College of Engineering Pune
Department of Instrumentation and Control
Soft Computing
Semester Examination

Solve six questions
[Four from section A and two quesyions from Section B]
Question 6 carries 10 marks]

1.Wherever feasible, include graphical presentation.
2. Methodical answers are expected

Total Marks: 50
Date : April 25, 2013
Duration : 3 Hours

Section A
Fuzzy Sets and Fuzzy logic
Solve four questions
Questions 6 carries 10 marks while all the questions carry equal marks

Question 1   [8]

a) We want to compare two sensors based upon their detection levels and gain settings. For a universe of discourse of gain settings, $X = \{0, 20, 40, 60, 80, 100\}$, the sensor detection levels for the monitoring of a standard item provides typical membership functions to represent the detection levels for each of the sensors; these are given below in standard discrete form:

Fuzzy set $S_1 = \{0/0 + 0.5 \ /20 \quad 0.65/40 + \ 0.85 \ /60 \ + \ 1 \ +/80 \ + \ 1 \ /100\}$
Fuzzy set $S_2 = \{0/0 + 0.45 \ /20 \quad 0.60/40 + \ 0.80 \ /60 \ + \ 0.95 \ +/80 \ + \ 1 \ /100\}$

Computations of mathematical expressions for the membership functions, and a fuzzy set with figures are necessary.

1. $\mu_{S_1 \ \overline{\cap} \ S_2}$
2. $\mu_{S_1 \cup S_2}$
3. $\mu_{S_1 \cap S_2}$

b) Explain with a venn diagram:
Why and how Fuzzy set is different from Classical sets?

Question 2   [8]

a) A group of international experts in fuzzy set theory were invited to classify the overall performance of five COEP research scholars attending lectures on fuzzy sets and fuzzy logic. The experts , after a lot of discussion, agreed to consider the following attributes in the

classifcation of the scholars. How would they judge similarlty of the research scholars with varying attributes? Explain the procedure in details. Compute similarity coefficients, plot dendrogram and offer your comments, if any.

Research Scholar ,R	Marks scored (out of 1000)	Creativity	Presentation skills	Confidence level
1	700	Good	Very Good	Good
2	620	Fair	Good	Fair
3	830	Good	Fair	Excellent
4	790	Excellent	Good	Fair
5	950	Excellent	Excellent	Good

b) Write a commentary on
  Hard C Mean and Fuzzy C Mean clustering
  Or
  Fuzzy equivalence and tolerence relation

Question 3   [8]

In the statistical characterization of fractured reservoirs, the goal is to classify the geology according to different kinds of fractures, which are mainly tectonic and regional fractures. The purpose of this classification is to do critical simulation based on well data, seismic data, and fracture pattern. After pattern recognition (using Cauchy–Euler detection algorithms or other methods) and classification of the fracture images derived from the outcrops of fractured reservoirs, a geological engineer can get different patterns corresponding to different fracture morphologies. Suppose the engineer obtains five images ($I1 \ldots I5$) from five different outcrops of fractured reservoirs, and their percentage values corresponding to three kinds of fractures (Tectonic fracture, Regional fracture, and Other fracture), as given below:

	I1	I2	I3	I4	I5
Tectonic fracture		0.6	0.6	0.3	0.5	0.2
Regional fracture		0.3	0.1	0.2	0.2	0.6
Other fracture	0.1	0.3	0.5	0.3	0.2

Develop a similarity relation
(*a*) using the cosine amplitude method or
(*b*) using the max–min method.
Transfrom fuzzy toleration to fuzzy equivalence relation

Question 4   [8]

You are directed to repair defective pumps in the villages. The distance between the villages is given in the tabular form. How will you classify and organise your program?

Village to Village		Distance (kms)
1	2	2
1	3	6
1	4	10
1	5	9
2	3	5
2	4	9
2	5	8
3	4	4
3	5	5
4	5	3

Use single linkage or nearest neighbour method for classifaction.

b) Describe Mamdani and TSK Fuzzy Models

Question 5 [8]

In the field of computer networking there is an imprecise relationship between the level of use of a network communication bandwidth and the latency experienced in peer – to – peer communications. Let X be a fuzzy set of use levels (in terms of the percentage of full band width used) and Y be a fuzzy set of latencies (in milliseconds)

X = {0.2 / 10 + 0.5 / 20 +0.8 /40 +1.0 /60 + 0.6 /80 + 0.1 / 100}
Y = {0.3/ 0.5 + 0.6 / 1 + 0.9 /1.5 +1.0 /4 + 0.6 / 8 +   0.3 / 20}
You have been given a second fuzzy set of bandwidth usage -
Z = {0.3 /10 + 0.6 /20 + 0.7 /40 + 0.9 / 60 + 1 / 80 + 0.5 / 100}

b) Explain
Four corner stones of fuzzy logic
Or
Canin analogy in max min compostional rule of inference.

Question 6 [10]

Air pollution studies have shown that the air qualty as this junction is very poor during peak traffic hours at Karve Road Junction, Pune. With an objective toreduce traffic congestion, you will be designing fuzzy logic based traffic signals system. In order to establish the combined belief, seven Indian Chest Physicians/ Pulmonologists, on the basis of their several years of experience, categorized the respiratory diseases into four groups: **A.** Simple Bronchitis and Chronic Obstructive Pulmonary disease (COPD) with lung cancer as the sub set of COPD **B.** Asthma **C.** Allergic Rhinitis and Conjunctivitis, and **D** Heart Attack. The experts were further

interviewed for their opinion on diseases caused/exacerbated due to increase in concentrations of air pollutants like RSPM, NO_x, and SO_x as these are the only pollutants monitored in India
The table presents the belief of the two experts.
You are expected to compute the combined belief fo the two experts in all the possible combination of respiratory diseases.

Disease	A	B	C	D	A∪B	A∪C	A∪D	B∪C	B∪D	C∪D
Expert1	0.04	0.07	0.08	0.03	0.06	0.07	0.06	0.08	0.08	0.06
Expert2	0.05	0.08	0.08	0.03	0.06	0.06	0.06	0.08	0.07	0.07

Continued..

Disease	A∪B∪C	A∪B∪D	B∪C∪D	A∪C∪D	A∪B∪C∪D
Expert1	0.08	0.07	0.06	0.08	0.08
Expert2	0.09	0.06	0.06	0.07	0.08

Section B

Artificial Neural Networks
Solve *any Two* questions

Question 7

Describe different components of an artificial neural network. [8]

Question 8 [8]

What is "generalization" in back-propagation training algorithm? What are the training, validation, and test sets? Describe at least one method used for achieving generalization.

Question 9 [8]

A Perceptron with a bipolar step function [$f(x) = 1$ for $x > 0$, and $f(x) = -1$ for $x <= 0$] has *constant* bias input $x_0 = 1$ and two variable inputs (x_1 and x_2). It has three weights: $w_0 = \theta = 0.4$ (bias value), $w_1 = 0.8$ and $w_2 = 0.1$, corresponding to these inputs.

The Perceptron is trained using the learning rule $\delta w_i = \eta(d - y)x_i$, $i = 0, 1, 2$; where $\mathbf{x} = (x_0, x_1, x_2)$ is the input vector, η is the learning rate, $\mathbf{w} = (w_0, w_1, w_2)$ is the weight vector, d is the desired output, and y is the actual output.

What are the new values of the weights and the bias after one step of training with the input vector $\mathbf{x} = [1, 1, 0]$ and desired output = -1, using a learning rate $\eta = 0.7$?