Indian Institute of Technology, Kharagpur 721 302

Date of Examination: April 26, 2019 (FN)
End-Spring Semester 2018-2019
CE31501: Soft-Computing Tools in Engineering

Time: 3 Hours
Full Marks: 60
B.Tech 3rd Year

No. of Students: 64

Important Instructions: (a) Attempt **ALL SIX** questions (b) All the questions carry equal marks. (c) **Assume data** wherever necessary and mention in your answer script. (d) Clean writing will be given credit.

Question 1:

(a) Give examples of interval-valued fuzzy sets and level 2 fuzzy sets.
(b) Explain fuzzy logic control system with detail design steps. How does it improve performance in comparison to the conventional control system? Give list of applications of fuzzy logic control.

Question 2:

For the given complete system (***Figure 1***) arrive at the Overall condition rating in linguistic form using any two decision-making criteria (Refer ***Figure 2-4*** for fuzzy rating, weights and condition rating). Use fuzzy weighted average approach for the expert evaluation data given below. ***Component 1*** has the weight value (w) as "Very Important".

Component 1 - Evaluation Data

	Rating (x)	Importance (w)
Sub-component 1	Moderate	Very important
Sub-component 2	Very Low	Rather Important

Component 2 – Evaluation Data

	Rating (x)	Importance (w)
Component 2	Very Low	Very important

Question 3:

Assume a standard 2-2-1 three-layered network with learning parameter as 0.9 and momentum parameter as 0.7. Perform hand calculations assuming back-propagation learning for two iterations on the pattern sets given below.

Pattern number	X_1	X_2	Target
1	0.2	0.4	0.6
2	0.7	0.3	0.1

Further assume that initial values for all biases are 0.01 and the values of input to hidden weights are –0.5; and hidden to output weights are 0.25. Use sigmoid as an activation function at hidden and output nodes.

Question 4:

(a) Explain Radial Basis Function network with the help of an example. Also, discuss about the basic characteristics of this algorithm.
(b) Explain in detail about the dynamic structures of committee machines.

Question 5:

(a) Explain various steps of knowledge discovery and data mining (KDDM). Give details of the algorithm and use of Self-Organizing Feature Maps (SOFM) in the context of knowledge discovery.
(b) Highlight various aspects of the Parallel Genetic Algorithm and their variants.

Question 6:

Given the perimeter of a rectangle must be at most 16 cm, construct the rectangle with maximum area. Formulate this as an optimization problem. Carry out step-by-step calculations for this problem using Genetic Algorithm assuming the initial population size of four. Accuracy of the variable is expected to be up to one decimal point. Restrict your demonstration for two generations only. If roulette-wheel selection, single-point crossover and two-point crossover with probability 0.95 and a bit-wise mutation with probability 0.05 are used, what impact it will have on the results after two generations. Comment on the results.

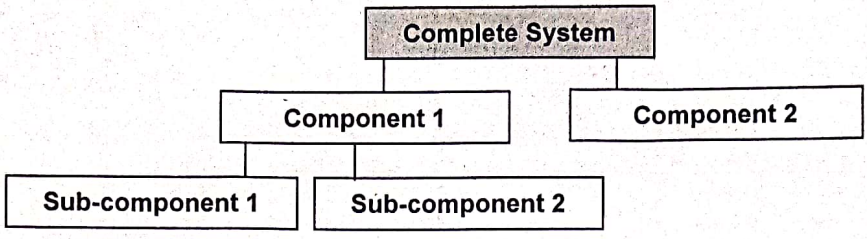

Figure 1: Complete System (Question 2)

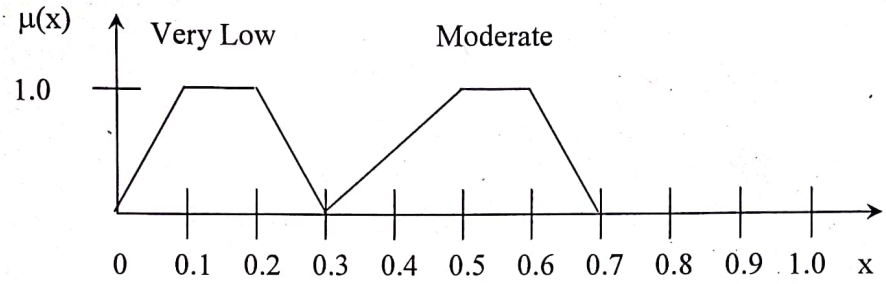

Figure 2: Fuzzy rating (Question 2)

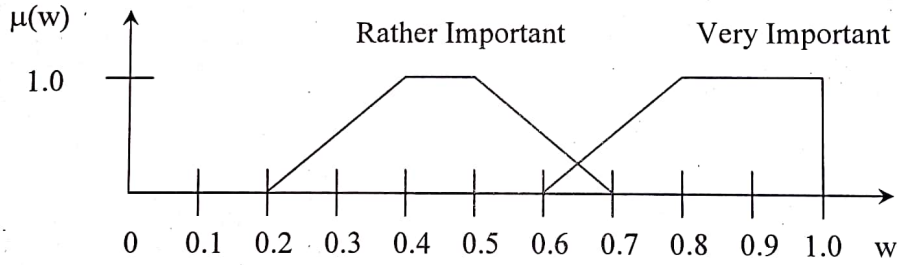

Figure 3: Fuzzy weights (Question 2)

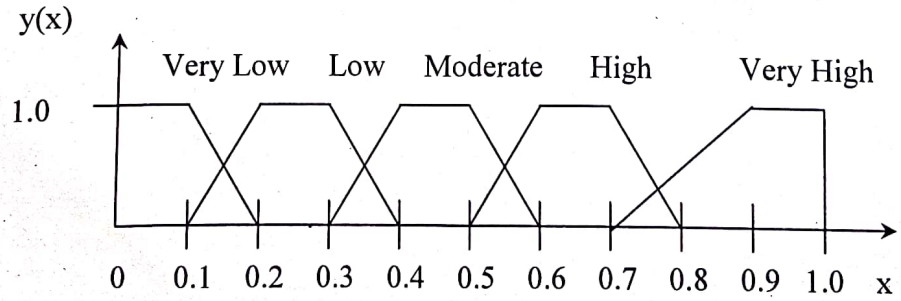

Figure 4: Fuzzy Component/Overall System condition rating (Question 2)

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