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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: SOFT COMPUTING [ELE 4026]

REVISED CREDIT SYSTEM

Time: 2.00 – 5.00 **Date: 21, November 2017** **Max. Marks: 50**

Instructions to Candidates:

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

1A. A bipolar sigmoidal neural network has the initial weight vector $W^{(0)} = [1\ -1\ 0\ 0.5]^t$.

Two sets of training inputs and respective desired response are as given below:

$X_1 = [1\ -2\ 0\ -1]^t$, $X_2 = [\ 0\ 1.5\ -0.5\ -1]^t$, $d_1 = -1$ and $d_2 = 0.5$.

Using delta learning rule obtain new vector $W^{(1)}$ after one iteration. Assume learning constant $c = 0.4$ function constant $\lambda = 1$. ***(04)***

1B. Design a discrete bipolar neural network to perform the following classification:

Class A – $X_1 = (-0.5, 2)$ $X_2 = (2, -1)$ output $d_A = -1$

Class B – $X_1 = (2, 0.5)$ $X_2 = (0.5, 1)$ output $d_B = 1$ ***(03)***

1C. State whether the statements given below are correct or not. If not correct, mention reasons and write possible correct statement.

(i) If energy level of a Hopfield network is positive, it is stable state.

(ii) Unipolar signum activation function is a special case of sigmoidal activation functions, if $\lambda = 1$.

(iii) Neural network can be used as memory element.

(iv) Delta learning rule is not applicable for discrete neural network. ***(03)***

2A. Design and draw the schematic of a Hopfield network to store the following bit patterns:

$S_1 = [1\ -1\ 1\ -1]^t$ $S_2 = [\ -1\ 1\ -1\ 1]^t$ and $S_3 = [-1\ -1\ 1\ 1]^t$.

Draw the state transition diagram for asynchronous mode retrieval of stored pattern when an arbitrary input $[1\ 1\ 1\ 1]^t$ is initially applied to the network. ***(04)***

2B. A neural network has one input neuron A and two output neurons B and C. Two inputs X and Y connected to input neuron through weights 1.5 and 2 respectively. The output of input neuron is connected to output neurons B and C through weights 3 and -1 respectively.

For certain input X = - 0.5 and Y = 0.2, the desired outputs of B and C are 0.45 and -0.8 respectively. Input neuron has the activation function **f(net) = net** and output neurons use bipolar activation functions with $\lambda = 1$.

Update all weights for one iteration using learning constant c = 1.2 by back propagation algorithm. ***(06)***

3A. Define the following terms used in fuzzy system:
(i) support (ii) alpha-cut (iii) convex ***(03)***

3B. Two fuzzy sets are defined as given below in a universe of discourse X[0:9]:

A=triangular (0, 3, 5) and B = trapezoidal (3, 5, 6, 9). The truncation levels of A and B are 0.5 and 1.0 respectively during a fuzzy rule implication. Determine the crisp output X* by centroid method of defuzzification. ***(04)***

3C. Relations R1 and R2 are as shown below:

$$R_1 = \begin{bmatrix} 0.2 & 0.3 & 0.5 & 0.8 & 0.9 & 0.1 \\ 0.4 & 0.8 & 1.0 & 0.7 & 0.5 & 0.3 \\ 0.9 & 0.4 & 0.5 & 0.8 & 0.1 & 0.6 \\ 0.3 & 0.6 & 0.9 & 0.8 & 0.5 & 0.2 \end{bmatrix} \qquad R_2 = \begin{bmatrix} 0.7 & 0.8 & 1.0 & 0.15 \\ 0.1 & 0.6 & 0.2 & 0.3 \\ 0.6 & 0.4 & 0.8 & 0.5 \\ 0.4 & 0.67 & 0.2 & 0.0 \\ 0.5 & 0.2 & 0.7 & 0.4 \\ 0.3 & 0.7 & 0.4 & 0.1 \end{bmatrix}$$

Obtain the composition Q = R_1 o R_2 by Mamdani max-min operation. ***(03)***

4A. Two linguistic variables A and B are defined as given below:

$$A = \left\{ \frac{0.5}{X_1} + \frac{1.0}{X_2} + \frac{0.6}{X_3} \right\} \qquad B = \left\{ \frac{1.0}{Y_1} + \frac{0.4}{Y_2} \right\}$$

Given fuzzy inference,
X is A^1
If X is A Then Y is B
Y is B^1
Interpret fuzzy rule A -> B using (i) Lukasiewicz implication (ii) Dienes-Rescher implication.

For $A^1 = \left\{ \frac{0.6}{X_1} + \frac{0.9}{X_2} + \frac{0.7}{X_3} \right\}$ find B^1 in each implication. ***(04)***

4B. A fuzzy controller is to be designed for field current control method (speed is inversely proportional to field current) of speed control of a DC shunt motor. For a given terminal voltage and required speed, the field current is to be determined. The universe of discourse are VOLT [0:250], RPM [0:1200] and AMP [0.25: 1.25]. The design shall include

(i) Linguistic values and respective equation for triangular membership functions for all linguistic variables considered
(ii) List of IF-THEN rules required

Calculate crisp value of field current for a sample input of 220 V and 900 rpm using mean of maximum method of defuzzification. ***(06)***

5A. Explain the terms with relevant illustrations as applied in Genetic Algorithm:
(i) Fitness (ii) Crossover ***(04)***

5B. Using Genetic Algorithm, optimize the function $f(x, y) = 1.5x^2 + 3y$ with boundary conditions of $3<x<6$ and $1<y<5$. Use a population size of 4 and 5-bit binary string representation of chromosome. ***(06)***