Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. COMPUTER SCIENCE AND ENGINEERING

END SEMESTER EXAMINATIONS, NOV 2019

SUBJECT: SOFT COMPUTING PARADIGMS (CSE 4031)

REVISED CREDIT SYSTEM
(23-11-2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. An odd sigmoidal function is defined by **3M**

$$\varphi(v) = \frac{1 - exp(-av)}{1 + exp(-av)} = \tanh\left(\frac{av}{2}\right)$$

Where tanh denotes a hyperbolic tangent. The limiting value of this second sigmoid function are -1 and +1. Show that the derivative of $\varphi(v)$ with respect to v is given by,

$$\frac{d\varphi}{dv} = \frac{a}{2}[1 - \varphi^2(v)]$$

What is the value of this derivative at the origin? Suppose that the slope parameter a is made infinitely large. What is the resulting form of $\varphi(v)$?

1B. Construct a fully recurrent network with 5 neurons, but with no self-feedback. **2M**

1C. What are the characteristics of an associative memory? Explain how to minimize the error using Widrow-Hoff's rule. The error correction learning rule may be implemented by using inhibition to subtract the desired response from the output, and then applying the anti-Hebbian rule. Justify this interpretation of error - correction learning. **5M**

2A. Find the weights using perceptron network for ANDNOT function, when all the inputs are presented only one time. Assume learning rate to be 1 and initial weight vectors and bias to be zero. Limit the training for one epoch. Use the following activation function, **4M**

$$y = \begin{cases} 1 \; if \; y > 0 \\ 0 \; if - 0 \leq y \leq 0 \\ -1 \; if \; y < -0 \end{cases}$$

2B. Explain absolute error - correction procedure for the adaptation of a single layer perceptron. What are the two conflicting requirements one should keep in mind, when learning rate parameter is assigned a value inside the range $0<\eta<=1$. **2M**

2C. Show that **4M**

$$\Delta w_{ij}(n) = \eta \sum_{t=0}^{n} \alpha^{n-t} \delta_j(t) y_i(t)$$

is the solution of the following difference equation:

$$\Delta w_{ij}(n) = \alpha \Delta w_{ij}(n-1) + \eta \delta_j(n) y_i(n)$$

Where α is a positive momentum constant. Based on the solution, what insightful observations made on the effect of the momentum term.

3A. Using back propagation network, find the new weights for the neural network. It is presented with the input pattern [0, 1] and the target output is 1. The initial weights are $[w_{11},w_{21},w_{01}]$ = [0.6 -0.1 0.3], $[w_{12},w_{22},w_{02}]$ = [-0.3 0.4 0.5] and $[w_{H1},w_{H2},W_{H0}]$ = [0.4 0.1 -0.2] and the learning rate is 0.25 and use sigmoidal activation function. **5M**

3B. Consider a given Kohonen self-organizing network with five cluster units and two input units. The weight vectors for the cluster units are given by **3M**

$$W = \begin{bmatrix} 0.3 & 0.2 & 0.1 & 0.8 & 0.4 \\ 0.5 & 0.6 & 0.7 & 0.9 & 0.2 \end{bmatrix}$$

a) Use the square of the Euclidean distance to find the winning cluster unit Yj for a given input pattern (0.2, 0.4). Using a learning rate of 0.2 and radius of neighborhood is zero. Find the updated weights for the winning unit Yj.
b) For the input vector (0.6,0.6) with learning rate 0.1, find the winning cluster unit Yj and its new weights.

3C. How do we define a topological neighborhood that is neuro-biologically correct? Justify your answer with valid mathematical model. **2M**

4A. Provide the weight equations for storing P patterns using Hebbian learning in auto associative and hetero associative memory model and how do you associate importance factor with some of the stored patters? Obtain the weight matrix for a Hetero associative network trained using Hebbian rule. The input vectors X's and corresponding target vectors T's are given as follows, **4M**

X1(1, -1, -1, -1) → T1(1, -1) X2(1, 1, -1, -1) → T2(1, -1)
X3(-1, -1, -1, 1) → T3(-1, 1) X4(-1, -1, 1, 1) → T4(-1, 1)
Test the performance of the network with [0 1 0 -1] and [-1 1 1 -1] in the test vector.

4B. The discretized membership functions for a transistor and a resistor are given below: **4M**

$$\mu_T=\left\{\frac{0}{0}+\frac{0.2}{1}+\frac{0.7}{2}+\frac{0.8}{3}+\frac{0.9}{4}+\frac{1}{5}\right\}, \mu_T=\left\{\frac{0}{0}+\frac{0.1}{1}+\frac{0.2}{2}+\frac{0.3}{3}+\frac{0.4}{4}+\frac{0.5}{5}\right\}$$

Find the following: (a) algebraic sum b) algebraic product c) bounded sum d) bounded difference

4C. Define Fuzzy Relations. Explain the operations on Fuzzy relation and Fuzzy Composition. **2M**

5A. Explain the basic features of the membership functions. Using Zadeh's notation, determine the lambda cut sets for the given fuzzy sets: **5M**

$$S_1=\left\{\frac{0}{0}+\frac{0.5}{20}+\frac{0.65}{40}+\frac{0.85}{60}+\frac{1.0}{80}+\frac{1.0}{100}\right\} \qquad S_2=\left\{\frac{0}{0}+\frac{0.45}{20}+\frac{0.6}{40}+\frac{0.8}{60}+\frac{0.95}{80}+\frac{1.0}{100}\right\}$$

Express the following for lambda to be 0.5:
a) $(S_1 \cup S_2)$ b) $(S_1 \cap S_2)$ c) $\overline{S_1}$ d) $\overline{S_2}$

5B. Write and explain the algorithm for a simple genetic algorithm. **5M**