Assignment

Due date 12 April 2020
If the classes in the university is not resumed on that day, then you need to submit the assignment to my email address shamimkaiser@gmail.com by 12 PM.
**After 12 PM, you will receive ZERO in the assignment.**

1. What is a fuzzy variable?
2. What is a membership function of a fuzzy set?
3. Can a fuzzy membership be True and False at the same time?

4. Consider the following real variables from everyday life:
   a. Income measured in $UK.
   b. Speed measured in meters per second.
   c. A TV show measured in how much you are interested watching it.
   d. A meal measured in how much you like to eat it.
   e. A traffic light measured in what color is on.

   In each case, suggest a fuzzy variable corresponding to these real variables. For which of these five variables the use of a fuzzy variable is not really necessary? Why?ve variables the use of a fuzzy variable is not really necessary? Why?

5. Consider the following fuzzy expert system for weather forecast:

Rule		Condition	Action		Confidence
R1:	IF	arrow is down	THEN	clouds	$M = 0.8$
R2:	IF	arrow is in the middle AND *moving down*	THEN	clouds	$M = 0.6$
R3:	IF	arrow is in the middle AND *moving up*	THEN	sunny	$M = 0.6$
R4:	IF	arrow is up	THEN	sunny	$M = 0.8$

The following two plots represent the membership functions of two fuzzy variables describing the position of the arrow of barometer (left) and the direction of its movement (right):
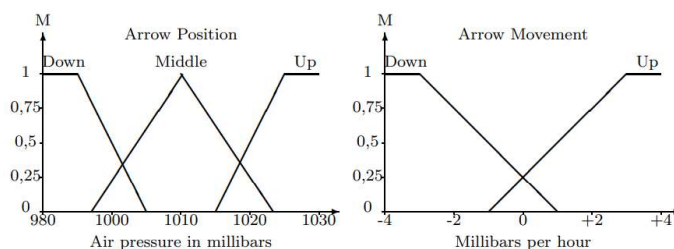
The air pressure is measured in millibars, and the speed of its change in millibars per hour. Answer the following questions

   a. How much is the arrow Down, Up or in the Middle if it indicates that the pressure is 1020 millibars? Use membership functions on the graph
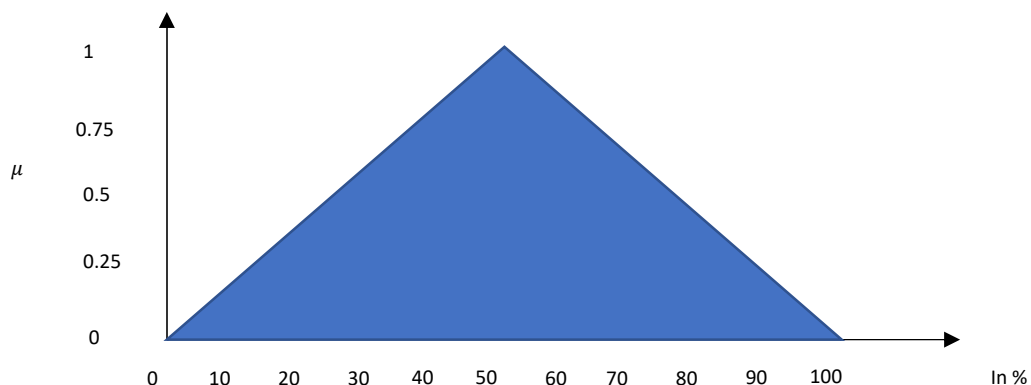
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      b. How much is the arrow moving Down or Up if the pressure changes -2 millibars every hours?

      c. Using the membership values found above and confidences of the rules in the table calculate the degree of confidence in that the sky is clear or cloudy

6. What is the purpose of defuzzyfication? Name at least one method used for defuzzyfication.

7. Determine the union and intersection of the fuzzy sets A = "comfortable house for a 4 persons - family" and B = "small house", where A = {(1, 0.1),(2, 0.5),(3, 0.8),(4, 1.0),(5, 0.7),(6, 0.2)} and B˜ = {(1, 1),(2, 0.8),(3, 0.4),(4, 0.1)}

8. Let x be a linguistic variable that measures a university's academic excellence, which takes values from the universe of discourse U ={1,2,3,4,5,6,7,8,9,10 } . Suppose the term set of x includes Excellent, Good, Fair, and Bad. Express these fuzzy sets through enumeration.

9. Let us consider the concept "moderately approved" regarding the public's opinion of a presidential candidate. The universe of discourse is the percentage of those people supporting the candidate in a national poll. To simplify the discussion we use a discrete universe of discourse U={0%,10%,20%, … ,100%}. The membership function of the moderately fuzzy set approved is shown in figure. Find the $\alpha - $ cut of the fuzzy set at 0.75, 0.5, 0.1.

10. A four person family wants to buy a house. An indication of how comfortable they are to be is the number of bedrooms in the house. But they also want a large house. Let U ={1,2,3,4,5,6,7,8,9,10} be the set of available houses described by their number of bedrooms. Then the fuzzy set C (for comfortable) may be described as

$$C = \left\{ \frac{0.2}{1}, \frac{0.5}{2}, \frac{0.8}{3}, \frac{1.0}{4}, \frac{0.7}{5}, \frac{0.3}{6}, \frac{0}{7}, \frac{0}{8}, \frac{0}{9}, \frac{0}{10} \right\}$$

Let L be the fuzzy set Large defined as

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$$L = \left\{ \frac{0}{1}, \frac{0}{2}, \frac{0.2}{3}, \frac{0.4}{4}, \frac{0.6}{5}, \frac{0.8}{6}, \frac{1}{2}, \frac{1}{8}, \frac{1}{9}, \frac{1}{10} \right\}$$

How many bedrooms are optimal? What is the maximum satisfactory to the grade? Find the number of bedrooms which are fully satisfactory because it is comfortable. Comments on these.

11. Given four jobs (Jobs 1, 2, 3, and 4); your task is to find the job which will give you the highest salary given the constraints that the job should be interesting and close to your home. Following is data for each job based on each criterion
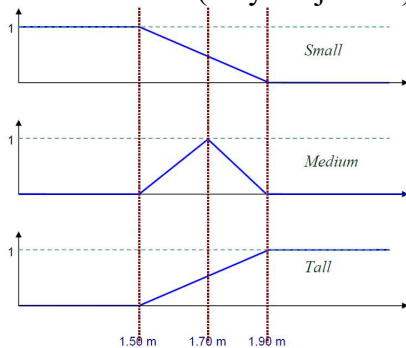Fuzzy Set for Salary={(1,0.875), (2,0.7), (3,0.5),(4,0.5)}
Fuzzy Set for Interest={(1,0.4), (2,0.6), (3,0.8),(4,0.6)}
Fuzzy Set for Drive={(1,0.1), (2,0.9), (3,0.7),(4,1)}
Also draw the Fuzzy plot for Decision

12. Consider these (very subjective) membership functions for the length of a person:

Compute the graphical representation of the membership function of:
$Small \cap Tall$, $(Small \cup Medium) - Tall$

13. Consider the grading system of BUP, draw triangular membership function for the system.

14. For a fuzzy relation R

$$R = \begin{bmatrix} 1 & 0.2 & 0.3 \\ 0.5 & 0.9 & 0.6 \\ 0.4 & 0.8 & 0.7 \end{bmatrix}$$

Find the alpha cut relation for the value of 0, 0.2 and 0.4

15. The fuzzy set of young is {(15,0.5),(20,0.8),(25,0.8),(30,0.5),(35,0.3)}, find the crisp value using MOM

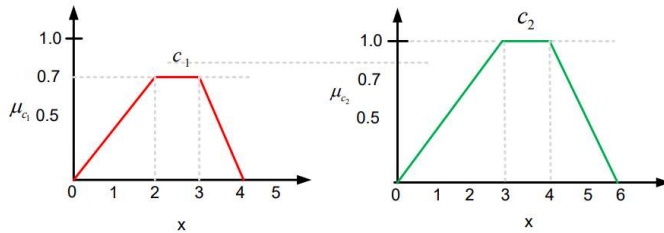16. Find the crisp value of $C_1 \cup C_2$ using CoG
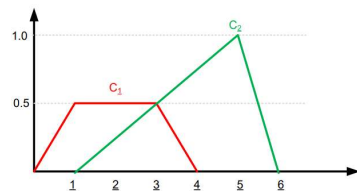
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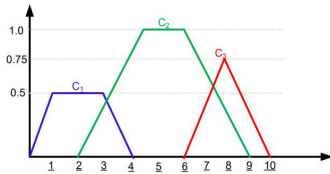
17.
18. Find the crisp value using weighted average method

19. Find the crisp value using all defuzzification method discussed in the class

20. The faulty measure of a circuit is defined fuzzily by three fuzzy sets namely Faulty(F),
    Fault tolerant (FT) and Robust(R) defined by three membership functions with number of
    faults occur as universe of discourses and is shown below.
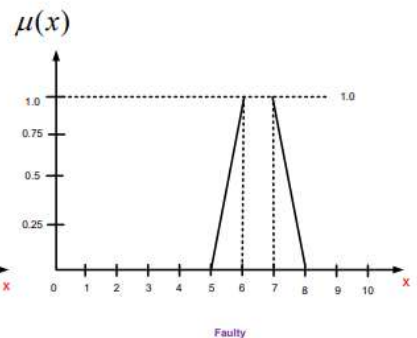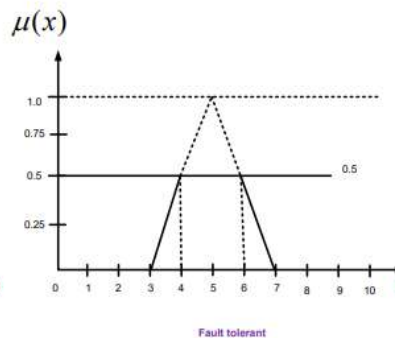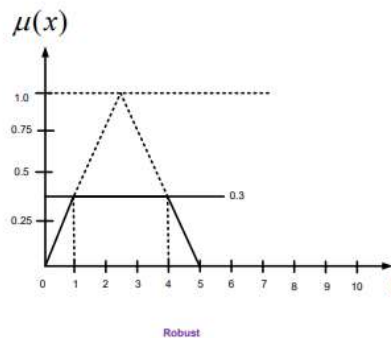
Reliability is measured as $R^* = F \cup FT \cup R$. With a certain observation in testing (x, 0.3)
$\in$ R,(x, 0.5) $\in$ FT,(x, 0.8) $\in$ F. Calculate the reliability measure in crisp value. Calculate
with 1) CoS 2) CoG .

21. Name three strengths and three weaknesses of fuzzy expert systems.