

APJ Abdul Kalam Technological University  
First Semester M.Tech Degree Examination January 2016

Ernakulam II Cluster

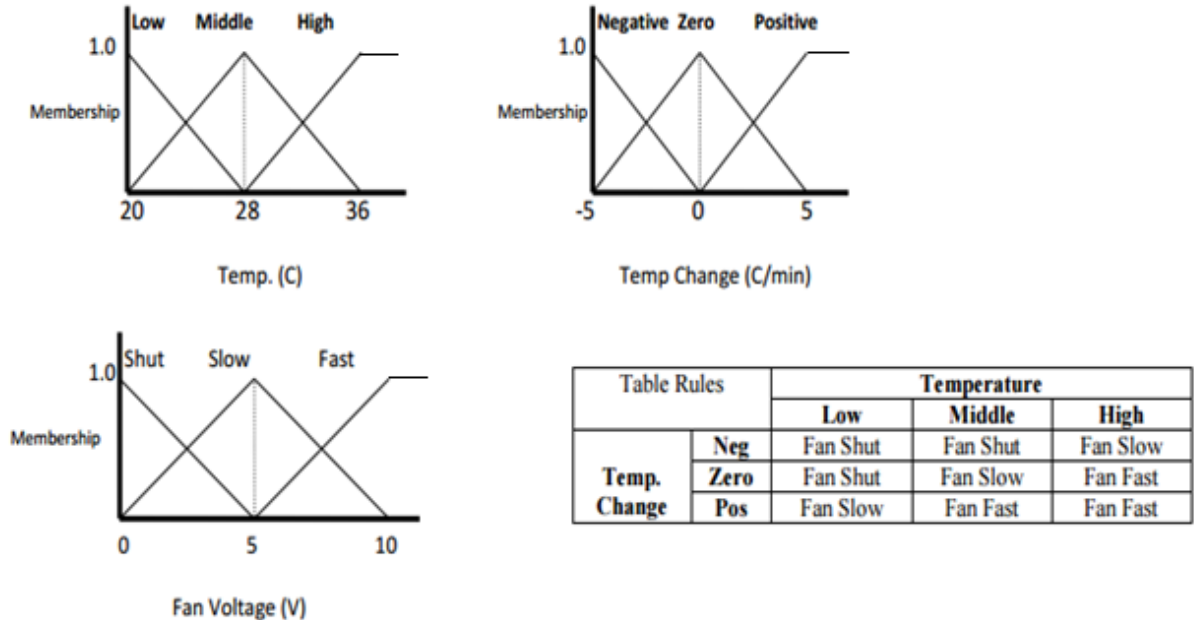
COMPUTER SCIENCE AND ENGINEERING  
Specialization: Computer Science and Engineering

Time: 3 hrs.

**05CS6001- COMPUTATIONAL INTELLIGENCE**

Max Marks: 60

I. a) A fuzzy system is used to control the temperature in a chamber. The inputs to the controller are the 'Temperature' and 'Temperature Change'. The output is the 'Fan Voltage'. The membership functions and the rule table are given below.



If the temperature is 28 degrees and the change of temperature is 0, answer the following questions:

i) What is the Fuzzification result of those inputs?

ii) Calculate the Fan Voltage using Mamdani Inference Engine. Describe how the answer is obtained. (6 Marks)

b) Consider the implication

*If service is good Then customer is satisfied*

The associated universes of discourses are

$U = \text{service-rating} = \{a, b, c, d, e\}$

$V = \text{satisfaction-grade} = \{1, 2, 3, 4, 5\}$

Both the sequences a, b, c, d, e, f and 1, 2, 3, 4, 5 are in ascending order. The fuzzy sets *good-service* and *satisfied* are given below.

$$\text{good-service} = \left\{ \frac{1.0}{a} + \frac{0.8}{b} + \frac{0.6}{c} + \frac{0.4}{d} + \frac{0.2}{e} \right\}$$

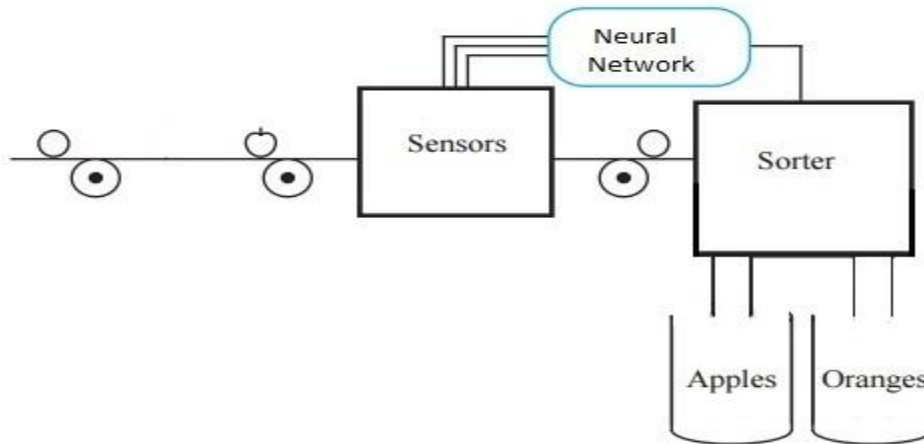
$$\text{satisfied} = \left\{ \frac{0.2}{1} + \frac{0.4}{2} + \frac{0.6}{3} + \frac{0.8}{4} + \frac{1.0}{5} \right\}$$

Express the implication in the form of a relation.

Using fuzzy inferencing draw the conclusion *very satisfied* when the service is known to be *very good* where very-good-service is given by

$$\text{very-good-service} = \left\{ \frac{0.8}{a} + \frac{0.6}{b} + \frac{0.4}{c} + \frac{0.0}{d} + \frac{0.0}{e} \right\} \quad (6 \text{ Marks})$$

II. A produce dealer has a warehouse that stores a variety of fruits and vegetables. When fruit is brought to the warehouse, various types of fruit may be mixed together. It consists set of sensors, which measure three properties of the fruit: shape, texture and weight. The shape sensor will output 1 if the fruit is approximately round and -1 if it is more elliptical. The texture sensor will output a 1 if the surface of the fruit is smooth and -1 if it is rough. The weight sensor will output a 1 if the fruit is more than one pound and -1 if it is less than one pound. The three sensor outputs will then be input to a neural network to decide which kind of fruit is on the conveyor.



- a) Consider ANN that can distinguish between apples and oranges, based on three sensor measurements: shape (round=1, elliptical=-1), texture (smooth=1, rough =-1), and weight (heavier than a pound=1, lighter=-1). As each fruit passes through the sensors it can be represented by a three dimensional vector. The first element of the vector will represent shape, the second element will represent texture and the third element will represent weight. Find out the prototype of orange and apple?

$$P = \begin{bmatrix} \text{shape} \\ \text{texture} \\ \text{weight} \end{bmatrix}$$

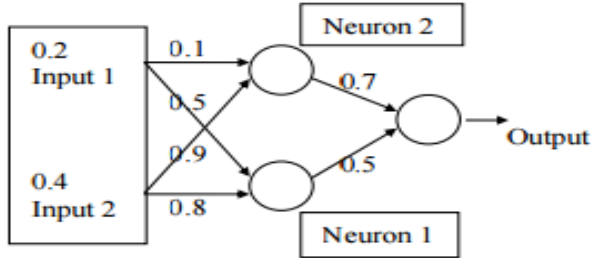
- b) Investigate the capabilities of two input single neuron perceptron.  
 c) Let's assume that weight matrix and bias will be

$$W = [0 \ 1 \ 0], \quad b = 0$$

Let's test the operation based on these and analyze whether it classifies or not.

d) What happens if we put not so perfect orange in to the classifier?

e) Calculate the output from this network assuming a Sigmoid Squashing Function.



(12 Marks)

III Suppose a genetic algorithm uses chromosomes of the form  $x = abcdefgh$  with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual  $x$  be calculated as:

$$f(x) = (a + b) - (c + d) + (e + f) - (g + h) ,$$

And let the initial population consist of four individuals with the following chromosomes:

$$x_1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$$

$$x_2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$$

$$x_3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$$

$$x_4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$$

a) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last. (4 Marks)

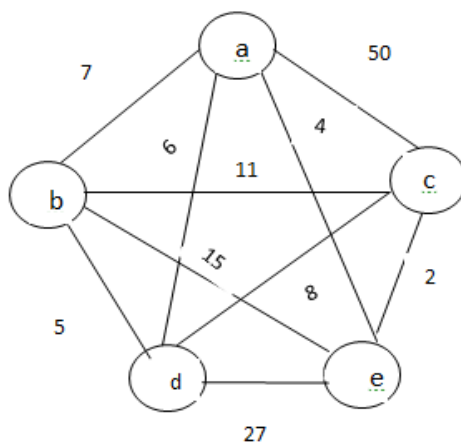
b) Perform the following crossover operations

i) Cross the fittest two individuals using one-point crossover at the middle point.

ii) Cross the second and third fittest individuals using a two point crossover (points b and f).

(8 Marks)

c) i) Consider a tiny instance of TSP with five cities as shown in figure. Each link between two cities is associated with a cost which must be incurred if the salesperson traverses that link. The TSP problem is to find a minimal cost tour .Represent the chromosome?



ii) Devise the binary chromosome. Explain the procedure of TSP chromosome decode. (6 Marks)

OR

IV. a) How kernels are useful for SVM Classification? What are the different kernels? Describe any one of the kernels (9 Marks)

b) Crossover is considered as an axle for the generation of new offspring. Describe different crossover operations. (9 Marks)

V.

a) Explain the working of Ant Colony Systems. (9 Marks)

b) What are Expert Systems? Mention some of their important features. Which are the major applications of Expert Systems? (9 Marks)

OR

VI.

a) Develop Ant Colony Optimization (ACO) for solving the Travelling Salesman Problem (TSP). (10 Marks)

b) Do you agree that an Expert System can replace the human in different expert areas? (4 Marks)

c) What is an expert system shell? What is the use of the automated reasoning tool in Expert System Shell? How the use of expert system shell helps to reduce the development time of an expert system drastically? (4 Marks)