Shortlisting Candidates for Job using Fuzzy Logic

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Abstract—In today's age of global competition, for industries it is very important to have human resources. In order to keep up with the dynamic nature of the current market it is important to select the right person for a particular post. Although many big industries have professional HR management team, shortlisting few candidates from hundreds of profiles is a tedious process and also the human decisions are not always precise. Therefore, by implementing this project we intend to develop a model which would help to make shortlisting the candidates easier. We have used fuzzy logic to implement the project. We have implemented fuzzy logic using fuzzy toolbox available in the MATLAB software.

Index Terms—Defuzzification,Fuzzy logic, Fuzzy inference, Fuzzy sets,Mamdani,Membership function, Sugeno.

1 Introduction

To solve real-life problems using microprocessors and microcontrollers we required high computational facilities, accurate equations and precise information. But this is not required always. We can reduce the complexity by using fuzzy logic and with the help of this project we have discussed a real-life problem faced by industries which can be easily resolved using fuzzy logic.

The problem we are dealing with is recruiting a suitable candidate for a required role. The time required for shortlisting a candidate using conventional techniques is a long. To solve real-life problems using microprocessors and microcontrollers we required high computational facilities, accurate equations and precise information. But this is not required always. We can reduce the complexity by using fuzzy logic and with the help of this project we have discussed a real-life problem faced by industries which can be easily resolved using fuzzy logic.

By means of this project we have tried to speed up the process of shortlisting. We have made a questionnaire to cater the needs of the industry for certain job profiles, which considers certain parameters like whether the candidate likes travelling, he is a good team player or is he affected by long working hours, etc. The candidature of a prospect is reviewed on the basis of the answers given to the questions using fuzzy logic and the candidate is shortlisted, rejected or kept in waiting list. Fuzzy logic controllers are becoming very popular now because of their ability to make decisions like human and by making proper assumptions. Therefore, they are used to develop highly sophisticated control systems.

2 FUZZY Logic

In wide sense, fuzzy logic is a form of soft computing which accommodates the imprecision of the real world. Fuzzy logic is a superset of Boolean logic that has is used to handle the concept of partial truth- truth values that lies between "complete truth" and "complete false". As its name suggests, it is the logic underlying modes of reasoning which are approximate rather than exact. Hence, fuzzy logic is a mechanism of finding order in vagueness. The importance of fuzzy logic derives from the fact that most modes of human reasoning and especially common sense reasoning are not accurate but approximate in nature.

The essential characteristics of fuzzy logic as founded by ZaderLotfi are as follows:

1. In fuzzy logic, exact reasoning is viewed as a limiting case of approximate reasoning.
2. In fuzzy logic everything is a matter of degree. Any logical system can be fuzzified.
3. In fuzzy logic, knowledge is interpreted as a collection of elastic or, equivalently, fuzzy constraint on a collection of variables.
4. Inference is viewed as a process of propagation of elastic constraints. The third statement hence, defines Boolean logic as a subset of Fuzzy logic. [1]

Terminologies used in fuzzy logic are as follows.

2.1. Fuzzy Set:

Fuzzy set is an extension of the classical set. In classical crisp set theory, the membership of elements complies with a binary logic --- either the element belongs to the crisp set or the element does not belong to the set. While in fuzzy set theory, it can contain elements with degree of membership between completely belonging to the set and completely not belonging to the set. [2] Figure 2.1.1 shows an example of fuzzy set used in this project.

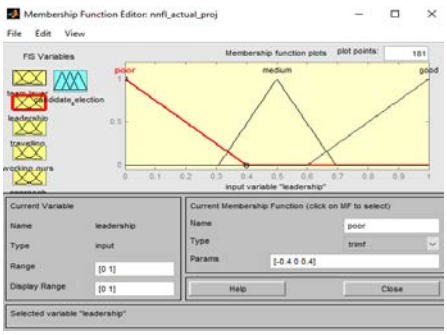

Figure 2.1.1 Fuzzy set for leadership skills

Basic Definitions and Operations:

The axiomatic bases of fuzzy set theory are manifold.Gottwald offers a good review we shall concentrate on the element of theory itself.

Definition 1: If X is a collection of objects denoted generically by x then a fuzzy set A in X is a set of ordered pairs.

$A= (x,\mu_A (x) | x \in X)$ .. (1)

μ_A (x) is called the membership function (generalized membership function) which maps X to the membership space M. Its range is a subset of non-negative real numbers whose supremum is finite.

For sup μ_A (x)= 1: normalized fuzzy set.

In Definition 1, the membership function of the fuzzy set is a crisp (real valued) function. Zadeh also defined fuzzy sets on which the membership function are themselves fuzzy sets . Those fuzzy sets can be defined as follows:

Definition 2: A type m fuzzy set is a fuzzy set whose membership values are m-1, m>1, fuzzy sets on [0,1].

Because the termination of the fuzzification and the stage r≤ m seems arbitrary or difficult to justify, Hirota17 defined a fuzzy set the membership function of which is pointwise a probability distribution: the probabilistic set.[4]

2.2. Membership function:

Membership functions can be defined as a curve which defines the feature of fuzzy set by assigning each element of fuzzy set a degree of membership.it maps each element of the input to a membership value in closed interval [0,1]. Figure 2.2.1 shows a general membership function curve.

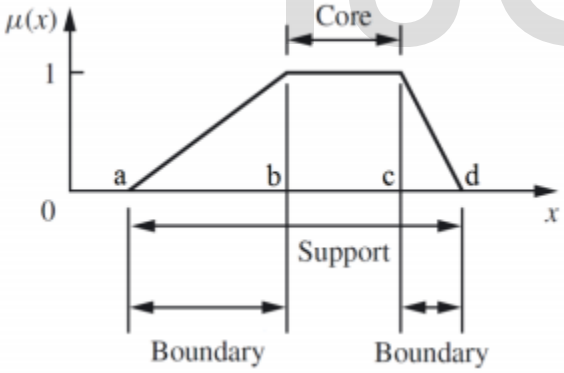

Fig 2.2.1 A sample of membership function.

The membership functions used are very poor, poor, medium, good and very good.

2.3. If-then rules:

In fuzzy inference system, if-then rules form the decision making mechanism which describes the state of input variable for occurrence of a particular output on the output variable. A single fuzzy If-Then rule follows the form

If m is A, Then n is B.

The "if" part is called the antecedent, with m as the input variable. The "then" part is called as the consequent, with n as the output variable. Here A and B are linguistic values, or adjectives in most cases, and this form of decision making works the concordant way with human judgment.

Figure 2.3.1 shows the rule base used in this project.

Fig 2.3.1 Rule Base used in the project.

For calculating output of a system using fuzzy logic following steps must be followed.

1. Fuzzifying the inputs using input membership functions.
2. Determining the rule strength on the basis of rule base using fuzzy inference system.
3. Defuzzification of the output to get appropriate output.

3. Fuzzy Inference System:

Mapping of given input variables onto an output space using deducing mechanism comprising of if-then rules, fuzzy logic operations and membership functions is done by fuzzy inference systems. Generally, three types of fuzzy inference methods are proposed in literature: Mamdani fuzzy inference, Sugeno fuzzy inference, and Tsukamoto fuzzy inference. All of these three methods can be divided into two processes. The first process is fuzzifying the crisp values of input variables into membership values according to appropriate fuzzy sets, and these three methods are exactly the same in this process. While the differences occur in the second process when the results of all rules are integrated into a single precise value for output. In Mamdani inference, the consequent of If-Then rule is defined by fuzzy set. The output fuzzy set of each rule will be reshaped by a matching number, and defuzzification is required after aggregating all of these reshaped fuzzy sets. But in Sugeno inference, the consequent of If-Then rule is explained by a polynomial with respect to input variables, thus the output of each rule is a single number. Then a weighting mechanism is implemented to work out the final crisp output.[2] Tsukamoto is not in relevance with the project that we are working on and therefore, we have used Mamdani and Sugeno inference systems to get the output. Fig 3.1 shows the output obtained using Mamdani fuzzy inference system. Fig 3.2 shows the output obtained using Sugeno inference system.

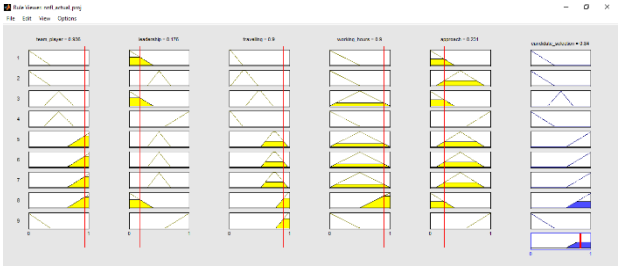

Fig 3.1 Output obtained using Mamdani inference system

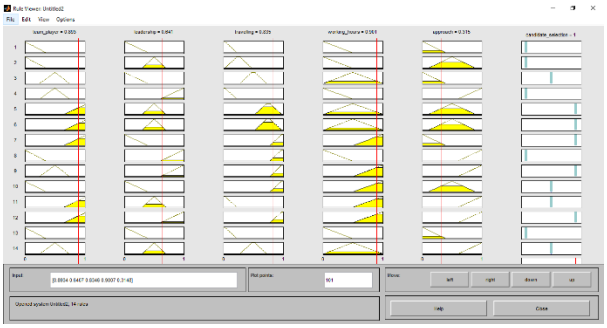

Fig 3.2 Output obtained using Sugeno inference system

4. Defuzzification:

Defuzzification is a mapping process from space of fuzzy control actions defined over an output universe of discourse into space of crisp control action.(3) In the decision analysis of the fuzzy environment, fuzzy numbers need to be compared and discriminated by decision makers. Ranking fuzzy numbers is not the total order relations under the ordinary meaning, but the partial order under the lattice structure. Thus, the ranking theories and methods of fuzzy numbers become one of the important and difficult task of fuzzy decision related problems. As the fuzzy number is determined by the membership function, to achieve the purpose of ranking, the sort of fuzzy numbers is to construct various order relationships from the standpoint of membership function to some extent. Practically, the centroids of fuzzy numbers are some properties of fuzzy numbers which are extracted from geometric aspects
There are seven methods for defuzzification:

1. Max membership principle,
2. Centroid method,
3. Weighted average method
4. Mean max membership method
5. Center of sums
6. Center of largest areas
7. Center of maxima.

Besides this, the degree of representative location is more important than average height in order to ranking fuzzy numbers more conveniently. Based on this concept, a revision of Cheng and Chu's method was presented as follows. For any two fuzzy numbers A and B , (a) if x A >xB , then B π A . (b) if x A <xB , then B ϕ A . (c) if x A =xB , then if A B y >y , then B π A ; else if A B y <y , then B ϕ A ; else A B y =y , then A ~ B . By studying, we found that these indexes have some obvious shortcomings for some fuzzy numbers' ranking.[5]

In this project, we have used centroid method for defuzzification process because of high accuracy and minimum latency it is the most efficient defuzzification process.

5. Limitations:

1. This system is not applicable for shortlisting of candidates for all job profiles, different job profiles may not have same requirements from the candidates.
2. This system does not consider all the parameters on deciding the suitability of a candidate. Like, soft skills are not considered.
3. Also, there is no way to check the authenticity of the rating. Some candidates may over-rate themselves, while some candidates may under-rate themselves.
4. This is customized for a certain job profile and with the increase in the parameters the complexity increases.

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