AML Assignment-3

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Dataset: ExtendedYaleB dataset

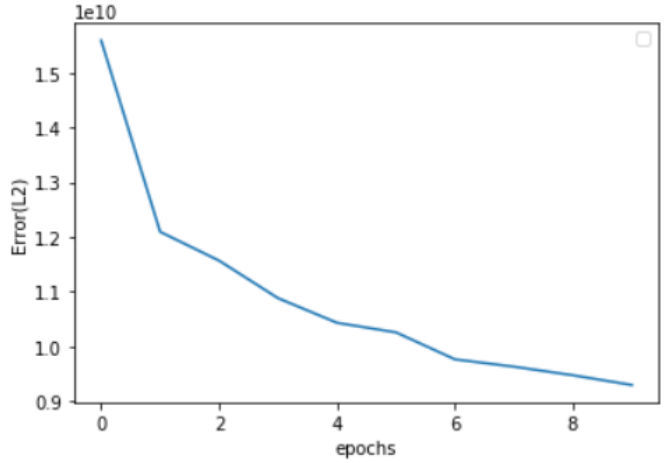
- For Dictionary learning and Transform learning, our dataset has 10 classes yaleB11-yaleB21 where each class has 585 images of 3x480x640 resolution.
- As this image is large, it is converted to grayscale image and then resized to 28x28 and 60x60 for our processing convenience (resized due to high computational duration).
- So our dataset has total of 5850 samples.

1. Dictionary learning:

- For Dictionary learning, optimization function is

$$\text{argmin} \sum ||Y\text{-}DX||^2_2 + \lambda||X||_0$$

- To update X (representation), I used OMP (orthogonal matching pursuit) algorithm.
- It initializes our representation approximation to our data by taking sparsity parameter.
- For this I used K-SVD algorithm for optimizing. It is used to update atoms of our D (dictionary).
- In this K-SVD algorithm, it will first fix the D and try to best fit our representation(X) iteratively.
- And next fix the X including rank-1 approximation of residual matrix that in previous step and updates the D.
- Trained the dictionary by choosing parameters sparsity, epochs and dimensions of our D and X.
- Tried Random initialization and Glorot initialization and reported the training errors.

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Execution time:  68.77 min
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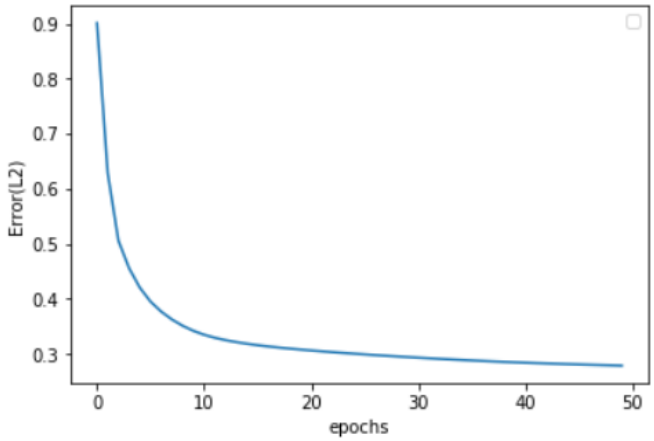
For more epochs-



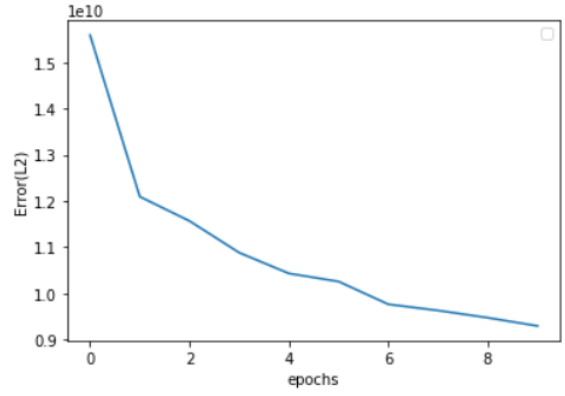
3. Transfer learning framework:

- Transfer learning is a technique used to improve the learning of the target predictive function. It depends on the source and target domains and tasks.
- In this our domain of source D_S and target D_T are similar i.e., the images are taken under different illuminations.
- And task is classification by forming the synthetic and analysis parts from dictionary learning and transform learning.
- We can design a convolutional transform learning (analysis framework) and include a classifier to it to recognize the class.
- We can design a network using CNN along with TL like in following papers paper1 (Convolutional TL), Inductive Transfer learning technique- paper2 (sparse multi-task and transfer learning).

- In Inductive transfer learning we will have source domain and target domain as same, and task is different (here classification) but related.
- Thus we can train our network using transfer learning (dictionary as weights) and classify our new dataset.

5. Analysis:

- For Dictionary learning, I trained for Random initialization and Glorot initialization for 28x28, 32x32, 60x60 image sizes for our computation convenience and analysed the performances of each.
- All the execution is under without GPU.
- Set the parameters of sparsity=4.
- For 60x60 image patches: trained for 8 epochs and convergence is observed as number of epochs are increased.
- As our dictionary size is more it is taking so much of time (it is taken >1hour for just 8epochs).
- By increasing epoch, the error is decreasing.
- For 28x28 image dataset: trained for 50 epochs and observed convergence is smooth and faster.
- As epochs are more giving better performance.

	Training error	Dictionary Visualization
60x60 image patches	 Execution time: 68.77 min	

28x28 image patches