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MODERN PROBLEMS OF RADIO ENGINEERING, TELECOMMUNICATIONS, AND COMPUTER SCIENCE

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of the XIIIth International Conference
TCSET'2016

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Ministry of Education and Science of Ukraine
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SECTION 9
INFORMATION PROCESSING

SECTION 10
BIOTECHNICAL AND MEDICAL DEVICES AND SYSTEMS

Data Representing and Processing in Expert Information System of Professional Activity Analysis

Oleh Zaritskiy, Petro Pavlenko, Andriy Tolbatov

Abstract - **In this paper the results of linguistic variables presentation: "Importance of job" and "Time of job", which are basis of data input and processing modules in information systems of professional activity analysis and estimation are given.**

Keywords - **analysis of professional activity, information system, software, expert system, fuzzy sets, linguistic variables, CLIPS.**

I. Introduction

According to the analysis of information and structural model [1,2], revealing links between models entities [3,4] it could been made conclusion about necessity of solving knowledge formalizing tasks as a part of expert information professional activity analysis and estimation system. Task of expert's knowledge formalizing are been complicated by problems of qualitative characteristics describing, which are not clear from numeric scale presentation. Besides, in the tasks, that are been solved by expert system, very often it is necessarily to use fuzzy knowledge, that could not been describe like absolutely TRUE or FALSE, for example, "Importance of job" and "Time of job", that influence on the "Weight of job" [5,6]. The main problem is absence of structural theoretical and practical approaches, that allow to present such a knowledge in information system [7]. So, consider this question from practical point of view in the main part of the article. In the article we will use fuzziness and uncertainty are the two distinct concepts employed in the CLIPS programming environment [8].

II. The Main Part

Using the fuzzy set theory, describe linguistic variables "Importance of job" and "Time of job", that are used for calculation one more variables "Weight of job". Each linguistic (fuzzy) variable has associated fuzzy term set (called primary terms in FuzzyCLIPS [9]) that is the set of values that the fuzzy variable may take.

More formally a fuzzy set A in a universe of discourse B is characterized by a membership function Eq.1:

$$\mu_A : B \to [0,1], \quad (1)$$

Which associates a number $\mu_A(x)$ in interval [0,1] with each element x of B.

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Linguistic variable "Importance of job" might be defined by the fuzzy using singleton representation set as given in Table 1. As a rule we use 5 points scale for estimation of importance of job, other words each expert might put mark from 0 to 5 for the job, if system uses

classical set theory, but human thinking and reasoning in this case involve fuzzy information like unimportant, average etc., that is more comfortable for humans.

TABLE 1

Fuzzy term "Importance of job"

Fuzzy set	Presentation
unimportant	$\frac{0}{0.1}+\frac{1}{0,8}+\frac{2}{0,25}+\frac{3}{0}$
average	$\frac{0}{0}+\frac{1}{0}+\frac{2}{0,3}+\frac{3}{1}+\frac{4}{0,3}+\frac{5}{0}$
important	$\frac{0}{0}+\frac{1}{0}+\frac{2}{0}+\frac{3}{0}+\frac{4}{1}+\frac{5}{0}$
significant	$\frac{0}{0}+\frac{1}{0}+\frac{2}{0}+\frac{3}{0}+\frac{4}{0,1}+\frac{5}{1}$

Linguistic variable "Time of job" in singleton representation might be presented similar way as given in Table 2. For presenting time we use scale from 0 to 1 and, for example, number 0,2 says, that it takes 20% of working time for person to fulfill the job.

TABLE 2

Fuzzy term "Time of job"

Fuzzy set	Presentation
from time to time	$\frac{0}{0.1}+\frac{0,1}{1}+\frac{0,2}{0,1}+\frac{0,3}{0}$
rarely	$\frac{0}{0.}+\frac{0,1}{0,5}+\frac{0,2}{1}+\frac{0,3}{0,5}+\frac{0,4}{0,1}+\frac{0,5}{0}$
often	$\frac{0,3}{0}+\frac{0,4}{0,5}+\frac{0,5}{1}+\frac{0,6}{0,5}+\frac{0,7}{0,1}+\frac{0,8}{0}$
very often	$\frac{0,4}{0}+\frac{0,5}{0,4}+\frac{0,6}{0,6}+\frac{0,7}{1}+\frac{0,8}{0,8}+\frac{0,9}{0,5}$
constantly	$\frac{0,6}{0}+\frac{0,7}{0,4}+\frac{0,8}{0,6}+\frac{0,9}{0,9}+\frac{1}{1}$

Sometimes, it is useful to describe a membership function using one of a set of standard function S, Π, Z Eq. 2-8 [9]. Parameters of this functions can be chosen, depending on applications. This functions are shown graphically in Figure 2.

$$S(u,a,c)=0, u \le a, u \in B \quad (2)$$

$$S(u,a,c)=2\left(\frac{u-a}{c-a}\right)^2, a<u\le\frac{a+c}{2} \quad (3)$$

$$S(u,a,c)=1-2\left(\frac{c-u}{c-a}\right)^2, \frac{a+c}{2}<u\le c \quad (4)$$

$$S(u,a,c)=1, c<u \quad (5)$$

$$Z(u,a,c)=1-S(u,a,c), c<u \quad (6)$$

$$\prod(u,d,b)=S(u,b-d,d), u \le b \quad (7)$$

$$\prod(u,d,b)=Z(u,b,b+d), b<u \quad (9)$$

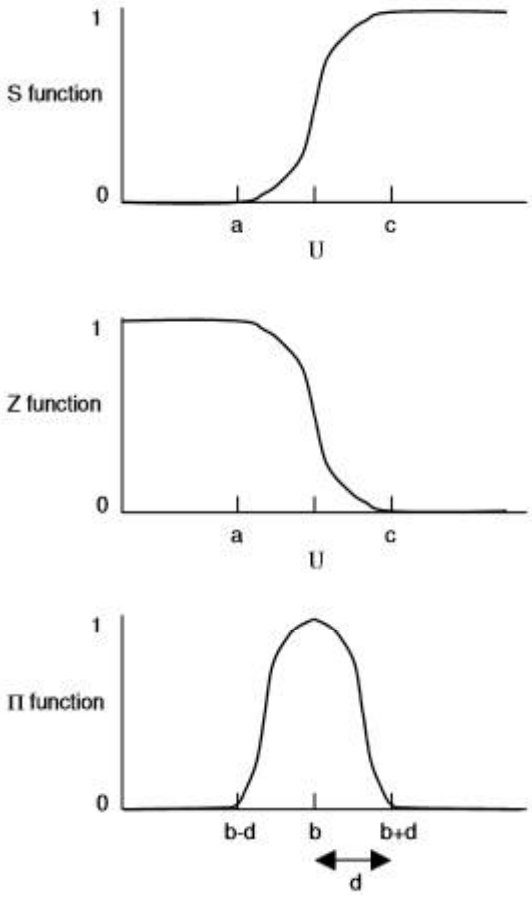

Fig.2. Standard fuzzy set functions

Practical implementation of set functions of linguistic variables in programming environment FuzzyCLIPS are presented above:

```
(deftemplate Job_Importance
  0 5 points
  ( (unim (z 0 3))      ; unimportant
    (aver (pi 1.5 3))   ; average
    (impr (pi 1 4))     ; important
    (sign (s 4 5))      ; significant
  ))
(deftemplate Job_Time "time of operation in parts of working time, 0,1=10%"
  0 1 time_part
  ( (fttt (z 0.1 0.2))          ; from time to time
    (rarl (pi 0.2 0.2))         ; rarely
    (oftn (pi 0.2 0.5))         ; often
    (voft (pi 0.2 0.7))         ; very often
    (cons (s 0.8 1))))          ; constantly
```

Graphical representation of fuzzy set “Importance of job” and “Time of job” is given in Figure 3,4.

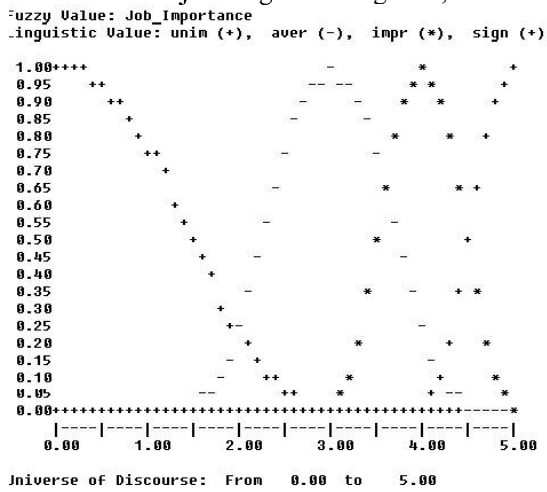

Fig.3. Fuzzy set “Importance of job”

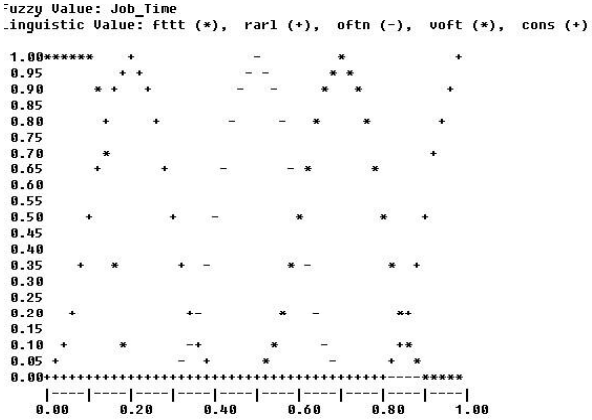

Fig.4. Fuzzy set “Time of job”

The outcome of the fuzzy inference process is a fuzzy set too, specifying a fuzzy description of a conclusion. However, in our cases, only a single discrete action may be applied for further calculation of weight of job, so a single points that reflect the best values of the sets “Importance of job” and “Time of job” need to be selected. This process of reducing a fuzzy set to a single point is known as defuzzification [9].

There are several possible methods: a method which has been widely adopted is to take the center of gravity COG or moment, the first one, and the Mean of maximum (MOM), another, that concentrates on the

values where the possibility distribution reaches a maximum.

The center of gravity method might be written as Eq.9

$$x' = \frac{\int_{x \in B} (x \cdot f(x))dx}{\int_{x \in B} f(x)dx}, \quad (9)$$

where x' is the recommended, defuzzified value, and the universe of discourse is B.

The MOM algorithm returns the x-coordinate (x'') of the point which the maximum membership (y) value of the set is reached as Eq. 10

$$x' = \sum_{j=1}^{J} \frac{x_J^*}{J}, \quad (10)$$

where J - is the total number of maxima.

In order to compare two methods one more template of facts has been created as presented:

```
(deftemplate Job_Description "Description of the job's operations"
   (multislot name (type STRING))
   (slot impr (type FUZZY-VALUE Job_Importance))
   (slot time (type FUZZY-VALUE Job_Time))
   (slot wght (type FLOAT)))
```

This template describes job using the linguistic variables that we discuss above, and has two more slots, that get name of job and store result of weight calculation.

For testing the following fact (job description) has been used:

```
(deffacts Job "Adding some operations"
 (Job_Description (name "Preparing the contract")
          (impr unim) (time fttt)))
```

Result of job's weight calculation using two methods is presented in Table 3.

TABLE 3

RESULT OF JOB'S WEIGHT CALCULATION

Method\ representation	Import.	Time	Weight
COG			
Singleton	0,3333	0,0765	0,0255
Standard function	0,1766	0,0765	0,0135
MOM			
Singleton	0,4000	0,0500	0,0200
Standard function	0,0000	0,0500	0.0000

III. CONCLUSION

Results of job's weight calculation presented in Table 3 allow us to make conclusion about possibility of using methods of center of gravity as a basis in calculating modules of information expert systems for estimation of profession activity complexity. Representation of linguistic variable is recommended to describe by singleton function using membership function.

As it clears, standard function sometimes can give zero result if using Mean of maximum (MOM) algorithm, that concentrates on the values where the possibility distribution reaches a maximum.

In this case, importance of the job takes value "unimportant" with the parameters of standard function: a=0, c=3. So MOM has found maximum value of variable (y=1, x=0) and give result equal 0. In the real world each expert has the opinion about importance of job, that might be in range from 0 to 3 according to scale. So it certainly better to use center of gravity algorithm for calculating single value of importance in order to take into account opinion all experts.

REFERENCES

[1] Zaritskyi, O.V. Theoretical basis of professional activity's functional model development. *Theoretical and applied science journal*. – Kyiv: EAU, 2015. – №2. – P.233 – 236.

[2] Zaritskyi, O.V. Functional modeling of professional activity basis element in frame ER-model // *«problem of informatization and control»*. – Kyiv: NAU, 2015. - №2(50). – P. 70 – 75.

[3] Zaritskyi, O.V. information modeling of decision making process // *«Software engineering»*. – Kyiv: NAU, 2015. - №1(25). – P.56 – 61.

[4] Zaritskyi, O.V., Sudik, V.V. Structural analysis of qualification level informational model, necessary for fulfilling job. *Eastern-European Journal of enterprise technologies*. - Kharkiv: «Technological center». - 2015. - № 5/2(77). – P. -14-19.

[5] Harvey R. J., Lozada-Larsen S. R. The Common-Metric System with Common-Metric Questionnaire: A Job Analysis System // *The Guide to Using the Common-Metric System for Human Resource Applications. Second Edition. Personnel Systems & Technologies Corporation*, 2002-2005. Chapter Two. — P. 2: http://cmqonline.com/documents/chapter2.pdf.

[6] Peterson N. G., Barman W. G, Fleishman E. A, Mumford M. D., Jeanneret P. R. *An Occupational Information System for the 21st Century* (The Development of O'Net), 1999.

[7] Fine S. A, Wiley W. W. An Introduction to Functional Job Analysis. — Kalamazoo, Michigan: W. E. Upjohn Institute of Employment Research, 1971.

[8] CLIPS Reference Manual. Volume 1. *Basic programming guide. Version 6.22*. – 2004. - 396.

[9] Bob Orchard FuzzyCLIPS Version 6.10d . *User's Guide Integrated Reasoning Group Institute for Information Technology National Research Council Canada*. 2004. - 82