Example EXAM APPROXIMATE REASONING ETSE, URV

Q1

Given the following network of inference with the corresponding Certainty factors of the rules, solve the following case where the evidences are:

CF(A)= 0.2, CF(B)= 0.9 and CF(D)= 0.8.

Rules are:

If (A or B) then C (CF= 0.8)

If C then E (CF= - 0.6)

If (B and D) then E (CF= 0.9)

Explain the conclusion you arrive about the fact E after the calculation of its CF.

ANSWER

Rule1:

CF(C) = CF (A or B) * CFrule1= max(A,B) * CFrule1= max(0.2,0.9) * 0.8 = 0.72

Rule 2:

CF(E) = CF (C) * CFrule2 = 0.72 * -0.6 = -0.432

Rule 3:

CF(E) = CF(B and D) * CFrule3 = min(B,D) * CFrule3 = min(0.9,0.8) * 0.9 = 0.72

Combination of rule 2 and rule 3 for E

(0.72 - 0.432) / (1 - 0.432) = 0.288/0.567 = 0.5

We have a moderate certainty about the fact E being true.

Q2

We are constructing a fuzzy expert system for medical diagnosis.

Define an input value for the concept "Body Mass Index". You must define all the information needed to introduce it in a software, like Matlab. In addition, if you can make a graphical representation of this variable, it would be nice. You can upload it from an screenshot or picture.

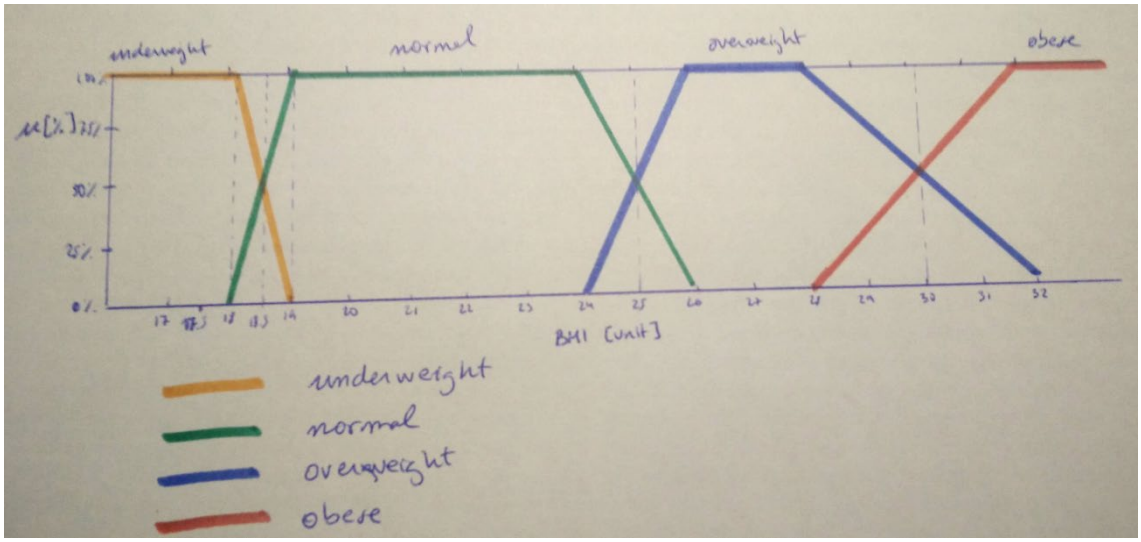
The *Body mass index* (*BMI*) is a measure of body fat based on height and weight.

The crisp values are in these points according to the Medical knowledge (found in web):

- underweight< 18.5
- normal: 18.5 to 25
- overweight: 25 to 30
- obese: > 30

We must fuzzify these thresholds. Moreover, we want it to define a fuzzy partition, so values should sum up to 1. For example:

```
FUZZIFY bmi
   TERM underweight:= (18,1) (19,0);
   TERM normal:= (18,0) (19,1) (24,1) (26,0);
   TERM overweight:= (24,0) (26,1) (28,1) (32,1);
   TERM obese:= (28,0) (32,1);
END_FUZZIFY
```



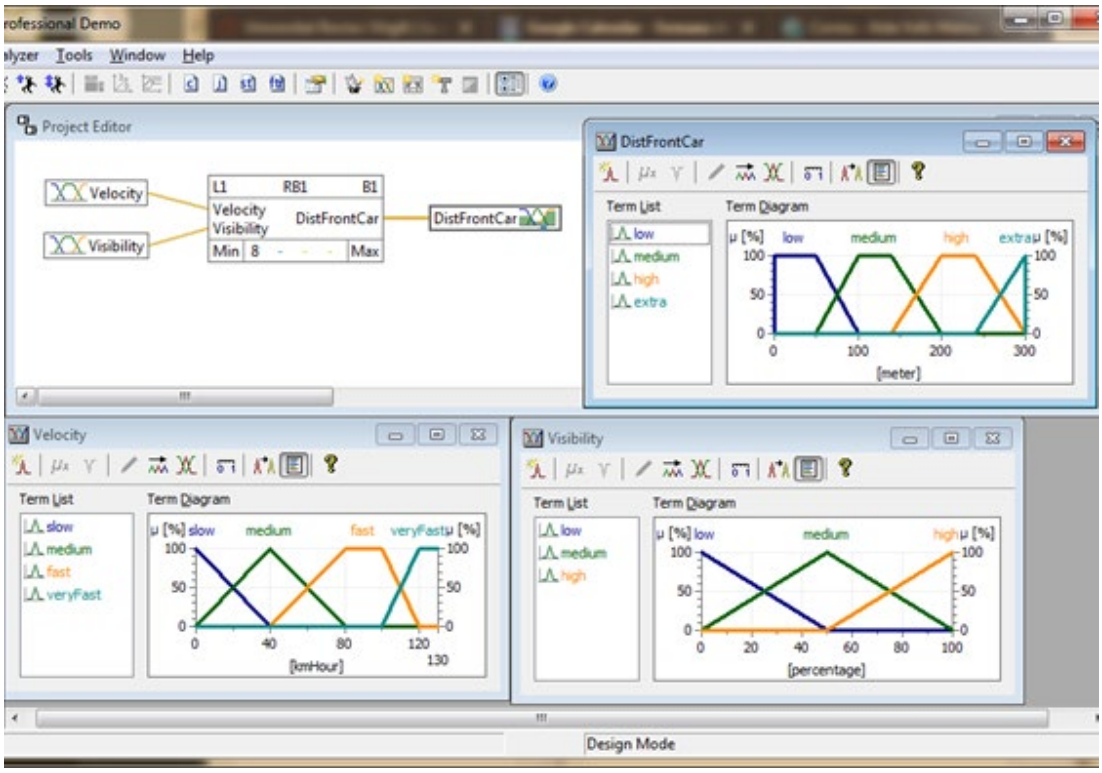
Q3

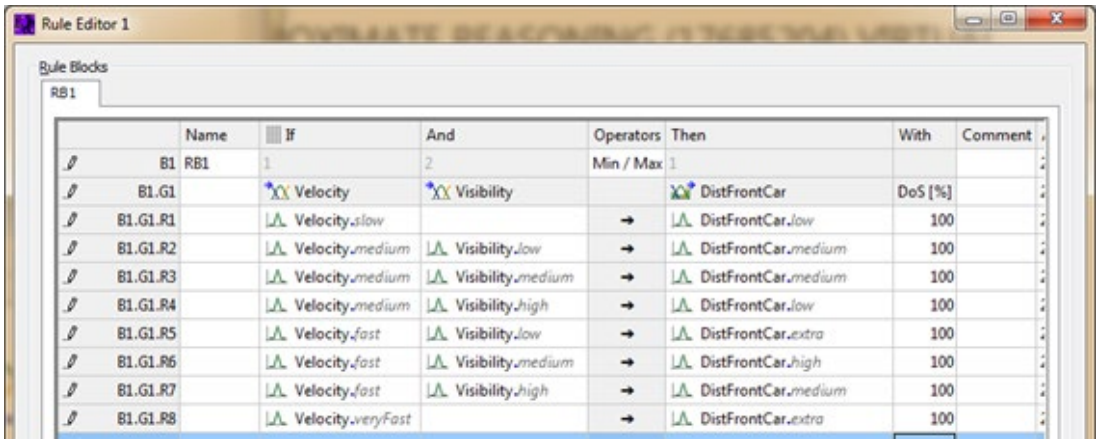
In the following images you can see an expert system that calculates the safe distance that a car must apply, using 2 input variables: Velocity in km/h and Visibility in %.

a) Indicate which rules are activated for a car that is moving at 105 km/h and the visibility is 40% due to fog. Write the level of activation of the premisses.

b) Write also which is the level of activation of the labels in the conclusions of these rules. Indicate the steps to calculate it.

c) What will change if the Degree of Support of rule R8 had a value below 50%? Put an example of the new outputs.





	Name	If	And	Operators	Then	With	Comment
B1	RB1	1	2	Min / Max	1		
B1.G1		Velocity	Visibility		DistFrontCar	DoS [%]	
B1.G1.R1		Velocity.slow		→	DistFrontCar.low	100	
B1.G1.R2		Velocity.medium	Visibility.low	→	DistFrontCar.medium	100	
B1.G1.R3		Velocity.medium	Visibility.medium	→	DistFrontCar.medium	100	
B1.G1.R4		Velocity.medium	Visibility.high	→	DistFrontCar.low	100	
B1.G1.R5		Velocity.fast	Visibility.low	→	DistFrontCar.extra	100	
B1.G1.R6		Velocity.fast	Visibility.medium	→	DistFrontCar.high	100	
B1.G1.R7		Velocity.fast	Visibility.high	→	DistFrontCar.medium	100	
B1.G1.R8		Velocity.veryFast		→	DistFrontCar.extra	100	

a)

Level of activation:

Velocity 105 km/h -> fast (0.75), very fast (0.25)

Visibility 40% -> medium (0.8), low (0.2)

B1.G1.R5 with Velocity.fast = 0.75 AND Visibility.low = 0.2

B1.G1.R6 with Velocity.fast = 0.75 AND Visibility.medium = 0.8

B1.G1.R8 with Velocity.veryFast = 0.25

b)

For computing the level of activation of the labels in the conclusions we need first to compute the premises together. As they are joined by AND, it consists on computing the min operation (regarding Mandami). Once we have this step, we join the values that activate the same label, in this case with an OR, which consists on a max operation (again, with Mandami).

B1.G1.R5 is activating Distfrontcar.extra with 0.2

B1.G1.R6 is activating Distfrontcar.high with 0.75

B1.G1.R8 is activation Distfrontcar.extra with 0.25

We combine R5 (0.2) and R8 (0.25) and obtain the final activation for Distfrontcar.extra is 0.25

c)

If we modify the DoS for R8 to be 50%, that means we need to use the product operation on the activation level. In this case that will mean R8 will drop to 0.125, and we have to re-compute the joining.

We combine R5 (0.2) and R8' (0.125) and obtain the final activation for Distfrontcar.extra is 0.2

Q4

We want to evaluate which are the good stock actions to invest in. We will use the model of Dempster-Shafer to calculate the belief-plausability interval for each of them.

We consider 3 possibilities: (S) Seur actions, (P) Paypal actions, (A) Alibaba actions.

We have built two mass assignments m1 and m2. We ask you to combine them and after that combination, calculate the belief and plausability for all possible subsets.

m1 ==> companies related to logistics have good prediction for their actions. So, m1(S,P)=0.8 and m1(A,S,P)=0.2

m2 ==> companies related to internet sales have good prediction for their actions. So, m2(A,P)=0.7 and m2(S)=0.3

After calculating the intervals, explain in which company stock actions you would invest your money.

m1(S,P)=0.8 and m1(A,S,P)=0.2

m2(A,P)=0.7 and m2(S)=0.3

We first combine evidences with the table and obtain the following masses:

m1/m2	SP 0.8	ASP 0.2
AP 0.7	P 0.56	AP 0.14
S 0.3	S 0.24	S 0.06

m(P) = 0.56

m(AP) = 0.14

m(S) = 0.24+0.06 = 0.30

sum (m(P),m(AP),m(S)=1, check! No degree of conflict as no mass assigned to the empty set.

The intervals are the following [belief plausability]:

	m1+m2	Bel	Pl
S	0.30	0.30	1-0.7=0.3
P	0.56	0.56	1-0.3=0.7
A	0	0	1-0.86=0.14
AP	0.14	0.14+0.56=0.7	1-0.3=0.7
AS	0	0.30	1-0.56=0.44
SP	0	0.30+0.56=0.86	1-0=1
APS	0	1	1

From the results, the company stock action to invest is P (Paypal), as it shows a higher belief than the others.