Charotar University of Science and Technology

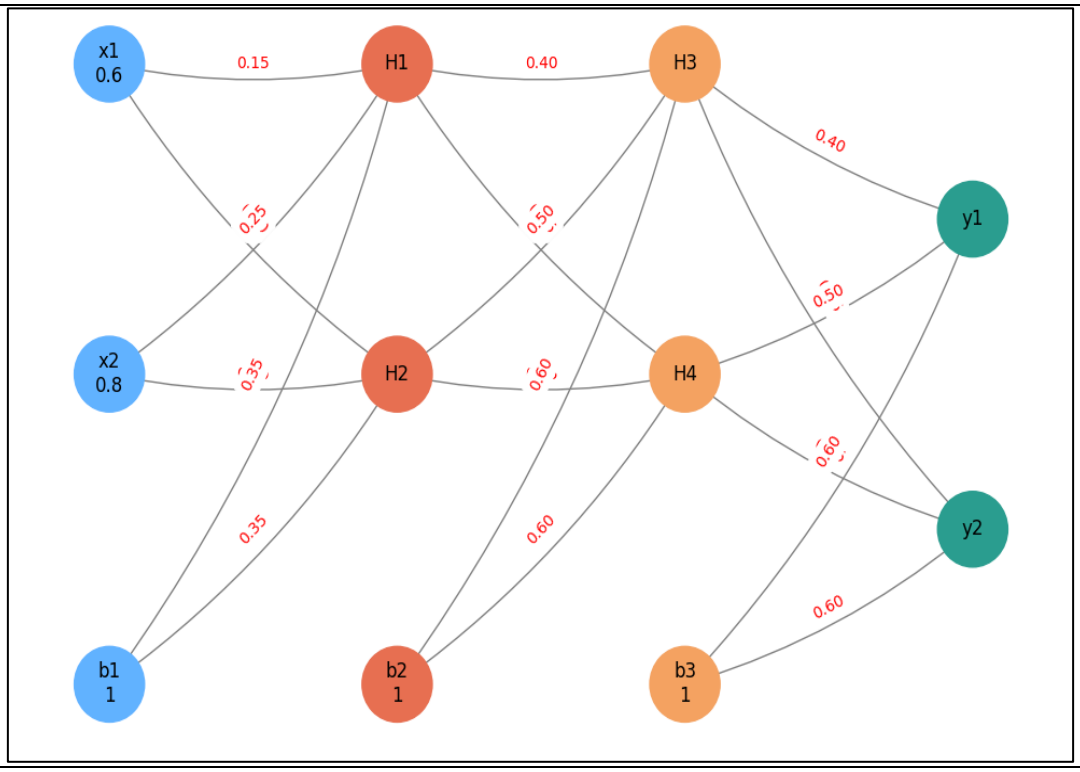
Devang Patel Institute of Advance Technology and Research

OCCSE3001/OCCE3001/OCIT3004 : Deep Learning (CIE 1)

Semester: 6th (B.Tech) Maximum Marks: 20

Date: 30/01/2026

Question	Marks	BT
1. A data center fire-detection system uses a McCulloch–Pitts neuron with four binary inputs: x_1(smoke), x_2(heat), x_3(flame), and x_4(power fluctuation). Each input is 1 if abnormal, else 0. All inputs have **equal weights**. To avoid false alarms and delayed response, the system should trigger an alert **only when at least three sensors are active**. Analyze the system by: 1. Determining the appropriate threshold value. 2. Explaining how this setup demonstrates the strengths and limitations of threshold-based neurons in safety-critical applications.	5	An
2. A city wants to automate traffic signals at an intersection. Sensors detect: • X1 = cars on main road • X2 = cars on side road • The system should turn green for the main road if main road has cars, unless side road has significantly more cars. The initial implementation uses a single-layer perceptron. Traffic engineers notice some misclassifications during peak hours. Tasks: 1. Design a McCulloch-Pitts (MCP) neuron and explain why a single-layer perceptron may fail in this scenario. 2. Propose a solution using MLP, and explain how hidden layers improve decision-making. 3. Redesign the system behaviour for a case where the neuron threshold is set too high and analyse its impact on overall traffic flow.	5	C
3. An institution uses a single linear-threshold rule to decide academic intervention based on two normalized inputs: x_1(attendance risk) and x_2(assessment risk). Observed anchor cases show: • $y = 1$when exactly one of $x_1, x_2$is high • $y = 0$when both are low or both are high The model used is: $$y = \begin{cases} 1, & \text{if } w_1x_1 + w_2x_2 + b \geq 0 \\ 0, & \text{otherwise} \end{cases}$$ Tasks: 1. Prove mathematically that no choice of w_1, w_2, bcan satisfy all four anchor cases. 2. State one consequence of using this simplified rule. 3. Suggest a deterministic redesign that correctly classifies all cases.	5	Ap
4. From below given neural network provide the error rate at output layer, Target value for y1 = 1 and y2 = 0. Consider learning rate = 0.1.	5	E


x1
0.6
x2
0.8
b1
1
H1
H2
b2
1
H3
H4
b3
1
y1
y2
0.15
0.40
0.25
0.50
0.35
0.60
0.40
0.50
0.60
0.35
0.60
0.60