Sample results week 13

1.1) Implement the LeNet-5 inspired architecture in PyTorch

```
Train Epoch: 1 [0/60000 (0%)] Loss: 2.313361
Train Epoch: 1 [3200/60000 (5%)]  Loss: 1.918577
Train Epoch: 1 [6400/60000 (11%)] Loss: 1.476162
Train Epoch: 1 [9600/60000 (16%)] Loss: 1.296645
Train Epoch: 1 [12800/60000 (21%)]  Loss: 1.200763
Train Epoch: 1 [16000/60000 (27%)]  Loss: 1.084725
Train Epoch: 1 [19200/60000 (32%)]  Loss: 1.145009
Train Epoch: 1 [22400/60000 (37%)]  Loss: 1.146343
Train Epoch: 1 [25600/60000 (43%)]  Loss: 1.055125
Train Epoch: 1 [28800/60000 (48%)]  Loss: 0.999970
Train Epoch: 1 [32000/60000 (53%)]  Loss: 0.983662
Train Epoch: 1 [35200/60000 (59%)]  Loss: 1.018559
Train Epoch: 1 [38400/60000 (64%)]  Loss: 1.021391
Train Epoch: 1 [41600/60000 (69%)]  Loss: 0.950940
Train Epoch: 1 [44800/60000 (75%)]  Loss: 0.984038
Train Epoch: 1 [48000/60000 (80%)]  Loss: 0.935742
Train Epoch: 1 [51200/60000 (85%)]  Loss: 0.885482
Train Epoch: 1 [54400/60000 (91%)]  Loss: 0.868328
Train Epoch: 1 [57600/60000 (96%)]  Loss: 0.905604

Test set: Average loss: 0.9050, Accuracy: 9508/10000 (95%)

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Test set: Average loss: 0.8190, Accuracy: 9872/10000 (99%)

Train Epoch: 10 [0/60000 (0%)]  Loss: 0.822833
Train Epoch: 10 [3200/60000 (5%)] Loss: 0.824039
Train Epoch: 10 [6400/60000 (11%)]  Loss: 0.815495
Train Epoch: 10 [9600/60000 (16%)]  Loss: 0.816115
Train Epoch: 10 [12800/60000 (21%)] Loss: 0.824427
Train Epoch: 10 [16000/60000 (27%)] Loss: 0.808371
Train Epoch: 10 [19200/60000 (32%)] Loss: 0.804259
Train Epoch: 10 [22400/60000 (37%)] Loss: 0.829416
Train Epoch: 10 [25600/60000 (43%)] Loss: 0.837269
Train Epoch: 10 [28800/60000 (48%)] Loss: 0.810035
Train Epoch: 10 [32000/60000 (53%)] Loss: 0.808683
Train Epoch: 10 [35200/60000 (59%)] Loss: 0.798765
Train Epoch: 10 [38400/60000 (64%)] Loss: 0.838107
Train Epoch: 10 [41600/60000 (69%)] Loss: 0.809600
Train Epoch: 10 [44800/60000 (75%)] Loss: 0.798065
Train Epoch: 10 [48000/60000 (80%)] Loss: 0.839781
Train Epoch: 10 [51200/60000 (85%)] Loss: 0.833170
```

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Train Epoch: 10 [54400/60000 (91%)] Loss: 0.814758
Train Epoch: 10 [57600/60000 (96%)] Loss: 0.802686

Test set: Average loss: 0.8181, Accuracy: 9888/10000 (99%)
```

2.1) Rerun the LeNet-5 network with only 100 examples total

```
Train Epoch: 1 [0/100 (0%)] Loss: 2.283840
Train Epoch: 2 [0/100 (0%)] Loss: 2.289171
Train Epoch: 3 [0/100 (0%)] Loss: 2.265617
Train Epoch: 4 [0/100 (0%)] Loss: 2.257952
Train Epoch: 5 [0/100 (0%)] Loss: 2.246766
Train Epoch: 6 [0/100 (0%)] Loss: 2.226400
Train Epoch: 7 [0/100 (0%)] Loss: 2.222587
Train Epoch: 8 [0/100 (0%)] Loss: 2.188046
Train Epoch: 9 [0/100 (0%)] Loss: 2.192306
Train Epoch: 10 [0/100 (0%)]  Loss: 2.184013

Test set: Average loss: 2.2471, Accuracy: 2163/10000 (21.630%)

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Train Epoch: 191 [0/100 (0%)] Loss: 0.895083
Train Epoch: 192 [0/100 (0%)] Loss: 0.912505
Train Epoch: 193 [0/100 (0%)] Loss: 0.915177
Train Epoch: 194 [0/100 (0%)] Loss: 0.896392
Train Epoch: 195 [0/100 (0%)] Loss: 0.909797
Train Epoch: 196 [0/100 (0%)] Loss: 0.902858
Train Epoch: 197 [0/100 (0%)] Loss: 0.906730
Train Epoch: 198 [0/100 (0%)] Loss: 0.906077
Train Epoch: 199 [0/100 (0%)] Loss: 0.897573
Train Epoch: 200 [0/100 (0%)] Loss: 0.908678

Test set: Average loss: 1.2633, Accuracy: 6719/10000 (67.190%)
```

3) Implement an Autoencoder and train it on the unlabelled data

```
AE Train Epoch: 1 [0/59900 (0%)]  Loss: 1.030817
AE Train Epoch: 1 [3200/59900 (5%)] Loss: 0.663437
AE Train Epoch: 1 [6400/59900 (11%)]  Loss: 0.593635
AE Train Epoch: 1 [9600/59900 (16%)]  Loss: 0.537074
AE Train Epoch: 1 [12800/59900 (21%)] Loss: 0.554126
AE Train Epoch: 1 [16000/59900 (27%)] Loss: 0.514349
AE Train Epoch: 1 [19200/59900 (32%)] Loss: 0.468036
AE Train Epoch: 1 [22400/59900 (37%)] Loss: 0.495048
AE Train Epoch: 1 [25600/59900 (43%)] Loss: 0.498358
AE Train Epoch: 1 [28800/59900 (48%)] Loss: 0.467358
AE Train Epoch: 1 [32000/59900 (53%)] Loss: 0.493066
AE Train Epoch: 1 [35200/59900 (59%)] Loss: 0.458010
AE Train Epoch: 1 [38400/59900 (64%)] Loss: 0.479157
AE Train Epoch: 1 [41600/59900 (69%)] Loss: 0.468090
AE Train Epoch: 1 [44800/59900 (75%)] Loss: 0.450645
AE Train Epoch: 1 [48000/59900 (80%)] Loss: 0.454568
AE Train Epoch: 1 [51200/59900 (85%)] Loss: 0.463239
AE Train Epoch: 1 [54400/59900 (91%)] Loss: 0.445538
AE Train Epoch: 1 [57600/59900 (96%)] Loss: 0.459576
```

Demo: Using the Autoencoder in a multi-task learning setup to improve classification performance.

```
Train Epoch: 1 [46800/59900 (5%)] ULoss: 0.617636  LLoss: 1.985754
Train Epoch: 1 [93600/59900 (11%)]  ULoss: 0.573890  LLoss: 1.717270
Train Epoch: 1 [140400/59900 (16%)] ULoss: 0.504677  LLoss: 1.581875
Train Epoch: 1 [187200/59900 (21%)] ULoss: 0.481448  LLoss: 1.574093
Train Epoch: 1 [234000/59900 (27%)] ULoss: 0.505062  LLoss: 1.468533
Train Epoch: 1 [280800/59900 (32%)] ULoss: 0.536226  LLoss: 1.484010
Train Epoch: 1 [327600/59900 (37%)] ULoss: 0.497999  LLoss: 1.433561
Train Epoch: 1 [374400/59900 (43%)] ULoss: 0.527766  LLoss: 1.362958
Train Epoch: 1 [421200/59900 (48%)] ULoss: 0.468996  LLoss: 1.398226
Train Epoch: 1 [468000/59900 (53%)] ULoss: 0.465888  LLoss: 1.394104
Train Epoch: 1 [514800/59900 (59%)] ULoss: 0.451794  LLoss: 1.313596
Train Epoch: 1 [561600/59900 (64%)] ULoss: 0.464181  LLoss: 1.334373
Train Epoch: 1 [608400/59900 (69%)] ULoss: 0.456084  LLoss: 1.333469
Train Epoch: 1 [655200/59900 (75%)] ULoss: 0.443087  LLoss: 1.320788
Train Epoch: 1 [702000/59900 (80%)] ULoss: 0.467138  LLoss: 1.301871
Train Epoch: 1 [748800/59900 (85%)] ULoss: 0.438664  LLoss: 1.268680
Train Epoch: 1 [795600/59900 (91%)] ULoss: 0.414645  LLoss: 1.259956
Train Epoch: 1 [842400/59900 (96%)] ULoss: 0.457728  LLoss: 1.258522

Test set: Average loss: 1.4930, Accuracy: 7483/10000 (74.830%)

Train Epoch: 5 [46800/59900 (5%)] ULoss: 0.404412  LLoss: 1.091267
```

```
Train Epoch: 5 [93600/59900 (11%)]  ULoss: 0.409370  LLoss: 1.074548
Train Epoch: 5 [140400/59900 (16%)] ULoss: 0.380917  LLoss: 1.083171
Train Epoch: 5 [187200/59900 (21%)] ULoss: 0.358110  LLoss: 1.081328
Train Epoch: 5 [234000/59900 (27%)] ULoss: 0.390399  LLoss: 1.089223
Train Epoch: 5 [280800/59900 (32%)] ULoss: 0.373408  LLoss: 1.077601
Train Epoch: 5 [327600/59900 (37%)] ULoss: 0.392297  LLoss: 1.082564
Train Epoch: 5 [374400/59900 (43%)] ULoss: 0.398118  LLoss: 1.083500
Train Epoch: 5 [421200/59900 (48%)] ULoss: 0.384028  LLoss: 1.076839
Train Epoch: 5 [468000/59900 (53%)] ULoss: 0.403664  LLoss: 1.071941
Train Epoch: 5 [514800/59900 (59%)] ULoss: 0.382327  LLoss: 1.071756
Train Epoch: 5 [561600/59900 (64%)] ULoss: 0.372120  LLoss: 1.085990
Train Epoch: 5 [608400/59900 (69%)] ULoss: 0.394229  LLoss: 1.078019
Train Epoch: 5 [655200/59900 (75%)] ULoss: 0.375618  LLoss: 1.075231
Train Epoch: 5 [702000/59900 (80%)] ULoss: 0.400611  LLoss: 1.076595
Train Epoch: 5 [748800/59900 (85%)] ULoss: 0.390586  LLoss: 1.066541
Train Epoch: 5 [795600/59900 (91%)] ULoss: 0.373513  LLoss: 1.073575
Train Epoch: 5 [842400/59900 (96%)] ULoss: 0.385781  LLoss: 1.068148

Test set: Average loss: 1.3942, Accuracy: 7771/10000 (77.710%)
```