Artificial Intelligence and Expert Systems

Assignment I

Faculty of mechanical engineering

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1- If A and B are fuzzy subsets of non-negative real number reference sets and A' and B' are complementary to A and B, plot:

- A set
- B set
- A' set
- B' set
- $A \cup B$
- $A \cap B$
- $A' \cup B'$
- $A \cap B$

Are A and B convex sets?

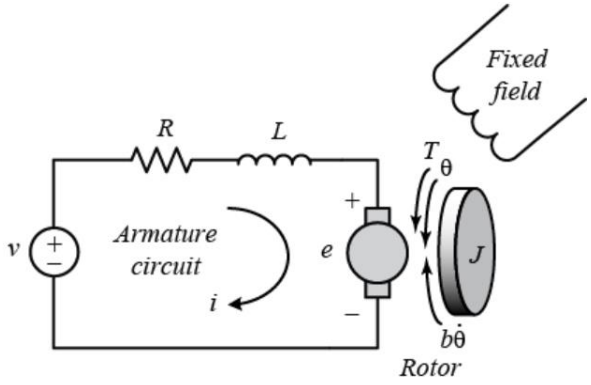
$$A = \begin{cases} 0 & if\ 0 < x < 1 \\ x - 1 & if\ 1 \leq x < 2 \\ 1 & if\ 2 \leq x < 3 \\ 4 - x & if\ 3 \leq x < 4 \\ 0 & if\ x \geq 4 \end{cases}$$

$$B = \begin{cases} e^{x-3} & if\ 0 < x < 3 \\ 1 & if\ 3 \leq x < 5 \\ 1 - \dfrac{x-5}{5} & if\ 5 \leq x < 10 \\ 0 & if\ x \geq 10 \end{cases}$$

2- Imagine that you work in a company and you are asked to design a system which can predict the probable salary of an employee based on his/her years of experience. For more information, you are given a dataset which contains information about years of experience and salary of 30 employees. Without using the Simulink package for fuzzy logic systems and by using pure MATLAB script which satisfies the following conditions:

- The function takes the years of experience as the input and outputs the estimated salary.
- Has 5 membership functions for the input.
- Has 5 membership functions for the output.
- Uses the mean of the maxima as the defuzzification methods.
- Rules are written inside the function.

3- Design a fuzzy controller to control the speed of a DC motor.



Implement the fuzzy controller designed in Matlab, and simulate the behavior of the system.

Analyze the results of the simulation, and explain how the fuzzy controller is able to control the speed of the DC motor.

The physical parameters of DC-motor		
(J)	moment of inertia of the rotor	0.01 kg.m^2
(K)	electromotive force constant	0.01 V/rad/sec
(b)	motor viscous friction constant	0.1 N.m.s
(R)	electric resistance	1 Ohm
(L)	electric inductance	0.5 H

Hint: the dynamic equations of dc-motor in state space form are:

$$\frac{d}{dt}\begin{bmatrix}\dot{\theta}\\ i\end{bmatrix} = \begin{bmatrix}\frac{-b}{J} & \frac{K}{J}\\ \frac{-K}{J} & \frac{-R}{L}\end{bmatrix}\begin{bmatrix}\dot{\theta}\\ i\end{bmatrix} + \begin{bmatrix}0\\ \frac{1}{L}\end{bmatrix}v \quad , \quad y = [1\ \ 0]\begin{bmatrix}\dot{\theta}\\ i\end{bmatrix}$$