U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**

Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**

Course Code: 24AM4PCIML **Max Marks: 100**

Course: INTRODUCTION TO MACHINE LEARNING

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			CO	PO	Marks
		UNIT - I			
1	a)	Identify the type of machine learning problem for each of the following scenarios. Justify your answers. i. Predicting if a new image has cat or dog based on the historical data of other images of cats and dogs, where you are supplied the information about which image is cat or dog. ii. Predict which team will win a tournament. iii. Predicting the monthly sales of a cloth store in rupees. iv. Group audio files based on language of the speakers.	CO1	PO1	**8**
	b)	Explain well posed learning problems with suitable examples	CO1	PO1	**4**
	c)	Write Candidate Elimination Algorithm and apply the same to identify the Version Space for the given dataset	CO1	PO2	**8**

Si.No	Eyes	Nose	Head	Color	Hair	Smile
1	Round	Triangle	Round	Purple	Yes	Yes
2	Square	Square	Square	Green	Yes	No
3	Square	Triangle	Round	Yellow	Yes	Yes
4	Round	Triangle	Round	Green	No	No
5	Square	Square	Round	Yellow	Yes	Yes

		UNIT - II								
2	a)	Derive local approximation of target function achieved using locally weighted regression	CO1	PO1	**6**					
	b)	NASA wants to discriminate between Martians (M) and Humans (H) based on the given dataset.	CO2	PO2	**10**					

Example	1	2	3	4	5	6	7	8	9	10
Species	M	M	M	M	M	H	H	H	H	H
Green	N	Y	Y	N	Y	N	N	N	Y	N
Legs	3	2	3	2	3	2	2	2	2	2
Height	S	T	T	S	T	T	S	T	S	T
Smelly	Y	N	N	Y	N	Y	N	N	N	Y

i. Construct the decision tree using ID3 Algorithm.

<table>
<tr><td></td><td></td><td></td><td>ii. Analyze the learned concept for Martian and write set of conjunctive rules.</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>c)</td><td>Explain the hypothesis space search in decision tree learning.</td><td>CO1</td><td>PO2</td><td>4</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>3</td><td>a)</td><td>Using the concept of Linear Support Vector Machine, obtain the corresponding hyperplane for the given Positively labeled data points (3,1) (3,-1) (6,1) (6,-1) and Negatively labeled data points (1,0) (0,1) (0,-1) (-1,0).</td><td>CO2</td><td>PO2</td><td>8</td></tr>
<tr><td></td><td></td><td>b)</td><td>Sample instances classifying the patient as Diabetic or not is summarized below. By applying K-Nearest Neighbor Classifier with k=3, classify the new instance: BMI=43.6, Age=40 accordingly.
<table>
<tr><td>BMI</td><td>33.6</td><td>26.6</td><td>23.4</td><td>43.1</td><td>35.3</td><td>35.9</td><td>36.7</td><td>25.7</td><td>23.3</td><td>31</td></tr>
<tr><td>Age</td><td>50</td><td>30</td><td>40</td><td>67</td><td>23</td><td>67</td><td>45</td><td>46</td><td>29</td><td>56</td></tr>
<tr><td>Sugar</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
</table></td><td>CO2</td><td>PO2</td><td>8</td></tr>
<tr><td></td><td></td><td>c)</td><td>Construct the decision trees to represent the following Boolean functions:
i. A V [B ∧ C]
ii. [A ∧ B] v [C ∧ D]</td><td>CO1</td><td>PO2</td><td>4</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td></td><td>4</td><td>a)</td><td>Derive an equation for the concept Maximum Likelihood and Least Squared Error Hypothesis.</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>b)</td><td>A data scientist has constructed a simplified Bayesian Belief Network (BBN) for diagnosing whether a patient has a certain Disease (D) based on two symptoms (S1 and S2). The observed conditional probabilities are:
D→S1; D→S2;
<table>
<tr><th>D</th><th>P(D)</th><th>P(S1|D)</th><th>P(S1|~D)</th><th>P(S2|D)</th><th>P(S2|~D)</th></tr>
<tr><td>True</td><td>0.1</td><td>0.8</td><td>0.3</td><td>0.7</td><td>0.4</td></tr>
<tr><td>False</td><td>0.9</td><td>0.2</td><td>0.7</td><td>0.3</td><td>0.6</td></tr>
</table>
Compute:
i. The joint probability of Symptoms given Disease.
ii. The total probability of Observing Symptoms.
iii. The probability of having the Disease given the Symptoms.</td><td>CO3</td><td>PO3</td><td>8</td></tr>
<tr><td></td><td></td><td>c)</td><td>Distinguish between voting, bagging and boosting ensemble learning techniques.</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>5</td><td>a)</td><td>Illustrate the process of estimating means of K Gaussians, using Estimation Maximization (EM) algorithm.</td><td>CO1</td><td>PO1</td><td>8</td></tr>
<tr><td></td><td></td><td>b)</td><td>Derive Minimum Description Length Principle using Bayes theorem.</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>c)</td><td>Consider the attributes {colour, legs, height, smelly} for the species classes:{M,H}. Apply Naïve bayes classifier to classify</td><td>CO2</td><td>PO2</td><td>6</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>the new instance – (Colour=Green, Legs=2, Height=tall and Smelly=No)
<table><tr><th>No</th><th>Colour</th><th>Legs</th><th>Height</th><th>Smelly</th><th>Species</th></tr><tr><td>1</td><td>White</td><td>3</td><td>Short</td><td>Yes</td><td>M</td></tr><tr><td>2</td><td>Green</td><td>2</td><td>Tall</td><td>No</td><td>M</td></tr><tr><td>3</td><td>Green</td><td>3</td><td>Short</td><td>Yes</td><td>M</td></tr><tr><td>4</td><td>White</td><td>3</td><td>Short</td><td>Yes</td><td>M</td></tr><tr><td>5</td><td>Green</td><td>2</td><td>Short</td><td>No</td><td>H</td></tr><tr><td>6</td><td>White</td><td>2</td><td>Tall</td><td>No</td><td>H</td></tr><tr><td>7</td><td>White</td><td>2</td><td>Tall</td><td>No</td><td>H</td></tr><tr><td>8</td><td>White</td><td>2</td><td>Short</td><td>Yes</td><td>H</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>a)</td><td>Illustrate any 2 methods that could be employed to determine the optimal value of k in k-means clustering along with the pros and cons of each method.</td><td>CO1</td><td>PO1</td><td>8</td></tr>
<tr><td></td><td>b)</td><td>For the given data, apply single-link hierarchical clustering technique to identify the clusters and conclude the solution by drawing a dendrogram.
<table><tr><th>Sample No.</th><th>P1</th><th>P2</th><th>P3</th><th>P4</th><th>P5</th><th>P6</th></tr><tr><td>X</td><td>0.4</td><td>0.22</td><td>0.35</td><td>0.26</td><td>0.08</td><td>0.45</td></tr><tr><td>Y</td><td>0.53</td><td>0.38</td><td>0.32</td><td>0.19</td><td>0.41</td><td>0.3</td></tr></table></td><td>CO1</td><td>PO2</td><td>6</td></tr>
<tr><td></td><td>c)</td><td>Identify the challenges associated with anomaly detection and elaborate on a real-world application which extensively employs the said technique</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>a)</td><td>Illustrate the following:
i. Kernel PCA
ii. Locally Linear Embedding</td><td>CO1</td><td>PO1</td><td>6</td></tr>
<tr><td></td><td>b)</td><td>i. Provide the steps used in Linear Discriminant Analysis (LDA) method.
ii. Apply LDA method to the data points: class1((2,2),(4,3),(5,1)) and class2((1,3),(5,5),(3,6)) and reduce the dimensionality.</td><td>CO1</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td>c)</td><td>Differentiate between sequential forward subset selection and sequential backward subset selection.</td><td>CO1</td><td>PO1</td><td>4</td></tr>
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