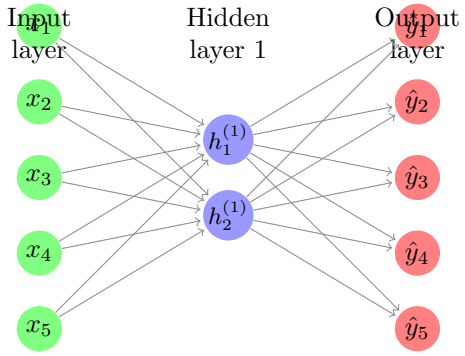
DEEP LEARNING WEEK 6

1. We are using the following autoencoder with linear encoder and linear decoder. The eigenvectors associated with the covariance matrix of our data X is $(V_1, V_2, V_3, V_4, V_5)$. What are the representations most likely to be learned by our hidden layer H? (Eigenvectors are written in decreasing order to the eigenvalues associated with them)



a)V_1, V_2
b)V_4, V_5
c)V_1, V_3
d)V_1, V_2, V_3, V_4, V_5
Answer: a)
Solution: Since the encoder and decoder functions are linear, the representation learned by our autoencoder will be the same as PCA, which for this case will be two eigenvectors with the largest corresponding eigenvalues.

2. What is the purpose of a decoder in an autoencoder?
a) To reconstruct the input data
b) To generate new data
c) To compress the input data
d) To extract features from the input data

Answer: a)

Solution: The decoder in an autoencoder is responsible for reconstructing the input data from the encoded representation generated by the encoder. It is used for data reconstruction and is typically the reverse of the encoding process.

3. What are the advantages of using a denoising autoencoder?
a) Robustness to noisy input data
b) Reduction of the risk of overfitting
c) Faster training time
d) It promotes sparsity in the hidden layer

Answer: a), b)

Solution: Denoising autoencoders are designed to handle noisy input data by reconstructing the original clean input from a corrupted version. This can increase the robustness of the network to noise in the input data.

4. We are given an autoencoder A. The average activation value of neurons in this network is 0.06. The given autoencoder is:

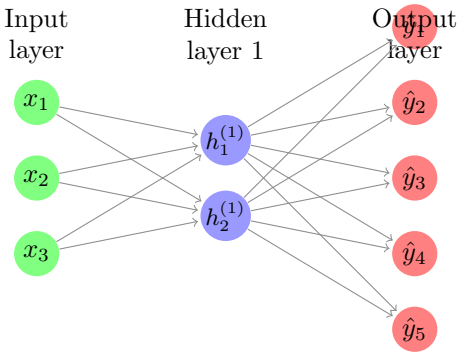
   a)Contractive autoencoder
   b)Overcomplete neural network
   c)Sparse autoencoder
   d)Denoising autoencoder

   Answer: c)

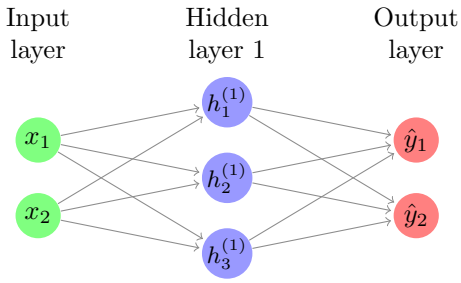
   Solution: The neurons are mostly inactive for a given input. Hence the autoencoder is sparse autoencoder.

5. Which of the following networks represents an autoencoder?

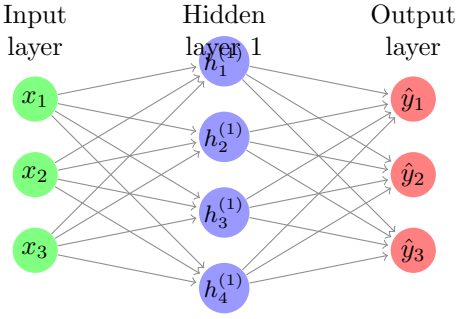
a)

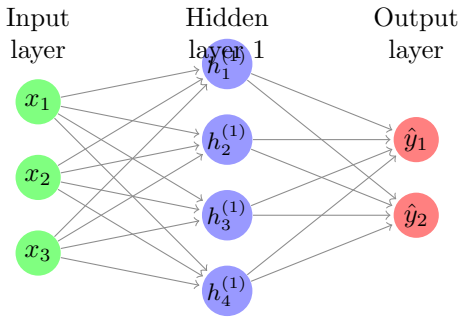


b)



c)





d)

Answer: c)
Solution: Autoencoder is used for learning the representation of input data. Hence the output layer's size should be the same as the input layer's size to compare the reconstruction error. ‘

6. If the dimension of the hidden layer representation is less than the dimension of the input layer, then what kind of autoencoder do we have?

   a)Complete autoencoder
   b)Under-complete autoencoder
   c)Overcomplete autoencoder
   d)Sparse autoencoder

   Answer:b)
   Solution: If the $dim(h_i) < dim(x_i)$ then the given autoencoder is a undercomplete encoder.

7. Consider a scenario where we have a single data point with features x1, x2, x3, x4, x5 taking values -1, 2, 3.2, -5.6, 0 respectively. In this case, which function would be most suitable to use on the output layer (decoder) of an autoencoder for training on this particular dataset ?

   a)Logistic
   b)Relu
   c)Tanh
   d)Linear
   Answer:d)
   Solution: Since our data comes from $\mathcal{R}$ and not $(-1, 1)$ or $(0, 1)$, Linear function would work best.

8. If the dimension of the input layer in an over-complete autoencoder is 5, what is the possible dimension of the hidden layer?
   a)4
   b)2
   c)8
   d)0

   Answer: c)

   Solution: The dimension of the hidden layer is higher than the input layer in the over-complete autoencoder.

9. What is the primary objective of contractive autoencoders that distinguishes them from vanilla autoencoders?
   a) They learn a low-dimensional representation of the input data
   b) They minimize the reconstruction error between the input and the output
   c) They capture only the important variations/features in the data
   d) They maximize the mutual information between the input and the output

   Answer: c)

   Solution: The contradictory penalty functions in the contractive encoder ensure that only the important variations/features are captured in the data.

10. What are the possible applications of autoencoders? (MSQ)

    a)Data Compression
    b)Extraction of important features
    c)Reducing noise
    d)All of these

    Answer:d)
    Solution: Under complete autoencoders compress the data using lower dimensional representation. In these lower dimensional representations, only important features are extracted hence reducing the noise.