Code No.: R22CS602PC

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CMR ENGINEERING COLLEGE: : HYDERABAD
UGC AUTONOMOUS
III–B.TECH–II–Semester End Examinations (Regular) - June- 2025
MACHINE LEARNING
(Common for CSE, IT, CSC, CSD, CSM)

[Time: 3 Hours] **[Max. Marks: 60]**

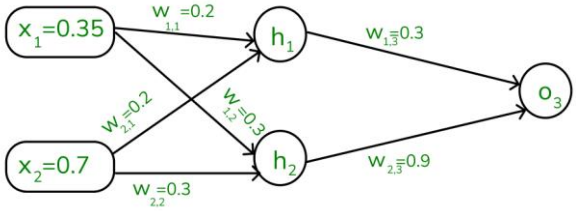
Note: This question paper contains two parts A and B.
Part A is compulsory which carries 10 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A **(10 Marks)**

1.	a)	Interpret checkers game as well posed learning problem.	[1M]
	b)	Given a perceptron with inputs x1=1, x2=0, weights w1=0.5, w2=−0.4, and threshold θ=0.2, compute the net input and determine the output (use step activation function).	[1M]
	c)	Explain the sigmoid output for net input = 0	[1M]
	d)	List any two activation functions is commonly used in MLP hidden layers	[1M]
	e)	Explain inductive bias in decision trees.	[1M]
	f)	For a Gaussian Mixture Model (GMM) with two components: Component1: w1=0.4, N(x|μ=0,σ=1)=0.6 Component2: w2=0.6, N(x|μ=2,σ=1)=0.3 What is total probability?	[1M]
	g)	Differentiate between PCA and LDA	[1M]
	h)	First principal component explains 70% variance, second explains 20%. How much is unexplained.	[1M]
	i)	Define Q Learning and Q(s,a)=1.0, r=2, γ=0.8, α=0.2, maxQ(s′,a′)=3. Calculate Update Q^{new} (s,a):	[1M]
	j)	Describe hidden in a Hidden Markov Model.	[1M]

PART-B **(50 Marks)**

2.	Describe in detail the components involved in Designing A Learning System.	[10M]
	OR	
3.	Derive perceptron training rule and design a Perceptron training model to implement the OR logic gate with weights w1=1, w2=1 and bias=-0.5.	[10M]
4.	Explain the concept of Radial Basis Function (RBF) Networks. How do RBF networks differ from MLPs? Illustrate with the mathematical form of the RBF function.	[10M]
	OR	
5.	Consider a simple MLP with target output as 0.5 and learning rate as 1, calculate the output of one forward pass and one backward pass.	[10M]



6. Derive the update equations for the means and variances in the EM algorithm for Gaussian Mixture Model (GMM). [10M]

OR

7. You are given six two-dimensional data points: (1, 2), (2, 1), (3, 4), (5, 7), (3, 5), and (4, 5). Suppose you want to cluster these points into two clusters using the K-means algorithm. The initial cluster centers are chosen as C1=(1,2) and C2=(5,7). Perform the following tasks: [10M]
   1. Assign each data point to the nearest cluster center based on Euclidean distance.
   2. Compute the new cluster centers as the mean of the points assigned to each cluster.
   3. Reassign the points to the nearest cluster centers using the updated centers.
   4. Repeat the above steps until the cluster centers no longer change or after two iterations.

8. What is Principal Component Analysis (PCA)? Explain the steps involved in PCA and derive the mathematical formulation for finding principal components using eigen value decomposition. [10M]

OR

9. Describe Genetic Algorithm and its process of initial population generation, selection using roulette wheel, crossover, mutation, and evaluation of fitness. [10M]

10. What are Graphical Models? Differentiate between Directed (Bayesian Networks) and Undirected (Markov Random Fields) graphical models with examples. [10M]

OR

11. What are tracking methods in machine learning and AI? Describe how HMMs or Kalman Filters are used in tracking dynamic systems. Provide real-world applications. [10M]

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