Exam Slot → **A**

APJ Abdul Kalam Technological University
First Semester M.Tech Degree Examination December 2016
Ernakulam II Cluster
COMPUTER SCIENCE AND ENGINEERING
Specialization: COMPUTER SCIENCE AND ENGINEERING

05CS 6001- COMPUTATIONAL INTELLIGENCE

Time: 3 hrs. Max. Marks: 60

I a) Consider a fuzzy based Robot system. The following tables describe the rules of how (speed and angle with which) the robot should turn based on the distance and angle of the obstacle from the robot. (12 Marks)

Rules for inferring angle for turn are given as

Distance→ / Angle	NEAR	FAR
Small	Sharp Turn	Medium Turn
Medium	Medium Turn	Mild Turn
Large	Mild Turn	Zero Turn

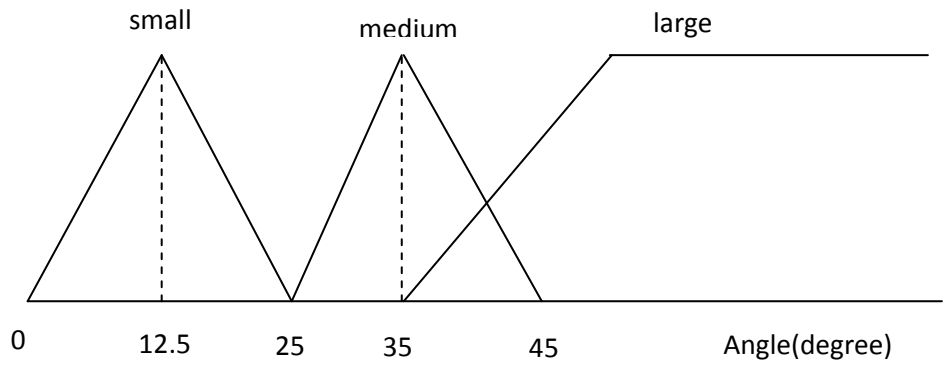
[Example Rule: If Distance from Obstacle is NEAR and Angle from the Obstacle is SMALL Then Turn Sharply]

Rules for Speed of turning are given as

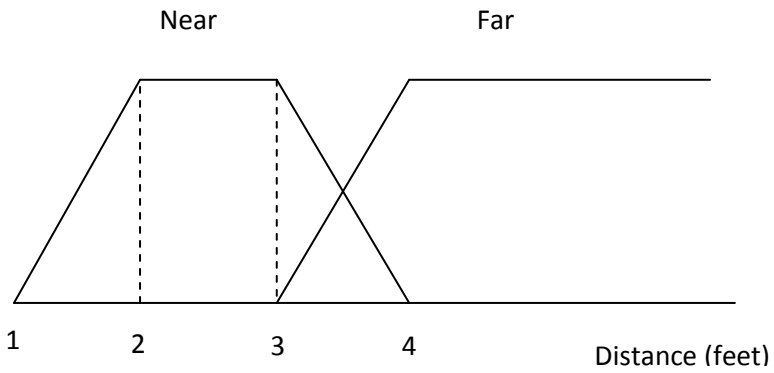
Distance→ / Angle	NEAR	FAR
Small	Slow	Fast
Medium	Slow	Very Fast
Large	Fast	Very Fast

[Example Rule: If Distance from Obstacle is NEAR and Angle from the Obstacle is SMALL Then Move Slowly]

Find the implications of the rules using Mamdani's inference and Centroid method. Compute the Speed and Angle for turning using Mamdani's inference and Centroid method when an obstacle is found at a distance of 2 feet at an angle of 30 °



Membership function for angle



Membership function for distance

II a) Four patterns $s_1 = [1, 0, 0]$, $s_2 = [0, 0, 1]$, $s_3 = [1, 1, 0]$, and $s_4 = [0, 1, 1]$ are to be clustered into two clusters. Illustrate the learning by Kohonen's SOM by applying only one input s_1 to the network and making suitable modifications to the weights. Take R = 0, $\eta = 0.8$ and the initial weight matrix as given below. (6 Marks)

$$W=\begin{bmatrix}0.5 & 0.3\\ 0.8 & 0.5\\ 0.3 & 0.3\end{bmatrix}$$

b) Describe the major steps in the back propagation algorithm to train a three layer feed-forward neural network. (6 Marks)

III a) Suppose a genetic algorithm uses chromosomes of the form x = abcdefghij with a fixed length of ten genes. Each gene can be any digit between 0 and 9.The function f(x) is given as

$$f(x)=a+ b+ c+ d+ e+ f+ g+ h+ i+ j$$

Let the fitness of individual x be calculated as:

$$\frac{1}{1+f(x)}$$

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

x1 = 6 5 4 1 3 5 3 2 7 1
x2 = 8 7 1 2 6 6 0 1 2 6
x3 = 2 3 9 2 1 2 8 5 8 1
x4 = 4 1 8 5 2 0 9 4 9 4

i) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last. (3 Marks)

ii) (6 Marks)

Perform the following crossover operations:

1. Cross the fittest two individuals using one–point crossover at the middle point
2. Cross the second and third fittest individuals using a two-point crossover (points b and f).

b) Explain multi-objective genetic algorithms (9 Marks)

OR

IV a) How support vector machine classifier classifies the classes. (10 Marks)

b) Write about support vector regression. (8 Marks)

V a) Write ACO algorithm for travelling salesman problem (8 Marks)

b) Write the stages in the development of an expert system (5 Marks)

c) Differentiate between forward reasoning and backward reasoning with suitable examples (5 Marks)

OR

VI a) Consider a particle swarm optimization system composed of three particles and V_{max} = 10. To facilitate calculation, ignore the fact that r_1 and r_2 are random numbers and fix them to 0.5. Assume two dimensional real valued space R^2 and the current state of the swarm as follows:

Initial Position of particles: $x_1 = (5, 5)$; $x_2 = (8, 4)$; $x_3 = (6, 7)$;
Individual best positions: $x^*_1 = (5, 5)$; $x^*_2 = (7, 4)$; $x^*_3 = (5, 6)$;
Social best position: $x^* = (5, 5)$;

Initial Velocities: $v_1 = (2, 2)$; $v_2 = (3, 3)$; $v_3 = (4, 4)$.

Calculate the position of the particles after one iteration using the equation,

$$v(i,d) = \omega\, v(i,d) + r_1(x^*(i,d) - x(i,d)) + r_2(x^*(d) - x(i,d))$$

to each particle i and dimension(or iteration) d. Assume $\omega = 1$.

Explain why the parameter ω is called inertia and what will be the impact high value for the parameter ω (10 Marks)

b) Do you agree that an Expert System can replace the human in different expert areas? Justify your answer. (5 Marks)

c) What is an expert system shell? How it helps in reducing the development time of an expert system drastically? (3 Marks)