EE5179 : Deep Learning for Imaging
Programming Assignment 3: Autoencoders

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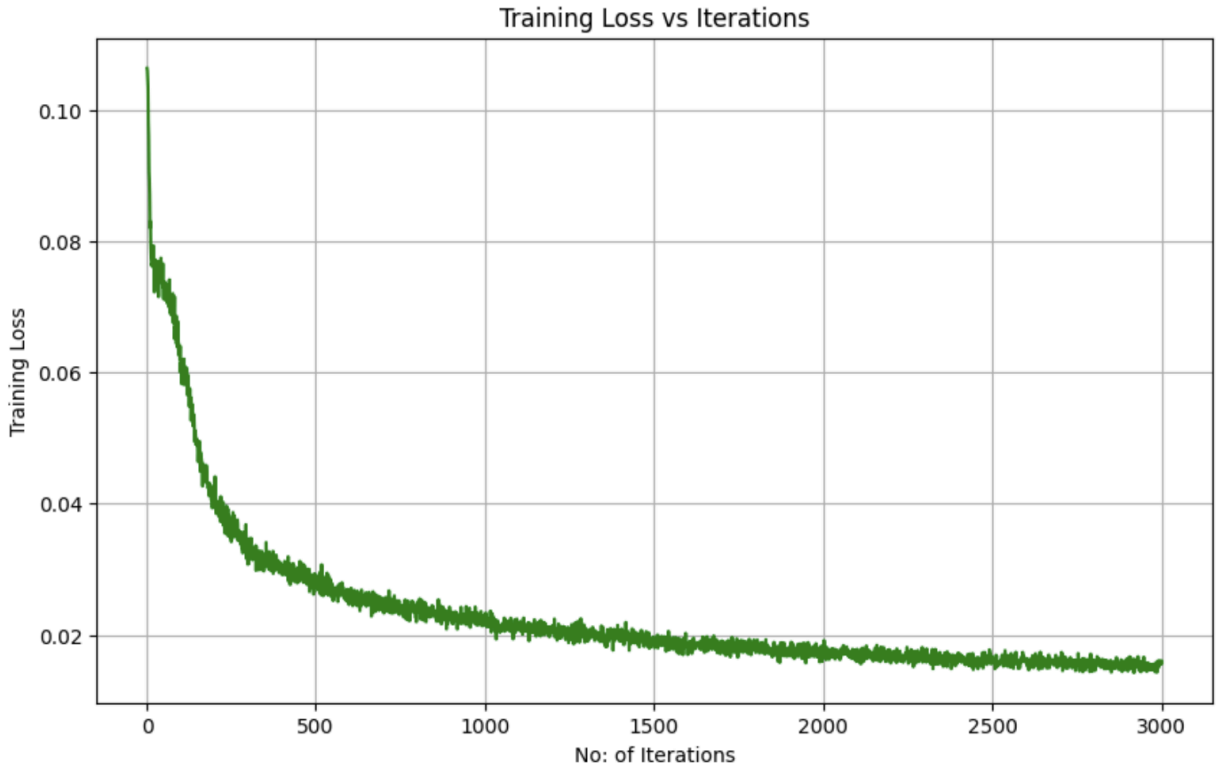
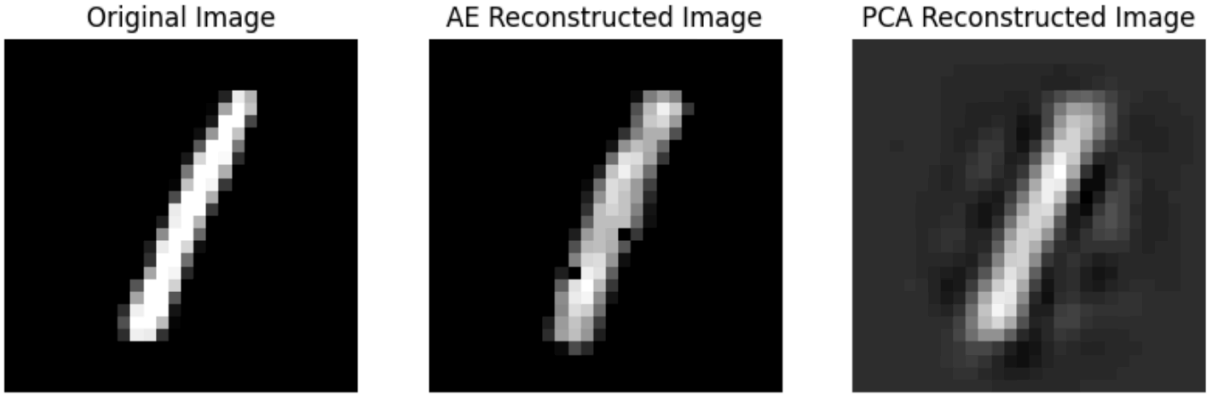
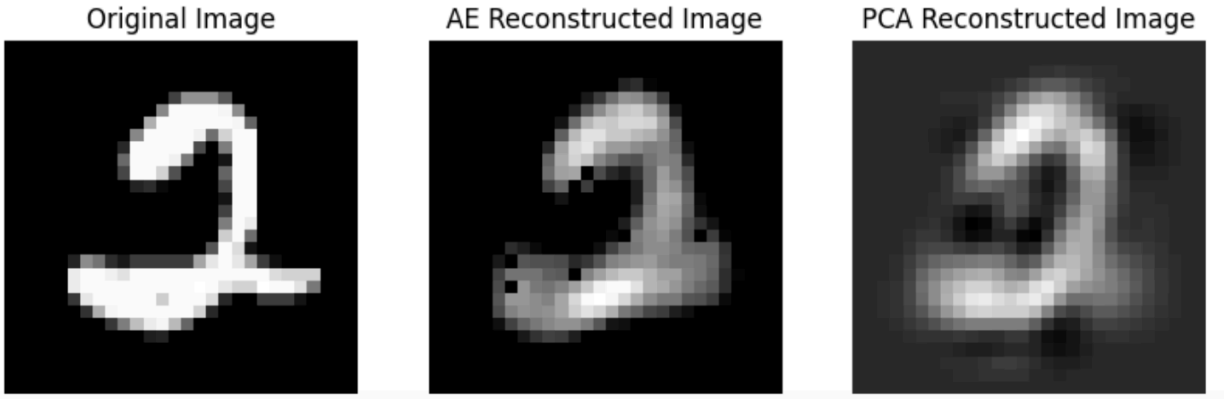
Comparing PCA and autoencoders



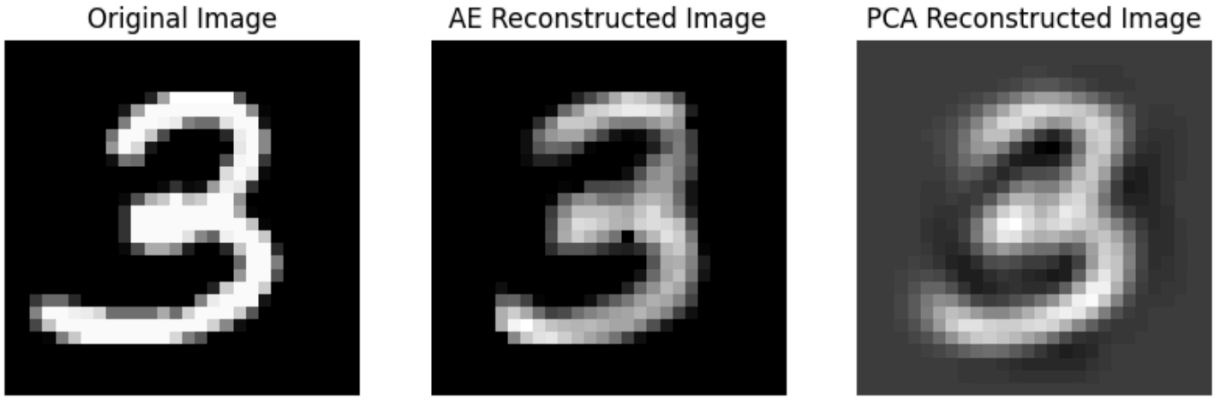
```
Reconstruction Error in AE: 5.114889141803459
Reconstruction Error in PCA: 4.906910216143052
```



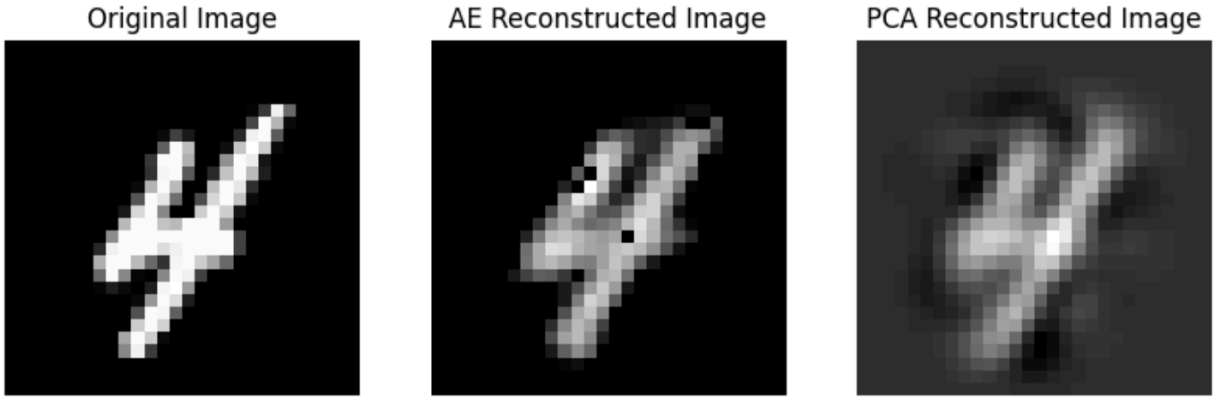

```
Reconstruction Error in AE: 22.499340382207624
Reconstruction Error in PCA: 16.862376030476067
```



```
Reconstruction Error in AE: 15.27587834574187
Reconstruction Error in PCA: 16.0457551172948
```

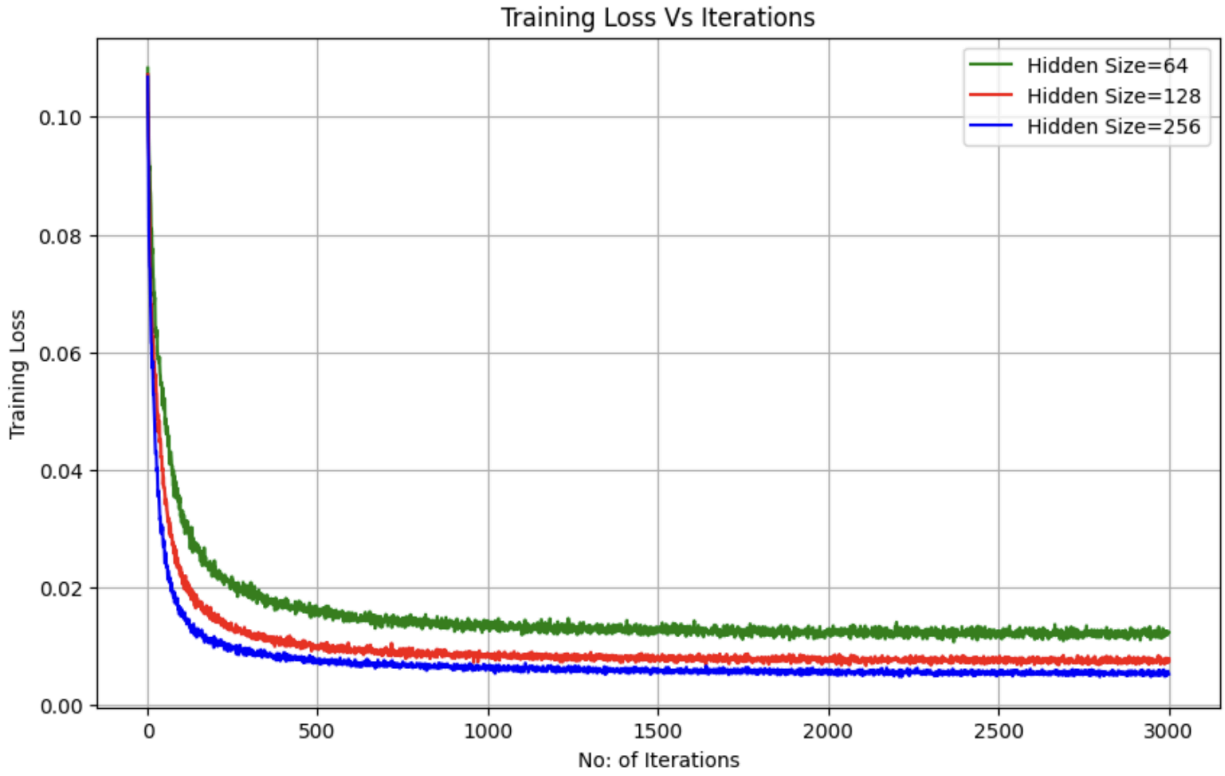



```
Reconstruction Error in AE: 13.645043006066087
Reconstruction Error in PCA: 10.714796514097081
```



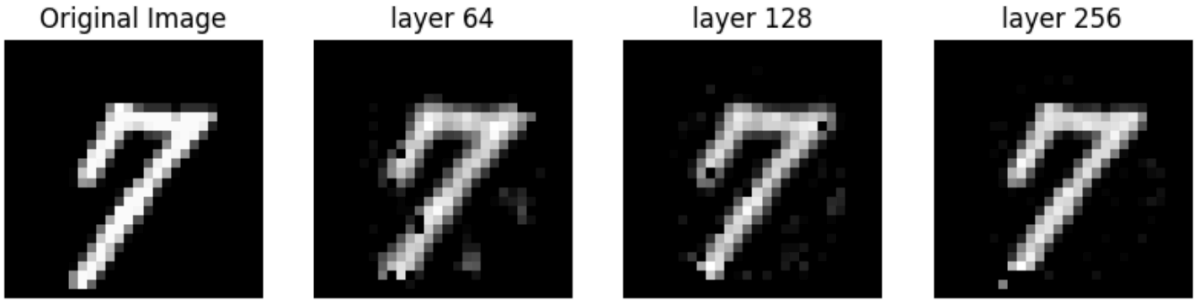
From a visual perspective, images reconstructed by the autoencoder appear more appealing due to their enhanced contrast. In contrast, while PCA-reconstructed images exhibit slightly lower reconstruction errors—the difference being minimal—they lack the improved contrast found in the autoencoder outputs.

Standard Autoencoder

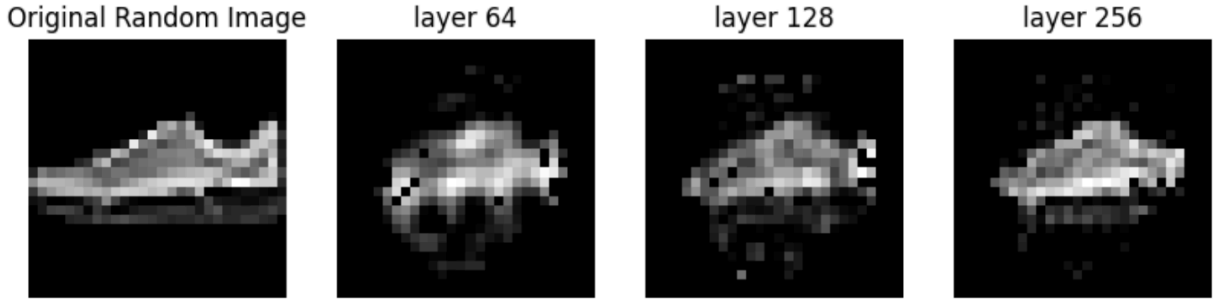


Reconstruction from testset image

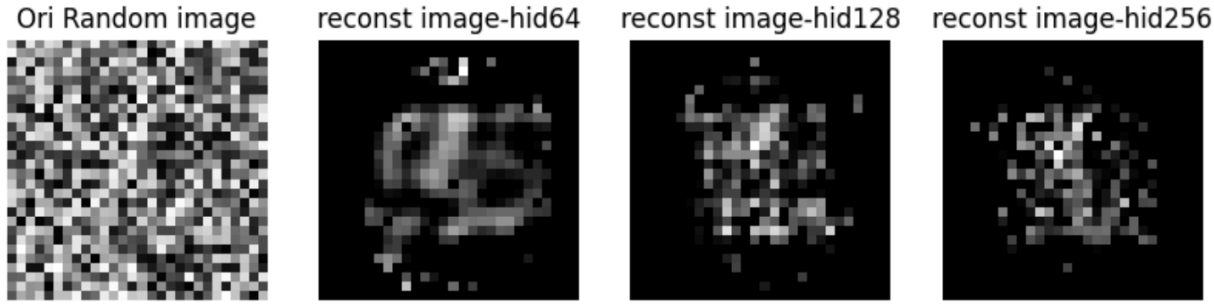
```
Reconstruction Error in hidden layer 64: 11.977818158376152
Reconstruction Error in hidden layer 128: 8.45122520312671
Reconstruction Error in hidden layer 256: 4.126620662363191
```



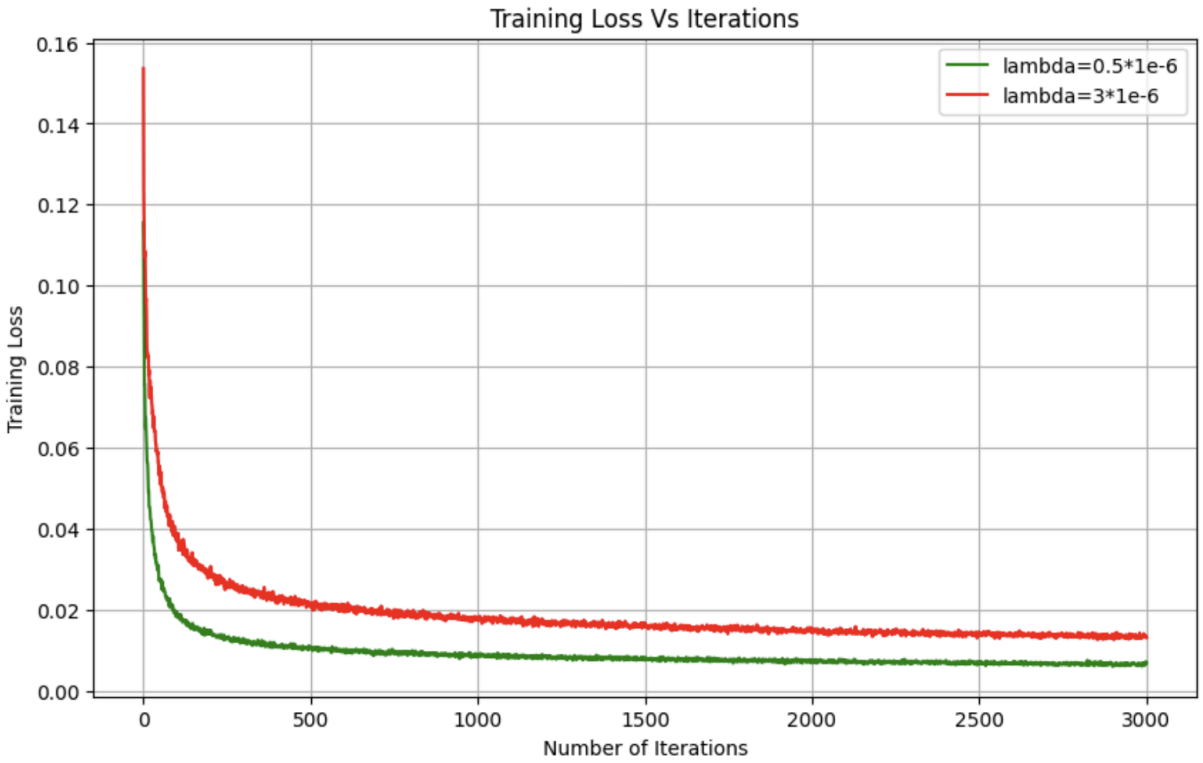
Reconstruction from non-digit images - Fashion MNIST o/p

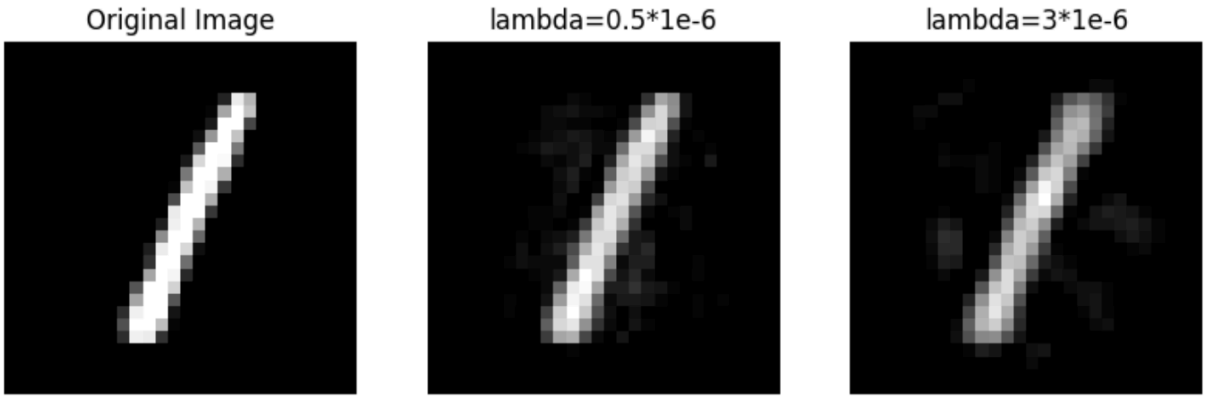


Reconstruction random noise images

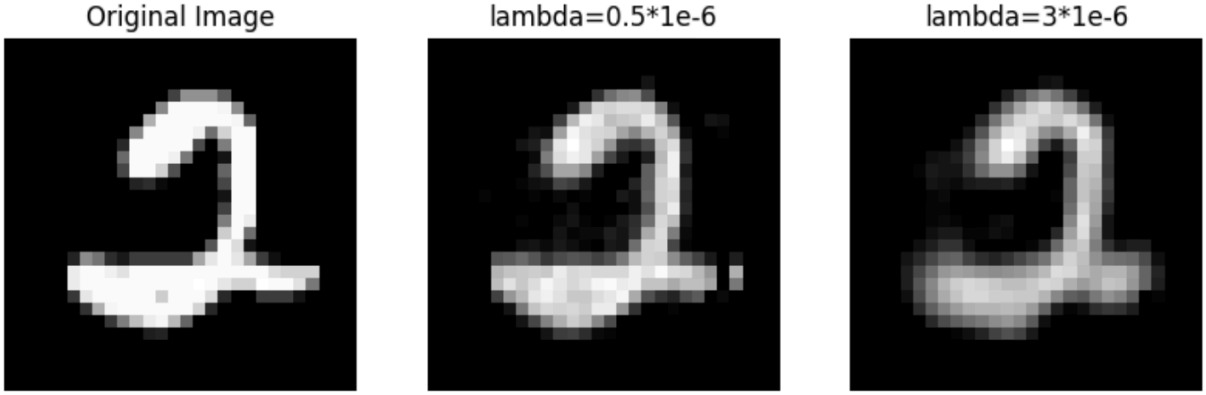


Sparse Autoencoders



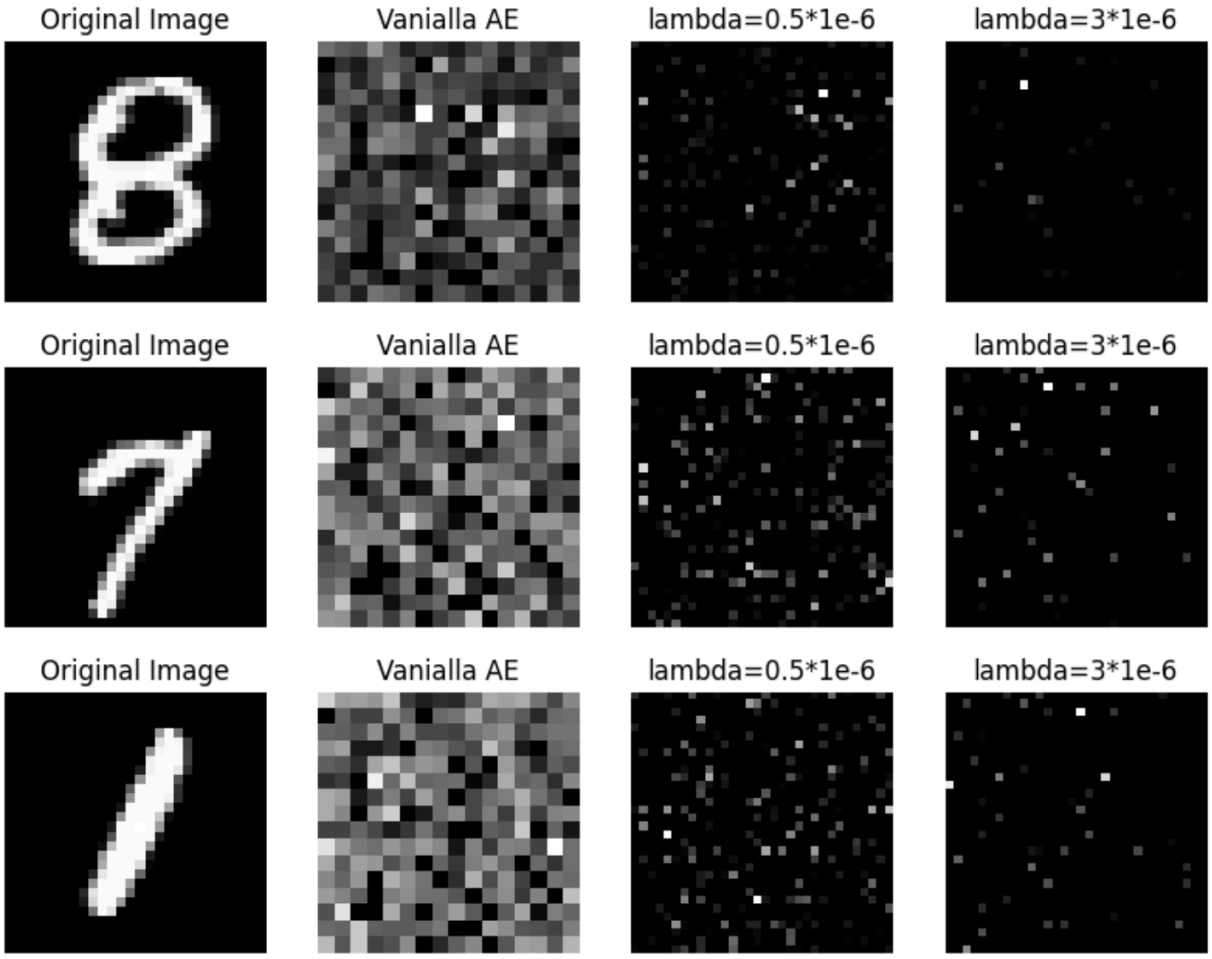



```
Reconstruction Error in SparseAE lambda = 0.5*1e-6 : 2.208584472857042
Reconstruction Error in SparseAE lambda = 3*1e-6: 3.6315592919954067
```

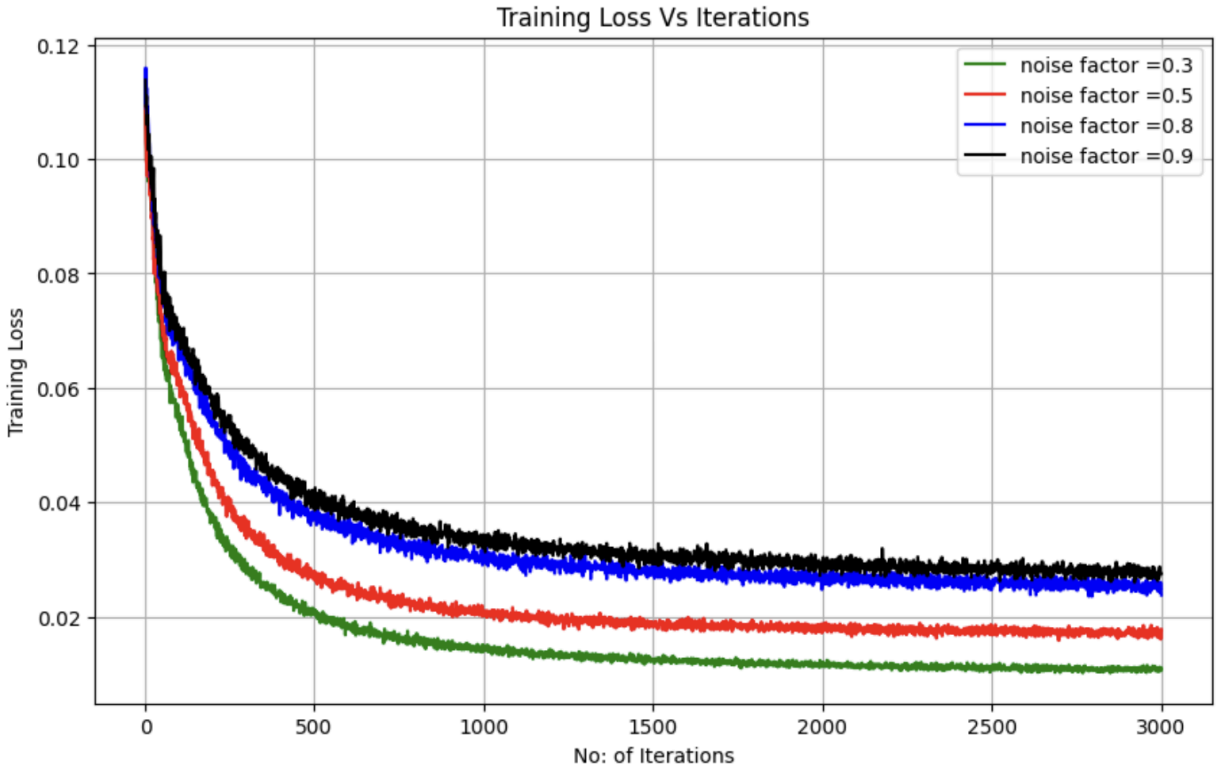



```
Reconstruction Error in SparseAE lambda = 0.5*1e-6 : 7.516961848370433
Reconstruction Error in SparseAE lambda = 3*1e-6: 10.700766658500626
```

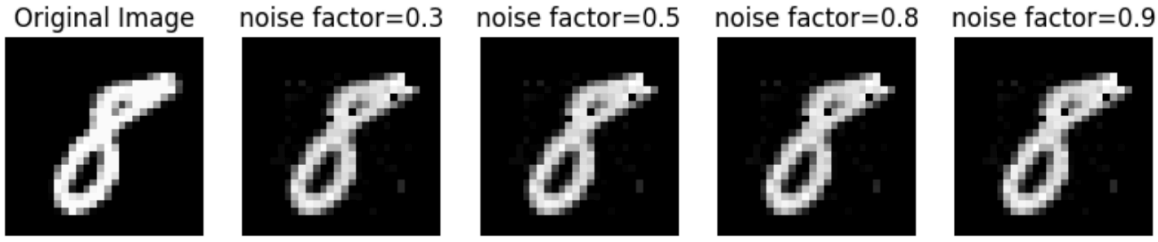
visualize the learned filters of the Sparse AE as images



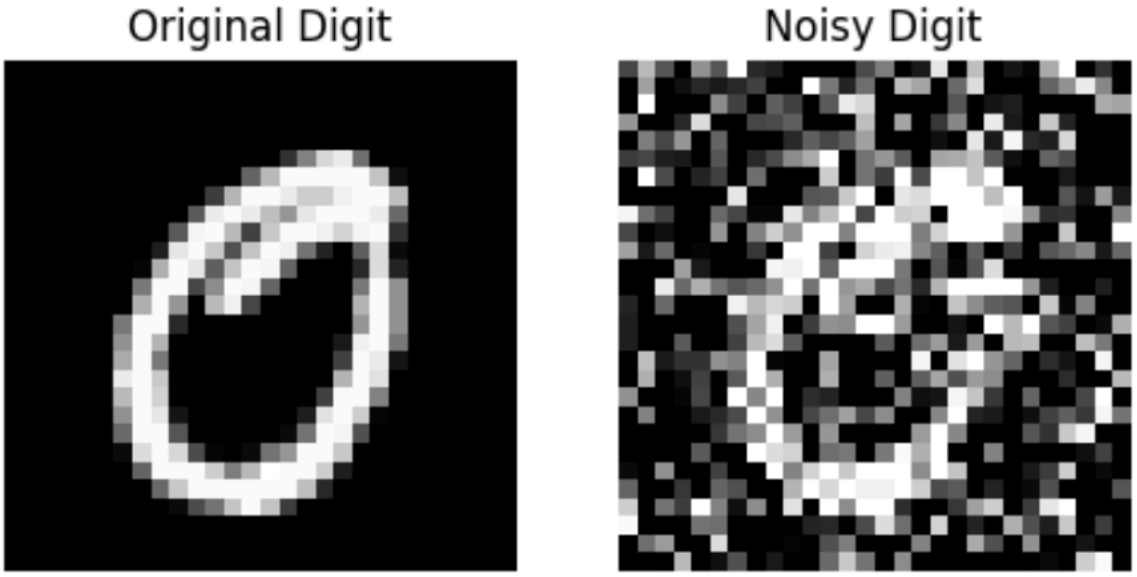
Denoising Autoencoders

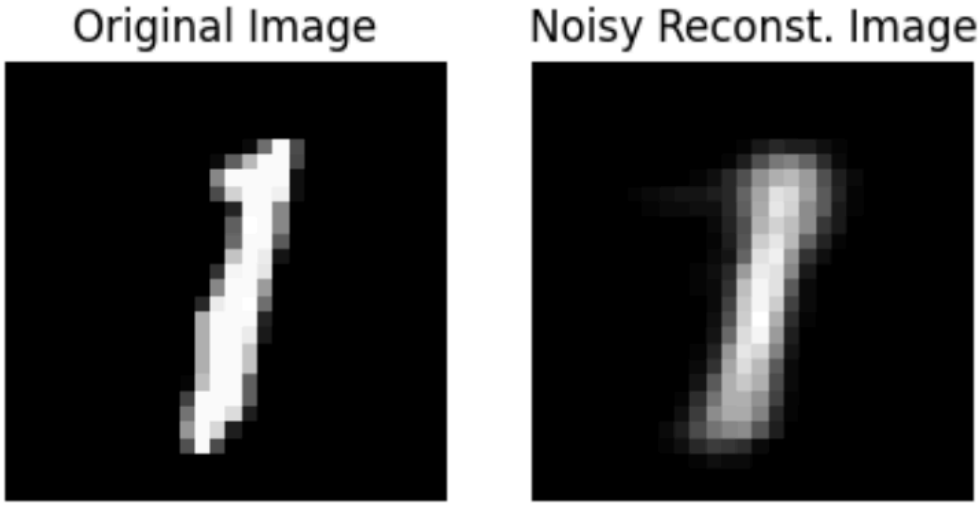



```
Reconstruction Error in VanillaAE with noise factor = 0.3 : 4.758285692172574
Reconstruction Error in VanillaAE with noise factor = 0.5 : 4.7709374212116415
Reconstruction Error in VanillaAE with noise factor = 0.8 : 4.758050556874504
Reconstruction Error in VanillaAE with noise factor = 0.9 : 4.75845746901802
```

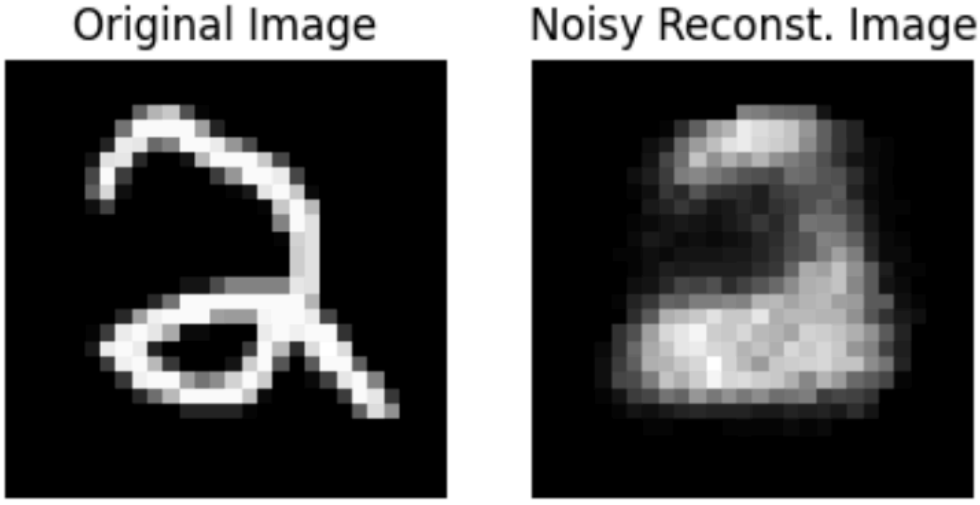


Manifold learning

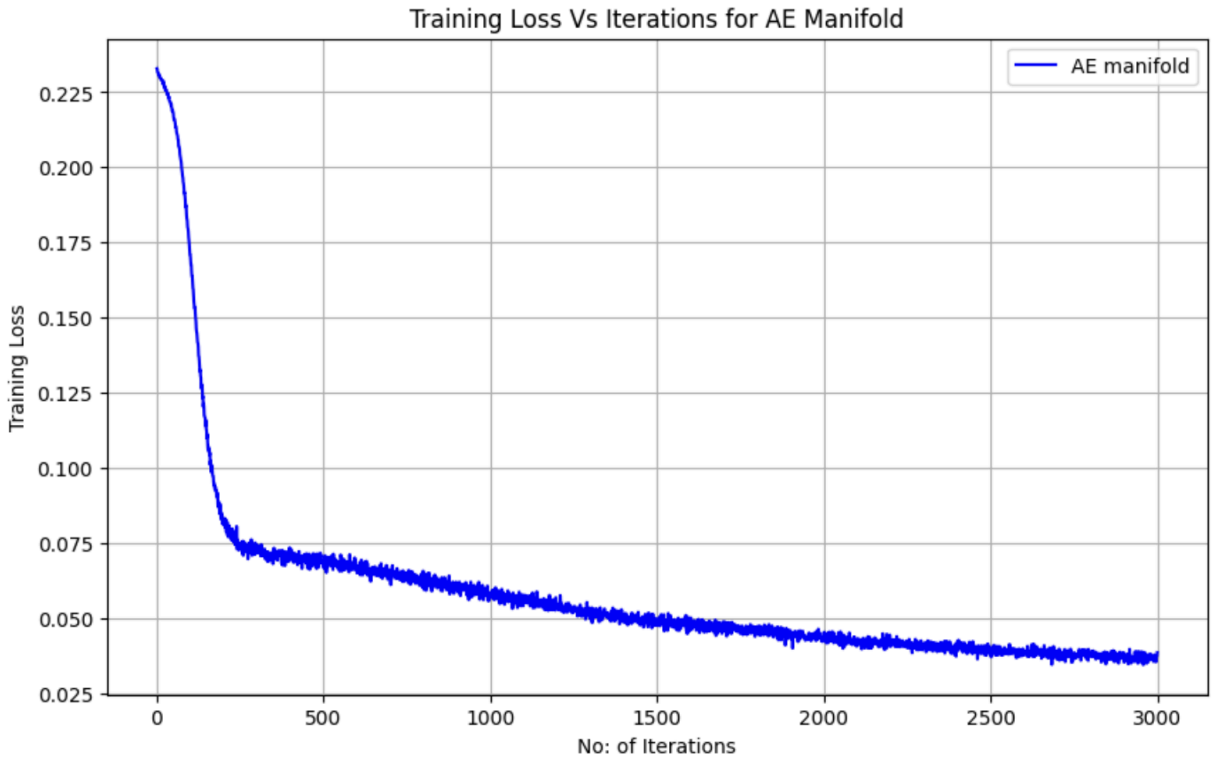




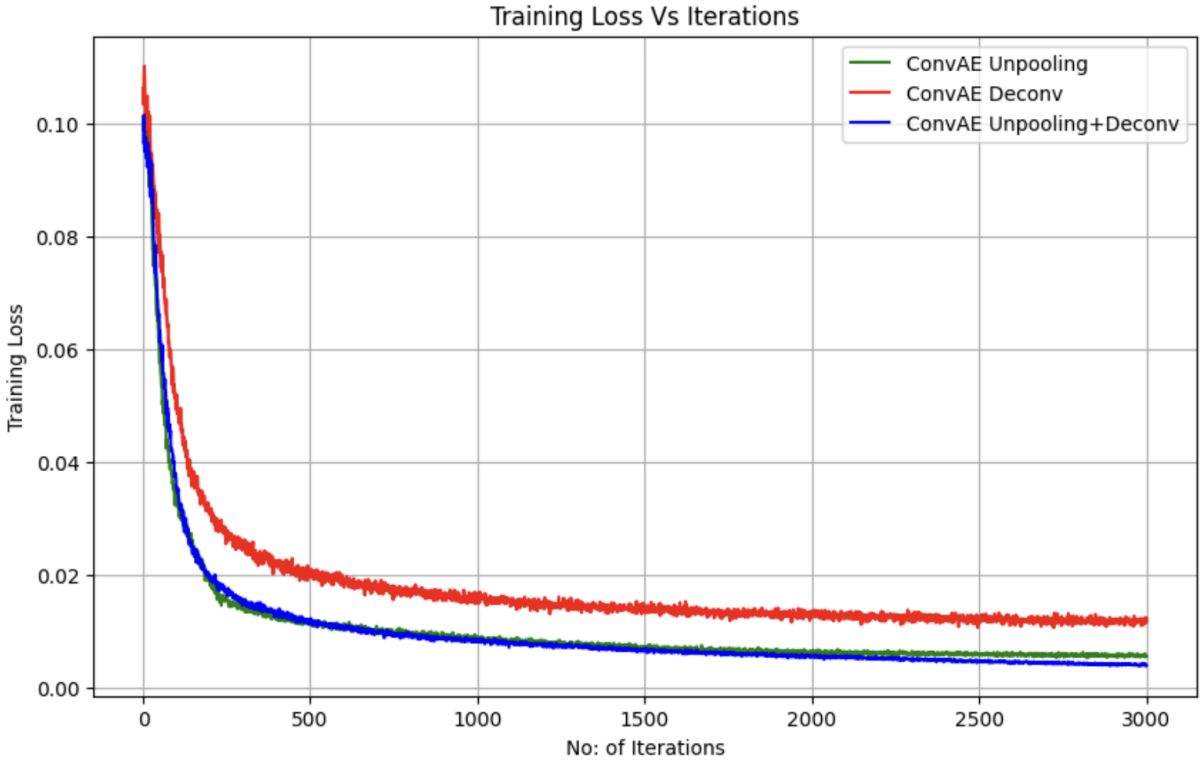
Reconstruction Error for Image 2: 0.00013714117812924087

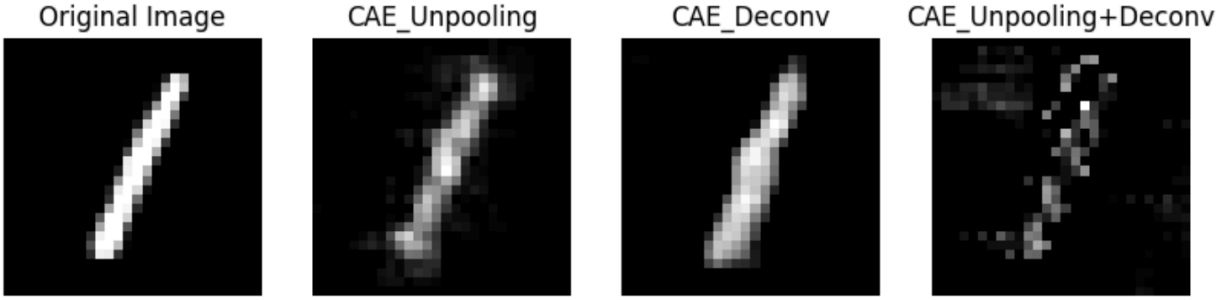


Reconstruction Error for Image 3: 0.0007182587287388742

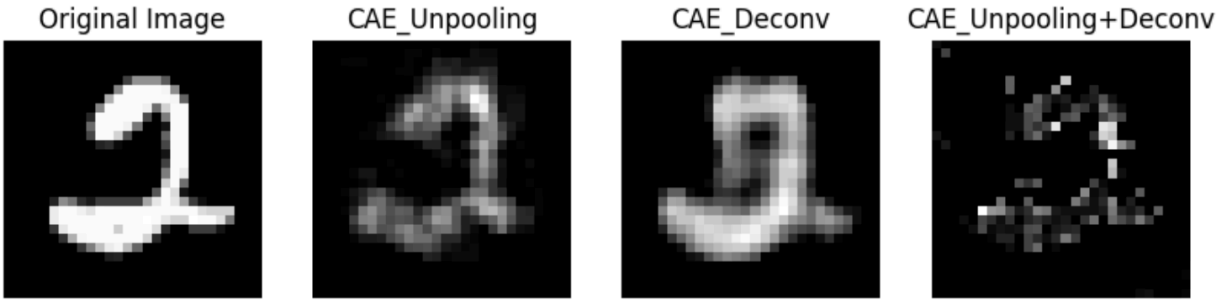

Training Loss Vs Iterations for AE Manifold
AE manifold
Training Loss
No: of Iterations
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0
500
1000
1500
2000
2500
3000

Convolutional Autoencoders



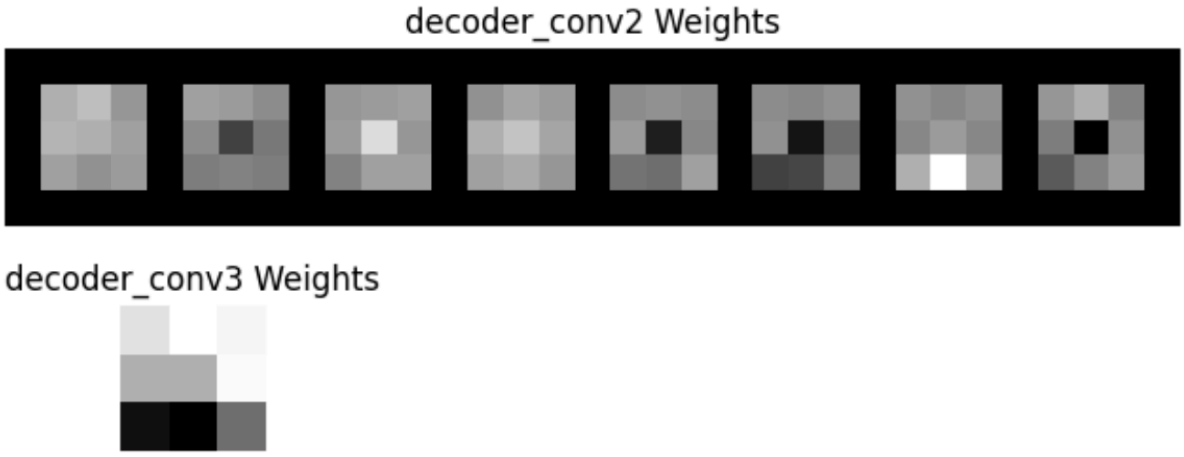



```
Reconstruction Error in ConvAE Unpooling: 41.09798739985503
Reconstruction Error in ConvAE Deconv: 11.099846611587598
Reconstruction Error in ConvAE Unpooling+Deconv: 157.03552962947595
```



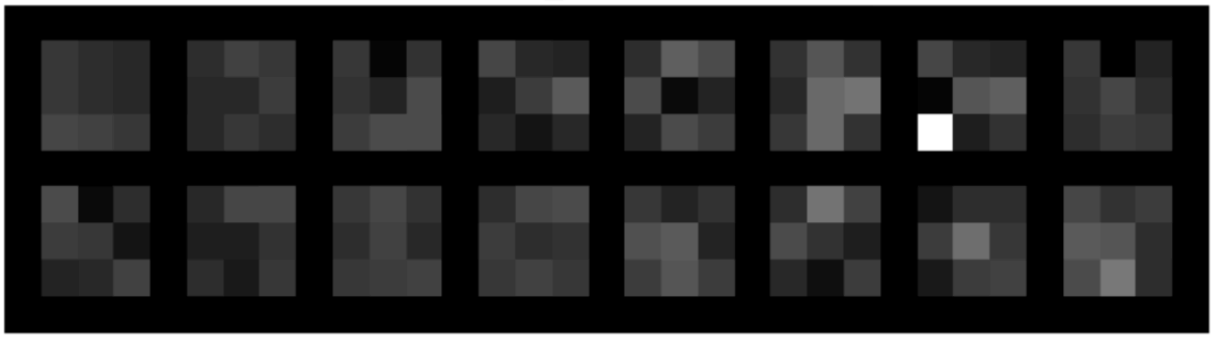

```
Reconstruction Error in ConvAE Unpooling: 249.00256747616373
Reconstruction Error in ConvAE Deconv: 49.661515593520456
Reconstruction Error in ConvAE Unpooling+Deconv: 906.3791487199521
```

Visualising decider weights for convolution Autoencoder with unpooling

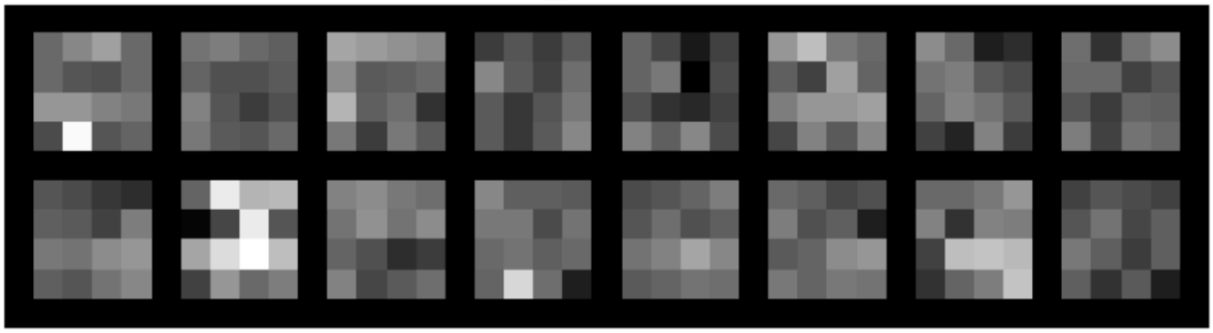


Visulalising decoder weights for convolution Autoencoders with deconvolution

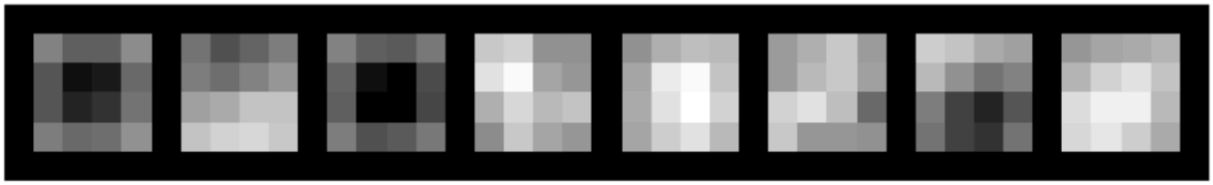
decoder_conv1 Weights



decoder_conv2 Weights



decoder_conv3 Weights



Visulalising decoder weights for convolution Autoencoders with unpooling + deconvolution