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Fuzzy Management on Human Centered Systems

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Abstract

In this paper the author discusses Fuzzy or non-Fuzzy, the best defined management is fuzzy, *i.e.* it is better to use in governing a human centered system not the conventional mathematical apparatus (specially when the mathematical apparatus leads to extremely large computational efforts) but the apparatus of fuzzy sets and algorithms.
*Keywords:*Fuzzy Management, Human centered system, Fuzzy Instructions, Insertion, Intuitively, Coalitions.

Introduction

By human centered system the author means a system with human beings as elements able to make decision and to communicate one with other in a given field of activity e.g. economic, political, legal, religious systems, etc. The author wants to govern this system in order to achieve some goal, fuzzy or non-fuzzy.

The main result obtained is Fuzzy or non-Fuzzy, the best defined management is fuzzy, *i.e.* it is better to use in governing a human centered system; not the conventional mathematical apparatus (especially when the mathematical apparatus of fuzzy sets and algorithms.

At the centre of our considerations is the existence of notion (ideas) which are fuzzy in any individual of the human centered system; this the author is able to exploit if we govern fuzzy but sacrifice precision but again significance (Zadeh's principle)[1,6].

Fuzzy Instruction:

Fuzzy governing is considered as a sequence of fuzzy instructions applied to a human centered system in order to improve its behaviors (or functioning) with respect to some goals set by the system or its governing body.

Let S be a set of instructions given to the human centered system H. An instructions S is called fuzzy with respect to the individual hi H if in response to s, hi generated a fuzzy set

$$F_1 = \sum_{j \in J} \mu_i \left(X_j\right) / X_j \tag{1}$$

Where x X is a alternatives generated by the individuals in H the alternatives may be Instructions or actions related to the meaning of s; J is a finite index set with more than 1 element and denotes a union of fuzzy singletons $\mu_i \left(X_j\right) / X_j$ rather than an arithmetic sum; $\mu_i \left(X_j\right)$ is grade of membership of x_i to F_j (membership function or compatibility function) and associates with each its compatibility with the meaning of s.

The fuzzy set F_j expresses a way of understanding s by h_i; equation (1) may be written in the following ways :

$$h_i \omega s \langle = \rangle F_i = \sum_{i \in j} \mu_i \left(x_j \right) / x_j \qquad (2)$$

where means "understands"

The support of F_i is defined as follows :

$$x_j \in \mathrm{supp} F_i \langle = \rangle \mu_i \left(x_j \right) < 0$$

Example 1. Let s = GO SLOWLY; h_1, h_2 H; X = {1,2,3,4,5,6,} is referred as available speeds (km per hour) at whip two individuals have to move in order to perform s. By identical conditions for the instructions execution, h_1 and h_2 understand the meaning of s as follows:

$$h_1 \omega s \langle = \rangle F_1 = 0.3/5 + 0.6/4 + 1/3 + 0.7/2 + 0.6/1$$

supp F_1 = {1, 2, 3, 4, 5}

$$h_2 \omega s \langle = \rangle F_2 = 0.6/4 + 0.7/3 + 1/3 + 0.9/2 + 1/1$$

supp F_2 = {1, 2, 3, 4}

A measure of similarity in ways of understanding given fuzzy instructions by the individuals hi and hk is expressed as

$$d(F_i, F_k) = 1 - \frac{\sum_{j=1}^{m} \left| \mu_j \left(x_j \right) - \mu_k \left(x_j \right) \right|}{m + \sum_{j=1}^{m} \min \left[\mu_j \left(x_j \right) \mu_k \left(x_j \right) \right]} \qquad (3)$$

where $X' = \mathrm{supp} F_j \cap \mathrm{supp} F_k, \left| X' \right| m, x_j \in X' \text{ for } j = 1....,m.$

In the example 1, $d(F_1, F_2) = 0.86$

We say that $F_i \varepsilon$ – coincide $F_k \left(F_i \varepsilon F_k : \right)$ with respect to given fuzzy instruction if $d \left(F_i \varepsilon F_k \right) \geq \varepsilon$

where $\varepsilon < 0$ is same preliminary assigned threshold value.

Insertion Trees :

Now let us define an important operation "insertion" which has a meaning of concretizing the ways of understanding fuzzy instructions (or clarification of ideas of notions)[2,3].

Let $h_{,,} \varpi s \langle = \rangle F_i = \sum_{j \in J} \mu_i \left(x_j \right) / x_j \text{ and } x_j \, (j_0 \in J)$ is a fuzzy instruction. If $X_{j0} = \sum_{k \in K} \mu_i \left(x_k \right) / x_k$ then "insertion" means building the fuzzy set

$$F_i^{'} = \sum_{j \in J/(J0)} \mu_i + \sum_{k \in K} \min \left[\mu_i \left(X_{j0} \right), \mu_i \left(x_k \right) \right] / x_k$$

Example 2. Let s = BUY MODERN AND INTERESTING BOOK ON CYBERNETICS

where $\tilde{x}_1 =$ to buy an interesting book on pattern recognition"

$\tilde{x}_2 =$ to buy an easy for understanding book on artificial intelligence

$\tilde{x}_3 =$ "to buy "Cybernetics" by N. Wiener"

and hi understands the meaning of fuzzy instructions x_1 and x_2 as follows

$$\tilde{x}_1 = 0.7/x11 + 0.6/x_{12}$$

$$\tilde{x}_2 = 0.8/x_{21} + 0.9/x_{22}$$

Where $x_{11} =$" to buy "Syntactic Pattern Recognition" by K. Fu"

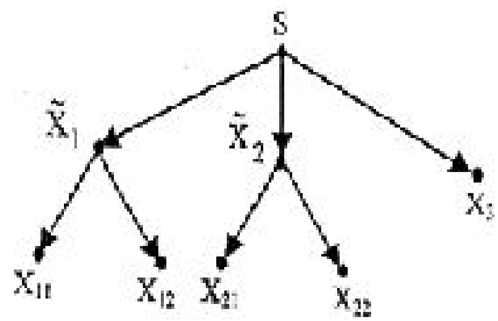
$x_{12} =$" to buy "Artificial Intelligence" by J.Slagle"

$x_{22} =$" to buy "Artificial Intelligence" by N. Nilsson".

The insertion tree of this example is;

Let us notice that x_{11}, x_{22}, x_3 are non-fuzzy

The "Insertion tree" represents the way in which a given individual hi understands the meaning of a given instruction s.



Formally : The insertion tree is an oriented[4,5] graph constructed by hi in response of s which nodes are all instructions generated by hi in the process of understanding s.

There is a natural order on the insertion tree :

We say that (instruction A) $\leq$ (insertion B) if after a finite number of insertions on B we have B = $\sum_{i \notin j} \mu_i \left(x_j \right) / x_j \text{ andA } x_{j0} \text{ for } j_0 \in J$

Intuitively: Executing A we execute B.

We say that a partial order on a set R is Artin's is it is impossible in the chain $A_1 \geq A_2 \geq ....A_n....$ to find more than finite different elements (different means : A_i and $\leq A_k \text{ andAi} \neq A_j = A_k$), where A_1, A_2,….. are arbitrary elements of R; in other words, there exists k such that $A_1 \geq A_2 \geq ...... \geq A_k = A_{k+1} = ...$ (stabilization of the chain); A_k is called a minimal element. A fuzzy instruction s is called feasible for h_1 if its insertion tree is Artin's in the order defined above with a non-fuzzy minimal element.

The insertion tree of a feasible instruction may be infinite. For example, the tree given on the fig. 2

With $A_i^{\{k\}}$ we we denote the k^{th} level of the insertion tree. We say that hi and hk understand s in – same way if there exist integers p and p' $(p,p'\geq 1)$ so that $A_i^{(p)} \overset{\varepsilon}{} A_i^{(p')}$.

Coalitions :

We introduce a threshold value δ so that if two individuals understand a given fuzzy instruction in –same way they form a coalition.

We suppose :

After the instruction is given, coalitions are formed because of the communication among the individuals in H.

$H = k_1 \cup k_2 \cup .... \cup k_n \cup \{k\}$ where if $h_i, h_j \in k_1$ then hi and hj understand the given fuzzy instruction in δ - same way; {k} is set of "hesitating" elements.

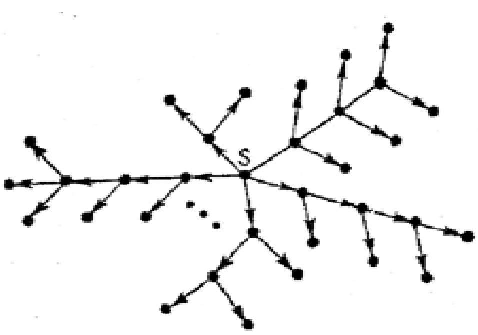


Figure 2

Let us emphasize that the formation of a coalition is possible because our governing is fuzzy. If we had strict instructions no "voluntary" coalitions with respect to these instructions would be formed.

Three conditions imply existence of main group (nucleus) of individuals playing a role of "dictators of particular type :

i. Fuzziness of the instruction.
ii. Communication among the individuals
iii. Outside necessity for decision making (or optimization of some utility function)

This result follows from a general principle of nucleus extracted from Arrow's well-known theorem, from the experiments of Gause in biology and form a series of other results and experiments in psychology, sociology and physics (Pavlov, Paulli).

Without losing the generality of the basic idea we state the principle of nucleus oriented to human centered system as follows :

In every human[7,8] centered system there is a group of leaders. The group of leaders includes mainly individuals who are most erudite in the field of activity in which the human centered system operates.

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