

Fuzzy Logic & Data Processing

Practice notes for Modern Method of Data Processing (CCOD)
in 2013

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PART I

Fuzzy Controller

1 Virtual metro

Let's create a virtual metro system with 2 cars on a loop line with 1000 pixels in which 4 stations 1, 2, 3 and 4 at pixel number 0, 250, 500 and 750, respectively.

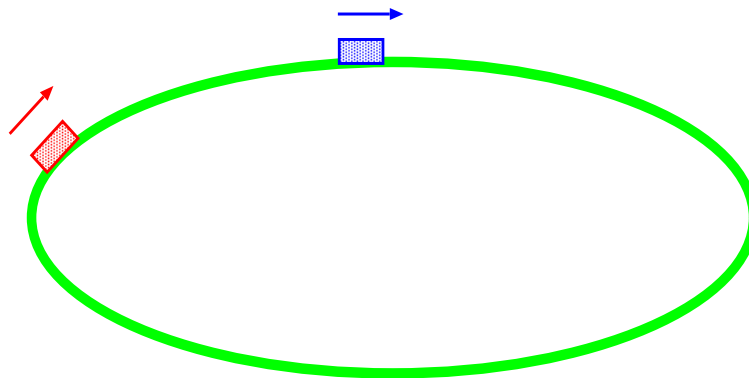


Figure 1: To de-fuzzify strength of break

Standard Initial Situations

- Car-A starts at the station "1" while Car-B at "3" both with initial speed 5 pixels at one time every time steps speed will be changed at random either by +1, -1, or no-change.
- Car-A starts at "1" with speed 1,2,3,4,5,5,5..., while car-B at "3" with 2,4,6,8,10,10,10,... Keep them move until crash.
 - * Or, when distance to the front car becomes less than, say, 20, then speed of car behind should -2 each time till stop, and then wait 10 steps of time and start again like before 1 -i 2 -i ... -i 10 -i 10 -i ...

Excercise

- * Speed v & distance r to the car in front of each car should be shown on the screen.

2 Membership functions

Design 3 sets of five membership functions

E.g., Speed =, Very Slow, Slow, Medium, Fast, Very Fast

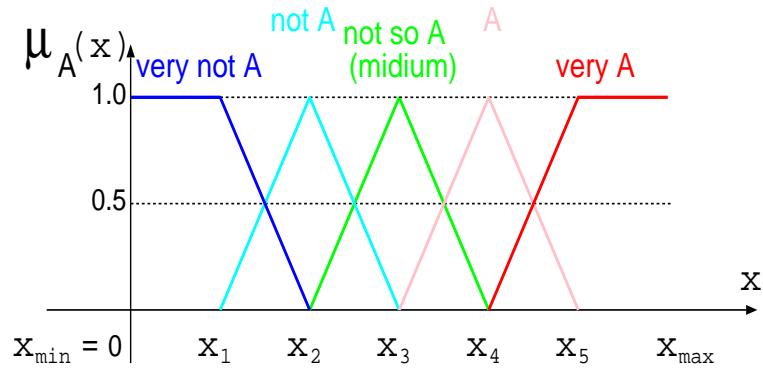


Figure 2: To de-fuzzify strength of break

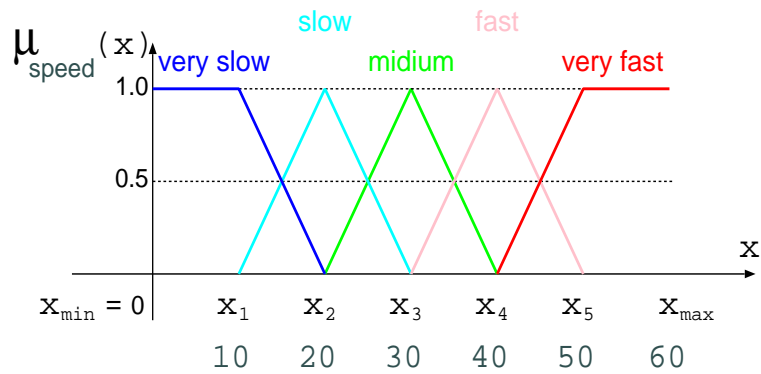


Figure 3: To de-fuzzify strength of break

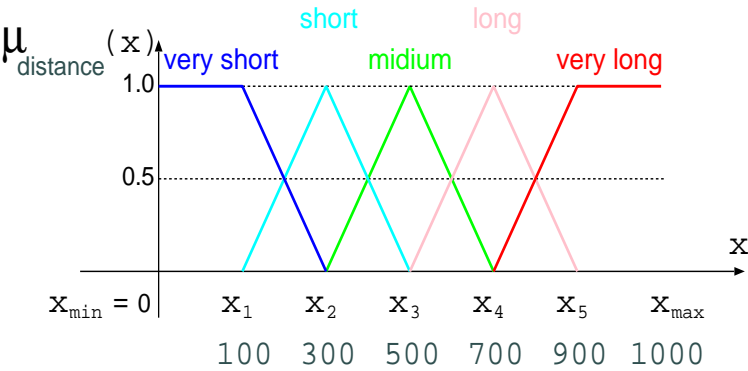


Figure 4: To de-fuzzify strength of break

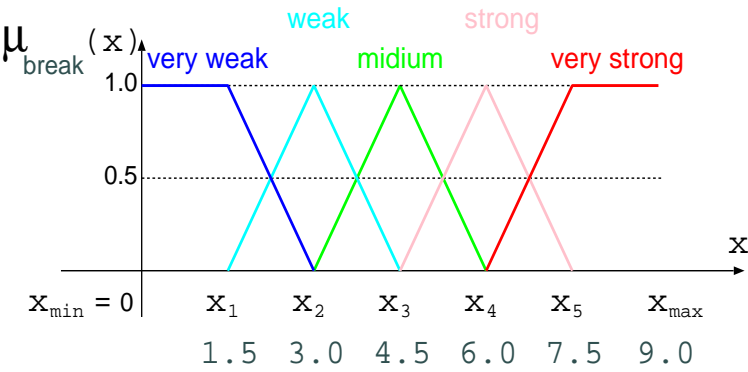


Figure 5: To de-fuzzify strength of break

3 Fuzzy Arithmetics

Excercise

Create system whose output is membership value when we give 3 input of speed, distance, break Then give me 11 such examples of data, such as (speed=13, distance=53, break=7 =, membership=0.23) Hopefully systematically chose 10 sets of data, i.e., speed is 10, distance is 20 then give me membership

4 Rule set

Design our set of 10 rules of "IF – AND – Then –

E.g. IF speed is fast AND distance is medium THEN break is weak.



Figure 6: To de-fuzzify strength of break



Figure 7: To de-fuzzify strength of break

Some rules are likely then large membership value, while others lesslikely and small membership value.

5 defuzzification

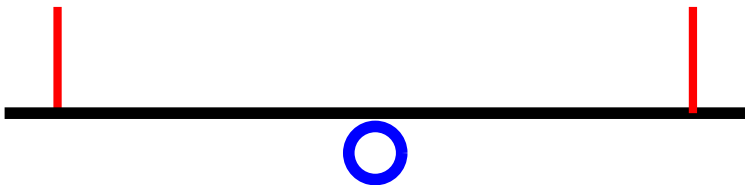


Figure 8: To de-fuzzify strength of break

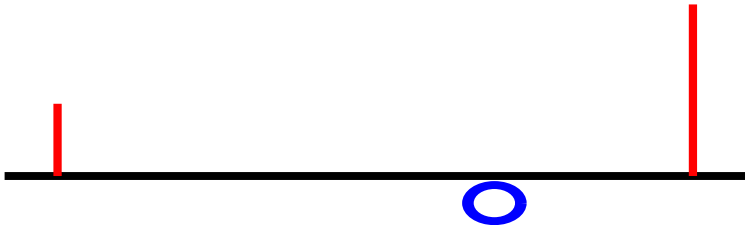


Figure 9: To de-fuzzify strength of break

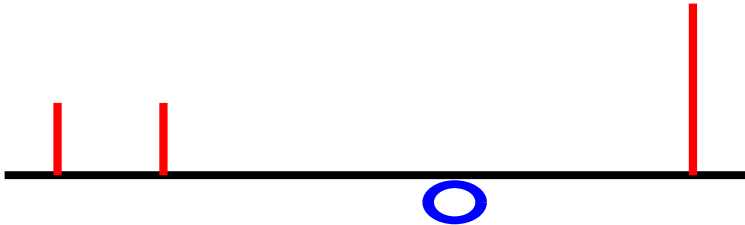


Figure 10: To de-fuzzify strength of break

6 speed & distance vs. break

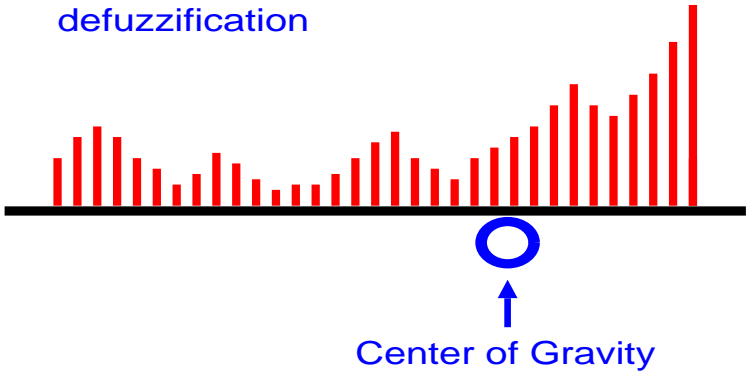


Figure 11: To de-fuzzify strength of break

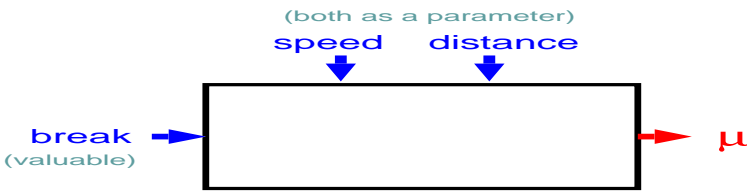


Figure 12: To de-fuzzify strength of break

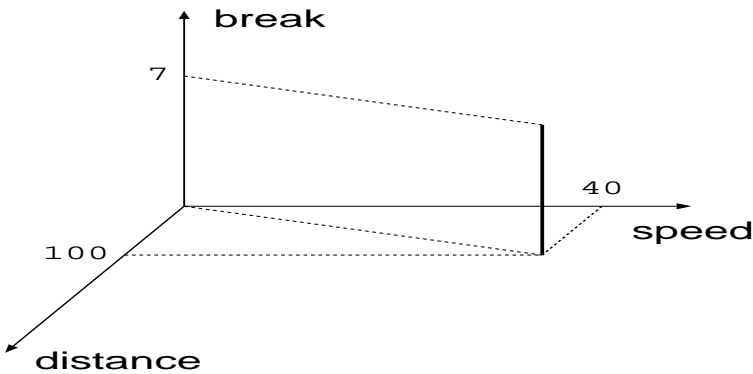


Figure 13: To de-fuzzify strength of break