मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद
प्रयागराज-211004 (भारत)
Motilal Nehru National Institute of Technology Allahabad
Prayagraj - 211 004 (India)

**Department of Computer Science & Engineering**
**Mid Semester Examination, Session 2023-24 (Odd)**

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|---|---|---|---|---|---|
| **Programme:** | *M.Tech.* | **Branch:** | *CS/IS/CS (Spec AI & Data Science)* | **Semester:** | *I* |
| **Course Name:** | *Soft Computing Techniques* | | | | |
| **Course Code:** | *<CS21308>* | **Max. Marks:** | *25* | | |
| **Time:** | *90 Minutes* | **Registration No.:** | | | |

**Instructions (related to question paper):**
1. *All questions are compulsory*
2. *Attempt the questions strictly in sequential order.*
3. *Calculator is allowed*
4. ***Write assumptions correctly (in case you feel data is missing)***

| | | | Marks | Corresponding course outcome with weightage (if any) |
|---|---|---|---|---|
| **Q1** | | **Write the answer of the following question** | | |
| | **a** | **Find the new weights and biases after first epoch**, using back-propagation for the network shown in Figure 1. The network is presented with the input pattern [ 0, 1] and the target output is + 1. Use a learning rate of $\alpha = 0.25$ and binary sigmoidal activation function. $X_1$ and $X_2$ represent input neurons and Y represents output neuron.<br>**Assume loss function L= Target outcome – Predicted outcome** | **(5)** | **CO-2** |

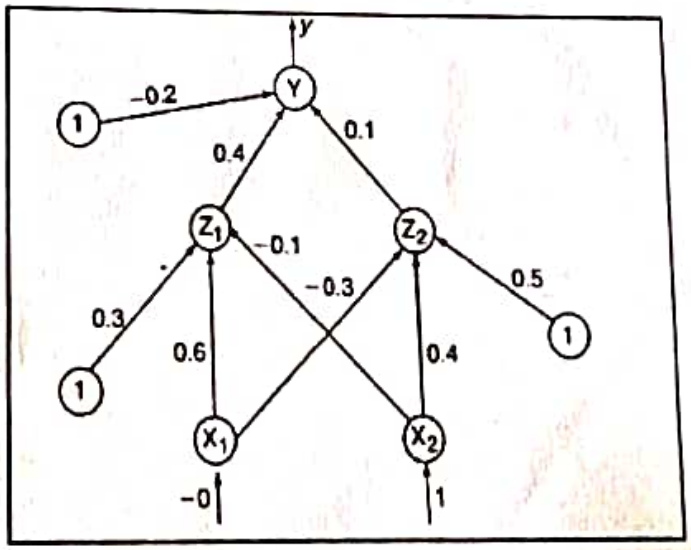


Figure 1: Network

$\delta_k = y(1-y)(t_k - y_k)$

With

$z_1 = z_1(1-z_1)(v_1 * \delta_p)$

| | | | | |
|---|---|---|---|---|
| **Q2** | | **Write the answer of the following questions** | | |
| | **a** | Explain the key differences between the RMSProp (Root Mean Square Propagation) and Adagrad optimization algorithms in machine learning. Additionally, discuss the impact of hyperparameter settings on the performance of these algorithms and the challenges associated with hyperparameter tuning. | **[3]** | **CO-1** |
| | **b** | For a neural network, the initial learning rate is 0.02 and the squared derivative of weight of a neuron in first iteration is 6. If the squared derivative increases by 5% in each iteration, show that using the Adagrad optimizer the learning rate will decrease to 1/10 after 10 iterations. [Assume $\delta = 10^{-5}$]. | **[2]** | **CO-2** |
| **Q3** | | **Write the answer of the following question** | | |
| | **a** | Take three-dimensional loss function given in equation 1<br>$L(w_1, w_2, w_3) = 2w_1^2 + 3w_2^2 + w_3^2$ ---------- (1)<br>The initial guess for the weight parameters $w_1 = 2.0$ , $w_2 = 3.0$ and $w_3 = 1.5$ The learning rate ($\alpha$) is set to 0.1. Perform two iterations of the Adagrad algorithm and calculate the updated values of weights at the end of each iteration. | **(5)** | **CO-1** |
| | | **Write the answer of the following question** | | |
| **Q4** | | Consider two fuzzy sets, A and B, with the following membership functions.<br>Fuzzy Set A: $A(x) = \begin{cases} 0.2 & \text{if } x \leq 4 \\ 0.6 & \text{if } 4 < x \leq 7 \\ 0.0 & \text{if } x > 7 \end{cases}$<br>Fuzzy Set B: $B(x) = \begin{cases} 0.0 & \text{if } x \leq 3 \\ 0.5 & \text{if } 3 < x \leq 6 \\ 0.8 & \text{if } x > 6 \end{cases}$<br>I. Calculate the union (OR) of fuzzy sets A and B.<br>II. Calculate the Intersection (AND) of fuzzy sets A and B<br>For each operation, provide the resulting membership function and describe its characteristics. | **(5)** | **CO-3** |
| **Q5** | | **Write the answer of the following questions** | | |
| | **a** | Discuss the advantages, and limitations of **Tanh** and **Sigmoid activation** functions based on its uses. | **(2.5)** | **CO-2** |
| | **b** | How can different shapes of membership functions, such as triangular, trapezoidal, and Gaussian, be used to model linguistic variables in fuzzy systems? | **(2.5)** | **CO-3** |