Total number of printed pages: **Programme UG/7th/UECE714B**

2023

Machine Learning

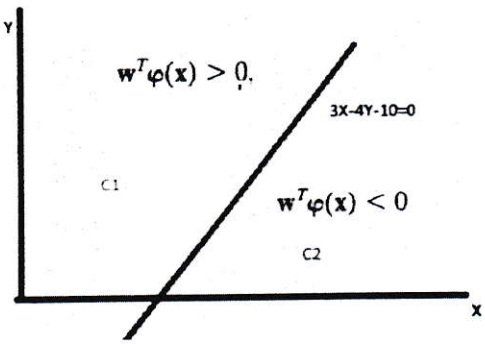
Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **Q-1 and any four from the rest***

1.	a)	Deduce the covariance matrix of the following feature vector. Deduce its Eigen values and Eigen vectors. Comment about the redundancy present in the feature. $x=\begin{bmatrix}-2\\2\end{bmatrix}$	(2+4+4+2)
	b)	An ANN has 50 input neurons, two hidden layers having 10 and 60 neurons. The network classifies 10 types of patterns. Each hidden neuron and output neuron contains a bias which can also be considered as a weight. Find total number of weight parameters including bias.	2
	c)	A multi-layer ANN has at least..... layer.	1
	d)	The role of bias is to..... the decision boundary i) shift vertically ii) shift horizontally iii) avoid singularity iv) reduce computation	1
	e)	Which of the following is a measure of the spread of data? i) Mean ii) Variance iii) Covariance iv) Median	1
	f)	Which of the following is a widely used and effective machine learning algorithm based on the idea of bagging: a) Random Forest b) Regression c) Stochastic Regression d) K-Means clustering	1
	g)	Which of the following require buffers? networks deals with temporal data sequence? i) Recurrent neural networking ii) Convolutional Neural Networking iii) Auto-encoder iv) Deconvolutional Neural Network	1
	h)	Which of the following is disadvantage of decision tree i) Decision trees are robust to outliers ii) Decision trees are prone to be overhit	1

		iii) Both of the above iv) None of the above	
2.	a)	Define the model of an artificial neuron and explain how you can implement a logic gate using that.	8
	b)	State the role of the activation function in convergence of the error function. Give example of any four activation function.	(4+8)
3.	a)	State the difference between the supervised and unsupervised learning.	4
	b)	State different steps of the KNN algorithm	6
	c)	c) There are following points with N=2. Initial random centroids of the clusters are taken as (0,0) and (4,4). Derive 2 iteration for the given data and find the final position of the centroids. (5) (1,1) (8,8) (-2,4) (6,6)	10
4	a)	a) Consider the cost function $E(w)=1/2\sigma^2-r_{xd}^T w+1/2 w^T R_x w$, where σ^2 is some constant and, $r_{xd}=\begin{bmatrix}.8182\\.354\end{bmatrix}$ and $R_x=\begin{bmatrix}1 & ,8182\\.8182 & 1\end{bmatrix}$ Find the optimum value w for which $E(w)$ will be minimum. Find value of the optimum error.	10
	b)	State different steps of the perceptron convergence algorithm.	10
5)	a)	What do you mean by a radial basis function? What is an X-OR problem in classification. State how radial basis function network resolves this problem.	3+3+6
	b)	The following figure shows the decision boundary by red color. There are 2 classes defined by C1 and C2. Find P1 (2,3) and P2(10,4) belongs to which class? Find the support of the plane with respect to 2 different classes. 	8

6	a)	State the advantage of deep learning over ANN. Define the following terminology i) Convolution layer, ii) Stride, iii) Up-sampling, iv) Down-sampling , v) RELU	2+15
	b)	Write a simple python code to build an ANN which has 20 input neuron, one hidden layer having 40 neuron and an output layer of 1 Neuron.	3
7		Write Short Notes (Any two)	10x2
	a)	Weight correction of output neurons in Back-propagation algorithm.	
	b)	Interpolation problem in Radial basis function.	
	c)	Auto encoder	
	d)	Principle component analysis	