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A Place for Fuzzy Logic in Database Management

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Abstract

The queries to database resources today in order to assist organizations make decisions tend to be crisp and deterministic.But human attempts at decision making are not always dependent on crisp values but values that are vague andundeterministic. In this paper an approach to querying a database is discussed and fuzzy logicis introduced at the query level to a database which is crisp,giving results which resembles that which a man would give.This logic is implemented using Microsoft Visual Basic and Microsoft SQL.

Keywords: Membership functions, Linguistic term, Linguistic Variable, Fuzzy Logic, Universe of Discuss, Query

1.0 Introduction

The storehouse of Organizational datain today's information age is the database. By its form,it makes data and information accessible to members of thatOrganization, permitted to access it.

With the Database Management System as a tool, information can be acquired from the databases andused for support in decision making by Organizational management and policy shaping. In our everyday activities, decisions are made by human reasoning, using parameters which more often than not, are vague and imprecise in nature. According to Zadeh, L. A [1], Humans have a remarkable capability to perform a wide variety of physical and mental tasks without any measurements and any computations.But in our computing with machines, which includes the use of databases in the decisions support system, the parameters which represents our model to which, we need to decide upon, are often crisp, precise and deterministic, highlighting the formal nature of our models. However, if we must completely trust the outcome of results from such models, the entire behavior of the situation under study must be perfect including the modeling language used: implying that the whole system must be a perfect match.Since the database management system tools havecome to stay as a means of assisting organizations decision making processes, we attempt to look at ways of using the database management tools to handle uncertainties and vagueness. According to Chen et al [2], Knowledge-based or Artificial Intelligence techniques are used increasingly as alternatives to more classical techniques to model environmental systems.

We try to build the uncertainties into the model to capture the realities of the natural World as seen by the human mind in decision making, thereby introducing Fuzzy logic.

Fuzzy systems enables the avenue to transform Linguistic descriptions into a mathematical framework in which suitable computations for processing data and formal inference can be carried out.

Fuzzy sets are sets with boundaries that are not precise and membership in this set is not an outright Yes or No (True or False) but rather, a degree of acceptability or belongingness this theory is called the fuzzy set theory.Classical control theory is based on mathematical models that describes the behavior of a system under consideration the main idea of fuzzy control on the other hand is to build a model of a human control expert who is capable of controlling the system without thinking in a mathematical model. The control expert specifies his control actions in the form of Linguistic rules which are then translated into fuzzy sets that can simulate the behavior of the human expert.

Incorporating the uncertainty and abstract nature inherent in human decision making into intelligent control Systems offers a more accurate and efficient approach which tends to capture the approximate and quantitative boundary conditions of system variables by fuzzy sets with membership functions. Such systemflexibility exhibits characters in near human terms.It has been demonstrated that such results are more reliable and robust.

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2.0 Fuzzy Sets

A fuzzy set μ of X is a function that maps from the universe X into the unit interval, ie μ : X – [0, 1], F (X) denotes the sets of all fuzzy sets of X.

The value μ (X) denotes the membership degree of x to the fuzzy setμ .

For example, the representation of the datum integer that is less than 20 gives the definition of the respective characteristics function.

$\mathring{U}_A$: N → {0,1}

$$\mathring{U}_A:(n)= \begin{cases} 1, \text{ if less than } 20 \\ 0 \text{ otherwise} \end{cases}$$

This yields a value of 1 for each element of the universe that belongs to A and a zero value for each element that does not.

If we have to characterize the linguistic term old, then in the human reasoning method, we will have a problem. The use of any characteristic function will result in a generally unsatisfactory situation.Such that, at a particular age X, a person is considered to be old while another age (X-1), the same person is considered not old.

3.0 Membership Functions

Let us consider an example: A Non-GovernmentalOrganizationdecides to provide assistance to the old and needy in the society. If a comprehensive database called BIODATA exists that has all the data regarding ages of all the people to be considered and their income for sustenance, then, a database query to get those names could be specified as follows.

SELECT NAME FROM BIODATA WHERE AGE>50 AND INCOME ≤ 3000

In this kind of system a 70 year old Grandfather with severe need ofassistance who earns 3,500 will not be selected simply because of the crisp nature of our data and the query mechanism which supports very rigid boundary conditions.

In fuzzy Logic, we could specify the same by defining two fuzzy sets AGE and INCOME and each person will have some membership level associated with the two sets as shown in the figures 2 and 3.

In order to implement fuzzy in Databases, our approach shall be by making fuzzy queries to classical Databases.

A Linguistic variable represents linguistic concepts interpreted in a particular context. It is a variable that represents a fuzzy number.

According to Robert Fuller [3], a linguistic variable is fully characterized by a quintuple (V,T,X,g,m), where

V= name of linguistic variable.

T= Set of linguistic terms that apply to this variable

X= Universal set of the values of X.

g= grammar for generating the linguistic terms.

m= Semantic rule that assigns to each term t ε T a fuzzy set on X.

It shows the four parameters associated with the linguistic term poor: α, β, γ , and Ω.

Between $\beta$and γ the membership value =1, while between (α, β) and (,Ω) the membership value lies between 0 and 1.

In this paper, fuzzy query to the front end of a classical / crisp database is introduced, and in Figures 2 and 3 we show the two linguistic variables and their linguistic terms and further define their membership functions as shown in the equations (1) to (5).

The linguistic terms for the linguistic variable Age can be defined as Young, Average, and Old, while that of income can be Small, Medium, Big.

The membership functions for the linguistic Variable INCOME using the linguistic terms very Young, Young, Average, Old, and very old is shown in equations 1 to 5

$$\mu_{\text{VERY POOR}}(X) = \begin{cases} 1, X <= \beta \\ 1 - \frac{X-\beta}{\delta-\beta}, \beta < X < \delta \\ 0, \text{otherwise} \end{cases} \quad (1)$$

$$\mu_{\text{POOR}}(X) = \begin{cases} 1 - \frac{X-\delta}{\alpha-\delta}, \delta < X < \alpha \\ \frac{X-\beta}{\delta-\beta} \quad \beta < X < \delta \\ 0, X < \beta \text{or } X > \alpha \end{cases} \quad \ldots\ldots\ldots \quad (2)$$

$$\mu_{\text{FAIR}}(X) = \begin{cases} 1 - \frac{X-\alpha}{\theta-\alpha}, \alpha < X < \theta \\ \frac{X-\delta}{\alpha-\delta} \quad \delta < X < \alpha \\ 0, X < \delta \text{ or } X > \theta \end{cases} \quad (3)$$

$$\mu_{\text{JUST OKAY}}(X) = \begin{cases} 1 - \frac{X-\theta}{\Phi-\theta}, \theta < X < \Phi \\ \frac{X-\alpha}{\theta-\alpha} \quad \alpha < X < \theta \\ 0, X < \alpha \text{ or } X > \Phi \end{cases} \quad (4)$$

$$\mu_{\text{OKAY}}(X) = \begin{cases} 1, X >= \Phi \\ \frac{X-\theta}{\Phi-\theta} \quad \theta < X < \Phi \\ 0, \text{otherwise} \end{cases} \quad (5)$$

4.0 Implementation

Having defined the membership function, a Visual Basic program is written to implement this using the crisp values of income and age in the database to associate each entry to a linguistic term. Hence during the query an easier representation can be dealt with rather than the constrained and restrictive representation.

This can be done with My SQL database and Visual Basic.We could therefore use a select statement to replace our earlier query such as
SELECT NAME FROM BIODATA WHERE AGE IS OLD AND INCOME IS SMALL.

5.0 Conclusion

With this kind of Logic the hard line boundary can be cushioned and a broader set solution from the crisp database set can be sieved. Though fuzzy in databases is still attracting much attention this work has shown that there could be major improvement in organizational management decisions that will implementfuzzy logic in their database operations. The only drawback is that due to the enormous computation that will be involved, in some cases, the system implementing fuzzy logic may be relatively slower than that using classical logic but with higher speed systems being developed in recent years this drawback may eventually fade away.

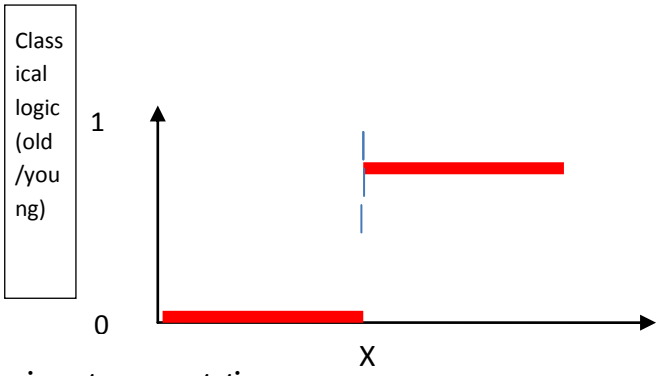

Figure 1: acharacteristic function of a crisp set representation

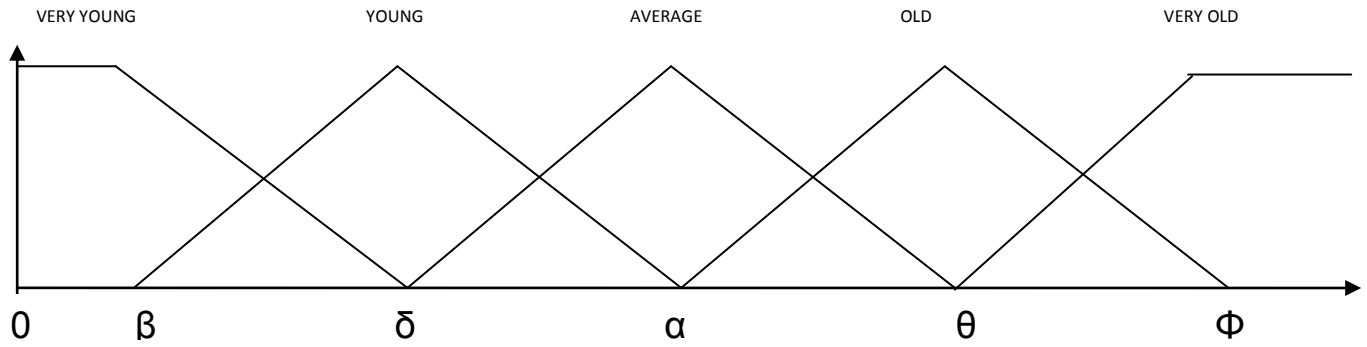

Figure 2: The membership function for the linguistic variable AGE

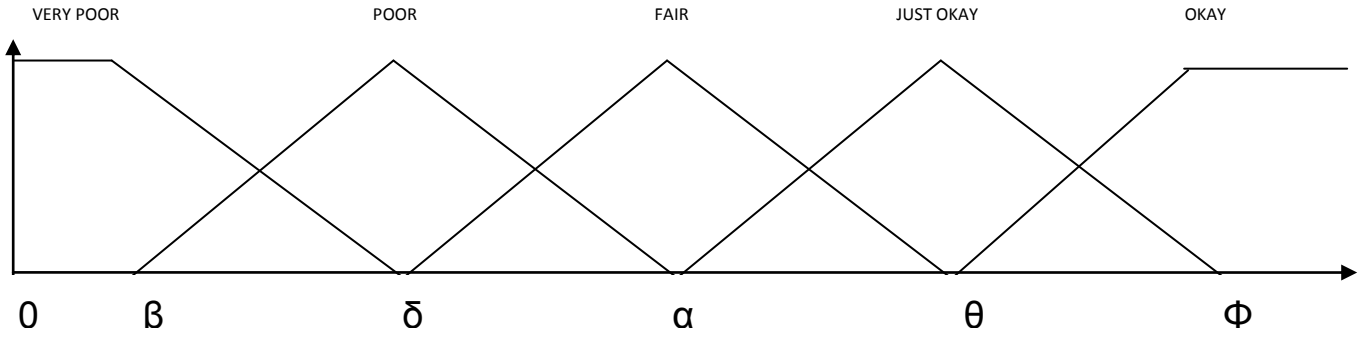

Figure 3: The membership function for the linguistic variable INCOME

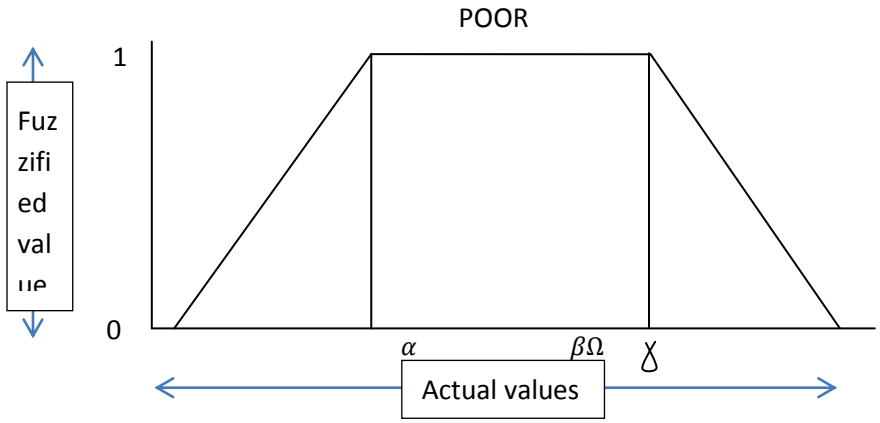

Figure 4: The possibilities Distribution for the linguisticterm POOR

TABLE 1: A Database Table Snapshot

NAME	GENDER	AGE	DEPT	INCOME
UMARU	M	54	ADMIN.	2950
JOE	M	61	CLEICAL	4250
SHITTU	M	29	ACC.	6000
EKONG	M	83	EDU	4332
MATTY	F	63	LEGAL 5554	5554
CHIKA	F	27	ACC	2999

References

[1] Zadeh L.A. (2002), "A new direction in A I : Towards of a computational theory perceptions " Technologies for constructing intelligent systems I, Physics – Verlag Heidelberg New York Pp 3-20

[2] Chen, S. H., Jakeman, A. J., and Norton, P. J. (2008), Artificial Intelligence techniques: An introduction to their use for modelling environmental systems, Journal of Mathematics and Computers in Simulation, Volume 78 Issue 2-3, July, 2008. Pages 379-400 Elsevier Science Publishers B. V. Amsterdam, The Netherlands.

[3] Robert , F. (2000), "Introduction to Neuro- Fuzzy systems", Physica-verlag Heidelberg, N.Y. U.S.A.

[4] Klir G.J and Yuan, B[2001], "Fuzzy sets and fuzzy logic : Theory and Application" Prentice Hall Inc. Englewood Cliffs, N.J; U.S.A.