Special Topics Project I

Fuzzy logic, a mathematical approach to reasoning with imprecise or uncertain information, has found widespread application in various fields, including finance. In the realm of credit loan assessment, fuzzy logic offers a valuable tool to handle the inherent uncertainties and complexities involved in evaluating a applicant's creditworthiness.

Understanding Fuzzy Logic

Fuzzy logic operates on the concept of degrees of truth, rather than absolute true or false values. This allows for the representation of vague or ambiguous information, such as "high credit score" or "low income," which are often encountered in credit assessment.

Key Steps in Fuzzy Logic-Based Credit Loan Assessment

1. Define Fuzzy Sets: Identify the relevant factors or variables that influence creditworthiness (e.g., income, debt-to-income ratio, credit history).

2. Create fuzzy sets for each variable to represent different linguistic terms or categories (e.g., "low," "medium," "high").

3. Define membership functions to assign degrees of membership for each variable within its corresponding fuzzy set.

4. Create Fuzzy Rules: Establish rules that connect the fuzzy sets to the overall creditworthiness assessment.
These rules can be based on expert knowledge, historical data, or a combination of both.
Example: "IF income is high AND debt-to-income ratio is low THEN creditworthiness is high."
Fuzzification:

5. Convert the input values (e.g., actual income, debt-to-income ratio) into fuzzy values by determining their degree of membership in the corresponding fuzzy sets.
Inference:

6. Apply the fuzzy rules to the fuzzified input values to obtain a fuzzy output representing the overall creditworthiness.
Defuzzification:

7. Convert the fuzzy output into a crisp value (e.g., a credit score) using a defuzzification method (e.g., centroid method, mean of maxima method).

In order not to offend any of us considering the financial environment, the currency in this project is given in US Dollars ☺
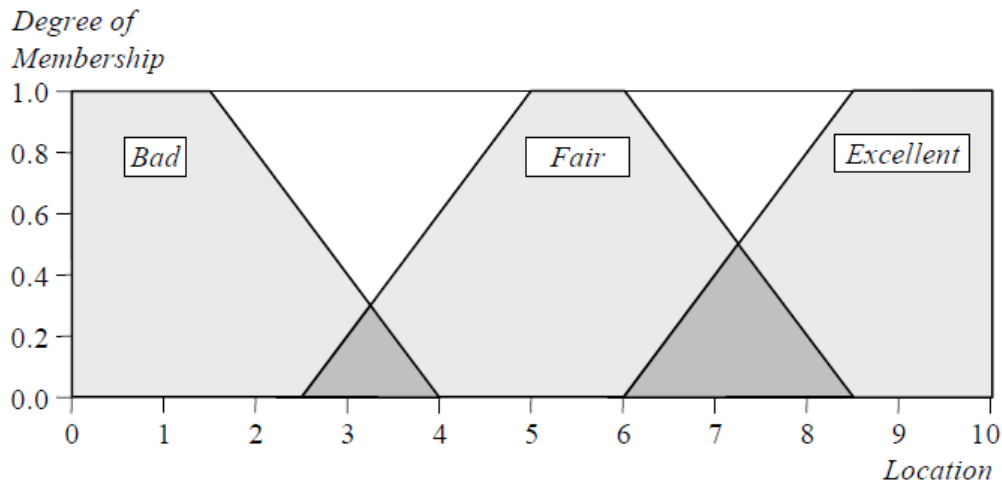
The document may appear lengthy at first sight, but do not be intimidated. A step-by-step approach is the answer.
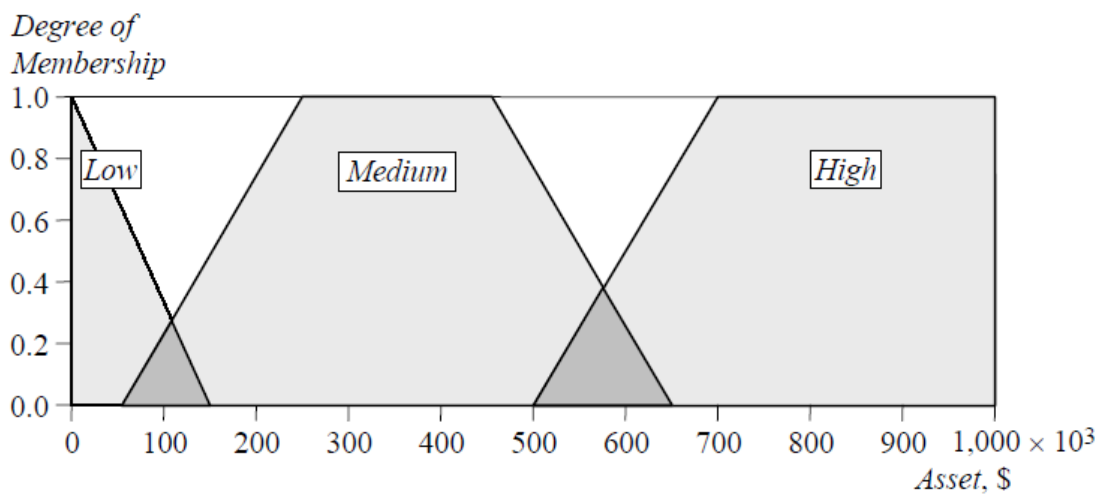
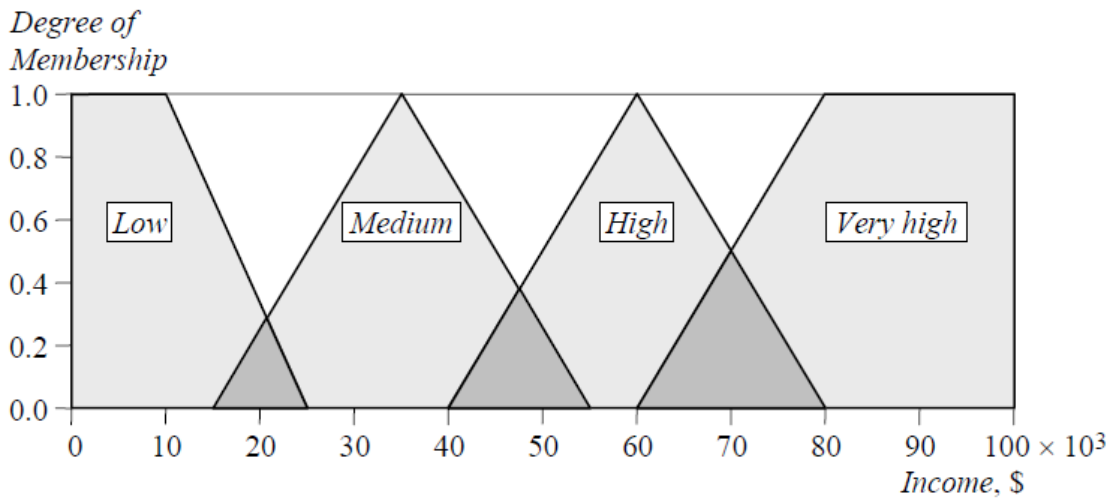Define the following membership functions:
1. Market value of the house

Degree of
Membership

Market value, $

2. Location of the house

Degree of
Membership

Location

3. Applicant's assets

Degree of
Membership
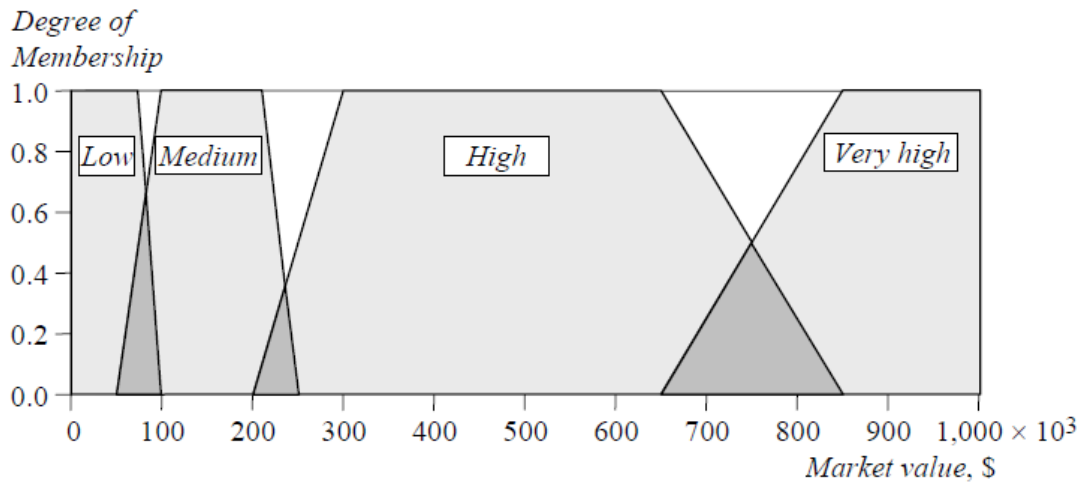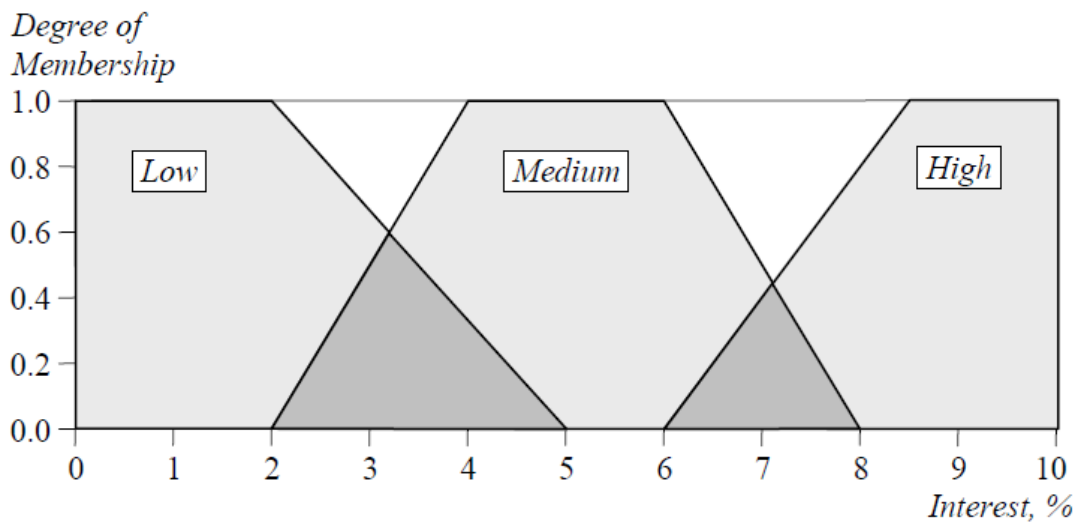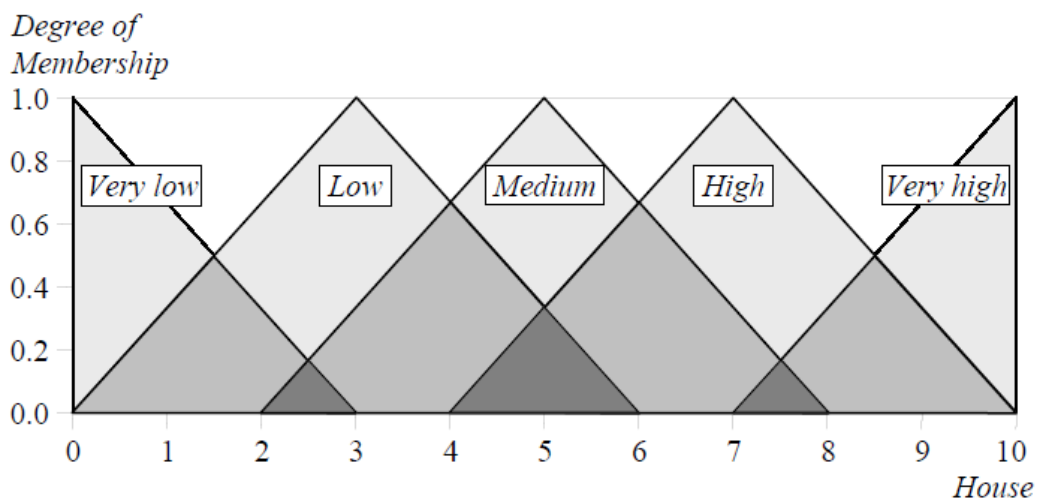

Asset, $

4. Applicant's salary

5. Interest rate

First, we will assess the property value based on the provided information. Next, the applicant will be evaluated. Finally, we will determine the loan amount.
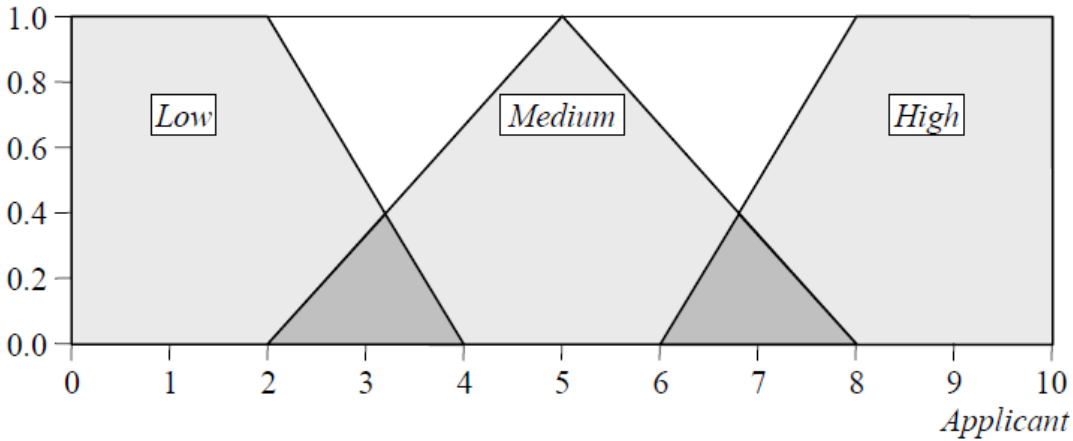
For this, we have 3 output membership functions, as follows:
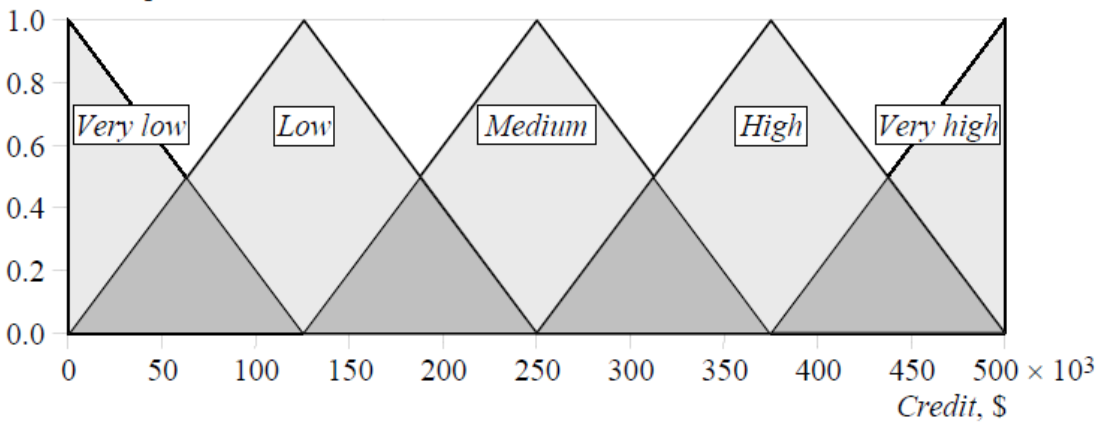
1. Evaluation of the house

2. Evaluation of the applicant

Degree of Membership

3. Evaluation of the loan amount

Degree of Membership

Given the input membership functions, your task is to perform a hierarchical assessment. First, evaluate the property value. Then, evaluate the applicant's creditworthiness. Finally, using the results of these evaluations, determine the maximum loan amount that the bank can safely provide.

Rules for evaluation

1. House Evaluation
1. If (Market_value is Low) then (House is Low)
2. If (Location is Bad) then (House is Low)
3. If (Location is Bad) and (Market_value is Low) then (House is Very_low)
4. If (Location is Bad) and (Market_value is Medium) then (House is Low)
5. If (Location is Bad) and (Market_value is High) then (House is Medium)
6. If (Location is Bad) and (Market_value is Very_high) then (House is High)
7. If (Location is Fair) and (Market_value is Low) then (House is Low)
8. If (Location is Fair) and (Market_value is Medium) then (House is Medium)
9. If (Location is Fair) and (Market_value is High) then (House is High)
10. If (Location is Fair) and (Market_value is Very_high) then (House is Very_high)
11. If (Location is Excellent) and (Market_value is Low) then (House is Medium)
12. If (Location is Excellent) and (Market_value is Medium) then (House is High)
13. If (Location is Excellent) and (Market_value is High) then (House is Very_high)
14. If (Location is Excellent) and (Market_value is Very_high) then (House is Very_high)

2. Application Evaluation

1. If (Asset is Low) and (Income is Low) then (Applicant is Low)
2. If (Asset is Low) and (Income is Medium) then (Applicant is Low)
3. If (Asset is Low) and (Income is High) then (Applicant is Medium)
4. If (Asset is Low) and (Income is Very_high) then (Applicant is High)
5. If (Asset is Medium) and (Income is Low) then (Applicant is Low)
6. If (Asset is Medium) and (Income is Medium) then (Applicant is Medium)
7. If (Asset is Medium) and (Income is High) then (Applicant is High)
8. If (Asset is Medium) and (Income is Very_high) then (Applicant is High)
9. If (Asset is High) and (Income is Low) then (Applicant is Medium)
10. If (Asset is High) and (Income is Medium) then (Applicant is Medium)
11. If (Asset is High) and (Income is High) then (Applicant is High)
12. If (Asset is High) and (Income is Very_high) then (Applicant is High)

3. Loan Amount Evaluation

1. If (Income is Low) and (Interest is Medium) then (Credit is Very_low)
2. If (Income is Low) and (Interest is High) then (Credit is Very_low)
2. If (Income is Medium) and (Interest is High) then (Credit is Low)
4. If (Applicant is Low) then (Credit is Very_low)
5. If (House is Very_low) then (Credit is Very_low)
6. If (Applicant is Medium) and (House is Very_low) then (Credit is Low)
7. If (Applicant is Medium) and (House is Low) then (Credit is Low)
8. If (Applicant is Medium) and (House is Medium) then (Credit is Medium)
9. If (Applicant is Medium) and (House is High) then (Credit is High)
10. If (Applicant is Medium) and (House is Very_high) then (Credit is High)
11. If (Applicant is High) and (House is Very_low) then (Credit is Low)
12. If (Applicant is High) and (House is Low) then (Credit is Medium)
13. If (Applicant is High) and (House is Medium) then (Credit is High)
14. If (Applicant is High) and (House is High) then (Credit is High)
15. If (Applicant is High) and (House is Very_high) then (Credit is Very_high)

Notes

1. You can use any language for implementation. Use of a toolbox (MATLAB FL Toolbox etc.) is <u>not permitted</u>. You must write your own membership functions and defuzzification code yourself.
2. You need to demonstrate your implementation and results with a 5-minute demo. In addition, you need to submit a one page printed report of your project results.
3. While showing your results, you must demonstrate the loan amounts that should be given to at least 5 different applicant scenarios for their desired houses.
4. The system you will develop should produce results using the Mamdani inference method.
5. Your code should include parts that improve code readability, such as variable naming and comment lines.
6. You should develop your project in groups of no more than 3 people. All group members must be present for the demo.
7. Deadline will be announced on the E-Kampus system.

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