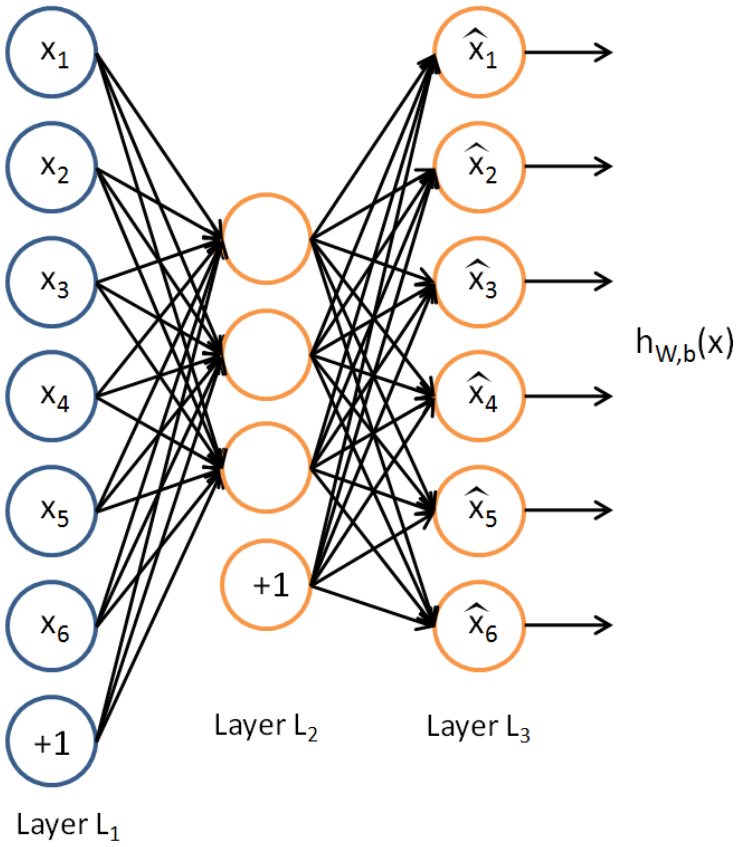
Autoencoder Implementation

Pankaj Chhabra, Shashank Singh

Autoencoders are neural networks whose output nodes are equal in number to its input nodes, its primary purpose being encoding its input in reduced dimensions. To come up with an efficient encoding for images of a certain pattern, it is trained with sample images of that pattern, for e.g.: faces.



Project

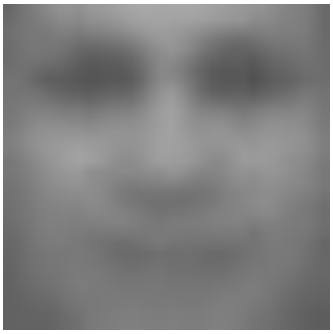
- Create an auto-encoder with 256 hidden nodes and 1 hidden layer.
- No use of libraries.
- To be extensible to create multi-layer (deep) neural network.
- Given training set of 32x32 images, any new image of same pattern should produce least root mean square error.
- Algorithm: http://ufldl.stanford.edu/tutorial/supervised/MultiLayerNeuralNetworks/

Approach and Implementation

1. Understanding key components of the algorithm:
   Forward Feed, Error Function, Backpropagation, Divergence
2. Design and development of a modular and configurable solution using MATLAB
3. Training
4. Plots for finding best parameters
5. Training with best parameters
6. Validations

Outcomes and Observations

Original

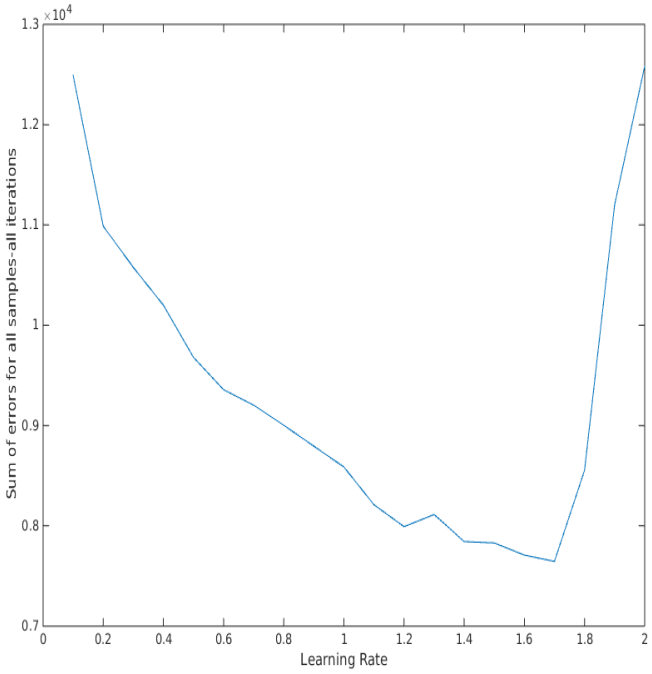


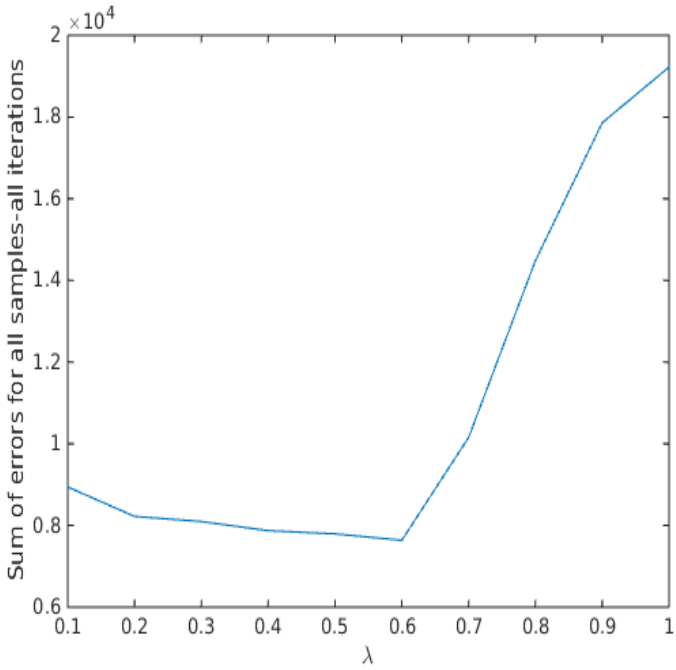
1 Layer

2 Layer

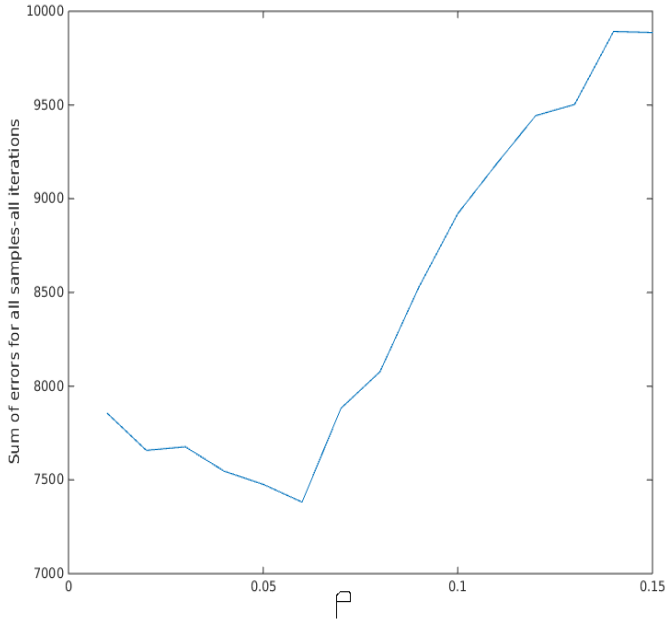
- Encodes a 'template' face that will match a wide variety of facial images
- Compressing 1024 pixel information to 256 nodes will bring errors
- The variety of shades, styles and expressions in faces makes it challenging
- Deep network = smoother image but not necessarily more accuracy

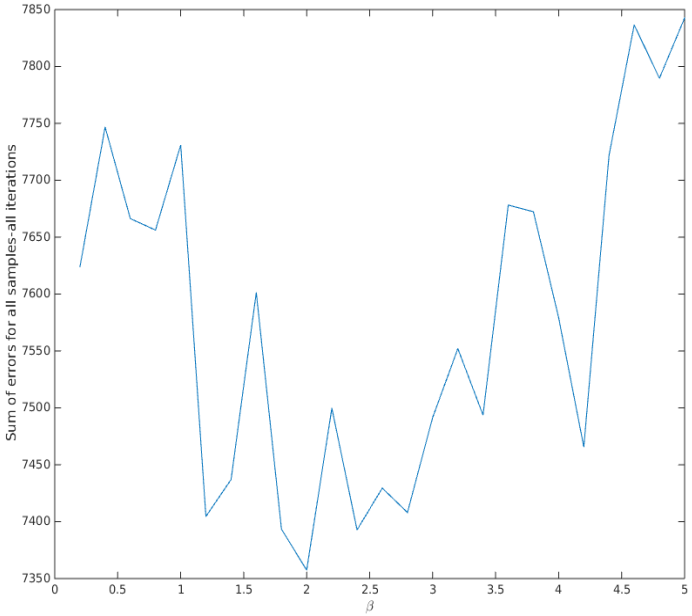
Plots that helped us figure out the optimum parameters



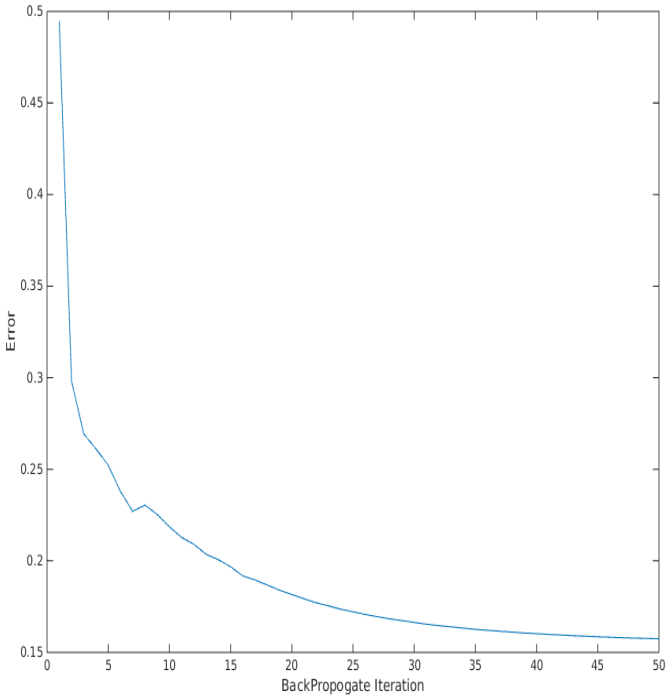


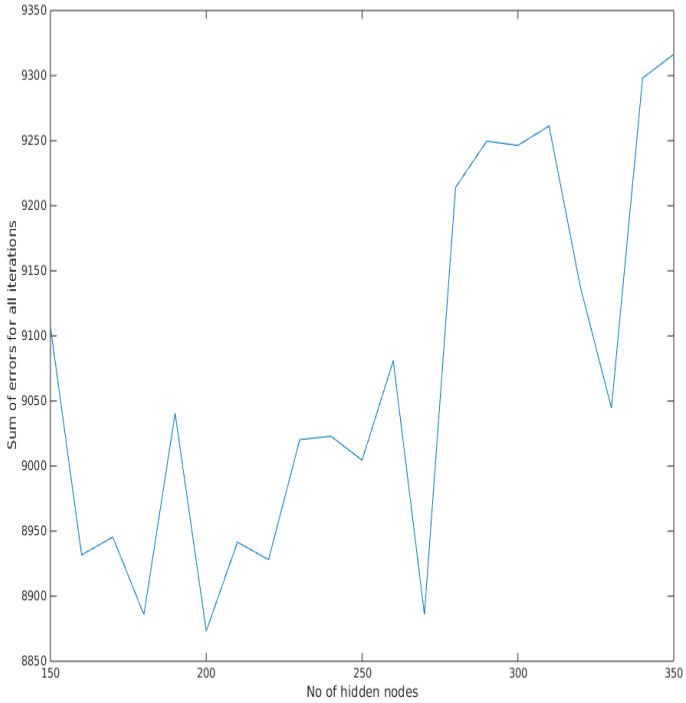
Errors is sum of all scaled (0-1, since network needs scaled input) errors for 1000 images in 50 iterations





Below plots show variations of errors with number of iterations and hidden node count





How To Use

- Open '**autoencoder.m**' file in MATLAB. Ensure your current MATLAB working directory is the directory in which that file is present.
- Configure the parameters in the configuration section like folder names of training and validation images, hidden layers and node count, etc.
- Ensure the valFolderPath is without the last slash and accessible from current directory. Advisable to keep it as a folder in the working directory itself.
- Most of the other parameters have been optimized for facial data. In case you want to try and change them, lookup their meaning here
- Once the script has finished execution, look at the encoded output images at the outFolderPath in the working directory.

Individual Contributions

Pankaj Chhabra: Functional overview, helper methods and parallel experiments.

Pankaj.Chhabra@asu.edu

Shashank Singh: Design and development, optimization.

Shashank.h.singh@asu.edu

References

1. http://ufldl.stanford.edu/tutorial/supervised/MultiLayerNeuralNetworks/
2. http://ufldl.stanford.edu/tutorial/unsupervised/Autoencoders/