Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER B.TECH (INFORMATION TECHNOLOGY / COMPUTER AND COMMUNICATION ENGINEERING) DEGREE END SEMESTER EXAMINATION-DEC 2021
SUBJECT:PROGRAM ELECTIVE-V NEURAL NETWORKS AND FUZZY LOGIC (ICT 4052)
(REVISED CREDIT SYSTEM)

TIME: 1.25 HOURS **17/12/2021** **MAX. MARKS: 20**

Instructions to candidates

- Answer **ALL TWO** full questions.
- Missing data, if any may be suitably assumed.

PART-B

1A. In a variant of LMS algorithm called leaky LMS algorithm, the cost function to be minimized is defined by

$$\mathcal{E}(n) = \frac{1}{2}|e(n)|^2 + \frac{\lambda}{2}||\mathbf{w}(n)||^2$$

where $\mathbf{w}(n)$ is the parameter vector, $e(n)$ is the estimation error, and λ is a constant. Similar to the ordinary LMS algorithm, we have

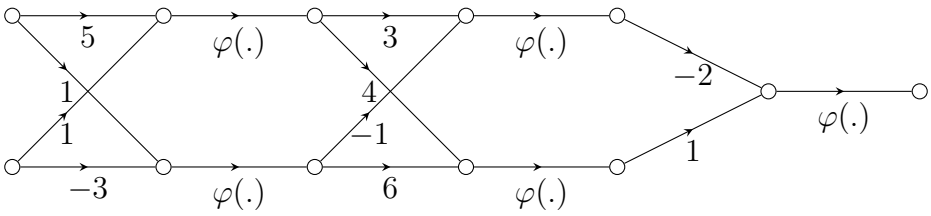
$$e(n) = d(n) - \mathbf{w}^T(n)\mathbf{x}(n)$$

where $d(n)$ is the desired response corresponding to the input vector $\mathbf{x}(n)$. Show that the time update for the parameter vector of the leaky LMS algorithm is defined by

$$\hat{\mathbf{w}}(n+1) = (1 - \eta\lambda)\hat{\mathbf{w}}(n) + \eta\mathbf{x}(n)e(n).$$

[5]

1B. Figure Q.1B, shows the signal-flow graph of a 2-2-2-1 feedforward network. The function $\varphi(.)$ denotes a logistic function.



Q.1B

(i) Write the input-output mapping defined by this network.

(ii) Suppose that the output neuron in the given signal-flow graph operates in its linear-region. Write the input-output mapping defined by this new network.

[3]

1C. Consider two one-dimensional, Gaussian-distributed classes $\mathscr{C}_1$ and $\mathscr{C}_2$ that have a common variance equal to 1. Their mean values are $\mu_1 = -10$ and $\mu_2 = +10$ respectively. These two classes are essentially linearly separable. Design a classifier that separates these two classes.

Table: Q.2A

x_1	x_2	x_3	R_1	R_2
1.5	1.0	0.8	1.0	0.0

[2]

2A. For the data shown in Table Q.2A, show the first iteration of back propagation algorithm in trying to compute the membership values for the input variables x_1, x_2 and x_3 in the output region R_1 and R_2. Use a $3 \times 3 \times 2$ neural network architecture. Assume a random set of weights for your neural network. [5]

2B. Two companies bid for a contract. A committee has to review the estimates of those companies and give reports to its chairperson. The reviewed reports are evaluated on a non dimensional scale and assigned a weighted score that is represented by a fuzzy membership function, as illustrated by the two fuzzy sets B_1 and B_2, in Figure 2B. The chairperson is interested in the lowest bid, as well as a metric to measure the combined "best" score. For the logical union of the membership function shown we want to find the defuzzified quantity. Calculate the defuzzified value, z^* using centroid method.

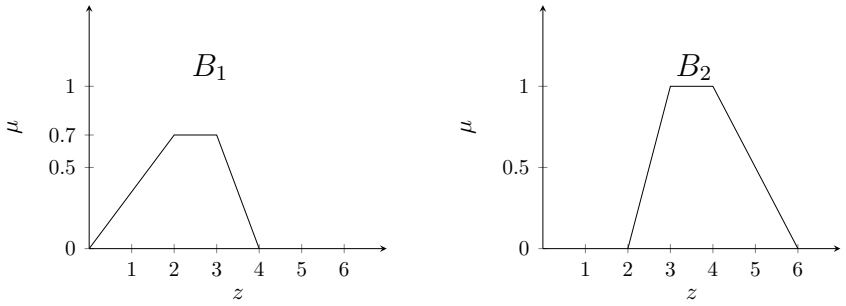


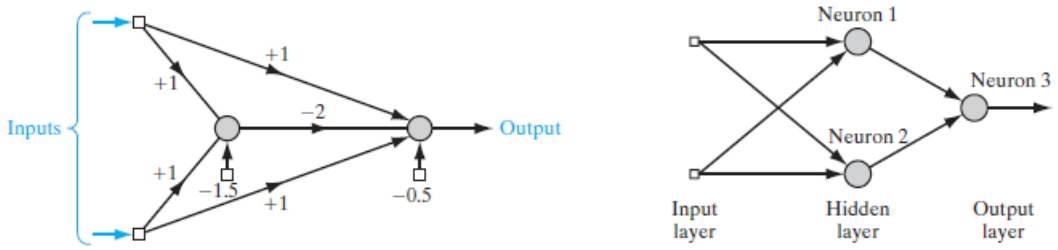
Figure 1: Q.2B

[3]

2C. Figure Q.2C(a) shows a neural network involving a single hidden neuron, for solving the XOR problem; this network may be viewed as an alternative to that given in Figure Q.2C(b). Show that the network of Figure Q.2C(a) solves the XOR problem by constructing

i) decision regions, and

ii) a truth table for the network.



(a) (b)

Figure: Q.2C

[2]