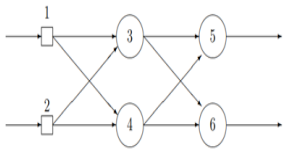
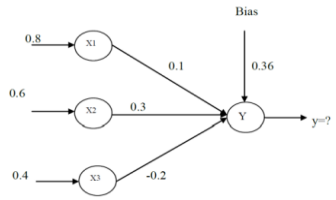
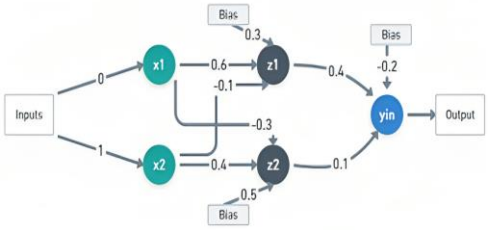
V Semester BTech Examination DEC 2023	Set No.: 01
Course name: Artificial Neural Network (CSE 3175) / (AI-ML)	Course code: CSE 3175

Q. No.	Description	Marks	Course Outcome (1-5)	Competency Levels (1-6)	AHEP LO LEVELS
1A	Explain how the structure and function of biological neurons contribute to the development of artificial neuron models. Analyze and differentiate the functionalities and structures between biological neurons and artificial neural networks.	4	1	4	2
1B	Explain the concept of learning and how does it differ in supervised, unsupervised, and reinforcement learning frameworks? Explain Winner takes all learning.	4	1	2	2
1C	Illustrate the importance of activation functions in the context of Multilayer Perceptrons (MLPs), emphasizing their role in shaping the network's functionality. Provide examples of commonly used activation functions.	2	2	2	2,3
2A	The following diagram represents a feed-forward neural network with one hidden layer:  Fig. 1. A weight on connection between nodes i and j is denoted by wij , such as w13 is the weight on the connection between nodes 1 and 3. The following table lists all the weights in the network: $w_{13} = -2$, $w_{23} = 3$, $w_{35} = 1$, $w_{45} = -1$ $w_{14} = 4$, $w_{24} = -1$, $w_{36} = -1$, $w_{46} = 1$ Each of the nodes 3, 4, 5 and 6 uses the following activation function: $\varphi(v) = \begin{cases} 1 & \text{if } v \geq 0 \\ 0 & \text{otherwise} \end{cases}$ where v denotes the weighted sum of a node. Each of the input nodes (1 and 2) can only receive binary values (either 0 or 1). Calculate the output of the network (y_5 and y_6) for each of the input patterns: Pattern: P_1 P_2 P_3 P_4 Node 1: 0 1 0 1 Node 2: 0 0 1 1	4	2	3	2,3
2B	Estimate the output of the neuron Y for the network shown in figure 2 using activation function as sigmoidal and Tan H.	4	2	3	2,3

	 Fig. 2.				
2C	Discuss the training process of an RBF network. Explain the methodology for determining the center and width parameters associated with the radial basis functions within the network.	**2**	**2**	**2**	**2,3**
3A	You have an RBF network with three Gaussian RBF neurons. The centers and widths (σ) for these neurons are as follows: RBF 1: Center (1, 1), σ = 0.5 RBF 2: Center (2, 2), σ = 0.3 RBF 3: Center (3, 3), σ = 0.4 Given an input pattern (2.5, 2.5). Estimate the outputs of each RBF neuron. Describe the process of training a Self-Organizing Map (SOM). What are the primary stages or essential steps within this process?	**2+2**	**2,3**	**5**	**2,3**
3B	Consider a Kohonen network with two cluster units and four input units. The weight vectors for the cluster units are $\begin{bmatrix} w_{11} & w_{12} \\ w_{21} & w_{22} \\ w_{31} & w_{32} \\ w_{41} & w_{42} \end{bmatrix} = \begin{bmatrix} 0.2 & 0.8 \\ 0.6 & 0.4 \\ 0.5 & 0.7 \\ 0.9 & 0.3 \end{bmatrix}$ Determine the winning cluster unit for the input patterns [1100], [0001], [1000], [0011] and update the weights.	**4**	**3**	**5**	**5,6**
3C	Elaborate the concept of "neighborhood" in the context of a SOM and how it evolves during the training process.	**2**	**3**	**6**	**5,6**
4A	Illustrate the basic concept and architecture of an RNN with the help of an example. How does it differ from feedforward neural networks?	**4**	**4**	**2**	**6**
4B	Construct a discrete Hopfield network to store the patterns S1 = [1 -1 1 -1] and S2= [-1 1 -1 1]. If the received pattern is [1 1 -1 1], identify the correct pattern.	**4**	**4**	**3**	**6**
4C	Explain the concept of associative memory and distinguish between auto-associative and hetero-associative memory within the framework of Hopfield networks.	**2**	**4**	**5**	**6**

5A	Explain the concept of the storage capacity of a Hopfield network. How does the number of neurons and the type of patterns influence the storage capacity? What is backpropagation through time (BPTT), and how does it differ from standard backpropagation used in feedforward neural networks?	**2+2**	**4, 5**	**5**	**2, 6**
5B	Using the back-propagation algorithm, estimate new weights for the following network [perform one iteration]. Target value: 1, learning rate =0.25, Activation function: Sigmoid function. 	**4**	**5**	**5**	**2**
5C	Explain the concept of "unrolling" an RNN in the context of BPTT. How does it help in training?	**2**	**5**	**2**	**2**

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