jFuzzyLogic

FCL example explained

Fuzzy Control Langage ***FCL*** is defined by IEC 1331 part 7. It's a simple language to define a fuzzy inferece system. We'll take a look at an example, for a more detailed explanation, please read the spec.

Keep in mind that FCL is defined as a 'Control language', so the main concept is a 'control block' which has some input and output variables (it's not a 'programm' in the usual way).
We'll be using this example, first take a look at it.

Ok, let's try to annalize each line:

- First you define each ***FUNCTION_BLOCK*** (there may be more than one in each file)

```
FUNCTION_BLOCK tipper
```

- Then input and output variable/s are defined (variable type is only ***REAL***, integer is not implemented yet)

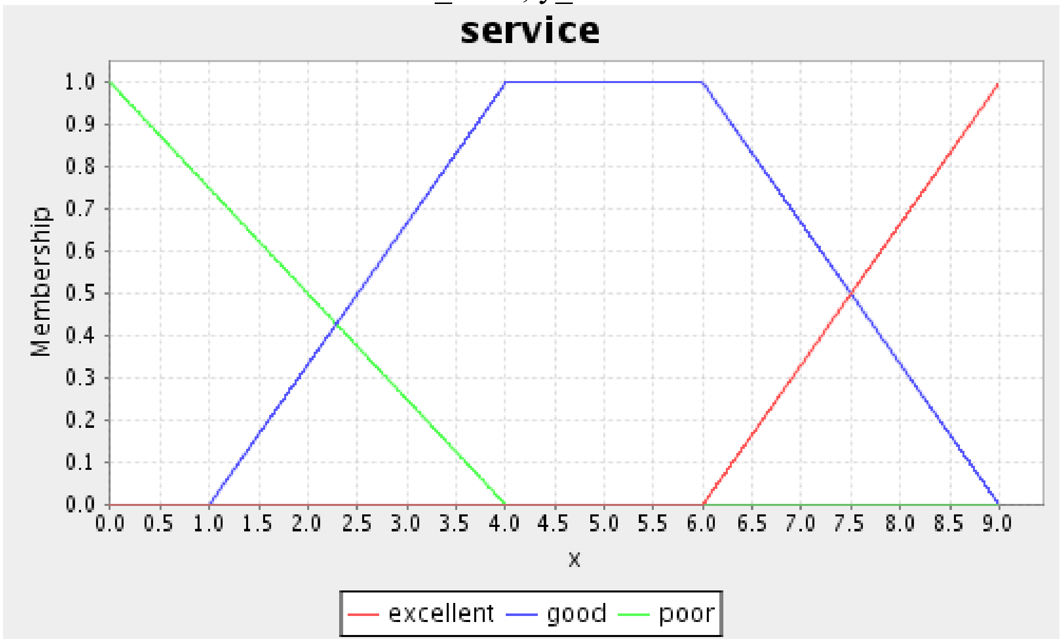
```
VAR_INPUT
    service : REAL;
    food : REAL;
END_VAR

VAR_OUTPUT
    tip : REAL;
END_VAR
```

- How each input variable is fuzzified is defined in ***FUZZIFY*** block. In each block we define one or more ***TERMs*** (also called LinguisticTerms). Each term is composed by a name and a membership function. E.g.:

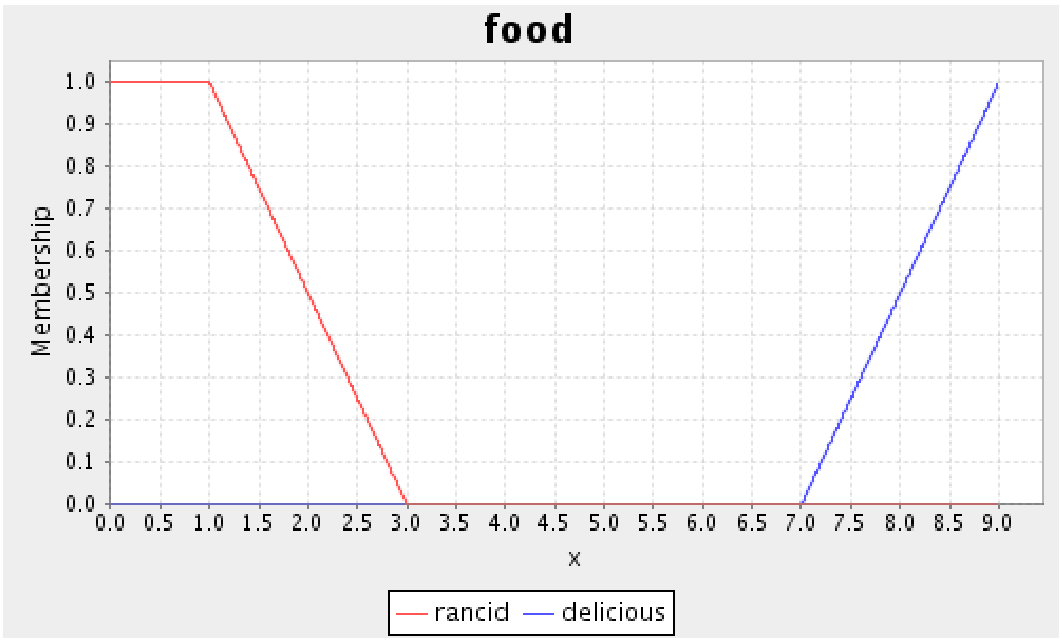
```
FUZZIFY service
    TERM poor := (0, 1) (4, 0) ;
    TERM good := (1, 0) (4,1) (6,1) (9,0);
    TERM excellent := (6, 0) (9, 1);
END_FUZZIFY
```

In this lines we define how variable ***service*** will be fuzzified. Three terms are used, for instance term ***poor*** uses a piece-wise linear membership function defined by points x_0 = 0, y_0 = 1 and x_1 = 4, y_1 = 0



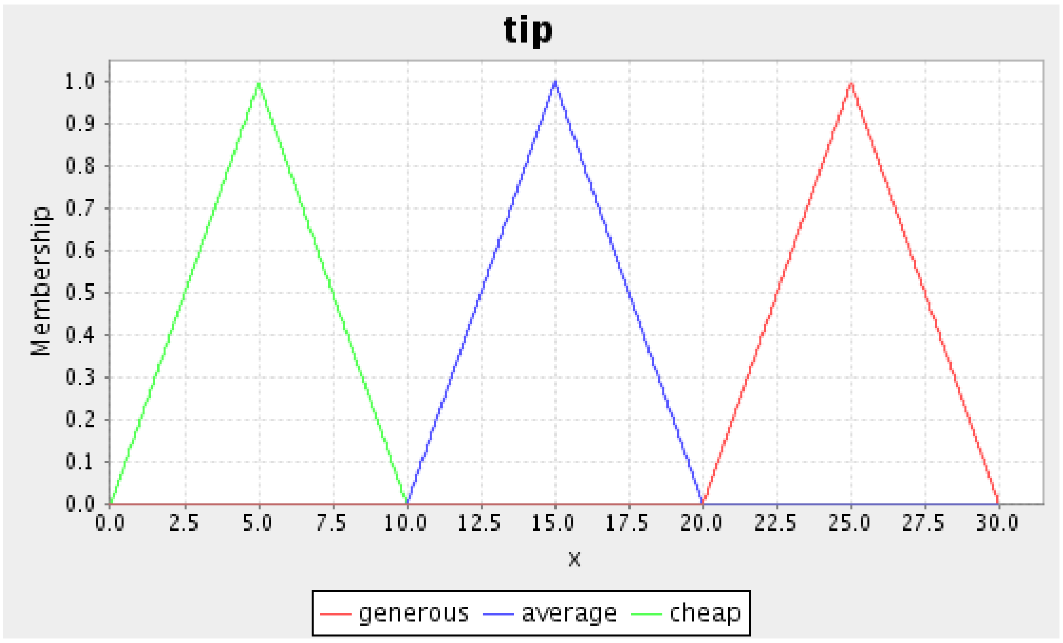
food variable fuzzify block is define likewise:

```
FUZZIFY food
    TERM rancid := (0, 1) (1, 1) (3,0) ;
    TERM delicious := (7,0) (9,1);
END_FUZZIFY
```



- Output variables are defuzzified to get a 'real' output number, this is defined in ***DEFUZZIFY*** block. Like FUZZIFY block, linguistic terms (or TERMs) are defined:

```
DEFUZZIFY tip
    TERM cheap := (0,0) (5,1) (10,0);
    TERM average := (10,0) (15,1) (20,0);
    TERM generous := (20,0) (25,1) (30,0);
```



Then we may define some other parameters:

```
    METHOD : COG;
```

Use 'Center of gravity' as defuzzifier's method.

```
    DEFAULT := 0;
```

Use '0' as default value (if no rule actuates this variable).

- We can define now the rules. This is done using a ***RULEBLOCK***. First we define some parameters:

```
RULEBLOCK No1
    AND : MIN;
```

Use 'min' for 'and' (also implicit use 'max' for 'or' to fulfill DeMorgan's Law)

```
    ACT : MIN;
```

Use 'min' activation method

```
    ACCU : MAX;
```

Use 'maximum' as accumulation method.

And now define some rules (3 in this case)

```
    RULE 1 : IF service IS poor OR food IS rancid THEN tip IS cheap;
    RULE 2 : IF service IS good THEN tip IS average;
    RULE 3 : IF service IS excellent AND food IS delicious THEN tip is generous;
END_RULEBLOCK
```

Ok, that's it, you've got a fuzzy controller.

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Fuzzy logic Wikipedia