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Class: IF-42-INT
Subject: Artificial Intelligence Observation Parallel Assignment 2

Report

This assignment is about the fuzzy logic system that I have built to choose 20 students who are eligible for registration fee assistance of 50%. There is an input data of 100 students in excel file which consist of two attributes of family incomes and expenses. The language that used to build is Python google colab. Thus, I upload the file excel to generate the results. The strategy that I used to build the system are fuzzification, inference and Defuzzification. These three steps are explained in the following:

1. **Linguistic Names**
   There are several linguistic variable that used for the system such as:
   - Input:
     - Incomes: Bottom, Middle, Upper
     - Expenses: Low, Average, High
   - Output:
     - Assistance: Rejected, Considered, Accepted

2. **Shape and Range of Membership Function**
   The following are incomes and expenses range that I made regarding to the data of input. From the input data I can determine the highest and the lowest of both income and expenses so there are probability of 50% that we can visualize between both attributes. Afterwards I divide them into three parts based on the variables linguistics that has been chosen. The range and shape of membership function from the two inputs are illustrated in the following graph.

   This is the incomes range and shape
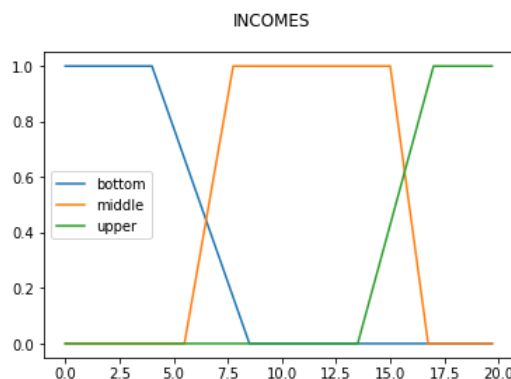
   Hence, there are range of each variable of income that we have seen in the graph above.
   - Upper

     1, if x > 17

     0, if x $\leq$ 13.50

   $\dfrac{x-13.50}{17-13.50}$, if $13.50 < x \leq 17$

   - Middle

     0, if x $\leq$ 5.50

     $\dfrac{x-5.50}{7.75-5.50}$, if $5.50 < x \leq 7.75$

     1, if $7.75 < x \leq 15$

     $\dfrac{16.75-x}{16.75-15}$, if $15 < x \leq 16.75$
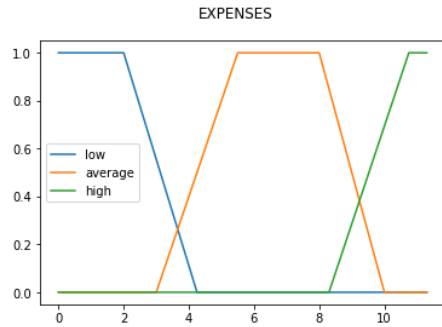
   - Bottom
   - 0, if x > 8.50
   - 1, if x $\leq$ 4
   - $\dfrac{8.50-x}{8.50-4}$, if $4 < x \leq 8.50$

   This is the expenses range and shape

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EXPENSES

0, if x ≤ 8.30

$\frac{x-8.30}{10.75-8.30}$, if $8.30 < $ x $\leq$ 10.75

- Average

  0, if x ≤ 3

  $\frac{x-3}{5-3}$, if $3 < x \leq 5$

  1, if $5 < x \leq 8$

  $\frac{10.30-x}{10.30-8}$, if $8 < x \leq 10.30$

- Low

- 0, if x > 4.25

- 1, if x ≤ 2

- $\frac{4.25-x}{4.25-2}$, if $2 < $ x ≤ 4.25

Hence, there are range of each variable of expense that we have seen in the graph above.
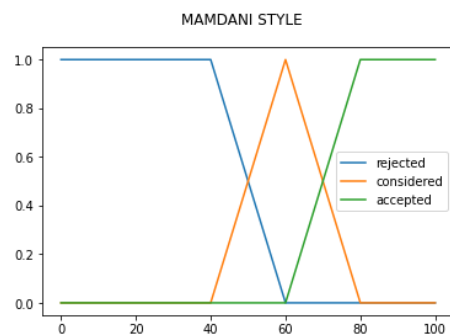
- High

  1, if x > 10.75

3. Inference Rules
The following is the rules that I have built based on the membership function.

Income	Expense	Result
Upper	High	Accepted
Upper	Average	Accepted
Upper	Low	Accepted
Middle	High	Considered
Middle	Average	Considered
Middle	Low	Accepted
Bottom	High	Rejected
Bottom	Average	Rejected
Bottom	Low	Considered

4. Defuzzification Method
The method that used is Mamdani because it is intuitive, well-suited and more interpretable rule base.

This is the Mamdani range and shape

MAMDANI STYLE

0, if x ≤ 60

$\frac{x-60}{80-60}$, if $60 < $ x < 80

- Considered

  0, if x ≤ 40

- $\frac{x-40}{60-40}$, if $40 < $ x < 60

  1, if x $= 60$

  $\frac{80-x}{80-60}$, if $60 < $ x ≤ 80

- Rejected

- 0, if x ≥ 60

- 1, if x ≤ 40

- $\frac{60-x}{60-40}$, if $40 < $ x < 60

Hence, there are range of each variable of Mamdani that we have seen in the graph above.

- Accepted

  1, if x ≥ 80

5. Output
The output of the student who is selected for scholarship are:

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The selected students are:
SID------>Result
1 -------> 60.00000000000001
44 -------> 60.00000000000001
3 -------> 60.0
5 -------> 60.0
8 -------> 60.0
9 -------> 60.0
10 -------> 60.0
15 -------> 60.0
20 -------> 60.0
22 -------> 60.0
24 -------> 60.0
28 -------> 60.0
29 -------> 60.0
30 -------> 60.0
31 -------> 60.0
34 -------> 60.0
35 -------> 60.0
45 -------> 60.0
57 -------> 60.0
58 -------> 60.0
```