Reg. No ..... Name 26P264

M. Sc. DEGREE END SEMESTER EXAMINATION - APRIL 2026

SEMESTER 2 - COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE)

COURSE: 24P2CAIT08 – MACHINE LEARNING

(For Regular 2025 Admission and Improvement/Supplementary 2024 Admission)

Time: Three hours **Max. Weightage: 30**

PART A **Weight: 1**

Answer any 8 questions

1. Discuss the concepts of Overfitting and Underfitting in machine learning with necessary illustrations. (U, CO1)

2. Briefly describe the Parzen Window technique for density estimation. How does the choice of window size affect the estimation? (U, CO1)

3. Describe how SVD is applied in image compression. (A, CO2)

4. Describe a kernel trick in SVM? Explain the difference between linear and non-linear kernels. (A, CO2)

5. Explain DBSCAN and how does it differ from K-means? Discuss its advantage when working with noisy data. (A, CO3)

6. Discuss the working principle of Self Organizing Maps. (A, CO3)

7. Outline the use of placeholders in TensorFlow? Give a practical example of when you would use a placeholder in a simple computation. (A, CO4)

8. Assume in a Markov model, the states are : 1. Rainy (R) 2. Cloudy (C) 3. Sunny (S). Assume the initial probability as Π(R)= 0.4 Π(C)= 0.3 Π(S)= 0.3. Analyze the probability of observing **SCRRRSC** given that today is S. (An, CO4)

	Rainy	Cloudy	Sunny
Rainy	0.5	0.3	0.2
Cloudy	0.2	0.4	0.4
Sunny	0.1	0.1	0.8

9. Examine the role of a convolutional layer in a CNN. Why is it effective for image processing? (An, CO5)

10. Outline the components of a Deep Neural Network. (An, CO5)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11. Discuss the general classes of machine learning problems. (U, CO1)

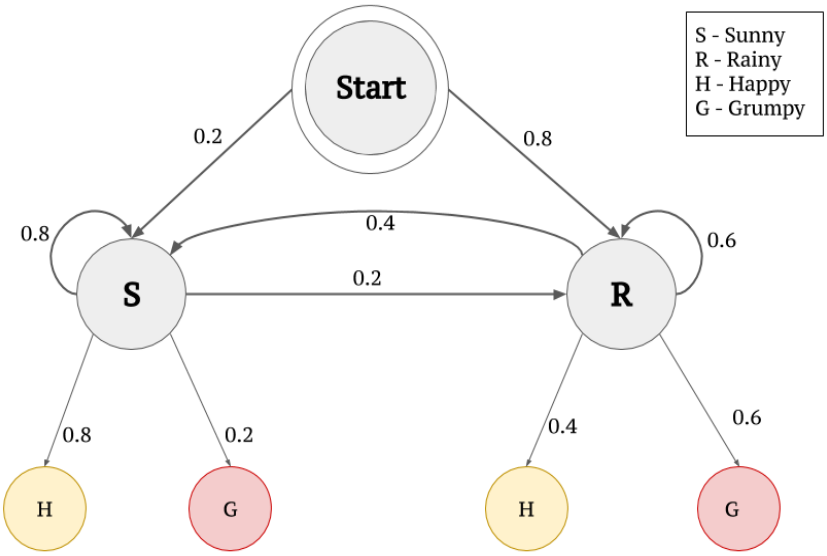
12. Demonstrate the PCA technique used in dimensionality reduction. (A, CO1)

13. Distinguish between Forward pass and Backward pass of a neural network. (An, CO2)

14. Differentiate between Linear and Logistic regression with necessary examples. (An, CO2)

15. Outline the differences between AGNES (Agglomerative Nesting) and DIANA (Divisive Analysis) clustering methods? Provide a use case for each. (A, CO3)

16. Apply the Viterbi Algorithm to decode the hidden state sequence of the observation: **Grumpy, Grumpy.** (A, CO4)



17. Write a basic TensorFlow program that creates two placeholders, adds them together, and prints the result. Explain how you would feed data into the placeholders. (An, CO5)

18. Examine how LSTM networks can be used for time-series prediction. (An, CO5)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. Explain the three primary paradigms of Machine Learning — Supervised, Unsupervised, and Reinforcement Learning. Discuss their core principles, key differences, and support your answer with clear real-life examples for each. (U, CO1)

20. You are given the following data points in a 2D space: (1, 2), (1, 4), (3, 3), (5, 2), (5, 4). Perform one iteration of the k-means algorithm with k = 2, using initial centroids (2, 3) and (4, 3). (A, CO2)

a) Calculate the Euclidean distance between each data point and the centroids.

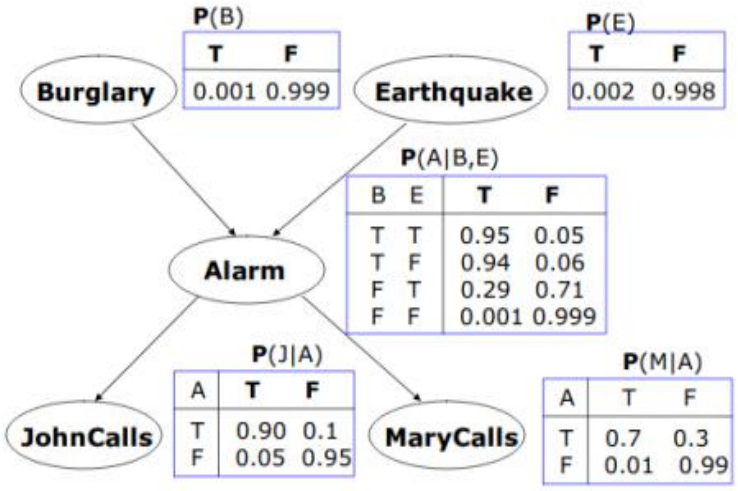
b) Assign each data point to the nearest centroid.

c) Calculate the new centroids based on the data point assignments.

21. i) Analyze the structure and working of Bayesian Belief Networks (BBNs). Explain how they represent probabilistic relationships among variables and how inference is performed in these networks. (A, CO3)

ii) Given the following scenario: Burglary can trigger the alarm. An earthquake can also trigger the alarm. If the alarm goes off, John and Mary may call Harry.

Calculate the probability that the alarm has sounded, but there is neither a burglary nor an earthquake, and both John and Mary called Harry.



22. You have a limited budget for labeling data. Describe an active learning strategy you would use to train a classifier with the fewest labeled examples. Justify your choice of query strategy. (A, CO5)

(**5 x 2 = 10)**

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO1	Explain the fundamental paradigms of machine learning and the principles of density estimation techniques.	U	1,2,11,19	9
CO2	Apply dimensionality reduction methods like PCA and SVD and implement classification algorithms such as Perceptron, Feed Forward Network, and SVM.	A	3,4,12,13	6
CO3	Analyze clustering techniques and regression models to discover patterns and predict outcomes from data.	An	5,6,14,15,20	11
CO4	Examine the efficiency of probabilistic models like Bayesian Networks, HMMs, and CRFs, and apply TensorFlow for machine learning tasks.	An	7,8,16,17,21	11
CO5	Evaluate the performance and applicability of deep learning architectures like CNNs, RNNs, and LSTMs in solving real-world problems.	E	9,10,18,22	9

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;