```
longest string: 46
string:  hsp22k57g23m69d20j46h44e61gzhwh54a17krb68b18ru
Labels to idx:
{'ranbyus_v2': 0, 'banjori': 1, 'murofet_v3': 2, 'pushdo': 3, 'tempedreve': 4, 'ramdo': 5, 'bedep': 6, 'fobber_v1': 7, 'proslikefan':
Domain Name:
 00000000000000000000000000000000trailer-defensecom
second Domain Name:
 00000000000000000000000000000000trailer-defensecom
Class Label encoded:
48
Domain Bigram Name:
 ['00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00', '00',
Domain Char Name:
 ['0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '
Class Label encoded:
48
Char Vocabulary len: 37
Bigram Vocabulary len: 1344
A Dataset Domain:
 Char encode:
[32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 32, 4, 29, 0, 36, 15, 7,
 Bigram encode:
[637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 637, 6:
 Label:
48
dataset len: 50898

Fold 1/5
epoch 1 / 6, step 300/1358, loss = 1.0527
epoch 1 / 6, step 600/1358, loss = 0.4646
epoch 1 / 6, step 900/1358, loss = 0.5365
epoch 1 / 6, step 1200/1358, loss = 0.6730
Epoch 1/6:
Train Accuracy: 0.6932
Train Precision: 0.6889
Train Recall: 0.6932
Train F1 Score: 0.6892
Epoch 1/6:
Accuracy: 0.7768
Precision: 0.7835
Recall: 0.7768
F1 Score: 0.7688
=================================================
epoch 2 / 6, step 300/1358, loss = 0.3465
epoch 2 / 6, step 600/1358, loss = 0.4925
epoch 2 / 6, step 900/1358, loss = 0.3440
epoch 2 / 6, step 1200/1358, loss = 0.5229
Epoch 2/6:
Train Accuracy: 0.8101
Train Precision: 0.8086
Train Recall: 0.8101
Train F1 Score: 0.8084
Epoch 2/6:
Accuracy: 0.7990
Precision: 0.8034
Recall: 0.7990
F1 Score: 0.7933
=================================================
epoch 3 / 6, step 300/1358, loss = 0.3644
epoch 3 / 6, step 600/1358, loss = 0.2208
epoch 3 / 6, step 900/1358, loss = 0.3673
epoch 3 / 6, step 1200/1358, loss = 0.2734
Epoch 3/6:
Train Accuracy: 0.8403
Train Precision: 0.8399
Train Recall: 0.8403
Train F1 Score: 0.8394
Epoch 3/6:
Accuracy: 0.8078
Precision: 0.8138
Recall: 0.8078
F1 Score: 0.8028
=================================================
epoch 4 / 6, step 300/1358, loss = 0.3347
epoch 4 / 6, step 600/1358, loss = 0.3466
epoch 4 / 6, step 900/1358, loss = 0.6021
epoch 4 / 6, step 1200/1358, loss = 0.2755
Epoch 4/6:
Train Accuracy: 0.8726
Train Precision: 0.8725
Train Recall: 0.8726
Train F1 Score: 0.8721
Epoch 4/6:
Accuracy: 0.7996
Precision: 0.8095
Recall: 0.7996
```

```
F1 Score: 0.7992
=================================================
epoch 5 / 6, step 300/1358, loss = 0.2814
epoch 5 / 6, step 600/1358, loss = 0.2504
epoch 5 / 6, step 900/1358, loss = 0.4054
epoch 5 / 6, step 1200/1358, loss = 0.1187
Epoch 5/6:
Train Accuracy: 0.8977
Train Precision: 0.8975
Train Recall: 0.8977
Train F1 Score: 0.8973
Epoch 5/6:
Accuracy: 0.8036
Precision: 0.8030
Recall: 0.8036
F1 Score: 0.8004
=================================================
epoch 6 / 6, step 300/1358, loss = 0.0916
epoch 6 / 6, step 600/1358, loss = 0.2616
epoch 6 / 6, step 900/1358, loss = 0.0993
epoch 6 / 6, step 1200/1358, loss = 0.0712
Epoch 6/6:
Train Accuracy: 0.9196
Train Precision: 0.9194
Train Recall: 0.9196
Train F1 Score: 0.9194
Epoch 6/6:
Accuracy: 0.8078
Precision: 0.8147
Recall: 0.8078
F1 Score: 0.8057
=================================================

Fold 2/5
epoch 1 / 6, step 300/1358, loss = 0.7495
epoch 1 / 6, step 600/1358, loss = 0.7231
epoch 1 / 6, step 900/1358, loss = 0.8144
epoch 1 / 6, step 1200/1358, loss = 0.7439
Epoch 1/6:
Train Accuracy: 0.6898
Train Precision: 0.6850
Train Recall: 0.6898
Train F1 Score: 0.6856
Epoch 1/6:
Accuracy: 0.7737
Precision: 0.8005
Recall: 0.7737
F1 Score: 0.7711
=================================================
epoch 2 / 6, step 300/1358, loss = 0.5428
epoch 2 / 6, step 600/1358, loss = 0.4712
epoch 2 / 6, step 900/1358, loss = 0.4645
epoch 2 / 6, step 1200/1358, loss = 0.2091
Epoch 2/6:
Train Accuracy: 0.8055
Train Precision: 0.8041
Train Recall: 0.8055
Train F1 Score: 0.8038
Epoch 2/6:
Accuracy: 0.7959
Precision: 0.7960
Recall: 0.7959
F1 Score: 0.7885
=================================================
epoch 3 / 6, step 300/1358, loss = 0.8144
epoch 3 / 6, step 600/1358, loss = 0.1251
epoch 3 / 6, step 900/1358, loss = 0.7799
epoch 3 / 6, step 1200/1358, loss = 0.3876
Epoch 3/6:
Train Accuracy: 0.8424
Train Precision: 0.8420
Train Recall: 0.8424
Train F1 Score: 0.8415
Epoch 3/6:
Accuracy: 0.7952
Precision: 0.8096
Recall: 0.7952
F1 Score: 0.7937
=================================================
epoch 4 / 6, step 300/1358, loss = 0.3571
epoch 4 / 6, step 600/1358, loss = 0.2991
epoch 4 / 6, step 900/1358, loss = 0.4247
epoch 4 / 6, step 1200/1358, loss = 0.4938
Epoch 4/6:
Train Accuracy: 0.8711
Train Precision: 0.8713
```

```
Train Recall: 0.8711
Train F1 Score: 0.8707
Epoch 4/6:
Accuracy: 0.8035
Precision: 0.8047
Recall: 0.8035
F1 Score: 0.7997
=================================================
epoch 5 / 6, step 300/1358, loss = 0.2058
epoch 5 / 6, step 600/1358, loss = 0.1829
epoch 5 / 6, step 900/1358, loss = 0.1828
epoch 5 / 6, step 1200/1358, loss = 0.5349
Epoch 5/6:
Train Accuracy: 0.8983
Train Precision: 0.8982
Train Recall: 0.8983
Train F1 Score: 0.8980
Epoch 5/6:
Accuracy: 0.7991
Precision: 0.8028
Recall: 0.7991
F1 Score: 0.7984
=================================================
epoch 6 / 6, step 300/1358, loss = 0.1540
epoch 6 / 6, step 600/1358, loss = 0.2255
epoch 6 / 6, step 900/1358, loss = 0.5299
epoch 6 / 6, step 1200/1358, loss = 0.2501
Epoch 6/6:
Train Accuracy: 0.9194
Train Precision: 0.9194
Train Recall: 0.9194
Train F1 Score: 0.9193
Epoch 6/6:
Accuracy: 0.7983
Precision: 0.7965
Recall: 0.7983
F1 Score: 0.7961
=================================================

Fold 3/5
epoch 1 / 6, step 300/1358, loss = 0.9562
epoch 1 / 6, step 600/1358, loss = 0.9595
epoch 1 / 6, step 900/1358, loss = 1.1251
epoch 1 / 6, step 1200/1358, loss = 1.0347
Epoch 1/6:
Train Accuracy: 0.6896
Train Precision: 0.6866
Train Recall: 0.6896
Train F1 Score: 0.6862
Epoch 1/6:
Accuracy: 0.7811
Precision: 0.8120
Recall: 0.7811
F1 Score: 0.7711
=================================================
epoch 2 / 6, step 300/1358, loss = 0.5408
epoch 2 / 6, step 600/1358, loss = 0.6752
epoch 2 / 6, step 900/1358, loss = 0.7436
epoch 2 / 6, step 1200/1358, loss = 0.4384
Epoch 2/6:
Train Accuracy: 0.8038
Train Precision: 0.8030
Train Recall: 0.8038
Train F1 Score: 0.8025
Epoch 2/6:
Accuracy: 0.7999
Precision: 0.8084
Recall: 0.7999
F1 Score: 0.7909
=================================================
epoch 3 / 6, step 300/1358, loss = 0.3983
epoch 3 / 6, step 600/1358, loss = 0.6815
epoch 3 / 6, step 900/1358, loss = 0.4728
epoch 3 / 6, step 1200/1358, loss = 0.5371
Epoch 3/6:
Train Accuracy: 0.8394
Train Precision: 0.8391
Train Recall: 0.8394
Train F1 Score: 0.8386
Epoch 3/6:
Accuracy: 0.7997
Precision: 0.8119
Recall: 0.7997
F1 Score: 0.7972
=================================================
epoch 4 / 6, step 300/1358, loss = 0.3786
```

```
epoch 4 / 6, step 600/1358, loss = 0.7012
epoch 4 / 6, step 900/1358, loss = 0.4079
epoch 4 / 6, step 1200/1358, loss = 0.3600
Epoch 4/6:
Train Accuracy: 0.8696
Train Precision: 0.8692
Train Recall: 0.8696
Train F1 Score: 0.8689
Epoch 4/6:
Accuracy: 0.7859
Precision: 0.8066
Recall: 0.7859
F1 Score: 0.7819
==================================================
epoch 5 / 6, step 300/1358, loss = 0.3217
epoch 5 / 6, step 600/1358, loss = 0.2404
epoch 5 / 6, step 900/1358, loss = 0.4562
epoch 5 / 6, step 1200/1358, loss = 0.3777
Epoch 5/6:
Train Accuracy: 0.8959
Train Precision: 0.8960
Train Recall: 0.8959
Train F1 Score: 0.8957
Epoch 5/6:
Accuracy: 0.8055
Precision: 0.8057
Recall: 0.8055
F1 Score: 0.8021
==================================================
epoch 6 / 6, step 300/1358, loss = 0.1509
epoch 6 / 6, step 600/1358, loss = 0.1428
epoch 6 / 6, step 900/1358, loss = 0.0784
epoch 6 / 6, step 1200/1358, loss = 0.2621
Epoch 6/6:
Train Accuracy: 0.9189
Train Precision: 0.9188
Train Recall: 0.9189
Train F1 Score: 0.9187
Epoch 6/6:
Accuracy: 0.7966
Precision: 0.7989
Recall: 0.7966
F1 Score: 0.7936
==================================================

Fold 4/5
epoch 1 / 6, step 300/1358, loss = 1.2511
epoch 1 / 6, step 600/1358, loss = 0.8353
epoch 1 / 6, step 900/1358, loss = 1.0741
epoch 1 / 6, step 1200/1358, loss = 0.9369
Epoch 1/6:
Train Accuracy: 0.6815
Train Precision: 0.6773
Train Recall: 0.6815
Train F1 Score: 0.6777
Epoch 1/6:
Accuracy: 0.7768
Precision: 0.7830
Recall: 0.7768
F1 Score: 0.7701
==================================================
epoch 2 / 6, step 300/1358, loss = 0.9804
epoch 2 / 6, step 600/1358, loss = 0.5797
epoch 2 / 6, step 900/1358, loss = 0.4691
epoch 2 / 6, step 1200/1358, loss = 0.5176
Epoch 2/6:
Train Accuracy: 0.8095
Train Precision: 0.8089
Train Recall: 0.8095
Train F1 Score: 0.8082
Epoch 2/6:
Accuracy: 0.7941
Precision: 0.8111
Recall: 0.7941
F1 Score: 0.7880
==================================================
epoch 3 / 6, step 300/1358, loss = 0.1682
epoch 3 / 6, step 600/1358, loss = 0.5581
epoch 3 / 6, step 900/1358, loss = 0.3928
epoch 3 / 6, step 1200/1358, loss = 0.2335
Epoch 3/6:
Train Accuracy: 0.8430
Train Precision: 0.8430
Train Recall: 0.8430
Train F1 Score: 0.8422
Epoch 3/6:
```

```
Accuracy: 0.8013
Precision: 0.8041
Recall: 0.8013
F1 Score: 0.7983
================================================
epoch 4 / 6, step 300/1358, loss = 0.6470
epoch 4 / 6, step 600/1358, loss = 0.5812
epoch 4 / 6, step 900/1358, loss = 0.4313
epoch 4 / 6, step 1200/1358, loss = 0.2568
Epoch 4/6:
Train Accuracy: 0.8739
Train Precision: 0.8740
Train Recall: 0.8739
Train F1 Score: 0.8735
Epoch 4/6:
Accuracy: 0.7940
Precision: 0.8002
Recall: 0.7940
F1 Score: 0.7927
================================================
epoch 5 / 6, step 300/1358, loss = 0.0858
epoch 5 / 6, step 600/1358, loss = 0.3734
epoch 5 / 6, step 900/1358, loss = 0.3095
epoch 5 / 6, step 1200/1358, loss = 0.2899
Epoch 5/6:
Train Accuracy: 0.8967
Train Precision: 0.8968
Train Recall: 0.8967
Train F1 Score: 0.8964
Epoch 5/6:
Accuracy: 0.7936
Precision: 0.7967
Recall: 0.7936
F1 Score: 0.7898
================================================
epoch 6 / 6, step 300/1358, loss = 0.1913
epoch 6 / 6, step 600/1358, loss = 0.1717
epoch 6 / 6, step 900/1358, loss = 0.1950
epoch 6 / 6, step 1200/1358, loss = 0.3464
Epoch 6/6:
Train Accuracy: 0.9212
Train Precision: 0.9212
Train Recall: 0.9212
Train F1 Score: 0.9211
Epoch 6/6:
Accuracy: 0.7940
Precision: 0.7954
Recall: 0.7940
F1 Score: 0.7925
================================================

Fold 5/5
epoch 1 / 6, step 300/1358, loss = 0.8567
epoch 1 / 6, step 600/1358, loss = 1.1024
epoch 1 / 6, step 900/1358, loss = 0.4813
epoch 1 / 6, step 1200/1358, loss = 0.4390
Epoch 1/6:
Train Accuracy: 0.6873
Train Precision: 0.6826
Train Recall: 0.6873
Train F1 Score: 0.6833
Epoch 1/6:
Accuracy: 0.7759
Precision: 0.7918
Recall: 0.7759
F1 Score: 0.7645
================================================
epoch 2 / 6, step 300/1358, loss = 0.4475
epoch 2 / 6, step 600/1358, loss = 0.3363
epoch 2 / 6, step 900/1358, loss = 0.6646
epoch 2 / 6, step 1200/1358, loss = 0.6074
Epoch 2/6:
Train Accuracy: 0.8018
Train Precision: 0.8012
Train Recall: 0.8018
Train F1 Score: 0.8006
Epoch 2/6:
Accuracy: 0.7974
Precision: 0.8055
Recall: 0.7974
F1 Score: 0.7928
================================================
epoch 3 / 6, step 300/1358, loss = 0.2703
epoch 3 / 6, step 600/1358, loss = 0.5018
epoch 3 / 6, step 900/1358, loss = 0.9588
epoch 3 / 6, step 1200/1358, loss = 0.8073
```
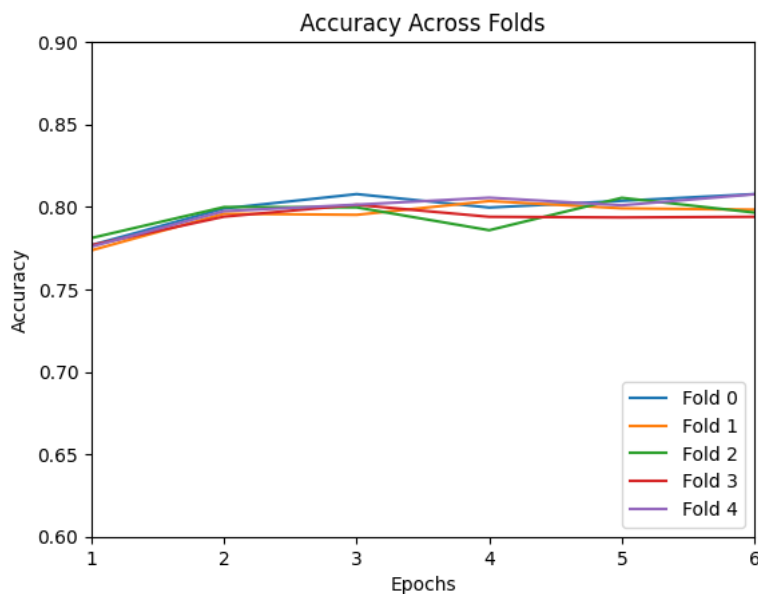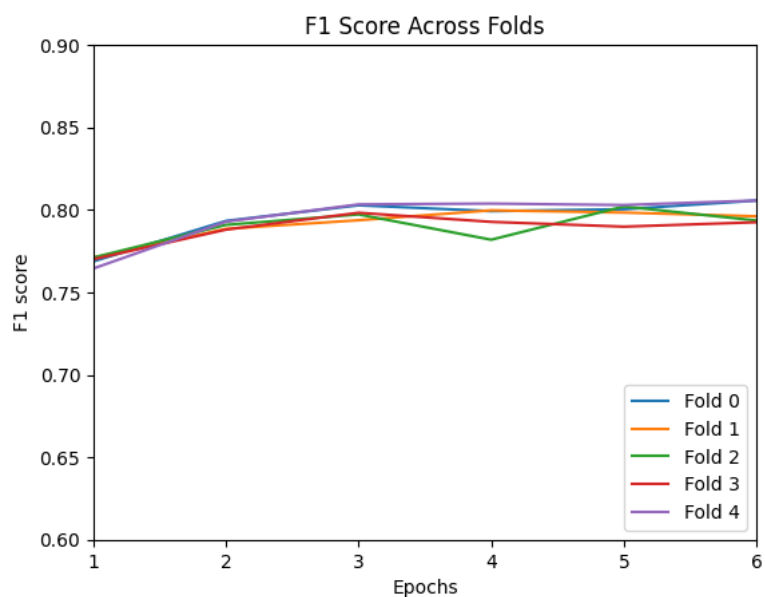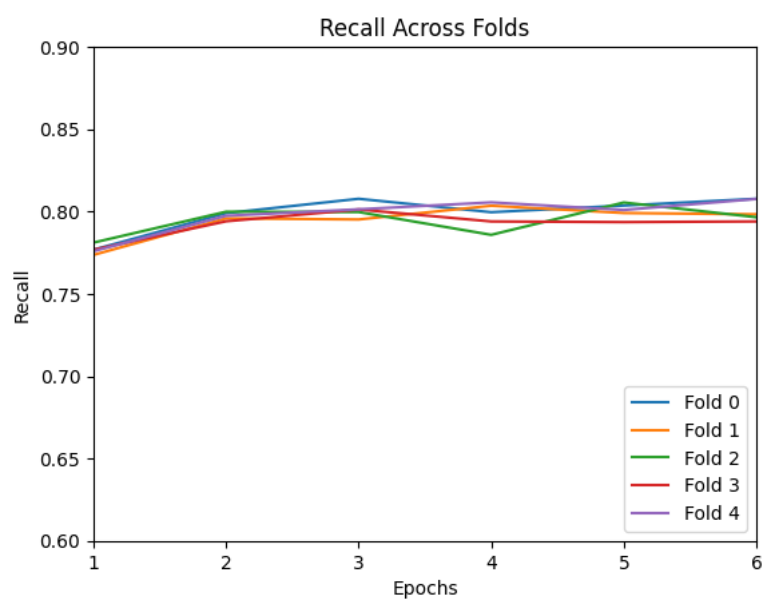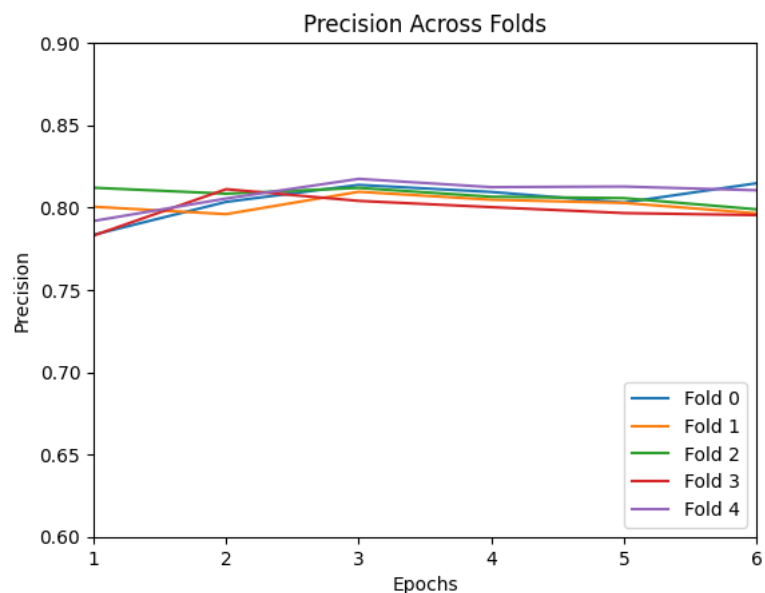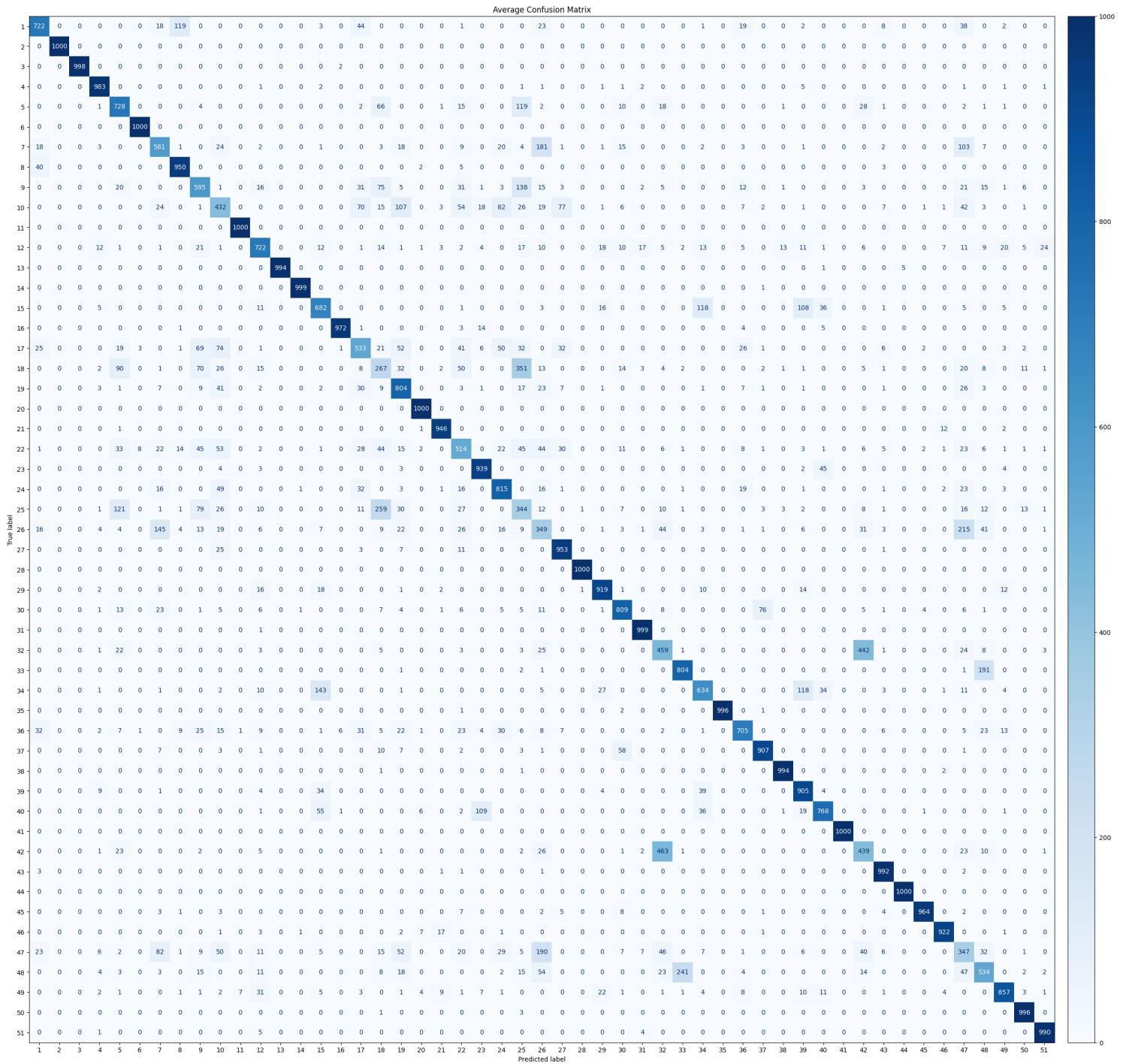
```
Epoch 3/6:
Train Accuracy: 0.8384
Train Precision: 0.8383
Train Recall: 0.8384
Train F1 Score: 0.8377
Epoch 3/6:
Accuracy: 0.8014
Precision: 0.8174
Recall: 0.8014
F1 Score: 0.8034
=================================================
epoch 4 / 6, step 300/1358, loss = 0.4145
epoch 4 / 6, step 600/1358, loss = 0.4376
epoch 4 / 6, step 900/1358, loss = 0.4829
epoch 4 / 6, step 1200/1358, loss = 0.4381
Epoch 4/6:
Train Accuracy: 0.8661
Train Precision: 0.8664
Train Recall: 0.8661
Train F1 Score: 0.8658
Epoch 4/6:
Accuracy: 0.8056
Precision: 0.8124
Recall: 0.8056
F1 Score: 0.8038
=================================================
epoch 5 / 6, step 300/1358, loss = 0.1785
epoch 5 / 6, step 600/1358, loss = 0.6584
epoch 5 / 6, step 900/1358, loss = 0.4107
epoch 5 / 6, step 1200/1358, loss = 0.1307
Epoch 5/6:
Train Accuracy: 0.8978
Train Precision: 0.8980
Train Recall: 0.8978
Train F1 Score: 0.8977
Epoch 5/6:
Accuracy: 0.8010
Precision: 0.8128
Recall: 0.8010
F1 Score: 0.8030
=================================================
epoch 6 / 6, step 300/1358, loss = 0.5694
epoch 6 / 6, step 600/1358, loss = 0.2018
epoch 6 / 6, step 900/1358, loss = 0.6376
epoch 6 / 6, step 1200/1358, loss = 0.2104
Epoch 6/6:
Train Accuracy: 0.9169
Train Precision: 0.9171
Train Recall: 0.9169
Train F1 Score: 0.9169
Epoch 6/6:
Accuracy: 0.8076
Precision: 0.8105
Recall: 0.8076
F1 Score: 0.8057
=================================================
```


Accuracy Across Folds

Precision Across Folds

Recall Across Folds

F1 Score Across Folds

Average Confusion Matrix

Classification report:

	precision	recall	f1-score	support
ranbyus_v2	0.82	0.72	0.77	1000
banjori	1.00	1.00	1.00	1000
murofet_v3	1.00	1.00	1.00	1000
pushdo	0.94	0.98	0.96	1000
tempedreve	0.67	0.73	0.70	1000
ramdo	0.99	1.00	0.99	1000
bedep	0.62	0.58	0.60	1000
fobber_v1	0.86	0.95	0.90	1000
proslikefan	0.62	0.59	0.61	1000
cryptolocker	0.50	0.43	0.47	1000
vawtrak_v1	0.99	1.00	1.00	1000
legit	0.80	0.72	0.76	1000
corebot	1.00	0.99	1.00	1000
ccleaner	1.00	1.00	1.00	1000
gozi_nasa	0.70	0.69	0.70	991
murofet_v1	0.99	0.97	0.98	1000
locky	0.64	0.53	0.58	1000
pykspa_noise	0.32	0.27	0.29	1000
tinba	0.67	0.80	0.73	1000
suppobox_3	0.98	1.00	0.99	1000

```
   suppobox_1    0.96    0.98    0.97     962
       qakbot    0.59    0.51    0.55    1000
     gozi_gpl    0.85    0.94    0.89    1000
    ranbyus_v1   0.76    0.81    0.79    1000
       pykspa    0.30    0.34    0.32    1000
      dircrypt   0.34    0.35    0.34    1000
    murofet_v2   0.85    0.95    0.90    1000
       sisron    1.00    1.00    1.00    1000
        matsnu   0.91    0.92    0.92     996
       shiotob   0.84    0.81    0.82    1000
    vawtrak_v2   0.96    1.00    0.98    1000
     fobber_v2   0.42    0.46    0.44    1000
     kraken_v1   0.76    0.80    0.78    1000
   gozi_rfc4343  0.73    0.64    0.68     995
   zeus-newgoz   1.00    1.00    1.00    1000
        necurs   0.85    0.70    0.77    1000
        qadars   0.91    0.91    0.91    1000
    suppobox_2   0.98    1.00    0.99     998
    gozi_luther  0.74    0.91    0.82    1000
        rovnix   0.85    0.77    0.81    1000
          dyre   1.00    1.00    1.00    1000
       alureon   0.43    0.44    0.43    1000
      padcrypt   0.94    0.99    0.97    1000
         symmi   1.00    1.00    1.00    1000
        chinad   0.99    0.96    0.98    1000
          pizd   0.97    0.96    0.97     956
        ramnit   0.34    0.35    0.34    1000
     kraken_v2   0.59    0.53    0.56    1000
        nymaim   0.92    0.86    0.89    1000
         simda   0.96    1.00    0.98    1000
    vawtrak_v3   0.96    0.99    0.98    1000

      accuracy                   0.80   50898
     macro avg   0.80    0.80    0.80   50898
  weighted avg   0.80    0.80    0.80   50898
```