



**INSTRUCTIONS**

*Time: 2 h.*

*Electronic devices with communication are not allowed.*

*Answer the exam using a black or blue ball pen.*

*You must give clear and detailed explanations (with examples, if appropriate)*

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**1. (2 points) Exercise on Certainty Factors.**

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

$CF(A) = 0.2$ ,  $CF(B) = 0.8$ ,  $CF(D) = 1$  and  $CF(E) = 0.5$

Rules are:

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

If C then S (CF= - 0.7)

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

Apply the Certainty Factor model, writing all the steps.

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

2. **(1 point)** Explain the main similarities and differences between the models of Fuzzy Sets and Certainty factors in terms of how they represent uncertainty/imprecision and the operators used.

3. **(2 points) Exercise Bayes networks.** We have a network with 4 nodes. The conclusion variable is C, and we want to discover if its value is Good or Bad. Introduce the following knowledge in the network and say which is the belief about the values of C.
- A is Low
  - D is Yes.

					A	pi	Baux	B	lambda
					high	0,3	0,3	0,3	1
					low	0,7	0,7	0,7	1
	A								
B	high	low							
y		0,5	0,8						
n		0,5	0,2						
					B	pi	Baux	B	lambda
					y	0,71	0,71	0,71	1
					n	0,29	0,29	0,29	1
	B								
C	y	n							
good		0,7	0						
bad		0,3	1						
					C	pi	Baux	B	lambda
					good	0,50	0,50	0,50	1,00
					bad	0,50	0,50	0,50	1,00
	C								
D	good	bad							
y		0,9	0,2						
n		0,1	0,8						
					D	pi	Baux	B	lambda
					y	0,55	0,55	0,55	1,00
					n	0,45	0,45	0,45	1,00

4. **(2 points) Exercise on Evidence Theory by Dempster-Shaffer.**

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

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  $m2(S)=0.3$

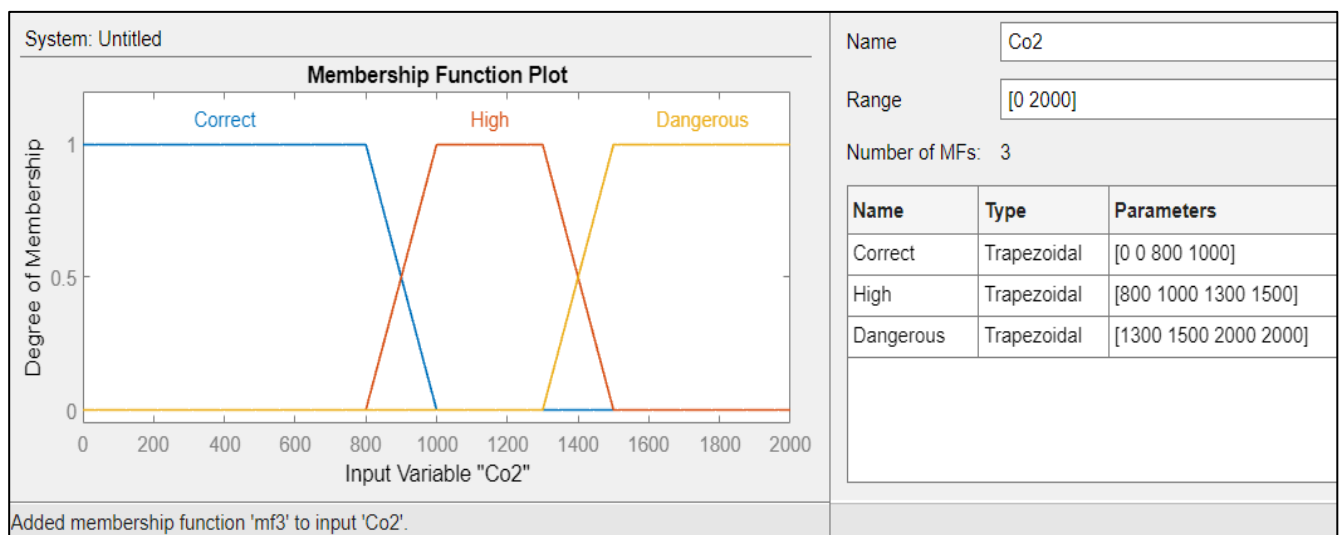
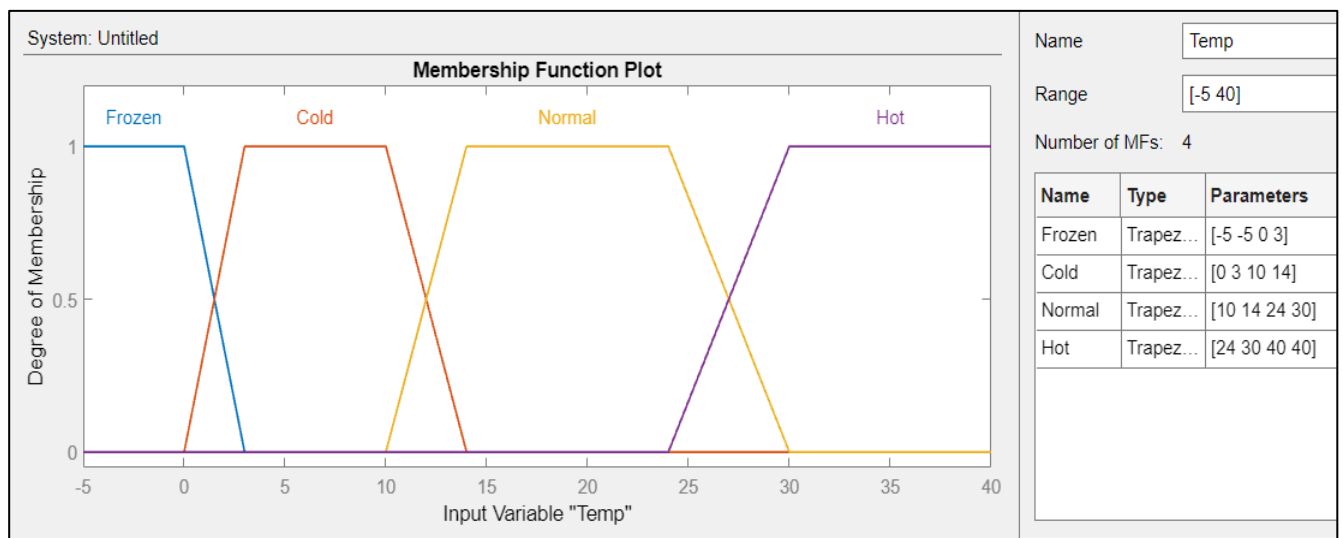
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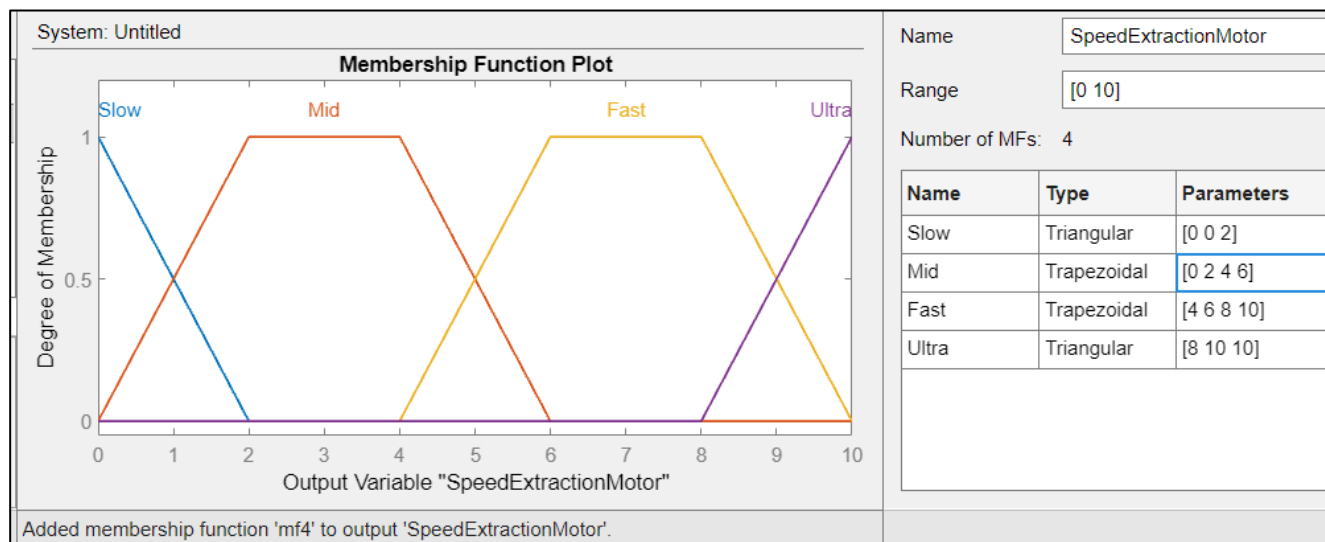
### 5. (3 points) Exercise on Fuzzy Systems

Here you have a Fuzzy Expert System for automatically control the speed of an air cleaner in a room to avoid Covid spread. The machine uses values of two input sensors: (1) temperature (in Celsius degrees), (2) Co2 concentration (in ppm).

Calculate and answer:

- Assign a **weight** (i.e. degree of support) to each rule, taking into account that the rules with less variables have less confidence than the ones of two variables (because they are more general). And that the ones related to Frozen temperature have less confidence than all the rest, as they are poorly tested in Tarragona.
- Calculate the conclusion of the rules using the Mamdani procedure (min and max) and the weights assigned in the previous point. Clearly indicate the degree of activation of each label and the rules activation steps. **Inputs: temperature = 26; Co2 = 1400.**
- Calculate the final defuzzified numerical value of the conclusion as the center of area (approximately by visual estimation).





Rules are the following:

	Rule
1	If Co2 is Dangerous then SpeedExtractionMotor is Ultra
2	If Temp is Frozen and Co2 is High then SpeedExtractionMotor is Mid
3	If Temp is Frozen and Co2 is Correct then SpeedExtractionMotor is Slow
4	If Temp is Cold and Co2 is High then SpeedExtractionMotor is Mid
5	If Temp is Cold and Co2 is Correct then SpeedExtractionMotor is Slow
6	If Temp is Normal and Co2 is High then SpeedExtractionMotor is Fast
7	If Temp is Normal and Co2 is Correct then SpeedExtractionMotor is Mid
8	If Temp is Hot and Co2 is High then SpeedExtractionMotor is Ultra
9	If Temp is Hot and Co2 <span>Correct</span> then SpeedExtractionMotor is Fast