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REPORT

Fuzzy logic is used in decision making problems. In this project, a decision support system will be developed for a applicant to get the amount of housing credit from banks. It will be a system that determines how much credit will be given by banks, using the information of the house and the applicant who will receive the credit.

Which components does a fuzzy system consist of ?

A fuzzy logic system consists of 4 components, which are related to each other in a certain order, as seen in the figure-1.
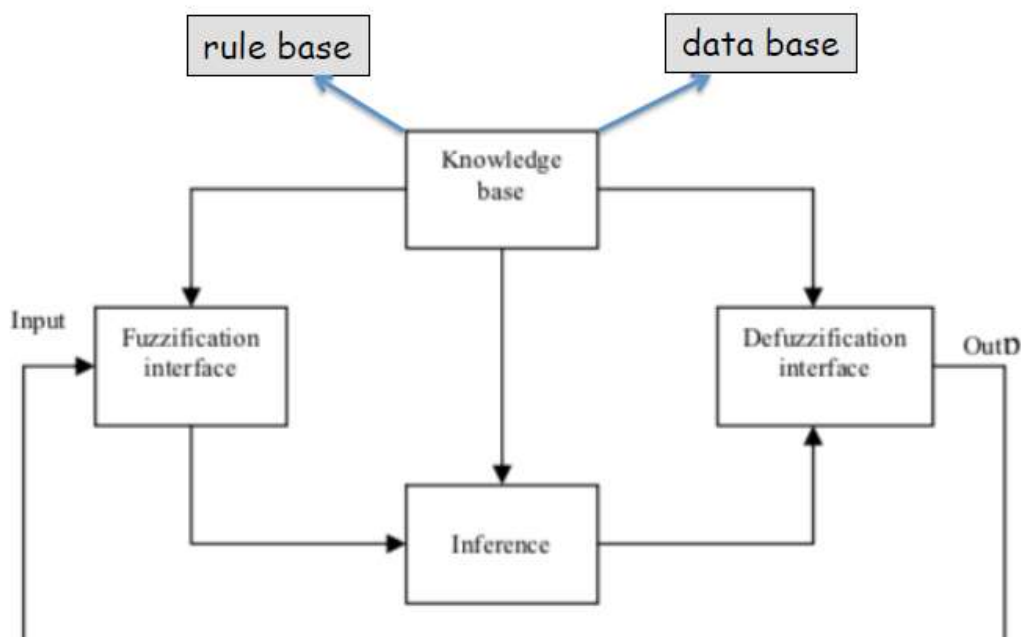

Figure-1:

1. Fuzzification :

The role of fuzzification is to convert the crisp input values into fuzzy values.

2. Knowledgbase :

As seen in Figure 1, it consists of Database and Rulebase parts.It stores the knowledge about all the input-output fuzzy relationships. It also has the membership function which defines the input variables to the fuzzy rule base and the output variables to the place under control. It contains all the rules and the if-then conditions offered by the experts to control the decision-making system.

3. Inference :

It helps us to determines the degree of match between fuzzy input and the rules. Based on the % match, it determines which rules need implement according to the given input field. After this, the applied rules are combined to develop the control actions. It simulates the human reasoning process by making fuzzy inference on the inputs and IF-THEN rules. The inference component is a mechanism that allows an evaluation to be made on the output at the end of the process.

4. Defuzzification :

At last the Defuzzification process is performed to convert the fuzzy sets into a crisp value. The most used defuzzification methods are:Mean of Maximum,Center of Area and Bisector of Area.

How this project works?

The construction processes of this project will be explained according to the fuzzy logic components, respectively.

1.) Fuzzification Process :

Crisp inputs received from the user during the fuzzification process are converted to a fuzzy form. Then it is given to the system.
In this project, fuzzification is performed by the Fuzzy logic Toolbox, which is the ready-made package of Matlab. Therefore, crisp input for each variable was included in the system as received. Crisp inputs included in the system are as follows,respectively:

- Market Value of the House
- Location Value of the House
- Asset Value of Applicant
- Income Value of the Applicant
- Interest Value

Thus, we have received the necessary crisp inputs taken from the outside, so that the system can decide.

2.)Knowledge Base Process :

The Knowledge Base consists of two main parts. These parts are rule based and database. The knowledge-base contains information about the critical data of the credit decision making mechanism and the relationship of this data with the system. The database component contains the membership set data of the system's inputs and outputs and the membership function information of these data. According to the parameters in the system are as follows:

- Low,Medium,High,Very High for Market Value
- Bad,Fair,Excellent for Location Value
- Low,Medium,High for Assest Value
- Low,Medium,High,Very High for Income Value
- Very Low,Low,Medium,High,Very High for House Value
- Low,Medium,High for Interest Value
- Low,Medium,High for Applicant Value
- Very Low,Low,Medium,High,Very High for Credit Amount Value

In the Rule-base component, rules are created based on the membership set data in the database component. With these rules, one of the structures required for the decision making mechanism is developed. As the rule set information of the project, 14 rules were defined for House Evaluation. 12 rules have been defined for Application Evaluation. Finally, 15 rules have been defined for Evaluation of the Amount of Credit. These rule sets are available in the file that the project was given. No other rule set was used other than this rule set.

3.) Inference Process :

As shown in Figure 1, an inference is obtained by using inputs from the fuzzification section, Database and Rule-Base data from the Knowledge Base section. Mamdani Fuzzy Inference system was used in this project. Since this system has a hierarchical structure, 3 separate inferences have been made.

Firstly, the location and market value inputs of the house are taken for House Evaluation Inference. Then an output is created according to the rule sets in the Knowledge Base. This output is a value that evaluates the house as an inference related to the house. Asset and Income inputs are taken for Applicant Evaluation. Then, an output is created according to the rule sets in the Knowledge-base. This output for Applicant Evaluation will be an inference about the applicant. Finally, for the Evaluation of the Amount of Credit, it is expected to receive the House Evaluation and Applicant Evaluation outputs as inputs. The Evaluation of the Amount of Credit takes 2 additional inputs separately. These inputs are Income and Interest. The Inference system generates an output for The Evaluation of Credit. This Output value is the amount of credit to be given by the bank to the applicant for credit.

Thus, a decision making mechanism has been developed according to the applicant using the Mamdani Inference logic.

4.) Defuzzification Process :

It can be considered as the opposite of blurring made in the Fuzzification section.Defuzzification rinses the result obtained with Inference in the Fuzzy system. Defuzzification converts fuzzy sets into crisp value. so it produces crisp number.
In the system, 3 defuzzifications will be made according to the hierarchical structure. These are respectively: House Evaluation, Applicant Evaluation, Evaluation of the Amount of Credit.

The Platfrom

Matlab was used for the system platform. Because the fuzzy logic toolbox in matlab can easily perform many Fuzzy logic operations on a GUI (included in the package) without writing any code.House evaluation, Applicant evaluation and Credit evaluation were done by creating fis files in Matlab. The file named Index.m contains the code document required for fis files to be in accordance with the hierarchical order.

Sample Inputs/Outputs

Applicant 1:

```
Command Window
>> Index
enter the Market value (0-1000):110
enter the Location value(0-10):2
Home output: 3
enter the Assest value (0-1000):130
enter the Income value(0-100):22
Applicant output: 4.1741
enter the Interest value (0-10):1
Credit Output: 169.166
fx >>
```

Applicant 2:

```
Command Window
>> Index
enter the Market value (0-1000):855
enter the Location value(0-10):7
Home output: 8.9124
enter the Assest value (0-1000):820
enter the Income value(0-100):69
Applicant output: 8.2857
enter the Interest value (0-10):1
Credit Output: 401.7049
fx >>
```

Applicant 3:

```
Command Window
>> Index
enter the Market value (0-1000):310
enter the Location value(0-10):5
Home output: 7
enter the Assest value (0-1000):180
enter the Income value(0-100):30
Applicant output: 5
enter the Interest value (0-10):1
Credit Output: 333.35
fx >>
```