SOFTWARE REQUIREMENT SCALING USING FUZZY LOGIC

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Abstract

Software project requirements and related parameters are always vague and time variant because of which Requirement engineering has three different problems – problem of scope, understanding and volatility. Traditional requirement Engineering suggests different checklists to overcome these problems, instead of this by providing possible formulated rule based logic, analyst or project manager can get refined set of requirements for further modeling and verification.

By applying proper fuzzy logic to requirement analysis process under technical supervision of complex, unstructured demands, the researcher can predict set of precise, correct and optimized categories of requirements in fuzzified rules to classify requirements as essential, desirable and deferred. For required verification, the researcher can again apply fuzzy on fuzzified categories itself to get more refined approach. This will help in scaling the requirements in requirement analysis and design phases so as to get generic, template-based, set of software goals and to prioritize requirements for better software project management.

Key words: Fuzzy logic, requirement analysis Requirement Engineering., Requirement Prioritization. Software project management.

1. Introduction:

Software projects requirements are highly complex to anticipate and involve number of different stakeholders specifying requirements. Sometimes unstructured and semi structured data becomes complex and vague; to restrict it for transaction processing and for further references, it is important to have proper structure. The key to successful software development has always been Risk Reduction and Accurate requirement framing from stakeholders communication and with Customer Minds. In such cases the uncertainty may arise due to partial information about what they (stakeholders) need, or due to partially reliable information, or due to imprecision in the representation, or due to multiple sources biases. Due to its vague and time variant nature and lack of any precise formal technique quality comprises. Again requirement analysis involves categorization, relationship, consistency, omissions requirements is often time consuming. Sometimes, it is difficult to arrive at a group consensus on a particular relationship between requirements which will be unambiguous and negotiated. To address these issues, researcher have developed a fuzzy logic-based extension to requirement engineering for capturing imprecise requirements to both facilitate communication of team members and have a formal representation of requirements. Based on this representation, inference scheme to reason about the implicit relationships between requirements and to get prioritize it in subsets.

Fuzzy set can be significant mathematical and more formal tool to handle such vagueness of requirement being collected. Fuzzy sets are sets whose elements have degrees of membership. With membership fitness valuations, many-valued logic can be extended to allow for fuzzy premises from which graded conclusions may be drawn using which requirements, objectives and scope of software projects can be defined more precisely, specifically and very rightly.

The membership function of a fuzzy set is a generalization of the indicator function in classical sets. In fuzzy logic, it represents the degree of truth as an extension of valuation. Degrees of truth are often confused with probabilities, although they are conceptually distinct, because fuzzy truth represents membership in vaguely defined sets, not likelihood of some event or condition. Membership functions were introduced by Zadeh in the first paper on fuzzy sets (1965).
By considering above points, software vaguely defined requirement set can be established and by applying fuzzy ranges and verifying each requirement fitness for membership to these ranges rules can be established to provide precise significant level of scaling to user demands conversion to software needs. The researcher would like to explore relative requirement scaling by applying multi-valued logic, to satisfy given constraints as parameters to verify which are vague in realistic to technical and logical computerized implementations.

2. Methodology:
The researcher would like to explore, if by applying fuzzy logic control system to get more refined, approximate, precise set of software project requirements. Fuzzy established rules once established can be easily grasped and implemented often to get more appropriate and bug free solutions.

<table>
<thead>
<tr>
<th>Table 1: Parameters Assumption Case:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter Name</td>
</tr>
<tr>
<td>Requirement Source</td>
</tr>
<tr>
<td>User</td>
</tr>
<tr>
<td>Time</td>
</tr>
<tr>
<td>Function</td>
</tr>
<tr>
<td>Hardware/Software Requirement</td>
</tr>
<tr>
<td>Operational Environment</td>
</tr>
<tr>
<td>Refined Requirement Category</td>
</tr>
</tbody>
</table>

The detail description of all parameters listed in Table No. 1 is given in the following code.

[System]
Name='scalingReq'
Type='mamdani'
Version=2.0
NumInputs=6
NumOutputs=1
NumRules=8
AndMethod='min'
OrMethod='max'
ImpMethod='min'
AggMethod='max'
DefuzzMethod='centroid'

[Input1]
Name='Requirement_Source'
Range=[0 100]
NumMFs=3
MF1='Operational':'trimf',[-40 0 94.58]
MF2='Middle':'trimf',[44.8 50 54.89]
MF3='Top':'trimf',[29.76 100 140]

[Input2]
Name='User'
Range=[0 100]
NumMFs=3
MF1='Novice':'trimf',[-40 0 19.71]
MF2='Intermediate':'trimf',[27.1 50 78.71]
MF3='Skilled':'trimf',[22.62 100 140]

[Input3]
Name='Time'
Range=[0 100]
NumMFs=3
MF1='PhaseI':'trimf',[-40 0 98.81]
MF2='PhaseII':'trimf',[29.8 50 77.65]

[Input4]
Name='Function'
Range=[0 100]
NumMFs=3
MF1='Input':'trimf',[-40 0 40]
MF2='Process':'trimf',[5.42 50 95.37]
MF3='Output':'trimf',[25 100 140]

[Input5]
Name='HWandSW'
Range=[0 100]
NumMFs=2
MF1='Inbuilt':'trimf',[-40 0 40]
MF2='Plgin':'trimf',[10 50 90]

[Input6]
Name='OperEnv'
Range=[0 100]
NumMFs=3
MF1='Simple':'trimf',[-40 0 40]
MF2='Normal':'trimf',[10 50 90]
MF3='Complex':'trimf',[60 100 140]

[Output1]
Name='ReqCategory'
Range=[0 100]
NumMFs=3
MF1='Essential':'trimf',[-40 0 40]
MF2='Desired':'trimf',[10 50 90]
MF3='Deferred':'trimf',[60 100 140]

Note: Degree of parameters will be based on requirement collected, in this case degrees are assumed.
Similarly fuzzy data set and answer spanning ranges can be specified for other remaining parameters for assumed case (Table No.1). Furthermore output function can determine different three categories as Essential requirements, Desirable requirements and deferred requirements.

As shown in above Figure 2, Fuzzy Inference System (FIS) for implementing fuzzy logic is developed which accepts six input parameters and one output parameter namely ‘ReqCategory’. This inference is for parameters specified in Table No. 1.

Figure 3 shows the definitions of inference rules for above considered parameters.
The above inference combinations in Figure 4, if changes with user specifications and as requirements are time variant one can change input parameter ranges and respectively can analyse change in output function membership which will help to study relationship of specific parameter to output.

With respect to values of input parameters for given requirements surface graph in figure 5 shows reflection on output.

Requirement Management involves elicitation, verification, validation, modeling, classification of requirements; all these things are done on analytic base. Technically it is very difficult to clearly specify and analyze set of requirements; it needs expertise knowledge and preciseness to take decisions about requirements. For the same reason and to get categorized refined set of requirement that is to work basis requirements as standard set with all basic needs expert system can help to analyst.

Number of parameters from of elicitation process involves requirement source, time, function, user, hardware and software requirement, operational environment to decide category and scope based of requirements.

Employing fuzzy control system in selection and decision of requirement for often situations of time, leads in similar kind of set of behavior/functionality of requirement. It helps to carefully identify and select authorized, collaborative, knowledgeable, committed set/areas to work on for development. Collaborative representatives will be simply categorized in generic roles by having multiple metrics for analysis as metrics of fuzzy membership function.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Rules</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All High Input</td>
<td>Essential</td>
</tr>
<tr>
<td></td>
<td>No Low Input</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>High Medium Low</td>
<td>Desirable</td>
</tr>
<tr>
<td>3</td>
<td>All Low Input</td>
<td>Extra/Deferred/Optional</td>
</tr>
<tr>
<td></td>
<td>No High Input</td>
<td></td>
</tr>
</tbody>
</table>

In next staging metric based filtering and analysis of requirement can refine parameter dependent requirements can be classified as Parameterized Requirements. These requirements can help to develop utility based requirements. It can help to design data structures and related events controlling to those structures. Basic parameterized framework or utility based requirements can form factory or building blocks of different functional needs.
By verifying specific nature, researcher can prioritize and validate requirements to get specific requirements. Specific requirements can help to design and develop special purpose modules or special object controls. All specific transactions can be refined separately and can be concentrated for sound transaction processing performance.

### Table No. 3

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Behavior for Membership Supervising</th>
<th>Predicted Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mostly required satisfying different parameter constraints</td>
<td>Essential</td>
</tr>
<tr>
<td>2</td>
<td>Average Requirements</td>
<td>Desirable</td>
</tr>
<tr>
<td>3</td>
<td>Least required</td>
<td>Extra/Deferred/Optional</td>
</tr>
</tbody>
</table>

The above Table No. 2 classification and Table No. 3 priority with respective membership behavior will help to differentiate desirable requirements to plan those properly and to differentiate deferred requirements to reduce unnecessary efforts and cost on unwanted functions. This will provide basis for requirement management, omissions, interrelationship, and resource allocation in software project management.

Requirements need to be processed during elicitation, modernization of existing system, software tools, on user demands, in change management or time-policy changes. It is quite likely that improving how the industry performs elicitation could have a dramatic effect on the success record of the industry. So from all these sources requirement generated is filtered, categorised, prioritized, verified, validated, classified to get differentiated patterns to reuse in software development.

### 3. Conclusion:

Different fuzzy set operations can be performed to discover more refined solution to any requirement problem to get it with certain category. Fuzzy set operations and relationship amongst fuzzy members can help to integrate and trace out requirement with different combinations of parameters. Timing constraints and incrementing requirements impacts can be handled more carefully.

Precise optimized requirements will reduce cost, efforts of software and using automated software tools fuzzification can be implemented easily and quickly which can support to analytical requirement scaling standards in Software Project Management.

### References:


### Note:

1. Above referred internet links are active as on 20th March 2014.
2. Figure No. 2 to Figure No. 5 is screen used for fuzzy classification, Software Tool used: MATLAB (matrix laboratory).