

# **Machine Learning - Test 2 Question Bank**

## **UNIT 2: MULTI-LAYER PERCEPTRON**

1. What do you understand by the term ‘MLP(Multi-layer Perceptron)’? What were the limitations of Single Layer Perceptron which led to the evolution of MLP?
2. “Multi-layer Perceptrons are the solution to the linear separability problem pointed out by Minsky and Papert in 1969”. Justify this statement with proper illustrations and examples.
3. Illustrate the working of a MLP with an example of your choice. Ensure that you show one ‘epoch’ (one forward pass and one backward pass). Also clearly depict the error in output and the modified weights.
4. Write, illustrate and explain the ‘Forward Pass Algorithm’ used in MLP.
5. What do you understand by ‘Back Propagation of error’ in MLP? Why is called ‘Gradient Descend’ in MLP?
6. Write, illustrate and explain the ‘Backpropagation Algorithm’ used in MLP.
7. Explain the two phases in the working of an MLP for one epoch - that is Forward Pass and Back Propagation of error.
8. What do you understand by the following terms w.r.t MLP:  
(i) Gradient Descend (ii) Local Optima (iii) Global Minima
9. What is the difference between linearly separable and non-linearly separable data? Explain with clear illustrations how MLP handles non-linearity.
10. Write the Backpropagation Algorithm in MLP. Explain with illustrations, the ‘Chain Rule’ in calculus in finding out the partial derivative of the total error ( $E_{\text{total}}$ ) w.r.t weights connecting the input and hidden layer, example  $w_1$ . (**Tip:** For illustration, take a three layer MLP having two neurons at each layer. Also, the mathematical derivation is **not** expected.)

## **UNIT 3 & UNIT 4: DIMENSIONALITY REDUCTION, SUPERVISED LEARNING, BAYESIAN DECISION THEORY**

11. Give any two reasons with examples why we need to do ‘dimensionality reduction’. What are the techniques of dimensionality reduction? Explain **any one** of them with an example.
12. Describe the similarities & differences between following dimensionality reduction techniques:  
(i) LDA and PCA (ii) PCA and ICA (iii) LDA and ICA

- 13.** Explain the working of PCA as a dimensionality reduction technique using any feature vector of your choice. (**Tip:** Make sure to clearly depict the values of Covariance matrix, Eigenvalues, Eigenvectors as well as the linear transformed feature vector).
- 14.** What do you understand by the following terms w.r.t LDA:  
(i) Fischer Ratio (ii) Scatter Within  $S_w$  (iii) Scatter Between  $S_B$
- 15.** Explain the working of LDA as a dimensionality reduction technique using any feature vector of your choice. (**Tip:** Make sure to clearly depict the values of  $S_w$ ,  $S_B$  matrices, Eigenvalues, Eigenvectors as well as the linear transformed feature vector).
- 16.** What are the limitations of PCA, LDA and ICA?
- 17.** What do you understand by ‘Independent Component Analysis(ICA)’? Where is it used?
- 18.** With example illustrations explain why LDA uses ‘mean’ as well as ‘two types of scatter’ while PCA uses only one type of ‘scatter’ (variance).
- 19.** Take any covariance matrix of your choice and use PCA to arrive at the Eigenvalues, Eigenvectors. Which Eigenvalues will you consider for the linear transformation along PC1? What is the reason for your choice?
- 20.** Take any scatter matrices ( $S_w$ ,  $S_B$ ) of your choice and use LDA to arrive at the Eigenvalues, Eigenvectors. Which Eigenvalues will you consider for the linear transformation? What is the reason for your choice?
- 21.** Exercises to Chapter 3 in Alpaydin Bayesian Decision Theory, all questions of Section 3.8.
- 22.** Explain with an example the steps involved in Iterative Dichotomiser 3(ID3) Algorithm.
- 23.** Write and explain the steps involved in Classification and Regression Trees (CART).
- 24.** What are the similarities and differences between ID3 and CART?
- 25.** With examples explain what do you understand by the terms:  
(i) Probably Approximately Correct (PAC) Learning  
(ii) VC (Vapnik-Chervonenkis) Dimension
- 26.** “The loss for a high-risk applicant incorrectly accepted may be different from the potential gain for an erroneously rejected low-risk applicant”. Justify using algorithm of ‘Losses & Risks’.
- 27.** Explain with an example how ‘Association Rule’ is applied to Basket Analysis.
- 28.** What do you understand by the following terms w.r.t ‘Association Rule’:  
(i) Support (ii) Confidence (iii) Lift (iv) Antecedent (v) Consequent