

Indian Institute of Technology Patna

Mid-Semester Examination, Sept, 2024

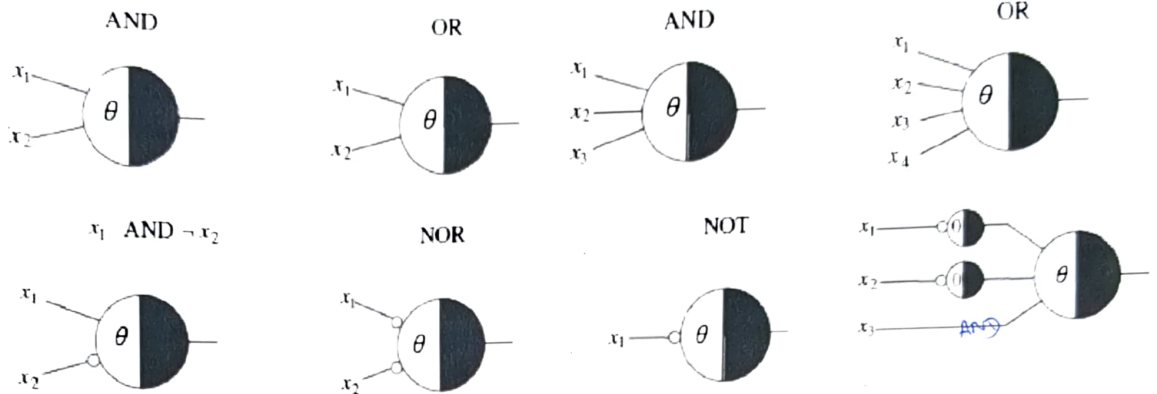
Sub: Soft Computing Application in Engineering (ME-6122)

Full Marks: 70

Time: 2 hours

(Attempt ALL questions, Write answer in one place, number of pages 2)

Q1. For a single McCulloch–Pitts unit, find the threshold unit θ for the following gates to transmit output signal assuming input signals are of binary coded (0,1) [15]



Q2. Describe different types of activation function with neat diagram [10]

Q3. A two-layer feedforward neural network having sigmoid activation function is used for mapping between input and output patterns in a two dimensional space. Hidden layer consists of 4 neuron and output layer having one neuron. Initial weight matrix between input-hidden layer and hidden-output layer along with input vectors are given below. A bias of -1 with weight 3.5 is added to output neuron. [15]

input vectors = $[x_1 \ x_2 \ -1]$ hidden - output weight (V) = $[1 \ 1 \ 1 \ 1]$

$$\text{input - hidden weight } (W) = \begin{bmatrix} 1 & 0 & 1 \\ -1 & 0 & -2 \\ 0 & 1 & 0 \\ 0 & -1 & -3 \end{bmatrix}$$

Using Cartesian co-ordinate, determine the ranges of inputs x_1 and x_2 for which output neuron will fire. As well as indicate the region for which output neuron wont fire. Find the decision equation that map input-output neurons?

Q4. Define α cut of fuzzy set? Determine all possible value of α cut and associated elements that will determine smart students in the class defined with following membership value.

Smart students (A) = $\{(x_1, 0.4), (x_2, 0.1), (x_3, 0.8), (x_4, 1)\}$ [5]

Q5. Consider a fuzzy set of three persons suffering of three diseases in time to time. Each disease associated with symptoms. Determine relation of symptoms to each person with its membership grade. [10]

Membership grade	Running nose	High temperature	Shivering
Typhoid	0.1	0.9	0.8
Viral fever	0.2	0.9	0.7
Common cold	0.9	0.4	0.6
Membership grade	Person 1	Person 2	Person 3
Typhoid	0.6	0.1	0.9
Viral fever	0.6	0.2	0.3
Common cold	0.9	0.9	0.4

Q6. Develop an artificial neural network architecture to classify four linearly non separable pattern (XOR function) as shown below the table with bipolar parity. Find the decision equation as output from neural network. Find the all weights and bias used during classification. Using truth table compare the outcome from ANN classifier and target data for these four pattern. [15]

X1	X2	Output
0	0	1
0	1	-1
1	0	-1
1	1	1