

ASSIGNMENT-3

Submitted by

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Submitted to

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Objective: Implement a simple encoder-decoder neural network with one hidden layer using MSE loss and 70:20:10 train:val:test split to train the network, and compare the reconstruction error.

Autoencoder and Principal Component Analysis:

1. Auto-encoders are capable of modelling Linear and complex non linear functions both.
2. A single layered autoencoder(Encoder-Decoder) with a linear activation function is very similar to PCA.
3. Auto-encoders are a type of deep neural networks that map the data to itself through a process of (non-linear) dimensionality reduction, followed by dimensionality expansion
4. PCA's objective is to find an invertible transformation from the original space of the data to a lower-dimensional space.
5. PCA can be kernalized to enable the search for non-linear transformations.
6. PCA is faster and computationally cheaper than autoencoders.

Code Implementation:

Experiments shows that a single layered autoencoder(Encoder-Decoder) with a linear activation function is very similar to PCA.

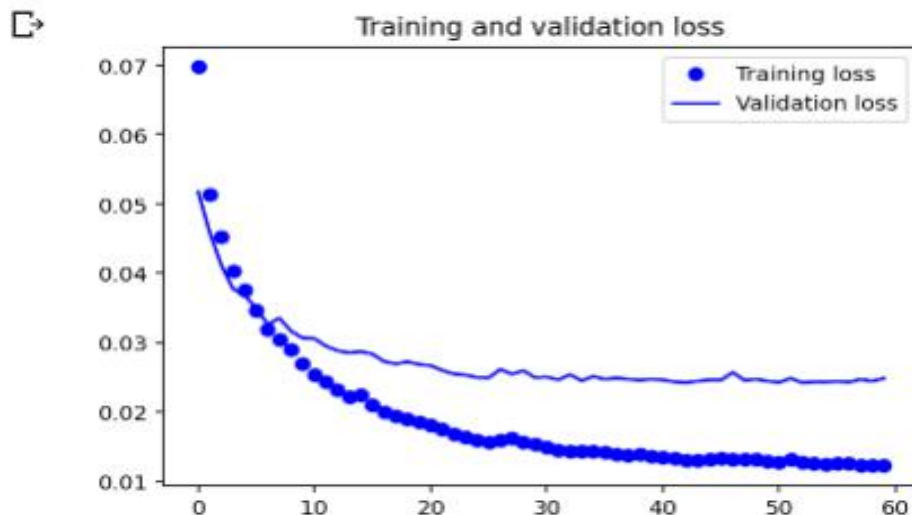
1. Split data into Train:Val:Test in ratio of 70:20:10

```
↳ Automatically created module for IPython interactive environment
530
(530, 250, 250)
Total dataset size:
n_samples: 530
n_features: 530
Training images size: 381
Validation images size: 96
Testing images size: 53
Training images shape: (381, 62500)
validation images shape: (96, 62500)
Testing images shape: (53, 62500)
```

2. MSE loss for Encoder-Decoder Neural Network

At epoch 51 with adam optimizer , ReLU, sigmoid activation function
training loss is 0.0122 , validation loss =0.0236 ,Testing loss = 0.0245

```
381/381 [=====] - 37s 98ms/step - loss: 0.0126 - val_loss: 0.0239
Epoch 49/60
381/381 [=====] - 37s 98ms/step - loss: 0.0125 - val_loss: 0.0240
Epoch 50/60
381/381 [=====] - 37s 97ms/step - loss: 0.0123 - val_loss: 0.0241
Epoch 51/60
381/381 [=====] - 39s 101ms/step - loss: 0.0122 - val_loss: 0.0236
Epoch 52/60
381/381 [=====] - 37s 98ms/step - loss: 0.0123 - val_loss: 0.0250
Epoch 53/60
381/381 [=====] - 37s 98ms/step - loss: 0.0128 - val_loss: 0.0248
Epoch 54/60
381/381 [=====] - 38s 101ms/step - loss: 0.0130 - val_loss: 0.0242
Epoch 55/60
381/381 [=====] - 37s 98ms/step - loss: 0.0126 - val_loss: 0.0239
Epoch 56/60
381/381 [=====] - 37s 98ms/step - loss: 0.0124 - val_loss: 0.0238
```



3. MSE loss for Principal Component Analysis:

MSE loss on training set: = 0.00206032

MSE loss on validation set: = 0.010891

MSE loss on test set= 0.0104066

4. Compare the reconstruction error:

Results shows even PCA is sometime better than single layer
encoder-decoder neural network for small datasets and with Linear
activation function

Results: We can also see the difference in below images

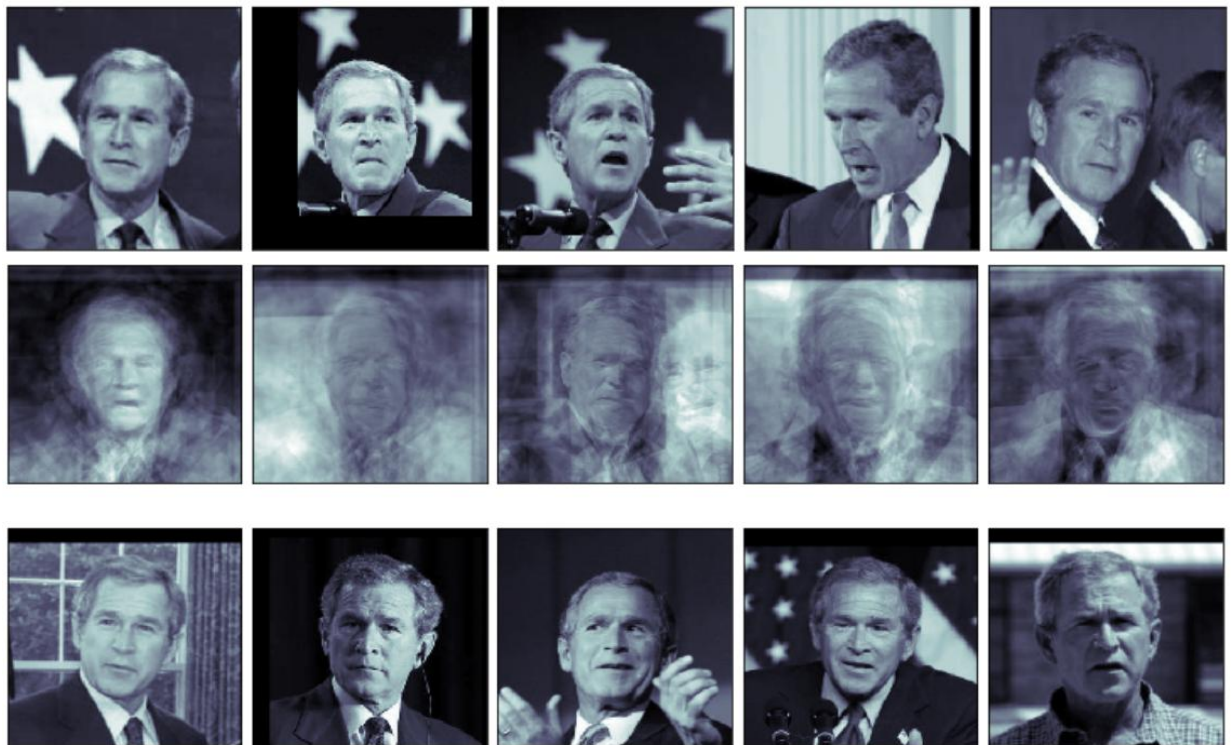
1. Encoder Decoder Neural network

Comparison of original image with reconstructed image



1. PCA results to show variation in the top few eigenvectors during reconstruction

When component = 53 for test data we got Highest accurate image



When component = 30 for test data



When component = 5 for test data poor accuracy

(53, 5)

[0.28457284 0.37143892 0.43604743 0.48917344 0.5344049]

