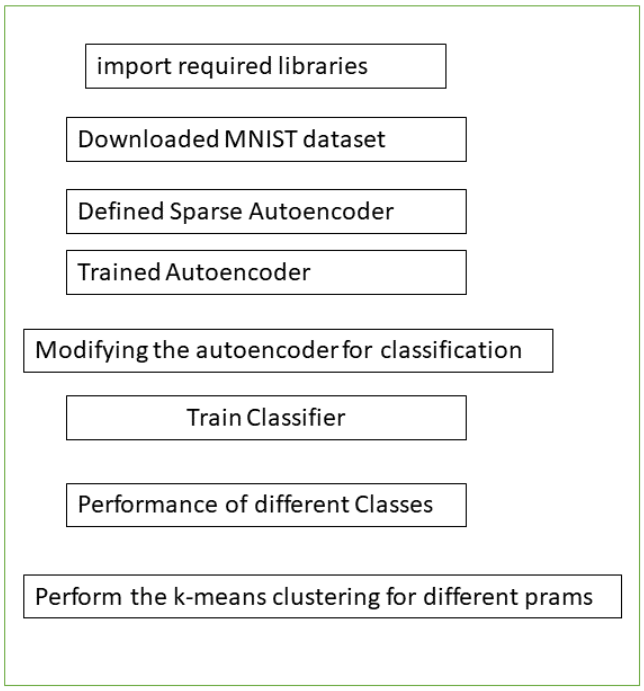
Question1: Implement the Sparse auto-encoders (AE).

M22AI567_Question1_SparseAutoEncoders.ipynb ---- is the complete file which hold the implementation of the complete task1.

Steps Followed

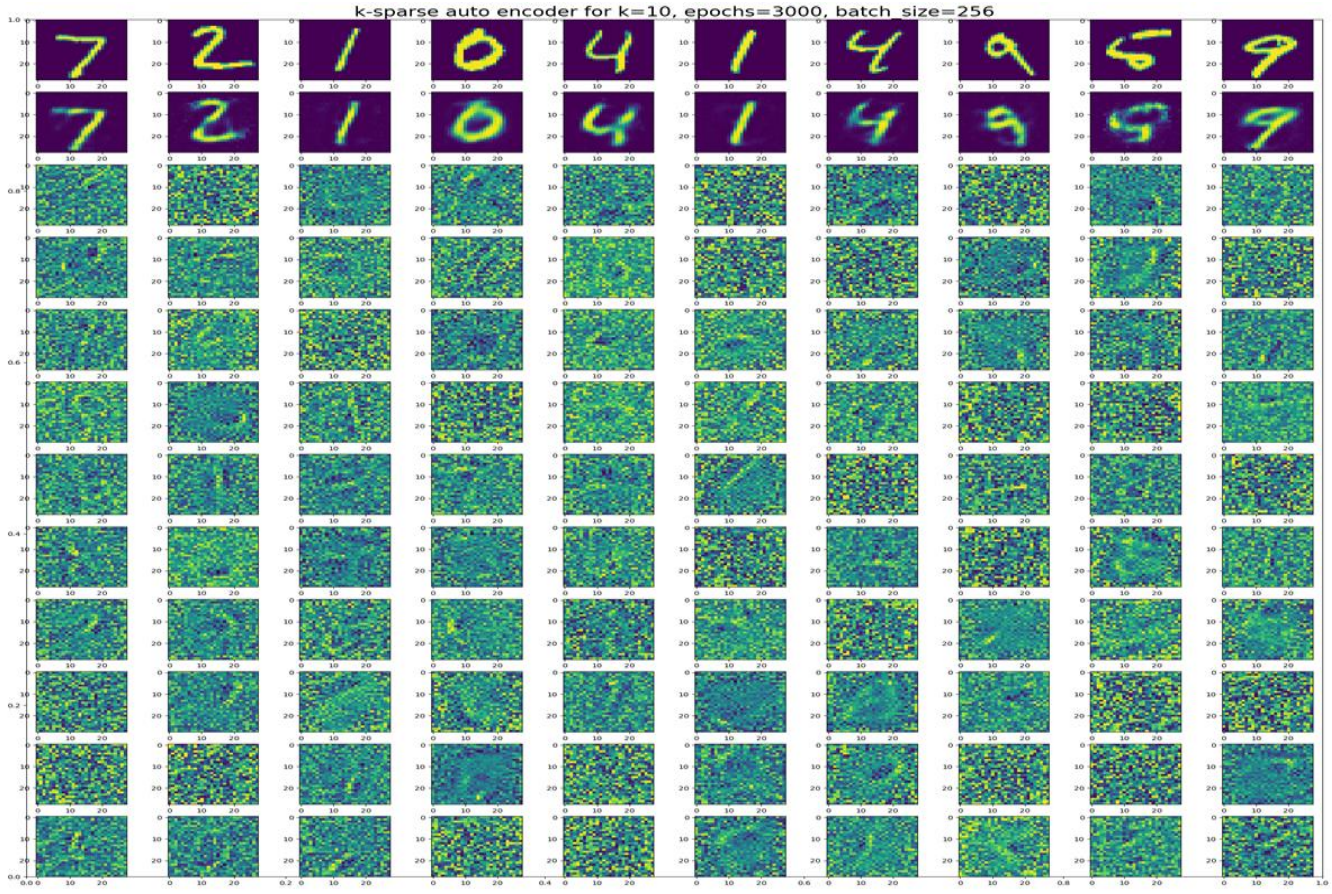


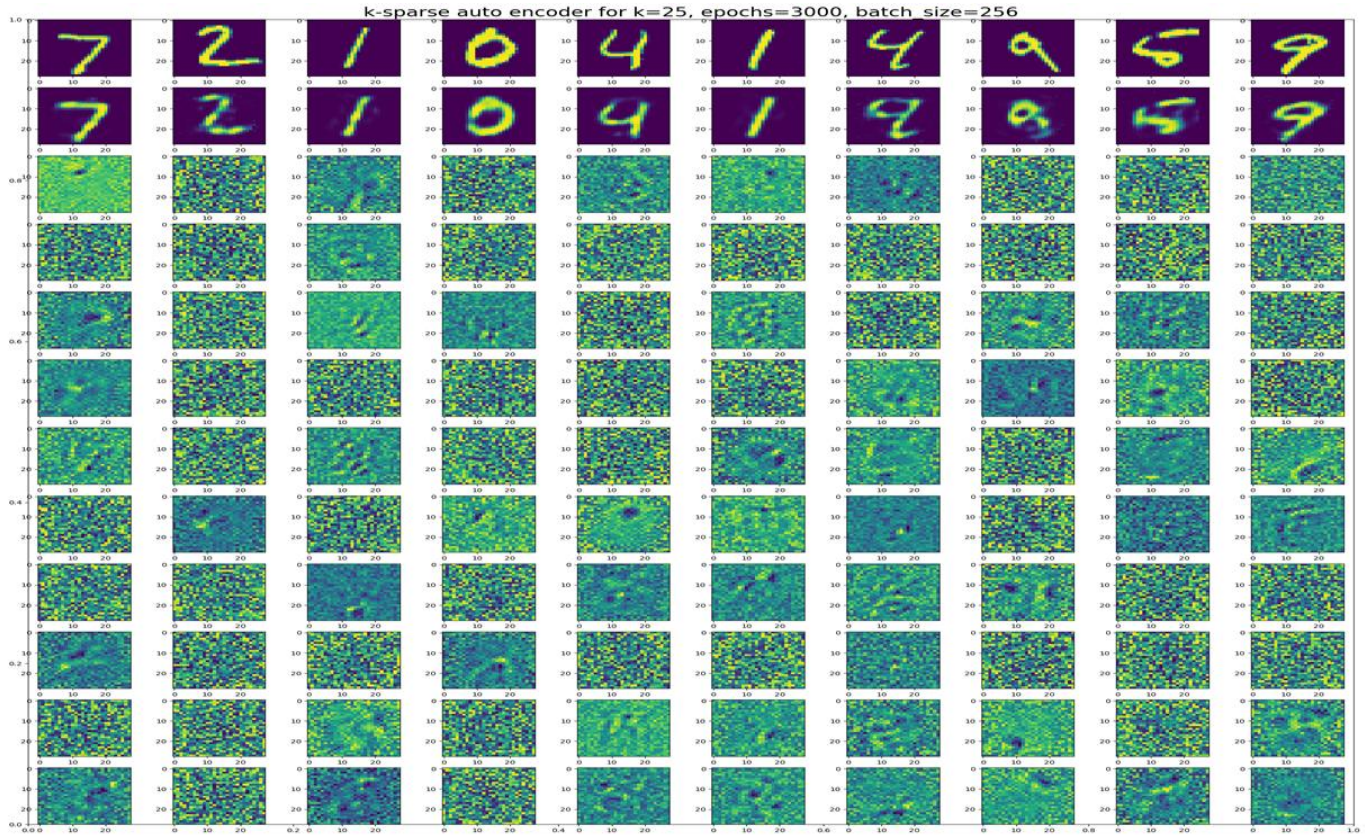
Performance:

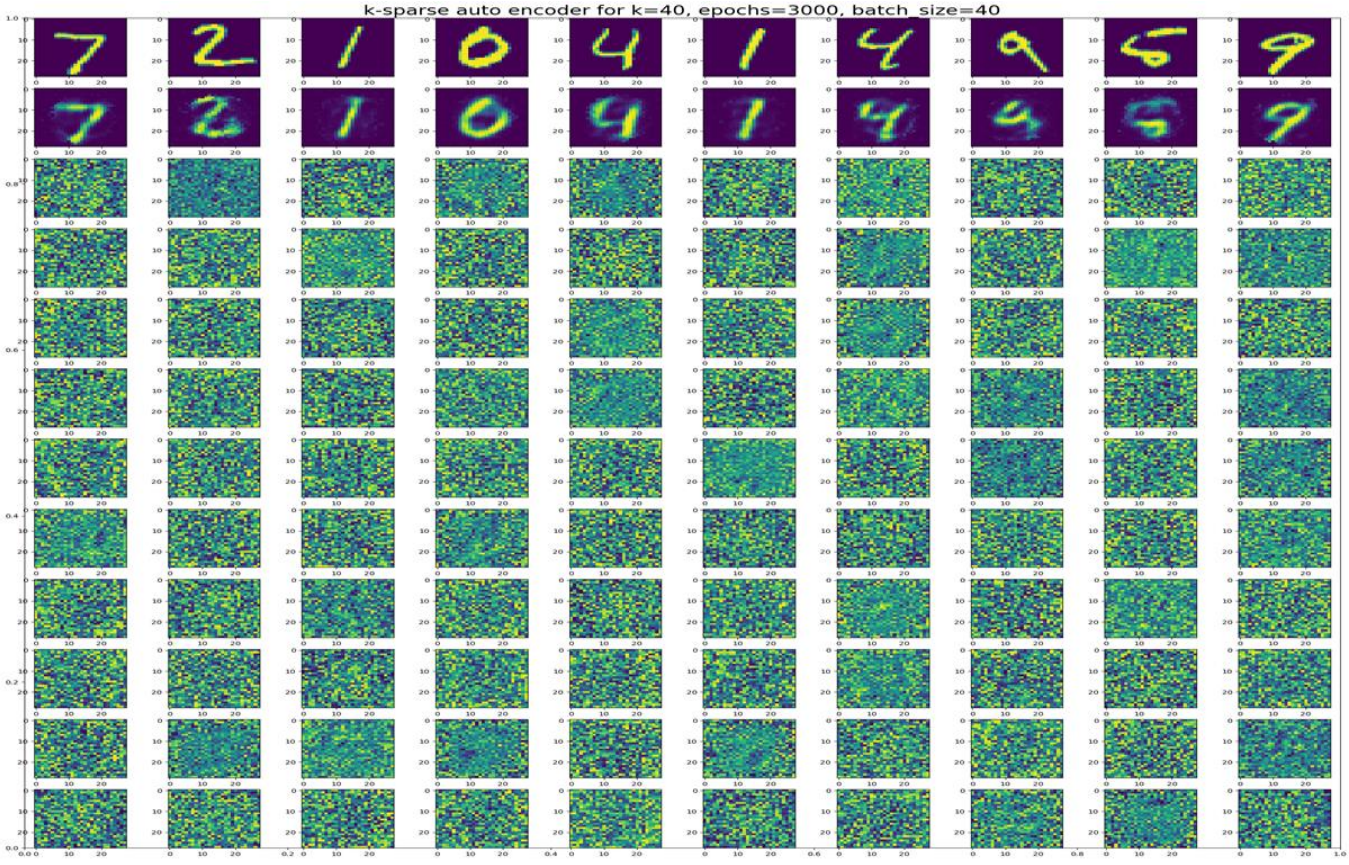
```
Training Performance
At Iteration : 1 / 10  ;  Train Error : 2.456811 ;Test Accuracy : 55.420000
At Iteration : 2 / 10  ;  Train Error : 1.119022 ;Test Accuracy : 68.910000
At Iteration : 3 / 10  ;  Train Error : 0.707241 ;Test Accuracy : 77.330000
At Iteration : 4 / 10  ;  Train Error : 0.510065 ;Test Accuracy : 86.570000
At Iteration : 5 / 10  ;  Train Error : 0.410135 ;Test Accuracy : 89.710000
At Iteration : 6 / 10  ;  Train Error : 0.371824 ;Test Accuracy : 90.440000
At Iteration : 7 / 10  ;  Train Error : 0.346546 ;Test Accuracy : 90.880000
At Iteration : 8 / 10  ;  Train Error : 0.327358 ;Test Accuracy : 91.440000
At Iteration : 9 / 10  ;  Train Error : 0.312980 ;Test Accuracy : 91.720000
At Iteration : 10 / 10  ;  Train Error : 0.301483 ;Test Accuracy : 92.070000
Accuracy of  zero : 98.061224 %
Accuracy of   one : 97.621145 %
Accuracy of   two : 90.116279 %
Accuracy of three : 91.287129 %
Accuracy of  four : 93.584521 %
Accuracy of  five : 85.313901 %
Accuracy of   six : 93.945720 %
Accuracy of seven : 92.315175 %
Accuracy of eight : 89.117043 %
Accuracy of  nine : 88.107037 %
```

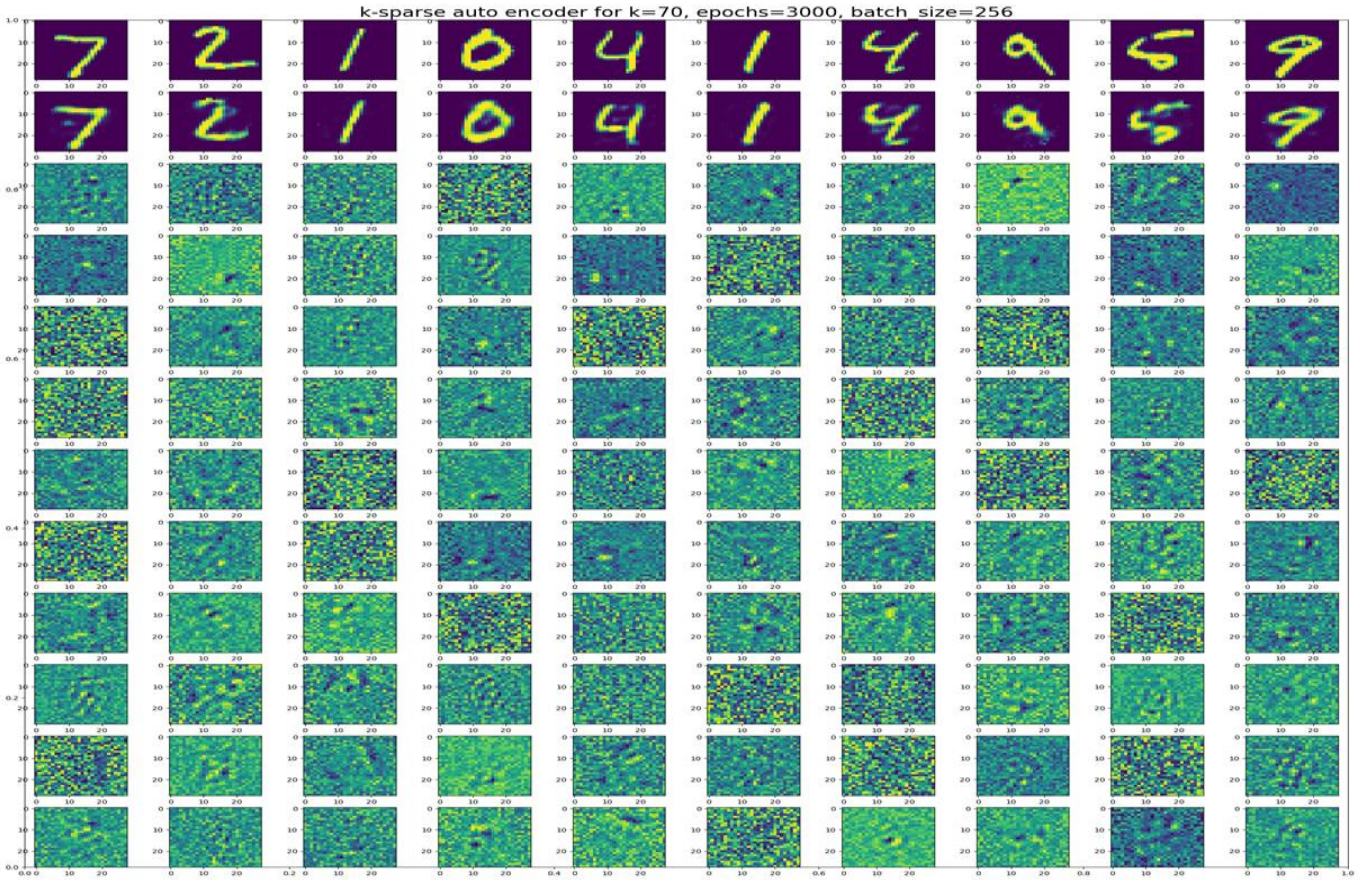
network:
layer - input: weights: (784, 30)
layer - hidden 1: weights: (30, 10)
layer - output: weights: (10, 10)
training start
epochs: 1000, loss: 0.0780, accuracy: 85.00%
epochs: 2000, loss: 0.0440, accuracy: 90.87%
epochs: 3000, loss: 0.0334, accuracy: 92.49%
epochs: 4000, loss: 0.0307, accuracy: 93.39%
epochs: 5000, loss: 0.0282, accuracy: 94.06%
epochs: 6000, loss: 0.0240, accuracy: 94.55%
epochs: 7000, loss: 0.0219, accuracy: 94.96%
epochs: 8000, loss: 0.0220, accuracy: 95.29%
epochs: 9000, loss: 0.0177, accuracy: 95.51%
epochs: 10000, loss: 0.0164, accuracy: 95.71%
training complete, elapsed time: 00:00:28
test accuracy: 93.97%

For Different values of k Performance:




k-sparse auto encoder for k=25, epochs=3000, batch_size=256


k-sparse auto encoder for k=40, epochs=3000, batch_size=40



References:

1. What happens in Sparse Auto encoder. URL: https://medium.com/@syoya/what-happens-in-parse-autencoder-b9a5a69da5c6.
2. Sparse Autoencoders for MNIST classification .
   URL: https://www.youtube.com/watch?v=DRsrjExb2q8
3. Sparse Autoencoders using L1 Regularization with PyTorch
   .URL:https://debuggercafe.com/sparse-autoencoders-using-l1-regularization-with-pytorch/
4. k-Sparse Autoencoders. Paper:https://arxiv.org/pdf/1312.5663.pdf
5. Self-Supervised Autoencoders for Clustering and Classification.
   paper:https://cidl.csd.auth.gr/resources/journal_pdfs/Nousi_EVOS.pdf