Register Number:……..

KUMARAGURU college of technology
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**B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024**

(Regulation 2018)

Fifth Semester

**ELECTRONICS AND COMMUNICATION ENGINEERING**

U18ECE0014: Machine Learning

**COURSE OUTCOMES**

**CO1:** Compare the various learning methods.
**CO2:** Compare and apply neural network-based learning algorithm
**CO3:** Apply appropriate linear model for a given application
**CO4:** Apply probabilistic, clustering and feature reduction technique for suitable application
**CO5:** Choose appropriate graphical model for given application

**Time: Three Hours** **Maximum Marks: 100**

**Answer all the Questions:-**
**PART A (10 x 2 = 20 Marks)**
**(Answer not more than 40 words)**

| | | | |
|---|---|---|---|
| 1. | What is the purpose of a training set in machine learning? | CO1 | [$K_2$] |
| 2. | Outline the bias-variance tradeoff and how it affects model selection. | CO1 | [$K_2$] |
| 3. | Why does the Perceptron fail to learn the XOR function? | CO2 | [$K_2$] |
| 4. | Compare and contrast RBF networks and Feedforward Neural Networks | CO2 | [$K_2$] |
| 5. | What are support vectors? Recall their role in Support Vector Machines. | CO3 | [$K_2$] |
| 6. | Summarize the limitations of least squares classification. | CO3 | [$K_2$] |
| 7. | How does GMM differ from K-means in terms of cluster assignment? | CO4 | [$K_2$] |
| 8. | How does Linear Discriminant Analysis (LDA) differ from Principal Component Analysis (PCA) in terms of objective? | CO4 | [$K_2$] |
| 9. | What is overfitting in decision trees, and how can it be prevented? | CO5 | [$K_2$] |
| 10. | What is the Markov property, and how does it relate to Markov models? | CO5 | [$K_2$] |

**Answer any FIVE Questions:-**
**PART B (5 x 16 = 80 Marks)**
**(Answer not more than 400 words)**

| | | | | | |
|---|---|---|---|---|---|
| 11. | a) | Explain in detail various types of learning. | 8 | CO1 | [$K_2$] |
| | b) | Examine how does the Vapnik-Chervonenkis (VC) bound relate to overfitting and generalization in machine learning? | 8 | CO1 | [$K_4$] |

12. a) Apply Perceptron learning algorithm to single layer feed forward network to implement an Odd Parity Checker for an input consisting of 3 bits including 2 data bits $D_1D_0$ and a parity bit P as MSB ($PD_1D_0$). Determine the weights and bias of the network after first iteration with initial weights and biases as 0 & learning rate $\alpha$=0.5. Assume $x_0$ is bias input (+1). (Note: An iteration refers to a single update of the model's parameters (weights and biases) during training.) 8 CO2 [$K_3$]

b) Build an RBF network for implementing the sum output of a half adder. 8 CO2 [$K_3$]

13. a) A company wants to predict the monthly sales revenue based on the amount spent on advertising in a given month. The company has data from the last 5 months on advertising expenditure (in $1,000) and corresponding sales revenue (in $10,000). The data is as follows: 8 CO3 [$K_3$]

| Month | Advertising Expenditure in$1000 | Sales Revenue in$100000 |
|---|---|---|
| 1 | 2 | 4.5 |
| 2 | 3 | 6.0 |
| 3 | 7 | 9.0 |
| 4 | 9 | 10.5 |
| 5 | 7 | 14.0 |

Predict the sales revenue for a future month where they plan to spend $6,000 on advertising using Least Squares Regression.

b) Explain the concept of maximum margin classifier with an example. 8 CO3 [$K_2$]

14. a) Describe the K-means clustering algorithm in detail, highlighting its objective function and the steps involved. Provide an example of clustering a small dataset and discuss how the choice of k affects the final clusters. 8 CO4 [$K_2$]

b) Given data points [1,2],[2,3],[5,6],[8,8] and k=2, assign the points to clusters using k-means and update the centroids iteratively. Initially, assume centroids are [1,2] and [8,8]. After the first iteration, the centroids might shift to [1.5,2.5] and [6.5,7]. Repeat this process until convergence. 8 CO4 [$K_3$]

15. a) A small company collects data on three features (e.g., height, weight, and age) from three employees. The data is represented as follows: 4 CO4 [K3]

$$X = \begin{bmatrix} 5 & 2 & 1 \\ 6 & 3 & 2 \\ 7 & 4 & 3 \end{bmatrix}$$

Apply PCA to reduce the dimensionality of this dataset.

b) Design a feed-forward neural network with two input nodes x1 & x2 and bias input node with input x0=+1, only one hidden-layer consists of two nodes Z1 & Z2 and one output node Y to implement two input EXOR gate. Each node in the hidden and output layer has a bias input value of +1. Apply Back propagation algorithm to update the weights and errors for one iteration and determine the output for newly updated weights. Assume α – 0.5 and initial weights as follows: 12 CO2 [K3]

Initial weights between input nodes to hidden nodes:

x1→ z1 = 0.6, x1→ z2 = 0.3, x2→z1=0.2, x2→z2=0.4.

Bias →Z1= 0.2, Bias →Z2 = 0.3

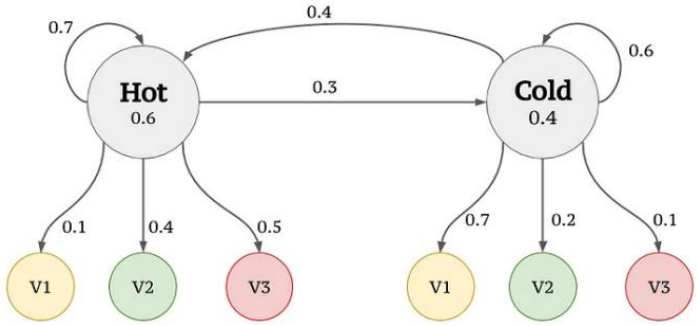
Initial weights between hidden to nodes output nodes:

Z1→Y = 0.2, Z2→Y = 0.5.

Bias →Y = 0.1

16. a) Explain directed graphical models (Bayesian networks) in detail. Include their structure, how they represent dependencies, and provide an example. 8 CO5 [K2]

b) Explain various components and steps of HMM. Also determine the 1. Initial state matrix, 2. State transition matrix, 3. Emission matrix for the HMM state machine given below. 8 CO5 [K3]

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