Autoencoders are an unsupervised learning technique in which neural networks are exploited for the task of learning representations. An auto-encoder is a neural network that learns to copy its input to its output. It has an internal (hidden) layer that describes a code used to represent the input, and it's made up of two main parts: an encoder that maps the input into the code, and a decoder that maps the code to a reconstruction of the original contribution as shown in Figure 1.
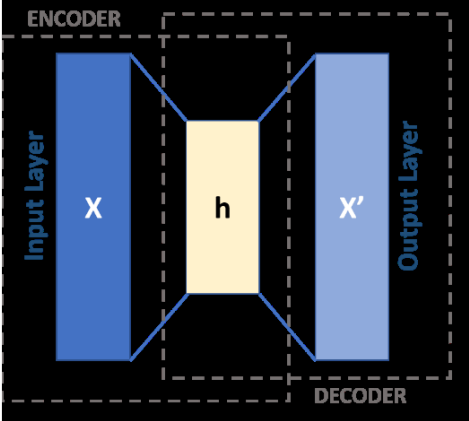

Figure 1. A general autoencoder

In this project, you are required to design and test an autoencoder. Here it is also required to write your own BPN algorithm. You are not allowed to use a library for BPN The multilayer perceptron neural network can be used to perform lossy data compression. Consider the neural network architecture shown in Figure 2. The network consists of two layers: a hidden layer and an output layer. The number of neurons in the hidden layer is smaller than the dimension of the input vectors, and it performs the compression of the input data to a lower-dimensional vector space. The vectors used as input patterns are used as target patterns as well. Therefore, the output layer of the network is trained to reconstruct the input data from their lower-dimensional representation.
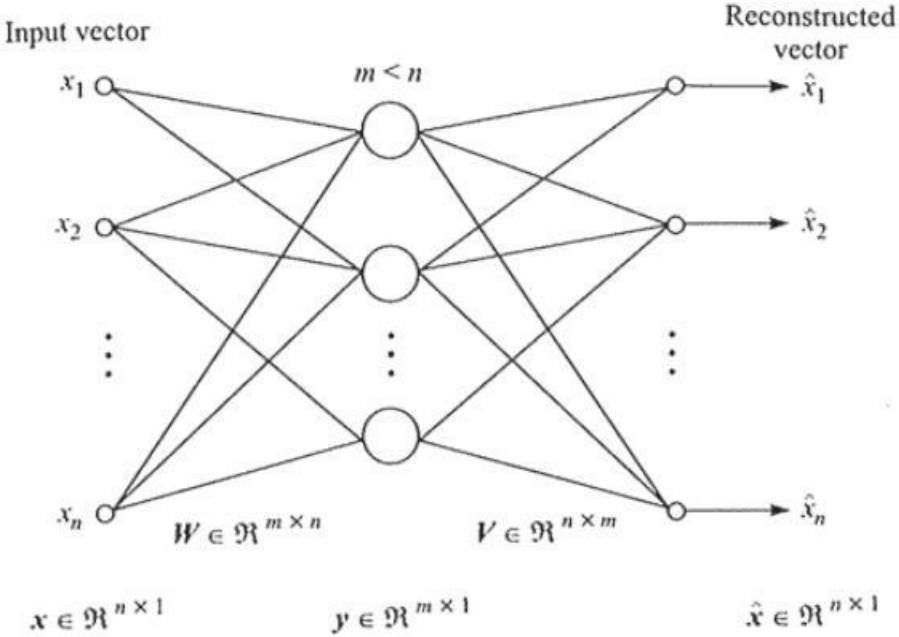

Figure 2. A multilayer architecture for image compression

After the network is trained, compression is performed by storing the outputs of the hidden layer instead of the input data. Also, to be able to reconstruct the data, the weights of the output layer

need to be stored as well. Let $\Psi_1(\cdot)$ and $\Psi_2(\cdot)$ be the nonlinear mappings performed by neurons in the hidden and output layers, respectively. After the network is trained, the compression step is accomplished as

$$y = \Psi_1(\boldsymbol{W}x)$$

The reconstruction of the original signal is performed as

$$\hat{x} = \Psi_2(\boldsymbol{V}y)$$

Write a computer program that uses the MLP NN trained by backpropagation to perform image compression. To generate the input/target vectors x, divide the image into 8-by-8-pixel blocks and arrange the elements of each block into a 64-dimensional vector. Experiment with different numbers of neurons in the hidden layer.

You can use a gray level image that you can chose or Leena image which is given in this homework.

Write a report which shows different kind of compression results.