19.08.2021

Ankara University
Computer Engineering Department
COM/BLM4513 Special Topics Midterm

Duraiton: 120 Minutes.
P.S.: 1. Write your answers in the spaces given.
2. Questions will only be answered using the methods described in the class.

QUESTIONS

1. (25 pts) Regarding expert systems

a. (**5 pts**) Indicate the differences between forward-chaining and backward-chaining given the inference mechanisms used. List the advantages and disadvantages for both.

b. (10 pts) Show the inference of Z according to the table given below using backward-chaining and specifying all subgoals.

Knowledge Base	**Database**
F & B -> Z C & D -> F A -> D	A B C E

c. (10 pts) Write the logical expression for the rule below and calculate the rule's certainty factor (cf) using the following certainty factors for the given evidence.

If today the weather is dry and the temperature is warm, or today the weather is dry and the temperature is warm and the weather is cloudy, tomorrow will be rainy. (cf=0.4)

Weather is dry (E_1, cf:0.3), Temperature is warm (E_2, cf: 0.2), Weather is cloudy (E_3, cf: 0.1), It's rainy (H)

2. (10 pts) If a patient has X disease, there is a 90% probability that a medical test will produce a positive result. It is known that 1% of the population has this disease and the probability of producing false positive results is 5%. If the test result is positive, calculate the probability that the patient is X patient using the Bayesian inference method.

4. (10 pts) According to the given probability table

Probability	Hypothesis		
	i=1	i=2	i=3
$p(H_i)$	0.40	0.35	0.25
$p(E_1\|H_i)$	0.3	0.8	0.5
$p(E_2\|H_i)$	0.9	0.0	0.7
$p(E_3\|H_i)$	0.6	0.7	0.9

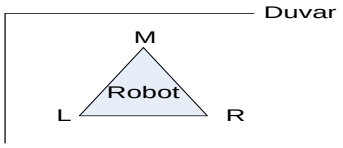
a. (5 pts) Calculate the posterior probability of the hypotheses given the E3 proof.

b. (5 puan) Calculate the posterior probability of the hypotheses given the evidences E1 and E3.

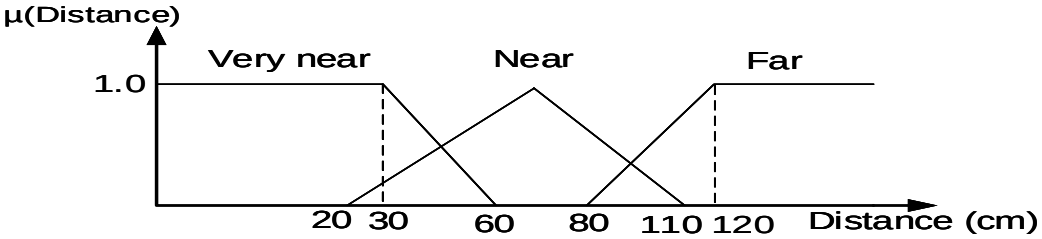
5. (15 pts) Explain the methods to speed up the learning process in neural networks.

1.	
2.	
3.	

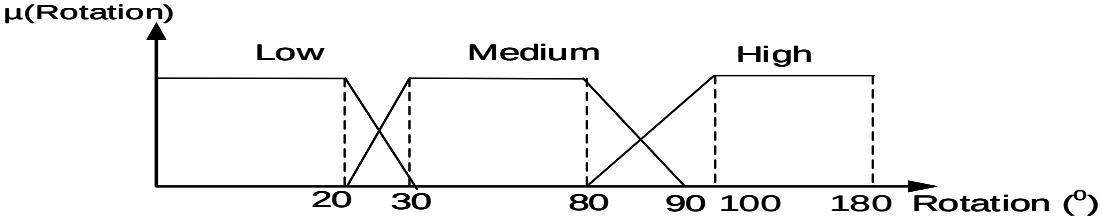
6. (20 pts) The position of a robot at a given moment, which has 3 distance sensors at its corners, left, middle and right (L, M and R) to avoid various obstacles such as walls, is given in the figure:



Values from the distance sensor are fuzzied using the following input membership function:



Then, the following output membership function is used to determine the amount of rotation according to the rule database:



It is assumed that the following rules exist in the rule database.

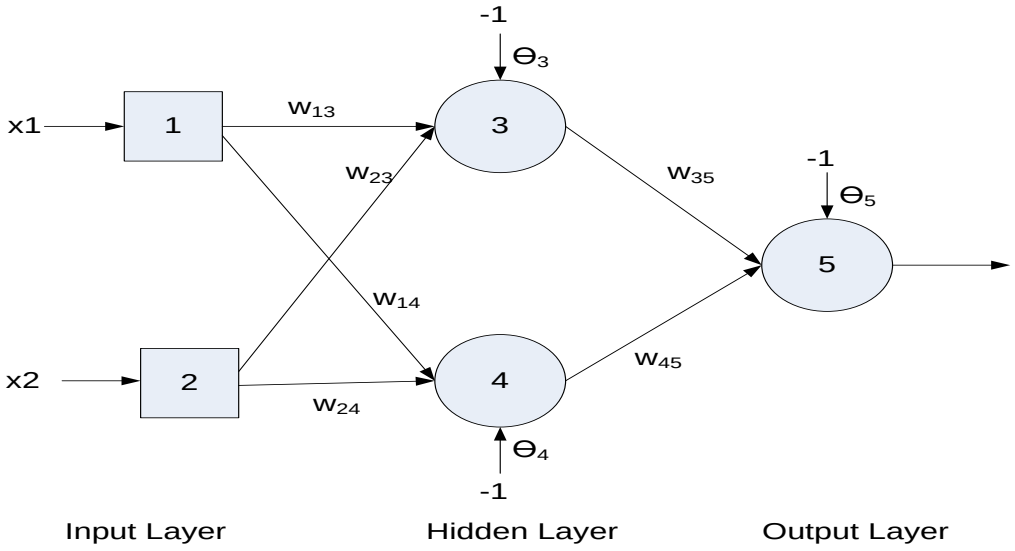
⋮

IF L *Very Near* **AND** M *Very Near* **THEN** rotation direction is Right and High.
IF L *Near* **AND** M *Very Near* **THEN** rotation direction is Right and Medium.

⋮

For the case where the values from the sensors are L=45 cm and M=20 cm, calculate the amount of rotation using the Mamdani subtraction method and clipping (the interval value can be taken as 10^0).

7. (20 pts) Train the given neural network for the X-OR process by showing all intermediate states as iterations for consecutive (0,1) values using the back-propagation method, and show the weight and threshold values of the network in the final state. The activation function to be used is sigmoid and all weight and threshold values will be taken as 0.5 initially.



Feedforward stage:

Backpropagation leaning stage:

Weights updating stage: