Algorithm Fuzzy logic algorithm

1. Define the linguistic variables and terms (initialization)
2. Construct the membership functions (initialization)
3. Construct the rule base (initialization)
4. Convert crisp input data to fuzzy values
   using the membership functions (fuzzification)
5. Evaluate the rules in the rule base (inference)
6. Combine the results of each rule (inference)
7. Convert the output data to non-fuzzy values (defuzzification)

You have to develop a fuzzy logic system for intelligence speed control system for a car. The inputs of your system is the ambience temperature which taken form the car sensors, and cloud cover data taken weather data server. Your system should suggest the driver what is the appropriate speed base on the inputs.

Step 1 (as algorithm above)

To determine the linguistic function its require an expert on particular field to set the appropriate terms to represent the variables and terms. For example, the ambiance temperature is represented as Temp below and the linguistic terms for the Temp divided into 4 categories namely Freezing (eg. tempreture from 0 degree F to 30 degree F), Cool, Warm and Hot.

As a human we used term to represent the condition such "*That boy is tall*" we do not used "*The boy height is 170cm*" or "*Watch out for the hot water*" not "*Watch out for the 100 degree C water*" we used term to represent the situation where in fuzzy system it's called linguistic terms.

For step 1 the expert had propose to you to use these terms:-

Temp: {Freezing(0-30), Cool(30-60), Warm(60-80), Hot(80-100)}

Cover:{Sunny(0-30), Partly Cloudy(30-70), Overcast(80-100)}

Speed:{Slow(0-50), Fast(50-100)}

Step 2

The membership functions constructed using the linguistic term above: -

Let do the first variable Temp, we start with Freezing,

(refer to my explanation and write it down)

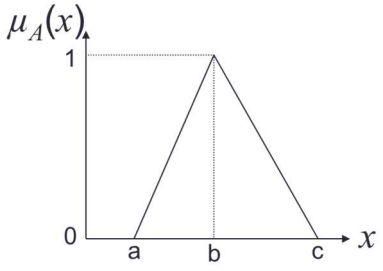
Next we do the Cool, Warm and Hot

Finally, we combine each of these into the Temp variables to represent the fuzzy set for that variables.

Next complete the other two variables namely Sunny and Speed.

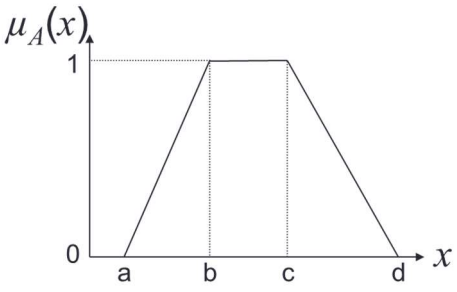
Then construct the fuzzy membership function as example below: -

$$\mu_A(x) = \begin{cases} 0 & if\ x \le a \\ \dfrac{x-a}{b-a} & if\ a \le x \le b \\ \dfrac{c-x}{c-b} & if\ b \le x \le c \\ 0 & if\ x \ge c \end{cases}$$



Or

$$\mu_A(x) = \begin{cases} 0 & if\ x \le a \\ \dfrac{x-a}{b-a} & if\ a \le x \le b \\ 1 & if\ b \le x \le c \\ \dfrac{d-x}{d-c} & if\ c \le x \le d \\ 0 & if\ x \ge d \end{cases}$$



Step 3

For our problem the rules are given as below:-

- If it's Sunny and Cool, drive Fast
- If it's Sunny and Hot, drive Fast
- If it's Cloudy and Warm, drive Slow
- If it's Cloudy and Cool, drive Slow

Example of fuzzy rules No. 1 can be constructed as below: -

Cover(Sunny) ^ Temp(Cool) => Speed (Fast)

As a normal predicate logic statement (eg. Your IF statement in programming follows the same concept)

Complete the other 3 rules.

Step 4-7 we continue with the next week tutorial.