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Variational Autoencoder Architecture:

Encoder:

- MLP layer1(28*28, activation = ‘ReLU’)
- MLP layer2(392, activation = ‘ReLU’)
- MLP layer3(196, activation = ‘ReLU’)
- MLP layer4(98, activation = ‘ReLU’)

Latent Layer:

- MLP layer5(8, activation = ‘ReLU’) - Mu
- MLP layer6(8, activation = ‘ReLU’) - Sigma

Reparematerization:

- Z = Mu + Sigma*N(0,1)

Decoder:

- MLP layer7(98, activation = ‘ReLU’)
- MLP layer8(196, activation = ‘ReLU’)
- MLP layer9(392, activation = ‘ReLU’)
- MLP layer10(28 * 28, activation = ‘ReLU’)

Hyperparameters:

- Optimizer: Adam
- Learning rate: 0.0005
- Batch size: 32
- Number of epochs:100
- Loss Function : Cross Entropy Loss + constant * KL divergence loss

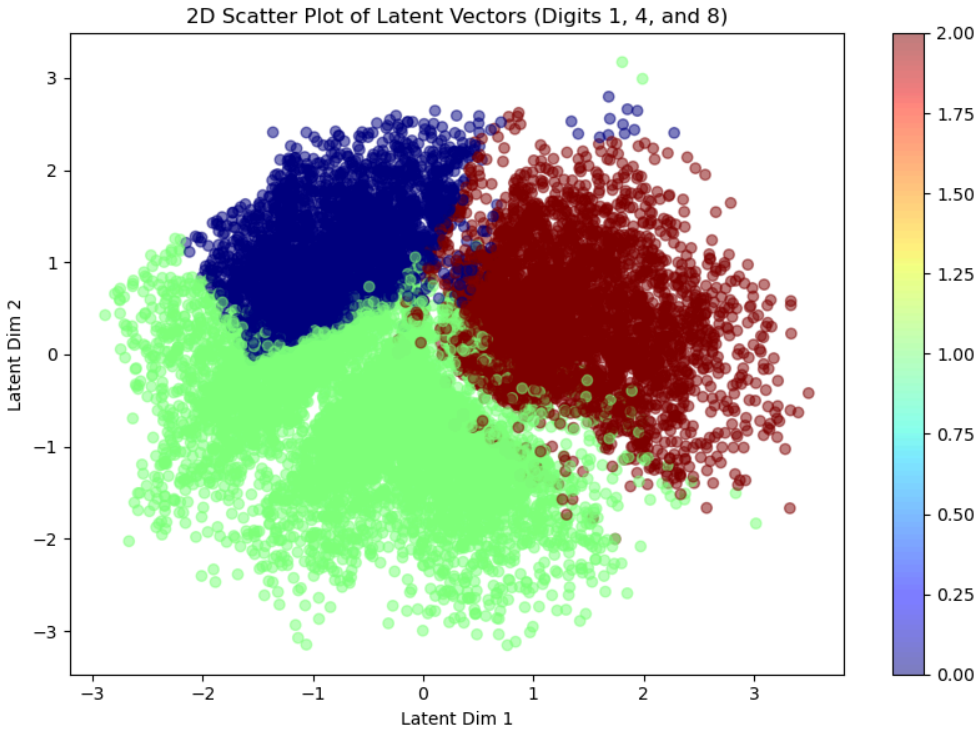
The constant term in loss function decides the KL divergence contribution to the total loss, we used constant value as 3 so that the approximate decoder function converges near to the original distribution.

Reconstruction of input Images:

- The upper side images in the above picture are inputs and the lower side images in above picture are outputs.
- Main emphasis of VAE is to learn key hidden features rather than just copying the input to the output. Our model is able to generate good results with generated images slightly different from the original images.
- The only problem we saw was that the images are blurry, which is a common drawback of VEA in general.

Gaussian Mixture Model:

- We wrote expectation and maximization functions for updating the cluster's distribution mean and sigma values
- Later we maximized the logarithmic likelihood of the GMM by repeating expectation and maximization steps until it converges.
- We stored the latent vectors(z) for the training dataset after the last epoch and we fitted a GMM for this collection of latent vectors using the fit function.
- We used the validation set which has labels to label the GMM clusters so that it can be used for classification.



- The above plot shows the classification clusters made by using GMM after convergence.
- The dimension of the latent vector is 8, we are projecting this vector space into 2 dim using PCA library. And it is performing the clustering decently.