
2	117	7	222	178	305	8	77	32	29	25
3	44	8	74	517	83	23	146	29	28	48
4	74	11	77	123	500	5	93	70	31	16
5	23	8	87	554	92	84	74	37	23	18
6	11	15	35	127	173	1	606	5	13	14
7	42	6	25	155	137	17	23	507	16	72
8	86	55	7	42	23	0	6	4	707	70
9	55	147	5	57	15	0	30	15	75	601

True Label (rows) / Predicted Label (columns)

2.a

Training & Validation Loss Over Epochs

Final Model Accuracy (R² Score): 0.2439

Model Complexity (Total Trainable Parameters): 48641

2.b

Training & Validation Loss Over Epochs
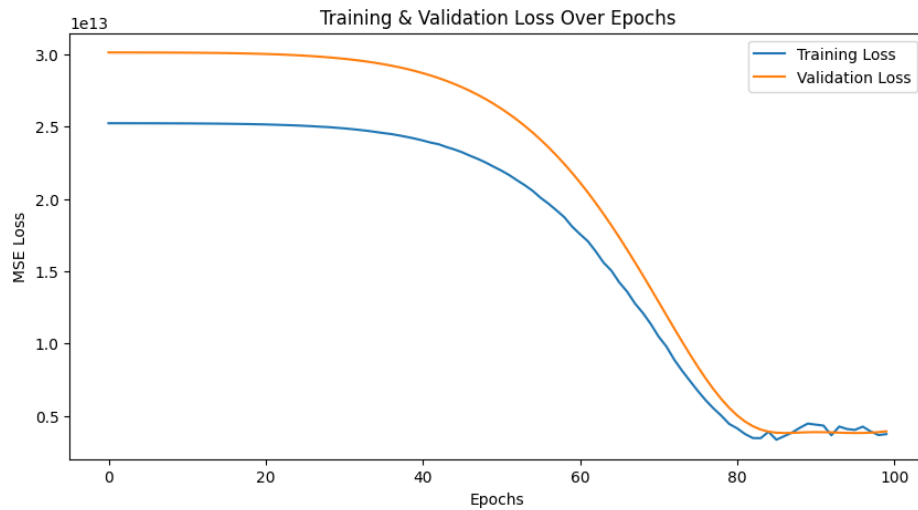
Final Model Accuracy (R² Score): 0.2445

Model Complexity (Total Trainable Parameters): 46593

There is a slight increase in the accuracy from R² Score of 0.2439 to R² Score of 0.2445.

Also the number of parameters decreased from 48641 to 46593.

2.c

I have increased the depth of the model from 4 hidden layers of 256, 128, 64, 32 neurons to five with 512, 256, 128, 64, 32 neurons.

Model Accuracy (R² Score): 0.1211 which decreased from before.

Model Complexity (Total Trainable Parameters): 181249 increased from before.