(5)

## B. Tech. 5<sup>th</sup> Semester End Semester Examination EE –370 Neural Networks and Fuzzy Logic Systems Time – 3 Hours MN

Dr. Sashel Chaucher

MM - 50

## Note1: Attempt any FIVE questions.

Q.1(a) Explain working of biological neuron and its mathematical model put forward by Mc Cullock and Pitts.

(b) Apply delta-learning rule to learn the relation between input and output patterns.  $X[1] = \begin{bmatrix} 1 & -2 & 0 & -1 \end{bmatrix}^{T}; X[2] = \begin{bmatrix} 0 & 1.5 & -0.5 & -1 \end{bmatrix}^{T}; X[3] = \begin{bmatrix} -1 & 1 & 0.5 & -1 \end{bmatrix}^{T} \text{ and } Y[1] = \begin{bmatrix} -1 \end{bmatrix};$   $Y[2] = \begin{bmatrix} -1 \end{bmatrix} \text{ and } Y[3] = 1. \text{ Weight vector, } W = \begin{bmatrix} 1 & -1 & 0 & 0.5 \end{bmatrix}^{T}.$ Perform one iteration of learning. Take bipolar sigmoidal ( $\lambda = 1$ ) activation function and learning constant  $\eta = 0.1.$ (5)

Q.2(a) If it is required to store three fundamental memories in the five neuron Hopfield network then find weight matrix, W.

 $X_{1} = [1, 1, 1, 1, 1]^{T}; \quad X_{2} = [1, -1, 1, -1, 1]^{T}; \quad X_{3} = [-1, 1, -1, 1, -1]^{T}.$ Apply X = [1, 1, -1, 1, 1] to find the recall. (5)

(b) Draw architecture of multi-layer perceptron model (MLP). Write procedural steps to train the network by error back propagation and finally how testing is carried out. Also suggest suitable training termination criterion to ensure generalization. (5)

Q.3(a) List and explain procedural steps for implementing Genetic Algorithm. (5)

(b) Draw the architecture of neuro-fuzzy system and show how information is processed through this hybrid system. Also explain how learning can be incorporated in this model. (5)

Q.4(a) (a) Define and explain the followings with examples:
(i) Union of fuzzy subsets (ii) Intersection of fuzzy subsets (iii) Proper fuzzy subset
(iv) α-cut of fuzzy subset (v) core of fuzzy subset

(b)What are three conditions that must be satisfied by the measure of fuzziness. Suggest a measure of fuzziness that satisfies above mentioned conditions. (5)

Q.5(a) With suitable block diagram explain Mamdani SISO fuzzy inference system. (5)

(b) Through Schema theorem prove that weak solutions get eliminated and strong solutions swell in number as genetic search move from generation to next. (5)

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Q. 6 It is desired to maintain the Cruise at a desired speed. A Fuzzy Cruise Controller is designed with rule base and term-sets as under



Fuzzy rule base governing the cruise control is given below:

Rule 1 If (speed difference is NL) and (acceleration is ZE) then (throttle control is PL) Rule 2 If (speed difference is ZE) and (acceleration is NL) then (throttle control is PL) Rule 3 If (speed difference is NM) and (acceleration is ZE) then (throttle control is PM Rule 4 If (speed difference is NS) and (acceleration is PS) then (throttle control is PS) Rule 5 If (speed difference is PS) and (acceleration is NS) then (throttle control is NS) Rule 6 If (speed difference is PL) and (acceleration is ZE) then (throttle control is NL) Rule 7 If (speed difference is ZE) and (acceleration is NS) then (throttle control is PS) Rule 8 If (speed difference is ZE) and (acceleration is NS) then (throttle control is PS)



Calculate the throttle control for a speed difference of 100 and acceleration of 70. (10)

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