ENGR – 3720U

A.I Project Part B

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Step 1: Specifying problem and linguistic variables:

The purpose of this project was to design a fuzzy expert system that calculates marriage compatibility given 5 major factors. This project uses the Mamdani-type fuzzy inference. The 5 linguistic variables in our project are personal characteristics, education, financial standing, beauty, and previous friendship and history.

Step 2: Determining and encoding the fuzzy sets:

The following figures show the universe of discourse for each linguistic variable. The fuzzy subsets are named in the figures. The domain and range is between 0 and 1.

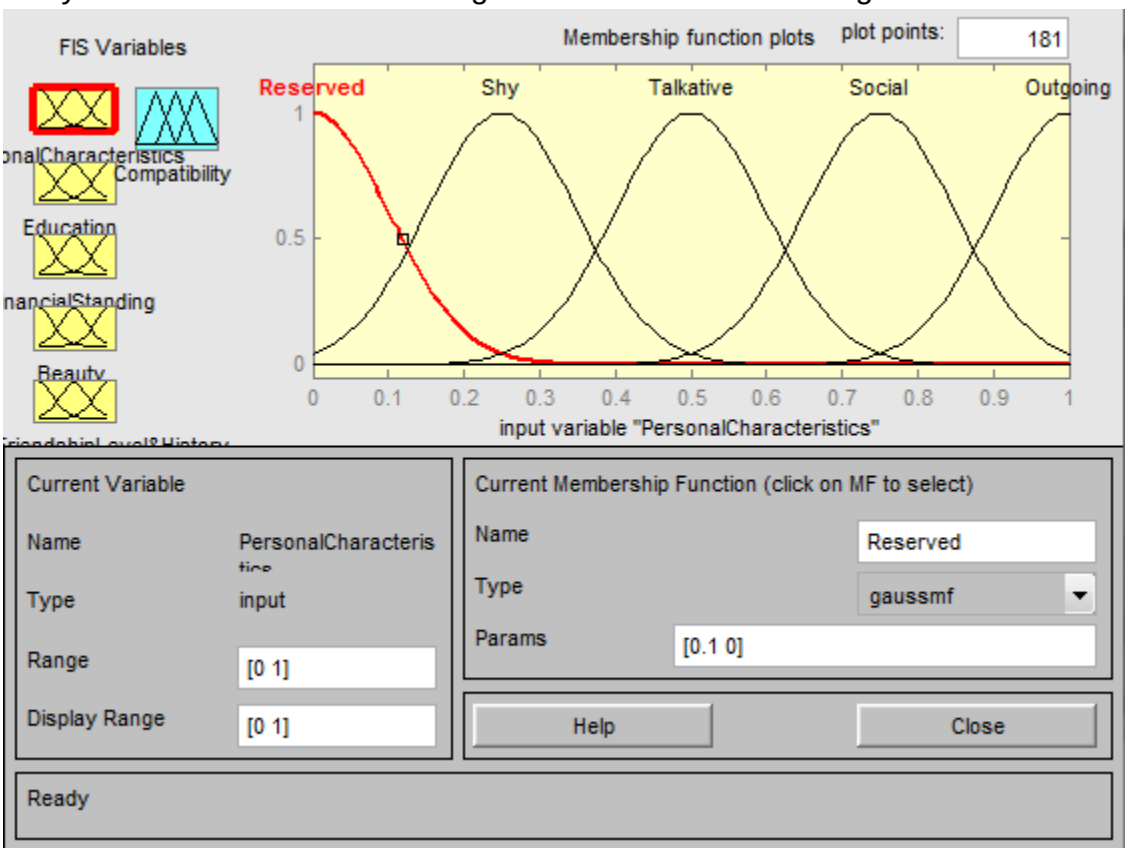


Figure 1

In figure 1, the subset names for personal characteristics are based on social life of a person. The membership function we used is gaussian because the subset input is fuzzy in practical life for a person. Also for that reason the names of the subset variables have not used scaling such as “very, extremely” etc.

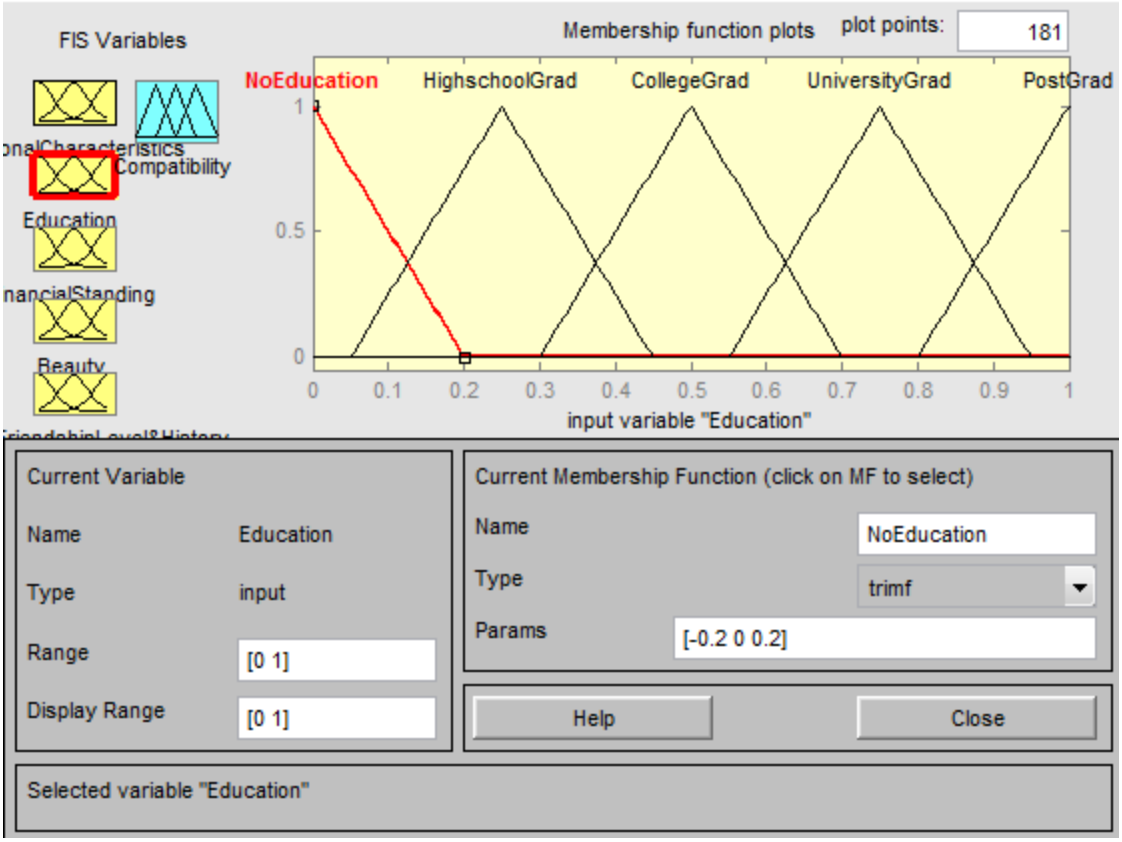


Figure 2

Figure 2 shows the subset for the variable education. Education is quantifiable in general using certifications. In this case the categories are used as names for the variables in the subset. They are linear functions because education not too fuzzy and a triangle shape significantly simplifies the process of computation.

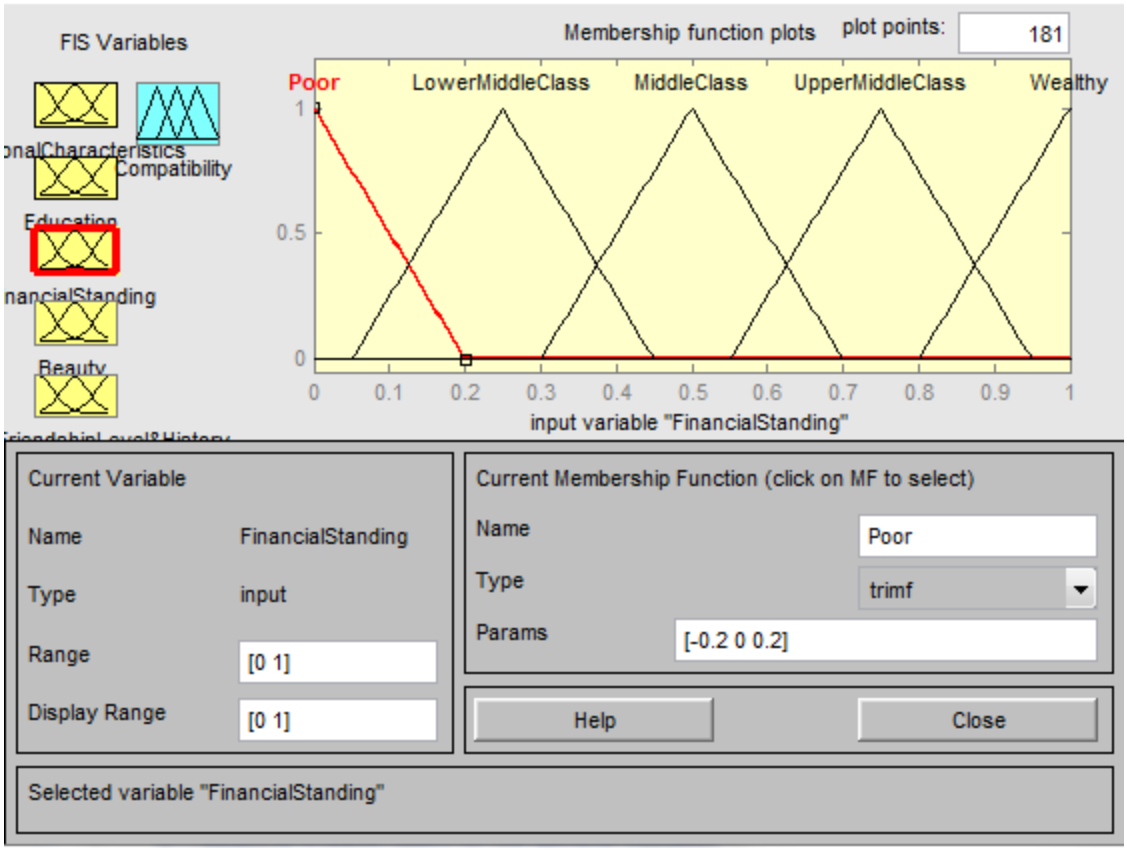


Figure 3

Figure 3 shows the subset for the variable financial standing. Financial standing is quantifiable by categorizing using monetary units. In this case the categories are used as names for the variables in the subset. They are a linear functions because financial standing not too fuzzy.

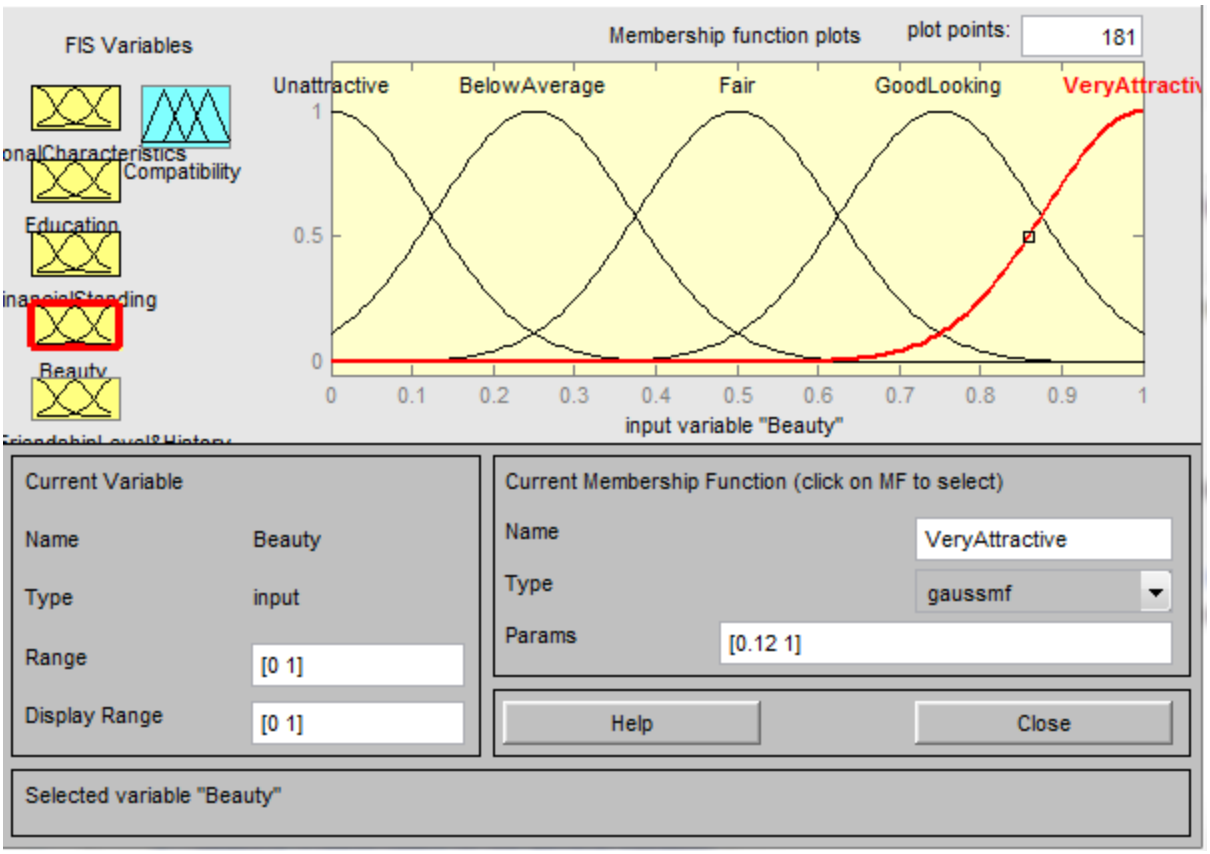


Figure4

Figure 4 shows the subset names for beauty. The membership function we used is gaussian because beauty of a person it is biased among everyone. The function is also horizontally stretched by a factor of 1.2 in comparison to figure 1 to show that this input is fuzzier and is not quantifiable.

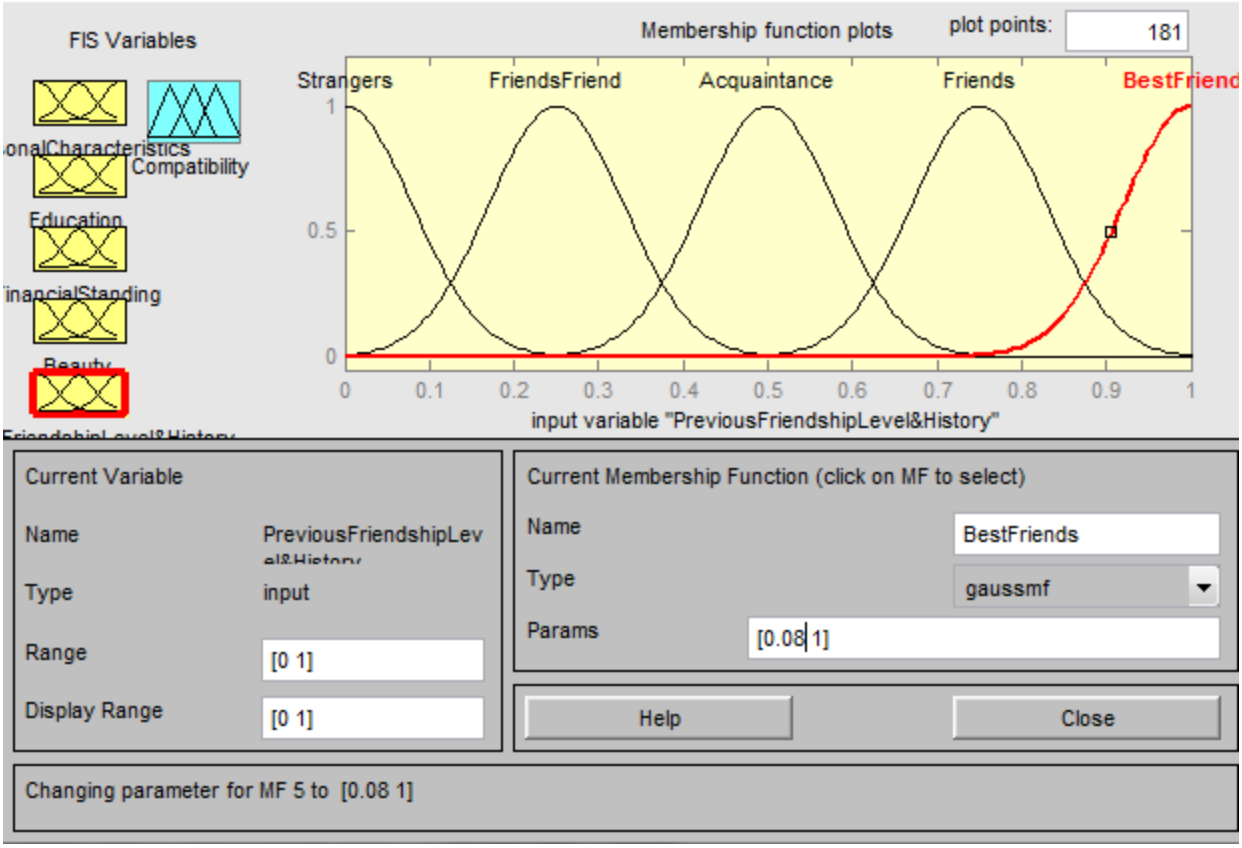


Figure 5

Figure 5 shows the subset of the variable previous friendship level and history. It is quantifiable up to a certain extent based on number of years the comparisons have known each other. Therefore the horizontal stretch has been decreased.

Step 3: Eliciting and constructing fuzzy rules:

1. If (PersonalCharacteristics is Outgoing) then (Compatibility is Very_Compatible) (0.35)
2. If (PersonalCharacteristics is Social) then (Compatibility is Mostly_Compatible) (0.35)
3. If (PersonalCharacteristics is Talkative) then (Compatibility is Somewhat_Compatible) (0.35)
4. If (PersonalCharacteristics is Shy) then (Compatibility is Little_Compability) (0.35)
5. If (PersonalCharacteristics is Reserved) then (Compatibility is Not_Compatible) (0.35)
6. If (Education is PostGrad) then (Compatibility is Very_Compatible) (0.45)
7. If (Education is UniversityGrad) then (Compatibility is Mostly_Compatible) (0.45)
8. If (Education is CollegeGrad) then (Compatibility is Somewhat_Compatible) (0.45)
9. If (Education is HighschoolGrad) then (Compatibility is Little_Compability) (0.45)
10. If (Education is NoEducation) then (Compatibility is Not_Compatible) (0.45)
11. If (FinancialStanding is Wealthy) then (Compatibility is Very_Compatible) (0.1)
12. If (FinancialStanding is UpperMiddleClass) then (Compatibility is Mostly_Compatible) (0.1)
13. If (FinancialStanding is MiddleClass) then (Compatibility is Somewhat_Compatible) (0.1)
14. If (FinancialStanding is LowerMiddleClass) then (Compatibility is Little_Compability) (0.1)
15. If (FinancialStanding is Poor) then (Compatibility is Not_Compatible) (0.1)
16. If (Beauty is Unattractive) then (Compatibility is Not_Compatible) (0.05)
17. If (Beauty is BelowAverage) then (Compatibility is Little_Compability) (0.05)
18. If (Beauty is Fair) then (Compatibility is Somewhat_Compatible) (0.05)
19. If (Beauty is GoodLooking) then (Compatibility is Mostly_Compatible) (0.05)
20. If (Beauty is VeryAttractive) then (Compatibility is Very_Compatible) (0.05)
21. If (PreviousFriendshipLevel&History is Strangers) then (Compatibility is Not_Compatible) (0.05)
22. If (PreviousFriendshipLevel&History is Acquaintance) then (Compatibility is Somewhat_Compatible) (0.05)
23. If (PreviousFriendshipLevel&History is Friends) then (Compatibility is Mostly_Compatible) (0.05)
24. If (PreviousFriendshipLevel&History is FriendsFriend) then (Compatibility is Little_Compability) (0.05)
25. If (PreviousFriendshipLevel&History is BestFriends) then (Compatibility is Very_Compatible) (0.05)

The output has 5 variables in its subset, so the inputs can be isolated and directly correlated with respect to the x values. The weights for each factor add up to 1 and are collected from a human.

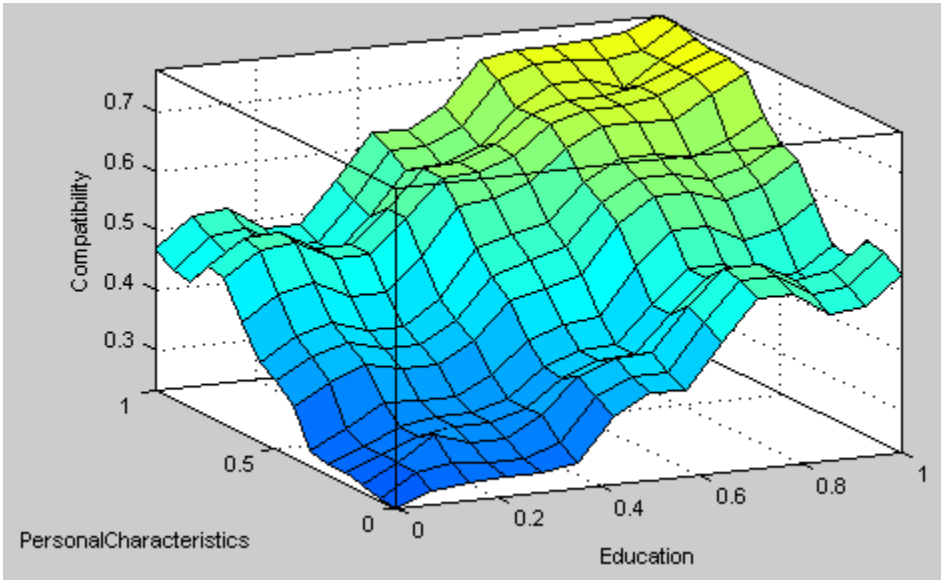
Personal Characteristics	35%
Education	45%
Financial standing	10%
Beauty	5%
Previous Friendship level	5%

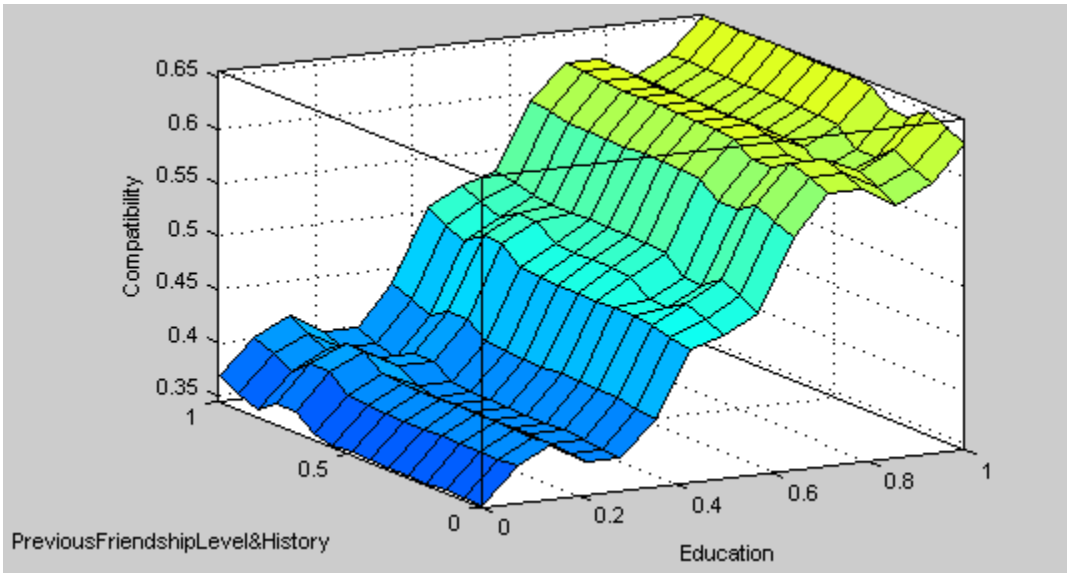
Step 4: Encoding fuzzy sets, fuzzy rules, and Procedures to perform fuzzy inference:

This system was implemented using a fuzzy logic development tool, MATLAB Fuzzy Logic Toolbox. The figures in this report are all screenshots from MATLAB from the implemented project.

Step 5: Evaluate and tune the system:

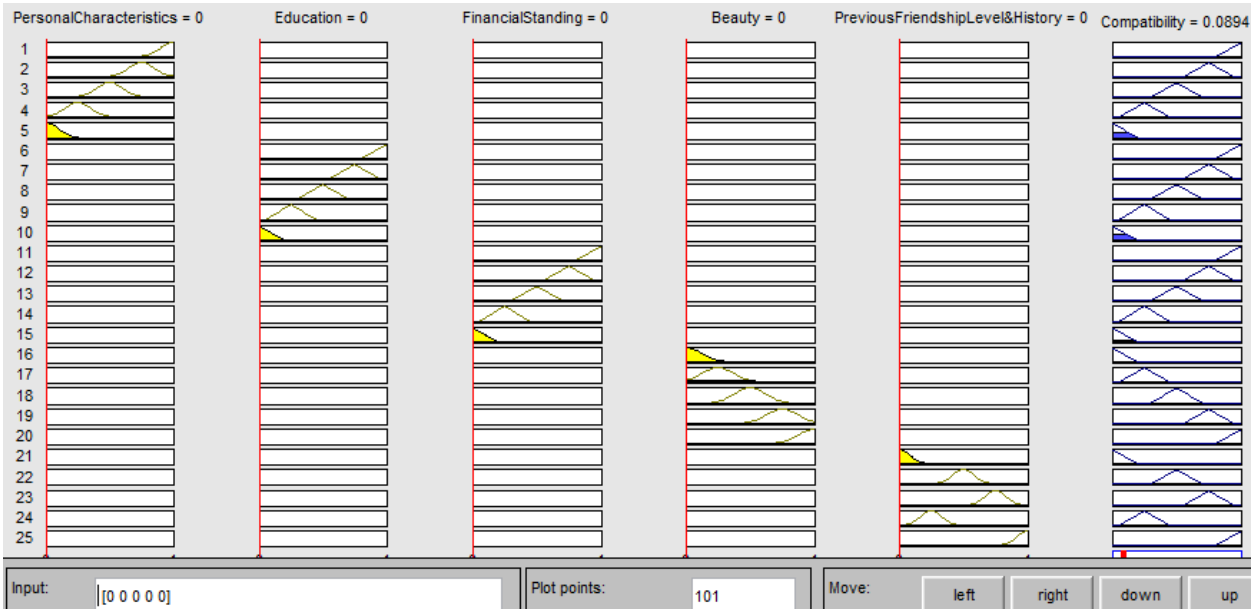
The surface views below show comparisons of the weights of the given variables. The first one is between personal characteristics and education. It is almost evenly distributed because their weights are almost the same where a personal characteristic is 0.35 and education is 0.45. The second figure compares education with previous friendship level which has a weight of 0.05. You can see the education weighing the compatibility towards its side.



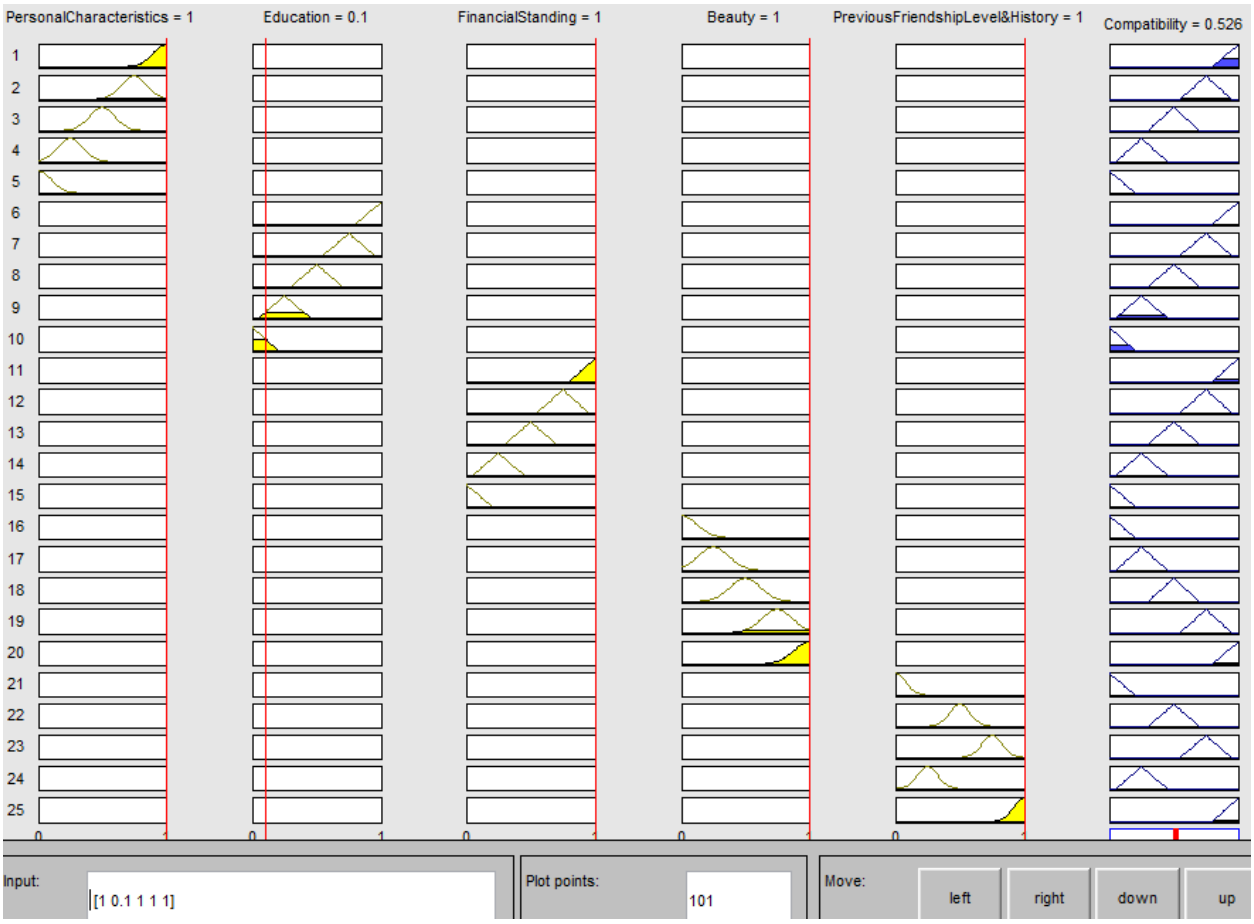


Test cases:

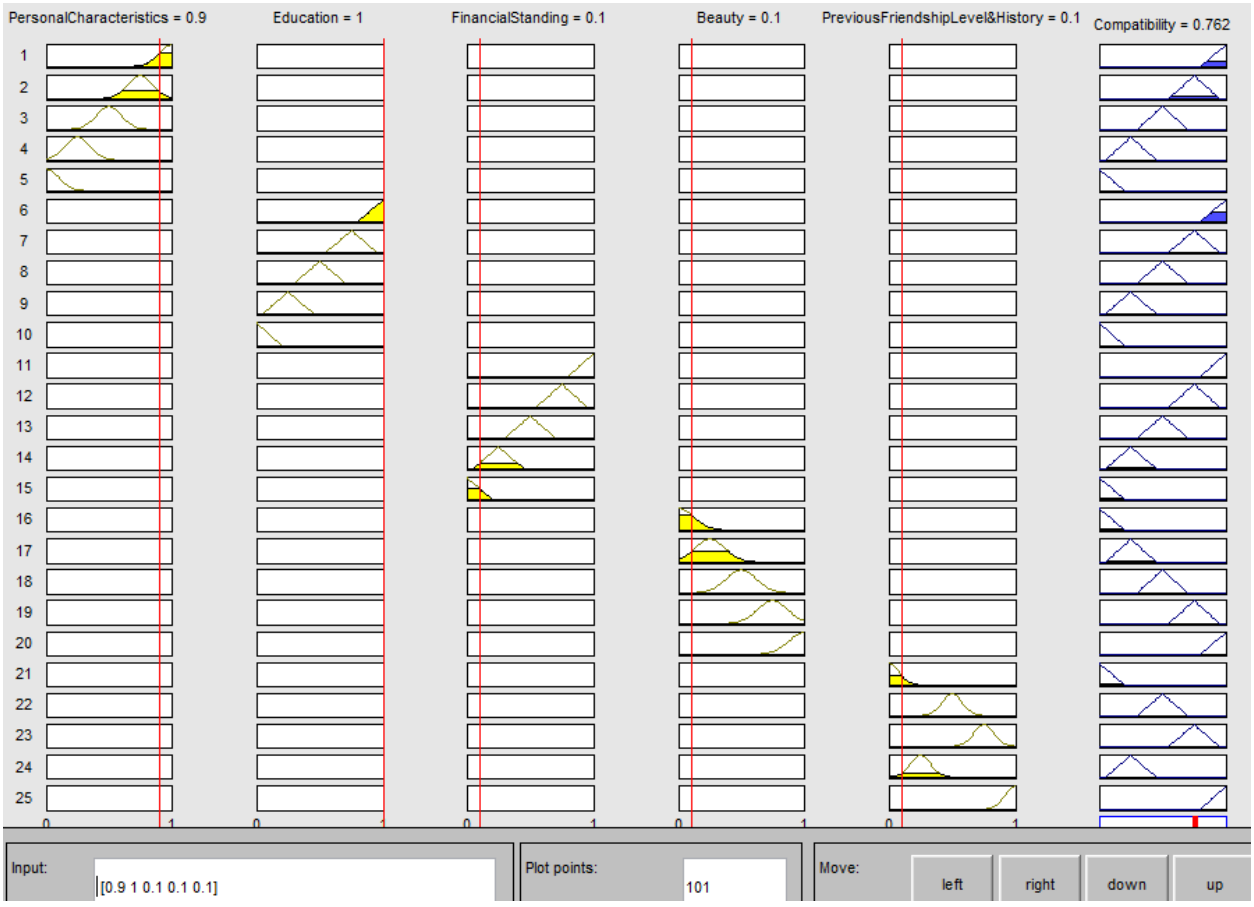
Using maximum inputs of 1 yields a 91% compatibility because the inputs are fuzzy and have different weights. This same concept applies to minimum inputs of 0 as you can see below.



The cases below test how well the weights work for the resulting compatibility. Education has the highest weight factor of 0.45. You can see below that the result is low because of education:


PersonalCharacteristics = 1
Education = 0.1
FinancialStanding = 1
Beauty = 1
PreviousFriendshipLevel&History = 1
Compatibility = 0.526
Input:
[1 0.1 1 1 1]
Plot points:
101
Move:
left
right
down
up

Now we will see the impact of the lower weighted factors on the compatibility. At 76% it is fairly high because the education and personal characteristics are high and the weights of the rest of the factors only add up to 20%.



Conclusion:

In conclusion the marriage decision maker fuzzy expert system project was a success. The output we get is correct in terms of the weights we have given to each factor. In a practical implantation a set of questions are usually designed to get an accurate yet fuzzy input for some of the non-quantifiable factors. An example is personal characteristics, a set of questions would be designed asked to the user when creating an account in a marriage website to determine a number for personal characteristics. The weights in the factors would also vary from user to user, however because the rules are simple the varying weights on factors can be accommodated in a real life practical example.