Library Software Selection: A Fuzzy Logic Approach

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Abstract

The availability of a large number of software packages in the market for library automation has made it important for libraries to adopt suitable criteria in the selection of appropriate software. An attempt has been made in this paper to develop a system for optimal selection of software products using fuzzy logic.

KEYWORDS: Library Software Selection, Fuzzy Logic, Library automation

0. Introduction

Today a large number of commercial library software packages are available in the market. Library and information professionals rarely have the opportunity to try different packages before selecting the appropriate product. The selection criteria for software can be quite extensive. Normally such factors as cost, user interface, ease of use, user friendliness, documentation etc., are considered for evaluation of library software packages. Although evaluating software is an inherently subjective enterprise, it is important to reduce the element of subjectivity in the decision processes related to selection and acquisition of appropriate package. It is in this context that Fuzzy Logic approach has been suggested. In a recent paper Machacha and Bhattacharya (2000) have explained the use of Fuzzy Logic approach for assessing attributes of software packages. However the number of variables that have been considered in their paper is only two. The number of variables that need to be considered in the selection of a library software package is indeed very large. In this paper an attempt has been made:

- To employ the fuzzy logic approach to examine variables related to user interface, in a library software package;
- To develop a Control Knowledge base consisting of a set of fuzzy rules associated with the variables; and
- To suggest a decision mechanism that would take into consideration the relative importance of each attribute in an effort to reduce the overall uncertainty.

1. User Interface

The term "user interface" specifies how the program and the user communicate with each other (Powell, 1991). Hildreth (1982) describes user interface as "the point or process, which joins two or more system components." It is a shared boundary defined by common physical, signal and logical characteristics, across which data travel. User interface is generally created in a layer of software that lies between the user at the terminal and the actual search and retrieval mechanism of the system. (Lawrence et al)

Some of the features found useful in a user interface include:

- Provision of access to the system functions in a manner that is complete, efficient and acceptable to users;
- Giving access to all functions and its displays in a form, which is intuitively accessible;
- Ensuring easy invoking of any function with facilities for easy recovery from errors and wrong choices;
- Provision of an aesthetically pleasing display with easy to understand and usable language and technology; and
- Supporting access to users with varying levels of skills and knowledge.

In order to achieve these, user interfaces usually incorporate certain devices such as

- Graphical user interface (GUI)
- Context sensitive help
- Function key commands
- Command driven method
- Multiple choice menu

2. What is Fuzzy Logic?

Fuzzy logic in general enables computers to emulate the human reasoning process, quantify imprecise information. Fuzzy logic is currently being used extensively in many applications in industry with a limited number of variables: applications to problems with large number of variables are not common. Some of the salient features of fuzzy logic

approach include:

- Subjective information that is available only as linguistic statements can be quantified;
- Fuzzy expressions are more natural for many human judgmental rules and statements than mathematical equations.

Fuzzy inference is based on two concepts: ***fuzzy implications*** and ***compositional rules of inference***. The process of fuzzification is essentially based on defining the input, the output and the relationships of the inputs to outputs. In actual application of fuzzy logic approach this is usually done by specifying a range of values for each attribute, obtaining responses, normalizing and mapping. Thus the logic offers a methodology for handling, manipulating and quantifying imprecise and vague data.

3. Methodology

For the purpose of this study, it was necessary in the first place to develop a ***control knowledge base*** consisting of a set of rules that could be used for evaluating user interfaces in library software. For this, opinions of 12 experts on the relative importance of the devices generally employed in user interfaces were obtained. Experts marked their opinion on a five point linguistic scale to indicate whether they considered the devices *Essential, Important, Desirable, of no significance* or *Not needed.*

The quantification of these opinions was done as below:

Ø The weighted average, standard deviation and confidence level (95%) for each feature were computed based on the experts' opinion.

Ø Standard Statistical techniques were used to arrive at a range of crisp values for each feature that would enable evaluating the feature in particular software; Crisp values for categorizing a software feature as ***Excellent, Good, Average*** or ***Poor*** were arrived at using standard statistical techniques. (See Table 1)

Table: 1

Devices	Poor	Average	Good	Excellent
1. Menu driven	0-2.0	1.5-2.5	2-3.5	3-
2. Command Driven	0-1	0.5-2	1.5-3	2.5-
3. Function key Commands	0-2	1-2.5	1.5-3.5	3-
4. GUI	0-1.5	1-2.5	2.5-3.5	3-
5. Context Sensitive help	0-2	1-2.5	2.25-3.5	3-

It is obvious that the crisp values differ from one device to another device. A certain amount of overlap in the values is also seen. This overlapping area is probably indicative of a transitional stage from one level to another. This is graphically represented in figures 1-5. From these graphs, a consolidated table indicating the crisp value and the

corresponding category was developed. (See table 2). This table was used as the basis for formulating a set of rules (See table 6) that could be employed in assessing User Interface in library software package.

4. Application

In order to test the methodology a study was conducted to assess user interface features of nine commonly used library software packages. Reference has already made to the commonly employed devices in user interfaces. Users with experience in using these packages were asked to give their opinion regarding the adequacy of the five devices. It is possible that users differ in their opinion of the adequacy of a device in any particular S/w package. The linguistic value assigned to a particular device may therefore differ from user to user. In the present context the value assigned to a device by a user could be any one of the four values namely *Poor, Average, Good,* and *Excellent*. The number of possible combinations would indeed be very large requiring formulation of a large number of rules. In practice it would be very difficult to base a decision process on such a large number of rules. Therefore in this experiment the possible options have been combined to result in a limited number of rules, which could be used practically to assess User Interface feature in library software packages. The weighted averages for the values obtained from users of respective packages are tabulated in Table- 3.

Table- 3: Weighted average value obtained from users of respective packages

Attributes	Allies n=26	Autolib n=27	Calliblan n=29	Collib n=21	Libasoft n=27	Librarian n=29	Libsys n=31	Nirmal n=28	TLMS n=14
Menu-driven	2.54	3.63	3.4	3.71	3.59	3.72	2.87	3.57	4
Command - Driven	2.5	1.04	2.7	2.95	0.96	3	2.19	2.14	2.71
Function key	3.46	3.41	3.6	3.67	3.41	3.66	2.87	3.54	2.71
GUI	3.08	2.85	2.5	1.71	0.44	2.45	2.68	2.57	2.86
Context-sensitive help	3.08	1.33	3.4	3.14	0.63	3.38	2.23	3	2.57

The fuzziness from the spreadsheet table is shown in table below (Table – 4). It is now possible to apply the rules of fuzzy logic to grade the user interface features in the software packages examined. An illustration of this and the corresponding rule from which this grading was arrived at is given in table 5.

Table – 4: Fuzziness from the spreadsheet table

Attributes	Allies n=26	Autolib n=27	Calliblan n=29	Collib n=21	Libasoft N=27	Librarian n=29	Libsys n=31	Nirmal n=28	TLMS n=14
Menu_driven	0.5 G	E	0.2 G + 0.8 E	E	E	E	0.9E	E	E
Command Driven	G	A	0.9 G+ 0.1 E	E	0.2P + 0.8 A	0.5 E	0.4 G + 0.7 E	0.6 G	0.8 G +0.1E
Function key	0.1G+ 0.8 E	0.1 G+ 0.8 E	E	E	0.1 G + 0.8 E	E	0.7 G +0.3 X	E	0.9 G +0.1X
GUI	G	0.6 G	0.1 G	0.7 A	P	0.2 A + 0.4 G	0.6 G	0.6 G	0.8 G
Context-sensitive help	0.9G+ 0.2 E	0.4P+ 0.2 A	0.4G + 0.8 E	0.8 G + 0.4E	0.7 P	0.4 G+ 0.8 E	0.8 A	G	0.5 G

Scale measure = 0 and 1

E = Excellent G = Good A = Average P = Poor

Table 5: Implications of Fuzzy rules

Package name	Over all Value	Rule No.
1. Allies for windows	Good	5
2. Autolib	Excellent	1
3. Calliblan	Good	7
4. Collib	Excellent	1
5. Libasoft	Excellent	1
6. Librarian	Excellent	1
7. Libsys	Excellent	1
8. Nirmal	Excellent	1

9.	TLMS	Excellent	1

6. CONCLUSION

This paper is primarily an attempt to demonstrate that fuzzy logic approach can be adopted in formulating a method for assessing library software packages. This method is clearly applicable in situations where the number of variables involved could be reduced to an optimal number for practical purposes.

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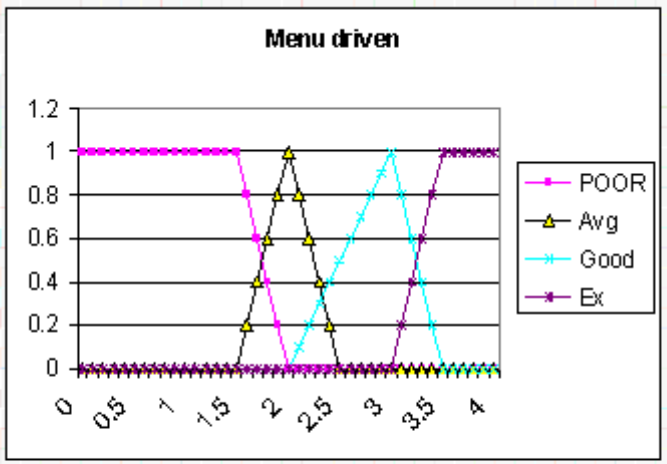


Figure 1: Menu Driven

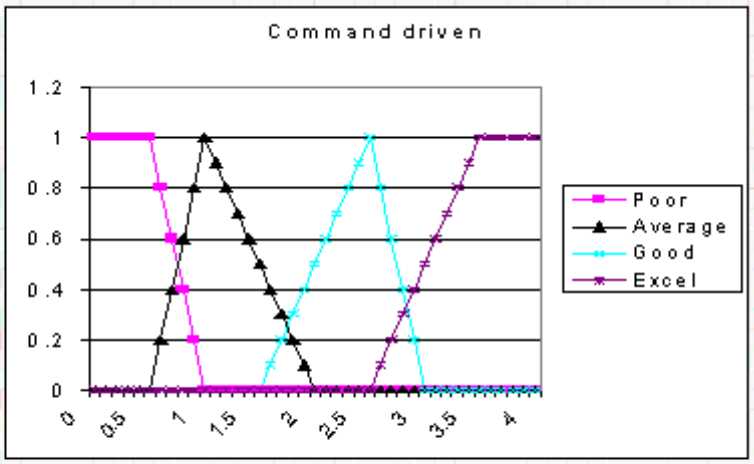
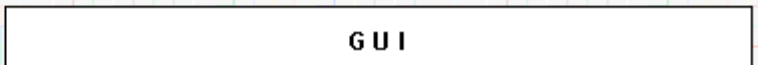


Figure 2: Command Driven



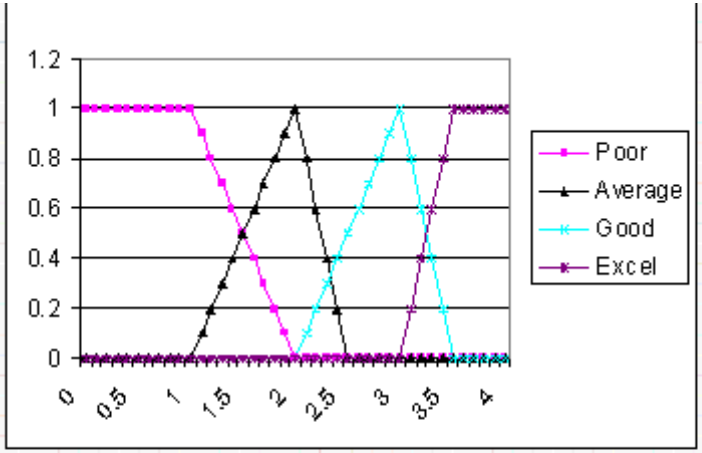


Figure 3: Function key

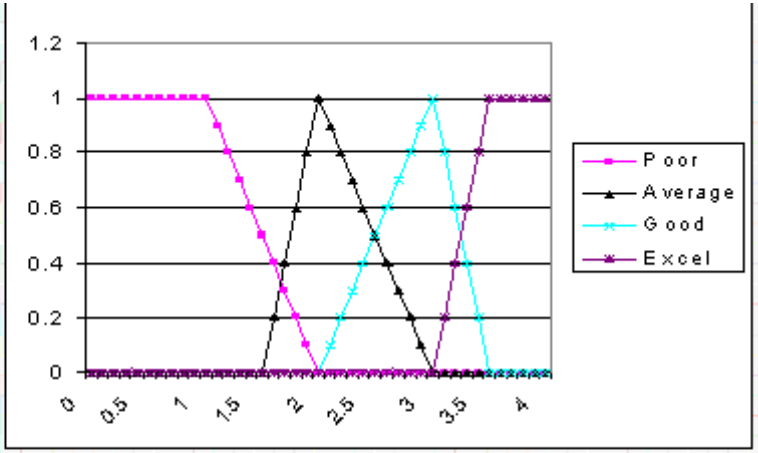


Figure 4: Graphic User Interface

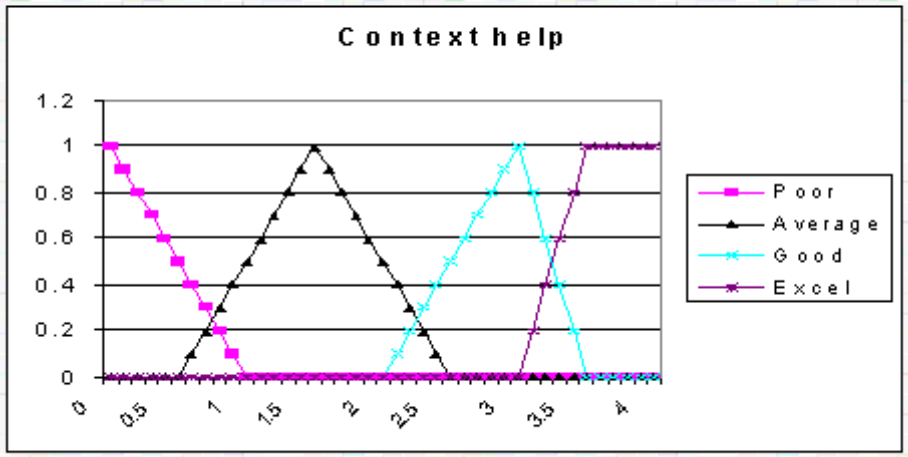


Figure 5: Context Help

Table 2: Spread sheet table

	MENU DRIVEN				COMMAND DRIVEN				FUNCTION KEY				GUI				CONTEXT HELP			
Crisp	P	A	G	E	P	A	G	E	P	A	G	E	P	A	G	E	P	A	G	E
0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
0.1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0.9	0	0	0
0.2	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0.8	0	0	0
0.3	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0.7	0	0	0
0.4	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0.6	0	0	0
0.5	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0.5	0	0	0
0.6	1	0	0	0	0.8	0.2	0	0	1	0	0	0	1	0	0	0	0.4	0.1	0	0
0.7	1	0	0	0	0.6	0.4	0	0	1	0	0	0	1	0	0	0	0.3	0.2	0	0
0.8	1	0	0	0	0.4	0.6	0	0	1	0	0	0	1	0	0	0	0.2	0.3	0	0
0.9	1	0	0	0	0.2	0.8	0	0	1	0	0	0	1	0	0	0	0.1	0.4	0	0
1	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0.5	0	0
1.1	1	0	0	0	0	0.9	0	0	0.9	0.1	0	0	0.9	0	0	0	0	0.6	0	0
1.2	1	0	0	0	0	0.8	0	0	0.8	0.2	0	0	0.8	0	0	0	0	0.7	0	0
1.3	1	0	0	0	0	0.7	0	0	0.7	0.3	0	0	0.7	0	0	0	0	0.8	0	0
1.4	1	0	0	0	0	0.6	0	0	0.6	0.4	0	0	0.6	0	0	0	0	0.9	0	0
1.5	1	0	0	0	0	0.5	0	0	0.5	0.5	0	0	0.5	0	0	0	0	1	0	0
1.6	0.8	0.2	0	0	0	0.4	0.1	0	0.4	0.6	0	0	0.4	0.2	0	0	0	0.9	0	0
1.7	0.6	0.4	0	0	0	0.3	0.2	0	0.3	0.7	0	0	0.3	0.4	0	0	0	0.8	0	0
1.8	0.4	0.6	0	0	0	0.2	0.3	0	0.2	0.8	0	0	0.2	0.6	0	0	0	0.7	0	0
1.9	0.2	0.8	0	0	0	0.1	0.4	0	0.1	0.9	0	0	0.1	0.8	0	0	0	0.6	0	0
2	0	1	0	0	0	0	0.5	0	0	1	0	0	0	1	0	0	0	0.5	0	0
2.1	0	0.8	0.1	0	0	0	0.6	0	0	0.8	0.1	0	0	0.9	0.1	0	0	0.4	0.1	0
2.2	0	0.6	0.2	0	0	0	0.7	0	0	0.6	0.2	0	0	0.8	0.2	0	0	0.3	0.2	0
2.3	0	0.4	0.3	0	0	0	0.8	0	0	0.4	0.3	0	0	0.7	0.3	0	0	0.2	0.3	0
2.4	0	0.2	0.4	0	0	0	0.9	0	0	0.2	0.4	0	0	0.6	0.4	0	0	0.1	0.4	0
2.5	0	0	0.5	0	0	0	1	0	0	0	0.5	0	0	0.5	0.5	0	0	0	0.5	0
2.6	0	0	0.6	0	0	0	0.8	0.1	0	0	0.6	0	0	0.4	0.6	0	0	0	0.6	0
2.7	0	0	0.7	0	0	0	0.6	0.2	0	0	0.7	0	0	0.3	0.7	0	0	0	0.7	0
2.8	0	0	0.8	0	0	0	0.4	0.3	0	0	0.8	0	0	0.2	0.8	0	0	0	0.8	0
2.9	0	0	0.9	0	0	0	0.2	0.4	0	0	0.9	0	0	0.1	0.9	0	0	0	0.9	0
3	0	0	1	0	0	0	0	0.5	0	0	1	0	0	0	1	0	0	0	1	0
3.1	0	0	0.8	0.2	0	0	0	0.6	0	0	0.8	0.2	0	0	0.8	0.2	0	0	0.8	0.2
3.2	0	0	0.6	0.4	0	0	0	0.7	0	0	0.6	0.4	0	0	0.6	0.4	0	0	0.6	0.4
3.3	0	0	0.4	0.6	0	0	0	0.8	0	0	0.4	0.6	0	0	0.4	0.6	0	0	0.4	0.6
3.4	0	0	0.2	0.8	0	0	0	0.9	0	0	0.2	0.8	0	0	0.2	0.8	0	0	0.2	0.8
3.5	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
3.6	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
3.7	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
3.8	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
3.9	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
4	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1

P = POOR A = AVERAGE G = GOOD E = EXCELLENT

Table 6: Fuzzy Rules for User Interface

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User Interface in Library software package is:

1. “Excellent” when Menu driven is “Excellent”
2. “Good” when Menu driven in “Good”
3. “Poor” when Menu driven is “Poor” and Command driven is “Poor”
4. “Excellent” when Menu driven is “Poor” and Command driven is “Excellent” and Context sensitive help is “Excellent”
5. “Good” when Menu driven is “Poor” and Command driven is “Excellent” and Context sensitive help is “Good”
6. “Good” when menu driven is “Poor” and command driven is “Excellent” and context sensitive help is ”Good”.
7. “Good” when menu driven is “Poor” and command driven is “Good” and context sensitive help is “Poor”
8. “Good” when menu driven is “Poor” and command driven is “Excellent” and context sensitive help is “Poor”
9. “Good” when menu driven is “Poor” and command driven is “Good” and context sensitive help is “Poor”
10. “Good” when menu driven is “Poor” and command driven is “Excellent” and context sensitive help is “Average”
11. “Average” when menu driven is “Poor” and command driven is “Good” and context sensitive help is “Average”
12. “Average” when menu driven is “Poor” and command driven is “Average” and context sensitive help is “Good”
13. “Average” when menu driven is “Poor” and command driven is “Average” and context sensitive help is “Excellent”
14. “Average” when menu driven is “Poor” and command driven is “Average” and context sensitive help is “Excellent”
15. “Average” when menu driven is “Poor” and command driven “Average”
16. “Average” when menu driven is “Average” and command driven “Poor”
17. “Excellent” when menu driven is “Average” and command driven “Excellent” and context sensitive help is “Average”
18. “Good” when menu driven is “ Average” and command driven is “Excellent” and context sensitive help is “Poor”
19. “Excellent” when menu driven is “ Average” and command driven is “Excellent” and context sensitive help is “Excellent”
20. “Good” when menu driven is “Average” and command driven is “ Excellent” and context sensitive help is “Good”
21. “Average” when menu driven is “Average” and command driven is “ Good” and context sensitive help is “Poor”
22. “Good” when menu driven is “Average” and command driven is “ Good” and context sensitive help is “Poor”
23. “Good” when menu driven is “Average” and command driven is “ Good” and context sensitive help is “Excellent”
24. “Average” when menu driven is “Average” and command driven is “ Average” and context sensitive help is “Poor”
25. “Good” when menu driven is “Average” and command driven is “ Good” and context sensitive help is “Average”

26. “Average” when menu driven is “Average” and command driven is “ Good” and context sensitive help is “Poor”
27. “Average” when menu driven is “Average” and command driven is “ Average” and context sensitive help is “Average”
28. “Average” when menu driven is “Average” and command driven is “ Average” and context sensitive help is “Good”
29. “Average” when menu driven is “Average” and command driven is “ Average” and context sensitive help is “Excellent”

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