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|  |  | FINAL |  |
| 1. |  | State the mathematical formulation of the SVM problem. Give the solution of the SVM problem. | 10 |
| 2. |  | Give an outline of an algorithm to find the SVM classifier. Using the SVM algorithm, find the SVM classifier for the following data: | 20 |
|  |  | Example no. x1 x2 Class  1 2 1 +1  2 4 3 −1 |  |
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| 3. |  | Explain cross-validation in machine learning. Explain the different types of cross-validations. | 10 |
| 4. |  | Explain with simple example the confusion matrix of a binary classification problem? | 10 |
| 5. |  | Assume the following: A database contains 80 records on a particular topic of which 55 are relevant to a certain investigation. A search was conducted on that topic and 50 records were retrieved. Of the 50 records retrieved, 40 were relevant. Construct the confusion matrix for the search and calculate the precision and recall scores for the search. | 10 |
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| 6. |  | Describe a discrete Markov process with an example. Let there be a discrete Markov process with two states S1 and S2. Given the following sequences of observations of these states, estimate the initial probabilities and the transition probabilities of the process. | 20 |
|  |  | S1S2; S2S2; S1S2; S2S1; S1S1; S2S1; S1S2; S1S1. |  |
| 7. |  | Describe a hidden Markov model in general case. What are the basic problems associated with a hidden Markov model? | 10 |
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| 8. |  | Name and define different activation functions in an artificial neuron with necessary expression and diagram. | 10 |
| 9. |  | Explain the schematic representation of a perceptron. Design a two layer network of perceptron to implement A AND B. | 20 |
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| 10. |  | Why dimensionality reduction is useful in machine learning? Describe the forward selection algorithm for implementing the subset selection procedure for dimensionality reduction | 10 |
| 11. |  | Explain the method of principal component analysis in machine learning. Given the following data, compute the principal component vectors and the first principal components: | 20 |
|  |  | x 2 3 7  y 11 14 26 |  |
|  |  |  |  |
| 12. |  | Name and define the characteristics of an artificial neural networks. | 10 |
| 13. |  | What is the basic idea of the backpropagation algorithm? Illustrate the various steps in the backpropagation algorithm, using a small network with two inputs, two outputs and one hidden layer. Assume that there are two observations: | 20 |
|  |  | Sample Input 1 Input 2 Output target 1 Output target 2  i1 i2 T1 T2  1 0.05 0.10 0.01 0.99  2 0.25 0.18 0.23 0.79 |  |
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| 14. |  | Illustrate the basic concepts and terminology of the theory of support vector machines by the following simple example where to develop some criteria for determining the weather conditions under which tennis can be played: | 20 |
|  |  | Temperature humidity play  85 85 no  60 70 yes  80 90 no  72 95 no  68 80 yes  74 73 yes  69 70 yes  75 85 no  83 78 no |  |
| 15. |  | Explain briefly the terms: Norm; Inner product; Angle between two vectors; Perpendicularity using following data: n=4; x=(-1, 2, 0, 3); y=(2, 3, 1, -4). | 10 |
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| 16. |  | State Bayes theorem and illustrate it with an example. Based on the following data determine the gender of a person having height 6 ft., weight 130 lbs. and foot size 8 in. (use naive Bayes algorithm). | 20 |
|  |  | Person height (feet) weight (lbs) foot size (inches)  male 6.00 180 10  male 6.00 180 10  male 5.50 170 8  male 6.00 170 10  female 5.00 130 8  female 5.50 150 6  female 5.00 130 6  female 6.00 150 8 |  |
|  |  | Find the ML estimate for the parameter p in the binomial distribution. |  |
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| 17. |  | What is Regression problem? Define different Regression models. | 10 |
| 18. |  | Explain polynomial regression using the following data: | 15 |
|  |  | x 3 4 5 6 7  y 2.5 3.2 3.8 6.5 11.5 |  |
| 19. |  | What is criterion for minimization of error in Regression problem? | 5 |
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| 20. |  | What is Regression tree? Using the following data construct a Regression tree: | 15 |
|  |  | x1 1 3 4 6 10 15 2 7 16 0  x2 12 23 21 10 27 23 35 12 27 17  y 10.1 15.3 11.5 13.9 17.8 23.1 12.7 43.0 17.6 14.9 |  |
| 21. |  | Consider the following set of training examples: |  |
|  |  | Instance Classification a1 a2  1 + T T  2 + T T  3 − T F  4 + F F  5 − F T  6 − F T |  |
|  |  | (a) What is the entropy of this collection of training examples with respect to the target  function “classification”?  (b) What is the information gain of a2 relative to these training examples? | 15 |
| 22. |  | What are Regression trees? Explain the concept of a regression tree using an example. | 10 |
| 23. |  | Use ID3 algorithm to construct a decision tree for the data in the following table: | 20 |
|  |  | Age Competition Type Class  Old Yes Software Down  Old No Software Down  Old No Hardware Down  Mid Yes Software Down  Mid Yes Hardware Down  Mid No Hardware UP  Mid No Software Up  New Yes Software Up  New No Hardware Up  New NO Software Up |  |
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