

Credit Decision System

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Problem Statement:

Design a controller to determine the credit decision. Input is Market Value, Location of House, Asset, Income, Interest. Derive set of rules for controller action and defuzzification. The design should be supported by figures wherever possible.

Methodology

Steps for solving fuzzy controller problems

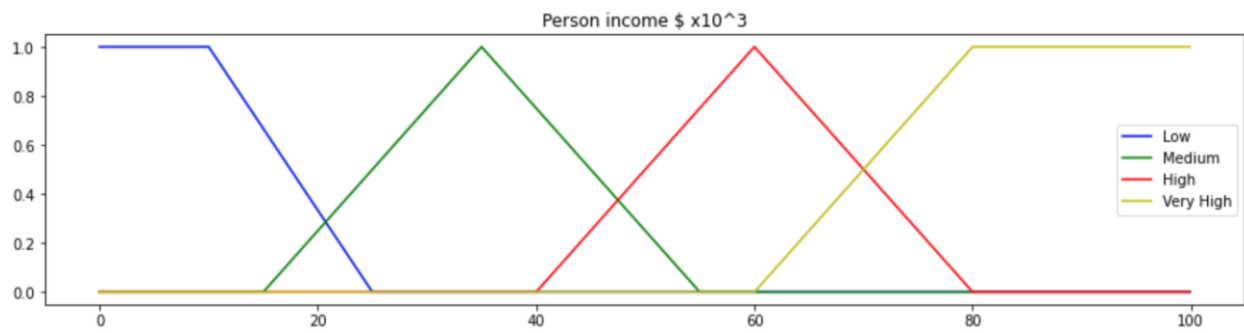
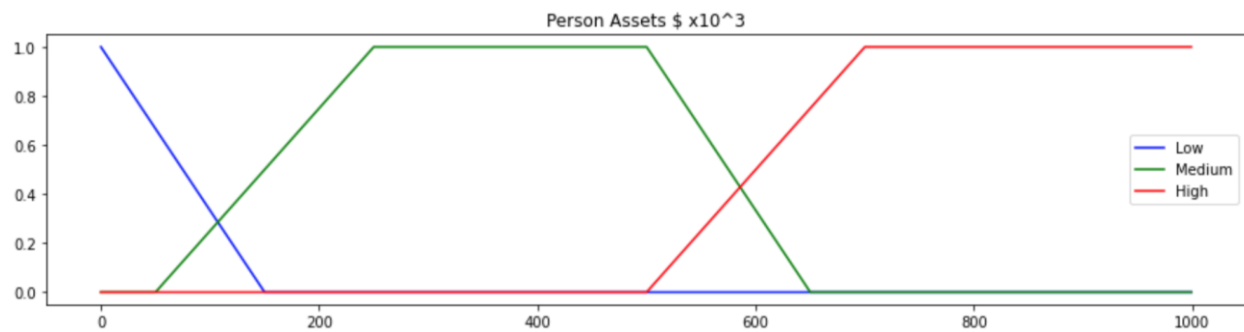
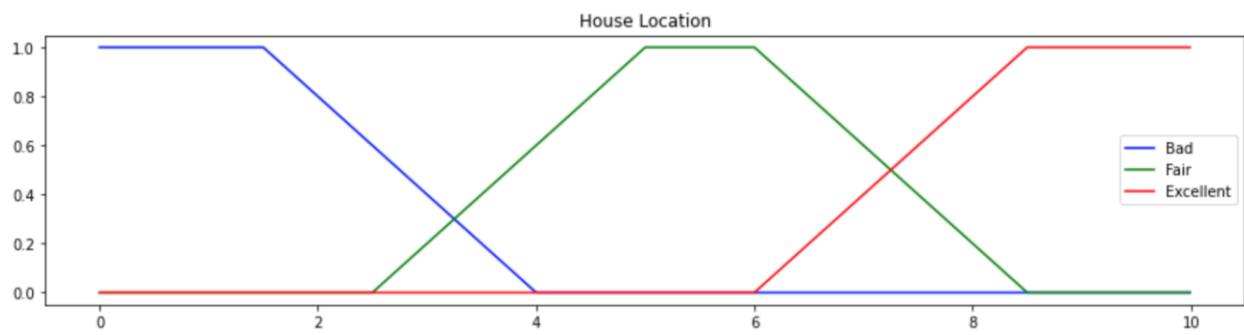
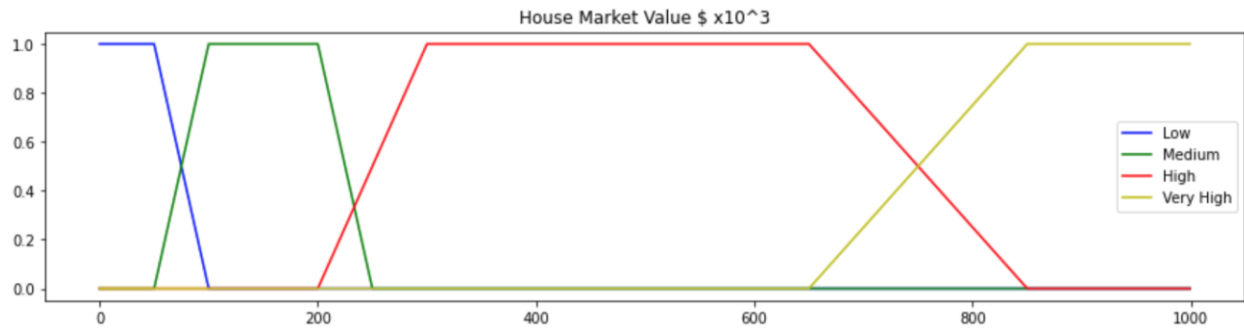
- Step 1: Identify input and output variables and decide descriptors for the same.
- Step 2: Define membership functions for each of the input and output variables.
- Step 3: Form a Rule base
- Step 4: Rule Evaluation
- Step 5: Defuzzification

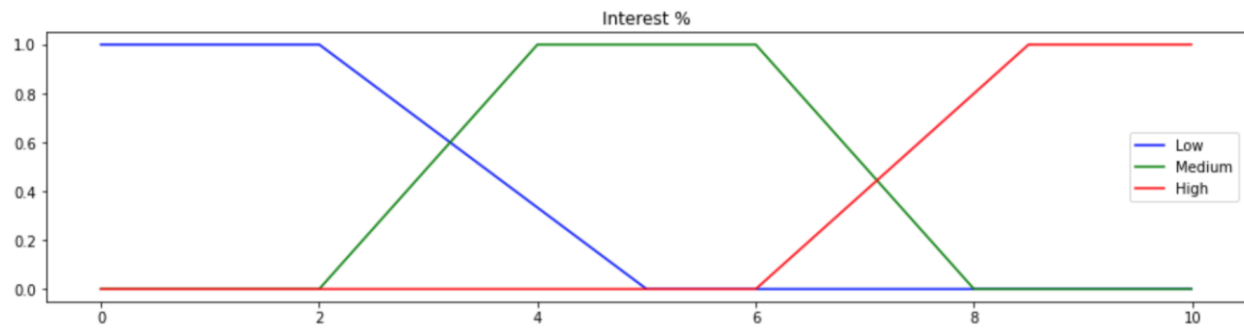
Step 1: Input-Output Variables & Descriptors

- Input Variables:
 - Market Value (low, medium, high, very high)
 - Location of House (bad, fair, excellent)
 - Asset (low, medium, high)
 - Income (low, medium, high, very high)
 - Interest (low, medium, high)
- Output:
 - House Evaluation (very low, low, medium, high, very high)
 - Applicant Evaluation (low, medium, high)
 - Credit Evaluation (very low, low, medium, high, very high)

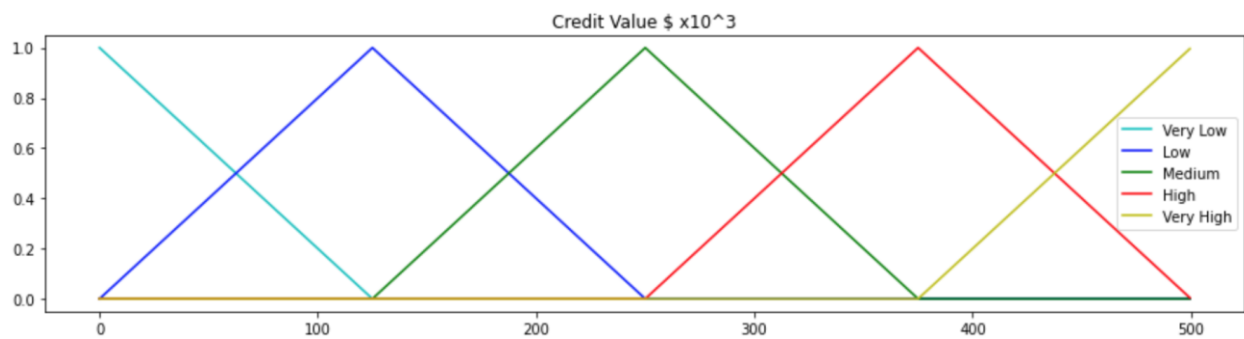
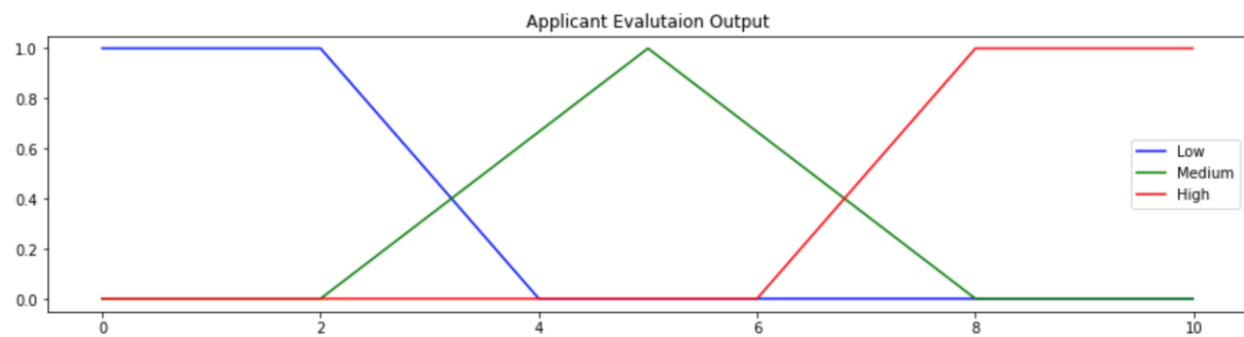
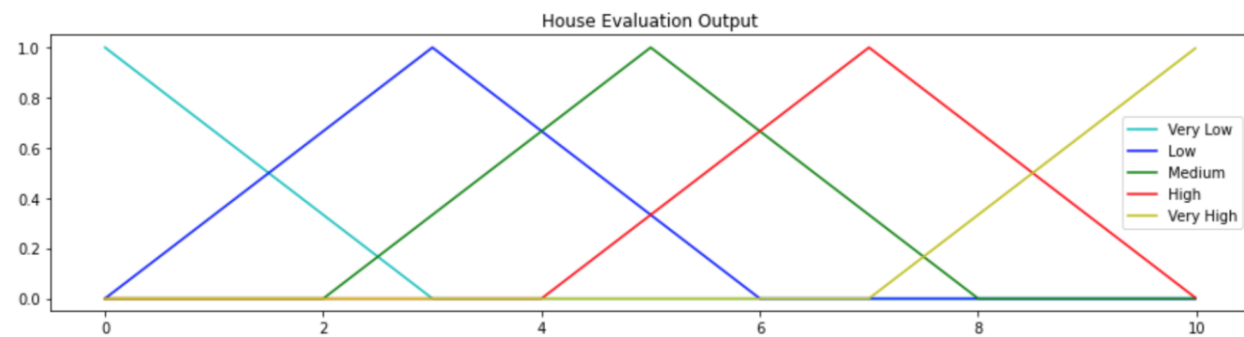
Step 2: Membership Functions

- Input:





- Output:



Step 3: Rule Base:

1. House Evaluation:

1. If (Market_value is Low) then (House is Low)
 - Market_value == Low AND House == Low ==> C1
2. If (Location is Bad) then (House is Low)
 - Location == Bad AND House == Low ==> C2
3. If (Location is Bad) and (Market_value is Low) then (House is Very_low)
 - (Location == Bad AND Market_value == Low) AND House == Very_Low ==> C3
4. If (Location is Bad) and (Market_value is Medium) then (House is Low)
 - (Location == Bad AND Market_value == Medium) AND House == Low ==> C4
5. If (Location is Bad) and (Market_value is High) then (House is Medium)
 - (Location == Bad AND Market_value == High) AND House == Medium ==> C5
6. If (Location is Bad) and (Market_value is Very_high) then (House is High)
 - (Location == Bad AND Market_value == Very_high) AND House == High ==> C6
7. If (Location is Fair) and (Market_value is Low) then (House is Low)
 - (Location == Fair AND Market_value == Low) AND House == Low ==> C7
8. If (Location is Fair) and (Market_value is Medium) then (House is Medium)
 - (Location == Fair AND Market_value == Medium) AND House == Medium ==> C8
9. If (Location is Fair) and (Market_value is High) then (House is High)
 - (Location == Fair AND Market_value == High) AND House == High ==> C9
10. If (Location is Fair) and (Market_value is Very_high) then (House is Very_high)
 - (Location == Fair AND Market_value == Very_high) AND House == Very_high ==> C10
11. If (Location is Excellent) and (Market_value is Low) then (House is Medium)
 - (Location == Excellent AND Market_value == Low) AND House == Medium ==> C11
12. If (Location is Excellent) and (Market_value is Medium) then (House is High)
 - (Location == Excellent AND Market_value == Medium) AND House == High ==> C12
13. If (Location is Excellent) and (Market_value is High) then (House is Very_high)
 - (Location == Excellent AND Market_value == high) AND House == Very_high ==> C13
14. If (Location is Excellent) and (Market_value is Very_high) then (House is Very_high)
 - (Location == Excellent AND Market_value == Very_high) AND House == Very_high ==> C14

Rule Base 1 Combining:

- => Rule = C1 OR C2 OR C3 OR C4 OR C5 OR C6 OR C7 OR C8 OR C9 OR C10 OR C11 OR C12 OR C13 OR C14

House Evaluation Rule base 1

1. If (Market_value is Low) then (House is Low)

- Market_value == Low AND House == Low ==> C1
- 2. If (Location is Bad) then (House is Low)
 - Location == Bad AND House == Low ==> C2
- 3. If (Location is Bad) and (Market_value is Low) then (House is Very_low)
 - (Location == Bad AND Market_value == Low) AND House == Very_Low ==> C3
- 4. If (Location is Bad) and (Market_value is Medium) then (House is Low)
 - (Location == Bad AND Market_value == Medium) AND House == Low ==> C4
- 5. If (Location is Bad) and (Market_value is High) then (House is Medium)
 - (Location == Bad AND Market_value == High) AND House == Medium ==> C5
- 6. If (Location is Bad) and (Market_value is Very_high) then (House is High)
 - (Location == Bad AND Market_value == Very_high) AND House == High ==> C6
- 7. If (Location is Fair) and (Market_value is Low) then (House is Low)
 - (Location == Fair AND Market_value == Low) AND House == Low ==> C7
- 8. If (Location is Fair) and (Market_value is Medium) then (House is Medium)
 - (Location == Fair AND Market_value == Medium) AND House == Medium ==> C8
- 9. If (Location is Fair) and (Market_value is High) then (House is High)
 - (Location == Fair AND Market_value == High) AND House == High ==> C9
- 10. If (Location is Fair) and (Market_value is Very_high) then (House is Very_high)
 - (Location == Fair AND Market_value == Very_high) AND House == Very_high ==> C10
- 11. If (Location is Excellent) and (Market_value is Low) then (House is Medium)
 - (Location == Excellent AND Market_value == Low) AND House == Medium ==> C11
- 12. If (Location is Excellent) and (Market_value is Medium) then (House is High)
 - (Location == Excellent AND Market_value == Medium) AND House == High ==> C12
- 13. If (Location is Excellent) and (Market_value is High) then (House is Very_high)
 - (Location == Excellent AND Market_value == high) AND House == Very_high ==> C13

14. If (Location is Excellent) and (Market_value is Very_high) then (House is Very_high)
- (Location == Excellent AND Market_value == Very_high) AND House == Very_high ==> C14

Rule Base 1 Combining:

- => Rule = C1 OR C2 OR C3 OR C4 OR C5 OR C6 OR C7 OR C8 OR C9 OR C10 OR C11 OR C12 OR C13 OR C14

Applicant Evaluation Rule base 2

1. If (Asset is Low) and (Income is Low) then (Applicant is Low)
 - (Asset == Low AND Income == Low) AND Applicant == Low ==> C1
2. If (Asset is Low) and (Income is Medium) then (Applicant is Low)
 - (Asset == Low AND Income == Medium) AND Applicant == Low ==> C2
3. If (Asset is Low) and (Income is High) then (Applicant is Medium)
 - (Asset == Low AND Income == High) AND Applicant == Medium ==> C3
4. If (Asset is Low) and (Income is Very_high) then (Applicant is High)
 - (Asset == Low AND Income == Very_high) AND Applicant == High ==> C4
5. If (Asset is Medium) and (Income is Low) then (Applicant is Low)
 - (Asset == Medium AND Income == Low) AND Applicant == Low ==> C5
6. If (Asset is Medium) and (Income is Medium) then (Applicant is Medium)
 - (Asset == Medium AND Income == Medium) AND Applicant == Medium ==> C6
7. If (Asset is Medium) and (Income is High) then (Applicant is High)
 - (Asset == Medium AND Income == High) AND Applicant == High ==> C7
8. If (Asset is Medium) and (Income is Very_high) then (Applicant is High)
 - (Asset == Medium AND Income == Very_high) AND Applicant == High ==> C8
9. If (Asset is High) and (Income is Low) then (Applicant is Medium)

- (Asset == High AND Income == Low) AND Applicant == Medium
==> C9
- 10. If (Asset is High) and (Income is Medium) then (Applicant is Medium)
 - (Asset == High AND Income == Medium) AND Applicant ==
Medium ==> C10
- 11. If (Asset is High) and (Income is High) then (Applicant is High)
 - (Asset == High AND Income == High) AND Applicant == High
==> C11
- 12. If (Asset is High) and (Income is Very_high) then (Applicant is High)
 - (Asset == High AND Income == Very_high) AND Applicant ==
High ==> C12

Rule Base 2 Combining

- => Rule = C1 OR C2 OR C3 OR C4 OR C5 OR C6 OR C7 OR C8 OR C9 OR C10
OR C11 OR C12

Credit Evaluation Rule Base 3

1. If (Income is Low) and (Interest is Medium) then (Credit is Very_low)
 - (Income == Low AND Interest == Medium) AND Credit ==
Very_Low ==> C1
2. If (Income is Low) and (Interest is High) then (Credit is Very_low)
 - (Income == Low AND Interest == High) AND Credit == Very_low
==> C2
3. If (Income is Medium) and (Interest is High) then (Credit is Low)
 - (Income == Medium AND Interest == High) AND Credit == Low
==> C3
4. If (Applicant is Low) then (Credit is Very_low)
 - Applicant == Low AND Credit == Very_low ==> C4
5. If (House is Very_low) then (Credit is Very_low)
 - House == Very_low AND Credit == Very_low ==> C5
6. If (Applicant is Medium) and (House is Very_low) then (Credit is Low)
 - (Applicant == Medium AND House == Very_low) AND Credit ==
Low ==> C6
7. If (Applicant is Medium) and (House is Low) then (Credit is Low)

- (Applicant == Medium AND House == Low) AND Credit == Low
==> C7
- 8. If (Applicant is Medium) and (House is Medium) then (Credit is Medium)
 - (Applicant == Medium AND House == Medium) AND Credit == Medium ==> C8
- 9. If (Applicant is Medium) and (House is High) then (Credit is High)
 - (Applicant == Medium AND House == High) AND Credit == High
==> C9
- 10. If (Applicant is Medium) and (House is Very_high) then (Credit is High)
 - (Applicant == Medium AND House == Very_high) AND Credit == High ==> C10
- 11. If (Applicant is High) and (House is Very_low) then (Credit is Low)
 - (Applicant == High AND House == Very_low) AND Credit == Low
==> C11
- 12. If (Applicant is High) and (House is Low) then (Credit is Medium)
 - (Applicant == High AND House == Low) AND Credit == Medium
==> C12
- 13. If (Applicant is High) and (House is Medium) then (Credit is High)
 - (Applicant == High AND House == Medium) AND Credit == High
==> C13
- 14. If (Applicant is High) and (House is High) then (Credit is High)
 - (Applicant == High AND House == High) AND Credit == High
==> C14
- 15. If (Applicant is High) and (House is Very_high) then (Credit is Very_high)
 - (Applicant == High AND House == Very_high) AND Credit == Very_high ==> C15

Rule Base 3 Combining

- => Rule = C1 OR C2 OR C3 OR C4 OR C5 OR C6 OR C7 OR C8 OR C9 OR C10
OR C11 OR C12 OR C13 OR C14 OR C15

Result

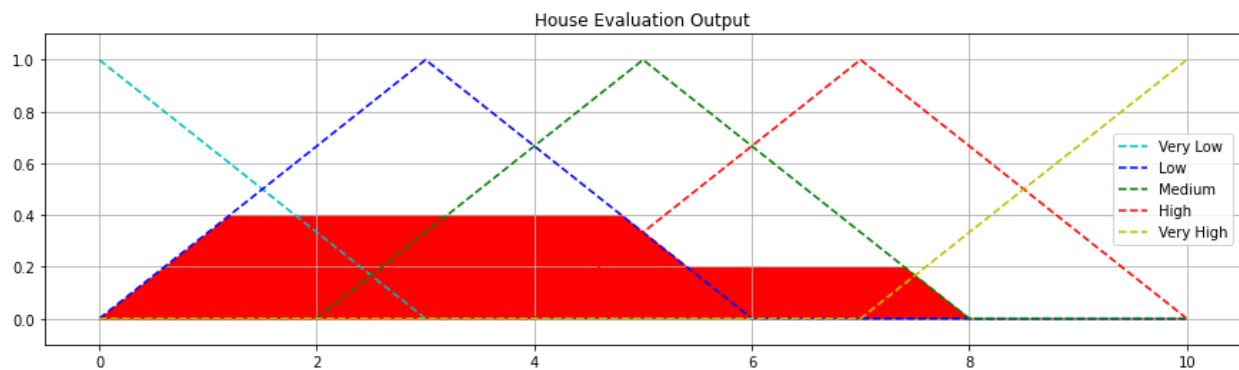
After applying all the rules from the rule base, the output of house evaluation, applicant evaluation and thereby credit evaluation is displayed.

The decision function is called by passing input variables

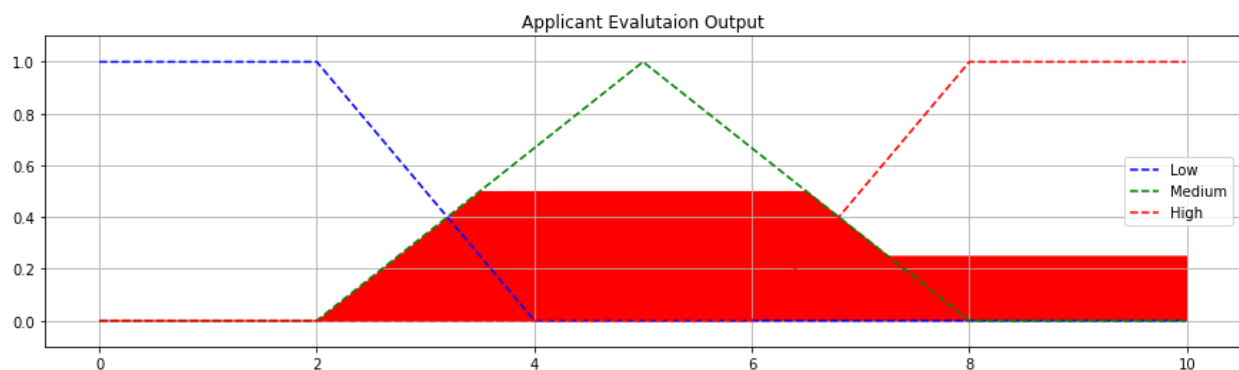
market_value : 150 , location: 3, assets: 550, income: 45, interest: 4

The output variables are shown using the following graphs:

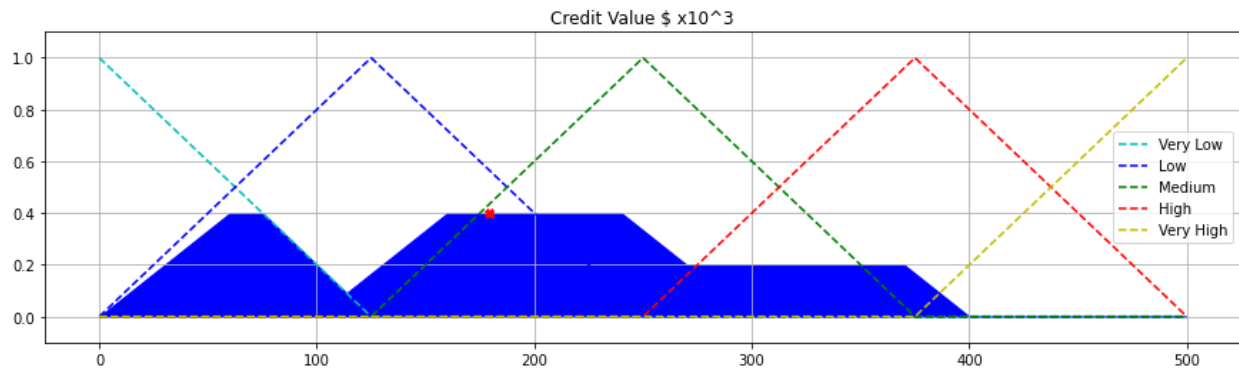
House Evaluation Output:



Applicant Evaluation Output:



Credit Evaluation Output:



The credit evaluation graph clearly shows that credit score belongs to the medium region with a value of 179.22×10^3 .

Conclusion

Contribution

Ayushi Desai - Step 1: Identify input and output variables and decide descriptors for the same. Step 2: Define membership functions for each of the input and output variables.

Jaynil Gaglani Step 3: Form a Rule base

Yash Gandhi Step 4: Rule Evaluation Step 5: Defuzzification