CS/B.Tech (BME)/SEM-7/BME-704D/2010-11
2010-11
NEURAL NETWORK AND FUZZY LOGIC CONTROL

*Time Allotted :* 3 Hours   *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : 10 × 1 = 10

    i)   Function of synaptic inhibition in a neural network is

         a)   linear

         b)   exponential

         c)   non-linear

         d)   hyperbolic.

    ii) Back propagation algorithm is a .... learning procedure.

         a)   supervised   b)   unsupervised

         c)   reinforcement   d)   none of these.

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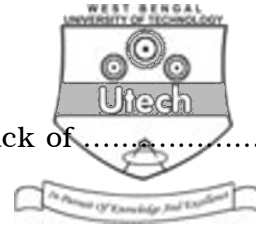
iii) Trapping at local minima is a drawback of .... algorithm.

a) Back propagation

b) Hopfield

c) Kohenen self-organisation

d) Adaptive resonance theory.

iv) Minimum criteria used in fuzzy logic is

a) when there is an AND operation

b) when there is an OR operation

c) in De-Morgan's theorem

d) none of these.

v) Considering a graphical representation of the 'tallness' of people using its appropriate member function, which of the following combinations are true ?

I. TALL is usually the fuzzy subset

II. HEIGHT is usually the fuzzy set
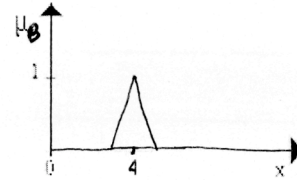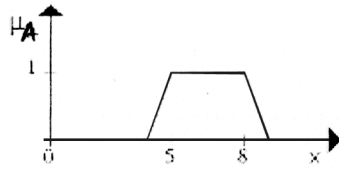
III. PEOPLE is usually the universe of discourse.

a) I, II & III
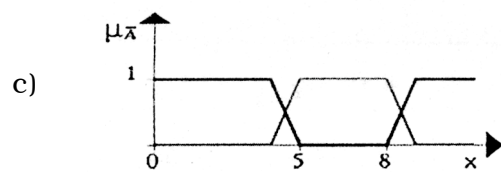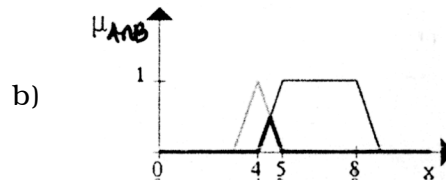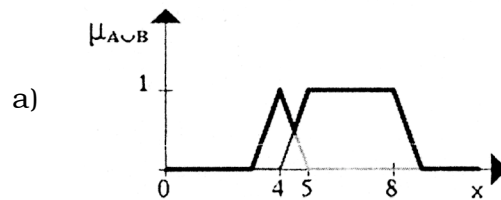
b) I & II

c) I & III

d) II & III.

vi) What is the Fuzzy Approximation Theorem (FAT) ?

    a) A fuzzy system can model any continuous system

    b) The conversion of fuzzy logic to probability

    c) A continuous system can model a fuzzy system

    d) Fuzzy patches covering a series of fuzzy rules.

vii) In an adaptive fuzzy system which of the following are true ?

    I. The machine learns as more data are fed into it.

    II. Neural network is used to find the fuzzy rules.

    III. The system creates rules without the intervention of human beings.

    a) I, II & III

    b) I & II

    c) I & III

    d) II & III.

viii) What are the following sequence of steps taken in designing a fuzzy logic machine ?

    a) fuzzification → rule evaluation → defuzzification

    b) rule evaluation → fuzzification → defuzzification

    c) fuzzy sets → defuzzification → rule evaluation

    d) defuzzification → rule evaluation → fuzzification.

ix) Given these fuzzy graphs for member functions *A* and *B*.

Which of the following graphs yields the result of the operation *A* or *B* ?

a)

b)

c)

d) none of these.

x) Who is the founder of fuzzy logic ?

    a) Aristotle   b) Buddha

    c) Zader Lotfi   d) Bart Kosko.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following.   3 × 5 = 15

2. What is fuzzy based controller ?

3. Develop a continuous membership function for a fuzzy set A = "about 30 years", B = "about 25 years" from a universal set of possible ages for people.

4. What are the common non-linear functions used for synaptic inhibition ?

5. Draw a schematic of artificial neural network. Explain how this network balance the threshold of output signal, keeping input features at constant amplitude.

6. Consider two universes : U = { 1, 2, 3 } and V = { 2, 3, 4 }. Construct $\mu_{EQUAL}(U, V)$ for $u\varepsilon V$ and $v\varepsilon V$ and hence determine R (u, v) in the matrix form.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

7. a) Define edge, shade and mixed range membership with respect to pixel intensity variance, and hence formulate a scheme for image matching with fuzzy features.   7

   b) Give a schematic of evaluation of $\mu_B(y)$ from $\mu_A(x)$; where x denotes age; y denotes speed; A_i is fuzzy subsets like young, old very old; B_i is fuzzy set like slow-runner, medium-fast-runner, fast-runner.   8

8. a) What is supervised learning in neural network ?   5

   b) What are the shortcomings of back propagation algorithm ? How can it be overcome by Kohenen Self-Organizing Neural Network ?   2 + 8

9. a) What are the designing considerations of simple fuzzy controllers ? Describe them with a suitable flow-chart.   5 + 5

   b) What are the design parameters of general fuzzy controller ?   5
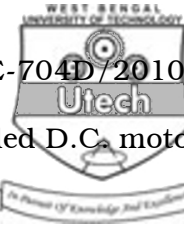
10. Given the fuzzy rules for an armature controlled D.C. motor :

    Rule 1 : If armature voltage (av) is HIGH

    Then speed is HIGH

    Rule 2 : If speed is HIGH

    Then back emf ($b\text{-}emf$) is HIGH

    Rule 3 : If back emf ($b\text{-}emf$) is HIGH

    Then speed is LOW

    For the given motor problem, given the following membership distributions :

    $$\mu_{\text{HIGH}}(av) = \left\{ \frac{0\cdot2}{2}V, \frac{0\cdot6}{4}V, \frac{0\cdot7}{10}V, \frac{0\cdot9}{12}V \right\}$$

    $$\mu_{\text{HIGH}}(\text{Speed}) = \left\{ \frac{0\cdot3}{40}r.p.m., \frac{0\cdot6}{60}r.p.m., \frac{0\cdot9}{90}r.p.m., \frac{0\cdot2}{100}r.p.m. \right\}$$

    $$\mu_{\text{HIGH}}(b-emf) = \left\{ \frac{0\cdot2}{0\cdot5}V, \frac{0\cdot4}{1}V, \frac{0\cdot6}{1\cdot5}V, \frac{0\cdot9}{2}V \right\}$$

    $$\mu_{\text{LOW}}(\text{Speed}) = \left\{ \frac{0\cdot9}{40}r.p.m., \frac{0\cdot8}{60}r.p.m., \frac{0\cdot4}{90}r.p.m., \frac{0\cdot2}{100}r.p.m. \right\}$$

    a) Evaluate implicational relational matrices $R1$ (av, speed) $R2$ (speed, $b\text{-}emf$) and $R3$ ($b\text{-}emf$, speed).

    3 + 3 + 3

    b) Given the membership distribution of armature voltage to be MORE-OR-LESS-HIGH, what would be the distribution of speed to be MORE-OR-LESS-HIGH by using rules 1 and 2.   6

11. What is fuzzy singleton ? What is defuzzifier ? State the significance of centre of area defuzzifier and centre average defuzzifier.   4 + 3 + 4 + 4