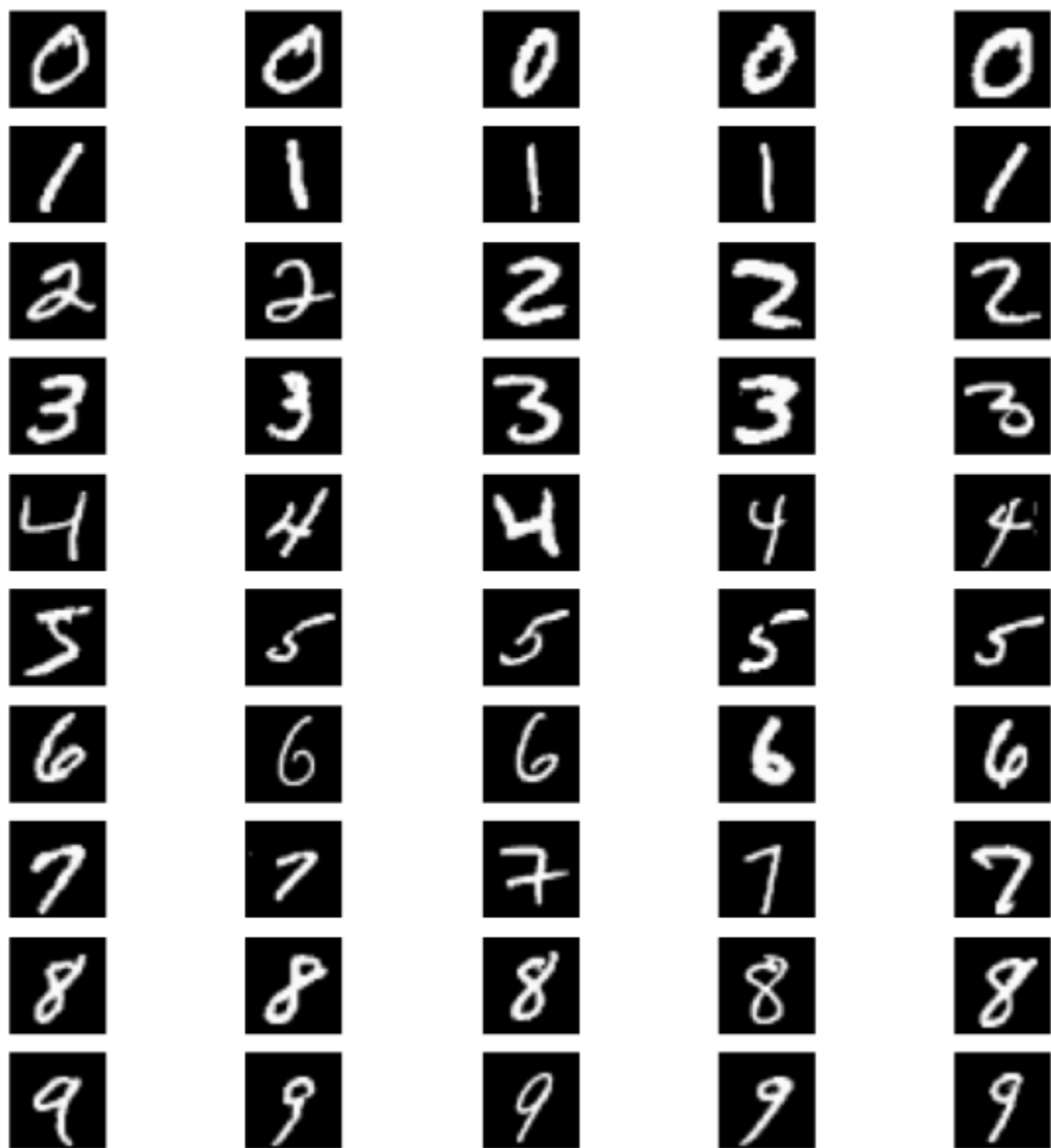Q1-

Data Visualization—

Formula for computing QD for QDA

```python
def qda_gpu(x, prior, mean, covariance):
    noise_level = 1e-6
    covariance += noise_level * np.eye(covariance.shape[0])

    inv_covariance = np.linalg.inv(covariance)
    log_cov = np.linalg.slogdet(covariance)[1]

    x_flatten = x.reshape(x.shape[0], -1)

    # Calculate the quadratic form part of the QDA expression
    quadratic_form = np.sum((x_flatten @ inv_covariance) * x_flatten, axis=1)

    # Calculate the linear part of the QDA expression
    linear_part = np.sum(mean * (inv_covariance @ x_flatten.T).T, axis=1) * (-2)

    # Calculate the constant part of the QDA expression
    constant_part = mean @ inv_covariance @ mean

    # Combine all parts to get the final QDA expression
    qda_result = -0.5 * (quadratic_form + linear_part + constant_part + log_cov) + np.log(prior)

    return qda_result
```

Overall and class-wise accuracy

```
Overall Accuracy: 0.6834
Class-wise Accuracy:
Class 0: 0.960204081632653
Class 1: 0.9374449339207048
Class 2: 0.4680232558139535
Class 3: 0.5118811881188119
Class 4: 0.45213849287169044
Class 5: 0.29596412556053814
Class 6: 0.9436325678496869
Class 7: 0.43287937743190663
Class 8: 0.8542094455852156
Class 9: 0.931615460852329
```

Q2
Reduced Dimension Visualization with mean squared error–

Reconstructed Images with p=5

Reconstructed Images with p=10

Reconstructed Images with p=20

Reconstructed Images with p=300

Reconstructed Images with p=784

Overall and classwise Accuracy for reduced Dimension—

```
Computing QDA Params: 100%|██████████| 10/10 [00:00<00:00, 9998.34it/s]
Performing QDA on GPU: 100%|██████████| 10/10 [00:00<00:00, 2211.72it/s]
```

```
QDA GPU Accuracy : for feature  5    0.7057
classwise accuracy --
accuracy of class 0 is 0.8795918367346939
accuracy of class 1 is 0.9568281938325991
accuracy of class 2 is 0.7655038759689923
accuracy of class 3 is 0.7158415841584158
accuracy of class 4 is 0.6089613034623218
accuracy of class 5 is 0.5526905829596412
accuracy of class 6 is 0.7901878914405011
accuracy of class 7 is 0.7441634241245136
accuracy of class 8 is 0.42915811088295686
accuracy of class 9 is 0.5599603567888999
```

```
Computing QDA Params: 100%|██████████| 10/10 [00:00<00:00, 5010.52it/s]
Performing QDA on GPU: 100%|██████████| 10/10 [00:00<00:00, 1998.52it/s]
```

```
QDA GPU Accuracy : for feature  10    0.858
classwise accuracy --
accuracy of class 0 is 0.9561224489795919
accuracy of class 1 is 0.9533039647577093
accuracy of class 2 is 0.8875968992248062
accuracy of class 3 is 0.8386138613861386
accuracy of class 4 is 0.7627291242362525
accuracy of class 5 is 0.8307174887892377
accuracy of class 6 is 0.8893528183716075
accuracy of class 7 is 0.853112840466926
accuracy of class 8 is 0.7823408624229979
accuracy of class 9 is 0.8097125867195243
```

```
Computing QDA Params: 100%|██████████| 10/10 [00:00<00:00, 4999.77it/s]
Performing QDA on GPU: 100%|██████████| 10/10 [00:00<00:00, 526.23it/s]
```

```
QDA GPU Accuracy : for feature  20    0.9084
classwise accuracy --
accuracy of class 0 is 0.9724489795918367
accuracy of class 1 is 0.9259911894273127
accuracy of class 2 is 0.9486434108527132
accuracy of class 3 is 0.8960396039603961
accuracy of class 4 is 0.9124236252545825
accuracy of class 5 is 0.9091928251121076
accuracy of class 6 is 0.9342379958246346
accuracy of class 7 is 0.8443579766536965
accuracy of class 8 is 0.8439425051334702
accuracy of class 9 is 0.8959365708622399
```

```
Computing QDA Params: 100%|██████████| 10/10 [00:00<00:00, 1427.90it/s]
Performing QDA on GPU: 100%|██████████| 10/10 [00:00<00:00, 20.75it/s]
```

```
QDA GPU Accuracy : for feature  300    0.9218
classwise accuracy --
accuracy of class 0 is 0.9816326530612245
accuracy of class 1 is 0.9797356828193833
accuracy of class 2 is 0.9428294573643411
accuracy of class 3 is 0.8465346534653465
accuracy of class 4 is 0.9185336048879837
accuracy of class 5 is 0.8699551569506726
accuracy of class 6 is 0.954070981210856
accuracy of class 7 is 0.9114785992217899
accuracy of class 8 is 0.8788501026694046
accuracy of class 9 is 0.9226957383548068
```

```
Computing QDA Params: 100%|███████████| 10/10 [00:00<00:00, 370.34it/s]
Performing QDA on GPU: 100%|███████████| 10/10 [00:02<00:00,  4.70it/s]

QDA GPU Accuracy : for feature  784   0.9246
classwise accuracy --
accuracy of class 0 is 0.9836734693877551
accuracy of class 1 is 0.9797356828193833
accuracy of class 2 is 0.9408914728682171
accuracy of class 3 is 0.8544554455445544
accuracy of class 4 is 0.9205702647657841
accuracy of class 5 is 0.8834080717488789
accuracy of class 6 is 0.9498956158663883
accuracy of class 7 is 0.9046692607003891
accuracy of class 8 is 0.8880903490759754
accuracy of class 9 is 0.9306243805748265
```