

Sample results week 12

1.1) Forward pass: Calculate the values of z_1 , z_2 , and y

$$z_1 = 0.0 \quad z_2 = 0.76 \quad y = 1.572$$

1.2) Compute the mean squared error

$$E = 0.0916$$

1.3) Using backpropagation, compute the gradient or the error w.r.t the weights $w^{(2)}_{2,2}$ and $w^{(1)}_{2,2}$

$$\begin{matrix} -0.3253 \\ -0.1883 \end{matrix}$$

1.4) Compute the updated weights for $w^{(2)}_{2,2}$ and $w^{(1)}_{2,2}$

$$w^{(2)}_2 = 2.2325 \text{ and } w^{(1)}_{2,2} = 2.2188$$

2) PyTorch: 2-layer MLP for classification

```
Train Epoch: 1 [0/60000 (0%)] Loss: 2.282346
Train Epoch: 1 [3200/60000 (5%)] Loss: 2.192860
Train Epoch: 1 [6400/60000 (11%)] Loss: 2.086071
Train Epoch: 1 [9600/60000 (16%)] Loss: 1.997170
```

```
Train Epoch: 1 [12800/60000 (21%)] Loss: 1.869065
Train Epoch: 1 [16000/60000 (27%)] Loss: 1.756833
Train Epoch: 1 [19200/60000 (32%)] Loss: 1.773450
Train Epoch: 1 [22400/60000 (37%)] Loss: 1.629265
Train Epoch: 1 [25600/60000 (43%)] Loss: 1.559843
Train Epoch: 1 [28800/60000 (48%)] Loss: 1.397276
Train Epoch: 1 [32000/60000 (53%)] Loss: 1.476961
Train Epoch: 1 [35200/60000 (59%)] Loss: 1.392096
Train Epoch: 1 [38400/60000 (64%)] Loss: 1.256073
Train Epoch: 1 [41600/60000 (69%)] Loss: 1.245575
Train Epoch: 1 [44800/60000 (75%)] Loss: 1.016568
Train Epoch: 1 [48000/60000 (80%)] Loss: 1.015481
Train Epoch: 1 [51200/60000 (85%)] Loss: 1.222300
Train Epoch: 1 [54400/60000 (91%)] Loss: 0.965435
Train Epoch: 1 [57600/60000 (96%)] Loss: 0.952111
```

Test set: Average loss: 0.9211, Accuracy: 8353/10000 (84%)

```
Train Epoch: 2 [0/60000 (0%)] Loss: 1.006724
Train Epoch: 2 [3200/60000 (5%)] Loss: 0.940486
Train Epoch: 2 [6400/60000 (11%)] Loss: 0.794760
Train Epoch: 2 [9600/60000 (16%)] Loss: 0.723778
Train Epoch: 2 [12800/60000 (21%)] Loss: 0.936512
Train Epoch: 2 [16000/60000 (27%)] Loss: 0.871495
Train Epoch: 2 [19200/60000 (32%)] Loss: 0.742040
Train Epoch: 2 [22400/60000 (37%)] Loss: 0.786906
Train Epoch: 2 [25600/60000 (43%)] Loss: 0.665047
Train Epoch: 2 [28800/60000 (48%)] Loss: 0.618858
Train Epoch: 2 [32000/60000 (53%)] Loss: 0.628458
Train Epoch: 2 [35200/60000 (59%)] Loss: 0.751313
Train Epoch: 2 [38400/60000 (64%)] Loss: 0.698365
Train Epoch: 2 [41600/60000 (69%)] Loss: 0.628357
Train Epoch: 2 [44800/60000 (75%)] Loss: 0.710858
Train Epoch: 2 [48000/60000 (80%)] Loss: 0.726926
Train Epoch: 2 [51200/60000 (85%)] Loss: 0.597844
Train Epoch: 2 [54400/60000 (91%)] Loss: 0.705241
Train Epoch: 2 [57600/60000 (96%)] Loss: 0.708254
```

Test set: Average loss: 0.5817, Accuracy: 8743/10000 (87%)

```
Train Epoch: 3 [0/60000 (0%)] Loss: 0.754283
Train Epoch: 3 [3200/60000 (5%)] Loss: 0.613805
Train Epoch: 3 [6400/60000 (11%)] Loss: 0.586619
Train Epoch: 3 [9600/60000 (16%)] Loss: 0.396473
Train Epoch: 3 [12800/60000 (21%)] Loss: 0.558825
Train Epoch: 3 [16000/60000 (27%)] Loss: 0.506572
Train Epoch: 3 [19200/60000 (32%)] Loss: 0.597295
Train Epoch: 3 [22400/60000 (37%)] Loss: 0.571245
Train Epoch: 3 [25600/60000 (43%)] Loss: 0.439682
Train Epoch: 3 [28800/60000 (48%)] Loss: 0.663544
Train Epoch: 3 [32000/60000 (53%)] Loss: 0.485984
Train Epoch: 3 [35200/60000 (59%)] Loss: 0.668479
Train Epoch: 3 [38400/60000 (64%)] Loss: 0.476659
Train Epoch: 3 [41600/60000 (69%)] Loss: 0.541416
```

Train Epoch: 3 [44800/60000 (75%)] Loss: 0.446552
Train Epoch: 3 [48000/60000 (80%)] Loss: 0.480338
Train Epoch: 3 [51200/60000 (85%)] Loss: 0.590924
Train Epoch: 3 [54400/60000 (91%)] Loss: 0.464441
Train Epoch: 3 [57600/60000 (96%)] Loss: 0.449151

Test set: Average loss: 0.4678, Accuracy: 8864/10000 (89%)

Train Epoch: 4 [0/60000 (0%)] Loss: 0.432850
Train Epoch: 4 [3200/60000 (5%)] Loss: 0.377917
Train Epoch: 4 [6400/60000 (11%)] Loss: 0.307713
Train Epoch: 4 [9600/60000 (16%)] Loss: 0.404561
Train Epoch: 4 [12800/60000 (21%)] Loss: 0.576835
Train Epoch: 4 [16000/60000 (27%)] Loss: 0.370762
Train Epoch: 4 [19200/60000 (32%)] Loss: 0.426309
Train Epoch: 4 [22400/60000 (37%)] Loss: 0.463094
Train Epoch: 4 [25600/60000 (43%)] Loss: 0.299368
Train Epoch: 4 [28800/60000 (48%)] Loss: 0.524536
Train Epoch: 4 [32000/60000 (53%)] Loss: 0.369034
Train Epoch: 4 [35200/60000 (59%)] Loss: 0.369169
Train Epoch: 4 [38400/60000 (64%)] Loss: 0.287969
Train Epoch: 4 [41600/60000 (69%)] Loss: 0.497225
Train Epoch: 4 [44800/60000 (75%)] Loss: 0.550104
Train Epoch: 4 [48000/60000 (80%)] Loss: 0.393593
Train Epoch: 4 [51200/60000 (85%)] Loss: 0.630297
Train Epoch: 4 [54400/60000 (91%)] Loss: 0.468216
Train Epoch: 4 [57600/60000 (96%)] Loss: 0.462986

Test set: Average loss: 0.4112, Accuracy: 8956/10000 (90%)

Train Epoch: 5 [0/60000 (0%)] Loss: 0.268104
Train Epoch: 5 [3200/60000 (5%)] Loss: 0.429832
Train Epoch: 5 [6400/60000 (11%)] Loss: 0.359750
Train Epoch: 5 [9600/60000 (16%)] Loss: 0.392197
Train Epoch: 5 [12800/60000 (21%)] Loss: 0.487182
Train Epoch: 5 [16000/60000 (27%)] Loss: 0.571447
Train Epoch: 5 [19200/60000 (32%)] Loss: 0.575523
Train Epoch: 5 [22400/60000 (37%)] Loss: 0.333958
Train Epoch: 5 [25600/60000 (43%)] Loss: 0.226182
Train Epoch: 5 [28800/60000 (48%)] Loss: 0.377405
Train Epoch: 5 [32000/60000 (53%)] Loss: 0.513616
Train Epoch: 5 [35200/60000 (59%)] Loss: 0.476012
Train Epoch: 5 [38400/60000 (64%)] Loss: 0.238248
Train Epoch: 5 [41600/60000 (69%)] Loss: 0.431389
Train Epoch: 5 [44800/60000 (75%)] Loss: 0.418650
Train Epoch: 5 [48000/60000 (80%)] Loss: 0.310396
Train Epoch: 5 [51200/60000 (85%)] Loss: 0.351179
Train Epoch: 5 [54400/60000 (91%)] Loss: 0.385922
Train Epoch: 5 [57600/60000 (96%)] Loss: 0.376956

Test set: Average loss: 0.3776, Accuracy: 8998/10000 (90%)