

Review Of Different Fuzzy Logic Approaches For Prioritizing Software Requirements

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Abstract: Software requirements prioritization is an important process where in the decision is taken as to which requirements will first be implemented and delivered in the first release. In past many projects have failed because of the results of improper prioritization technique. We have many prioritization techniques in the literature each one with its own positive and negative side. This paper enumerates different Fuzzy logic-based requirements prioritization approaches. We also present latest work in this field.

Index Terms: Requirements Engineering, Requirements Prioritization, Prioritization Techniques, Fuzzy Logic.

1. INTRODUCTION

Software development life cycle has different phases viz., Requirement gathering and analysis, Design, Implementation or coding, Testing, Deployment, Maintenance. Requirements engineering is the starting phase where in the analyst tries to understand different needs of the stake holder, needs of stakeholders is expressed as requirements. Requirements prioritization plays the role of assigning priority to multiple requirements expressed by multiple stakeholders, it emphasizes as to which requirements will be implemented and delivered in the first release cycle and which requirements will be follow up in the subsequent releases. Requirements prioritization fosters various techniques for resolving indistinctness, fuzziness and ambiguity among the conflicting requirements between various stakeholders [1,2]. Prioritizing requirements plays an integral role in software development process as it enhances software release planning, budget control and scheduling [3]. In literature there are numerous techniques available towards Prioritizing requirements, viz. Analytical Hierarchical Process, Cumulative Voting, Numerical Assignment Technique, Ranking, Wieger's Method, Top-ten requirements, Theory W, Planning game with each approach having positive and negative side. This paper focuses enumerates different Fuzzy logic approaches towards Prioritizing requirements that have been used in past and also latest approach. Reason for focusing on Fuzzy approach is its power to deal with uncertainty and vague nature of requirements which are not been considered in the traditional approaches as aforesaid. The flow of this paper is as follows Section II illustrates comprehensive literature review on Fuzzy logic based prioritizing requirements. Section III describes the observations of past work. Section IV concludes the paper

2 RELATED WORK

Neha Mishra, M.Akheela Khanum, Kavita Agrawal [4], have proposed an algorithm which works in three stages, first and second stages achieve prioritization from the perspective of stakeholders and experts and in the third stage they have used Fuzzy logic approach to requirement prioritization is modeled in the form of fuzzy rules, which is based on Mamdani method. They have developed fuzzy system in terms of input/output variables. The parameters selected for input are Cost, Design time, Performance, Response time, Number of Stakeholders. The output parameters are Completeness and Understandability. The main theme of this work is on requirement completeness and understandability prediction in the activity of requirement engineering phase in software development. Bhagyashri B. Jawale, Girish Kumar Patnaik, Ashish T. Bhole [5], have developed Adaptive Fuzzy Hierarchical Cumulative Voting (AFHCV) which is an extension of Fuzzy Hierarchical Cumulative Voting (FHCV) technique, in order to increase the coverage of events that can occur at runtime. Input to the proposed system is a hierarchically arranged requirement set. Output of the proposed system is prioritized requirement set in hierarchical format. In FHCV for calculating priorities, triangular fuzzy numbers are used. FHCV do not provide the way to add or change requirements value at run time. AFHCV uses re-prioritization process to recalculate the priorities of all requirements collectively. AFHCV technique provides way to change requirements priority value or add some requirements to existing data set at runtime. Vibha Gaur, Anuja Soni [6], have proposed an integrated approach to requirement prioritization, which is split up the various sections First they work with individual concerns for this here they have used Yager's method for decision making. Second stage they deal with consolidated concerns. Finally, they prioritize the requirements, and to illustrate their proposed methodology they took a case study of Material Management Agent Oriented System. V. C. Gerogiannis, and G. Tzikas [7], prioritize software requirements based on ratings expressed from different stakeholders with the following steps, Step 1: Specify Importance Values for Stakeholders and Determine Weights for the Prioritization Criteria, Step 2: Stakeholders Evaluate Requirements with respect to the Prioritization Criteria, Step 3: Calculate Weighted Aggregated Ratings for the Values of Requirements, Step 4: Calculate the Final Requirements Priorities They prioritize requirements based on vague ratings from various stakeholders. Similarities in stakeholder's ratings are used to derive a final requirements status which imitates aggregated valuations of all stakeholders more logically, reasonably and without bias. The proposed

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approach is based on qualitative stakeholders' evaluations expressed and calculated in the form of fuzzy linguistic 2-tuples. Muhammad Ramzan, M. Arfan Jaffar and Arshad Ali Shahid [8], have proposed a multilevel prioritization and classification technique which involves various stakeholders and automated fuzzy logic-based system at various stages to iteratively prioritize the requirements, the iterative process ensures requirements are evaluated multiple times by all actors and more realistic results are achieved. Their technique works in different stages, with first stage they perform Requirement elicitation and stakeholder level prioritization, output of this stage is stakeholder profile, in second stage stakeholder profile is submitted to experts for second level prioritization, experts use requirements classification factors (RCF) which is again of two types Project specific requirement specification factors (pRCF) and Requirement specific requirement specification factors (rRCF). In the third and fourth stages they use Fuzzy logic-based requirement prioritization in particular they use Fuzzy c-means (FCM) is a method. They have also done experimental evaluation of various prioritization techniques using different types of projects. M. SADIQ [9], has worked on stakeholder prioritization on the basis of importance of requirements. This paper has three main steps, where in step 1 specifies stakeholder types and their roles, based on functional and non-functional criteria. Step 2 selects and classifies requirements, for this the author uses Fuzzy AHP for pair wise comparisons among requirements, then the fuzzy assessment of the DM is acquired in the form of linguistic terminologies, next for this assessment performance matrix (pr) would be constructed by using the "extended addition and scalar multiplication" (EASM). Based on the results of step 2, in step 3 the stakeholders are differentiated in terms of influence, which is used to show the command of the stakeholders with in a project. Dayvison Chaves Lima, Fabrício Freitas, Gutavo Campos, and Jefferson Souza [10] propose a formal framework guided by fuzzy goals for requirements prioritization, examples of goals include customer satisfaction, satisfy quality requirements, delivery within deadline. The framework allows the representation of fuzzy software goals, fuzzy desired situations and fuzzy requirements for the stakeholder and also, they give quantitative definitions of the same. A desired situation is followed and each situation is defined by goals which had an importance value. A goal is collected by an aspect and its aspiration level. The framework generates a ranked list of requirements, based on position to goals. Precise variations in aspiration levels and goals' importance will lead to different lists. Philip Achimugu, Ali Selamat, Roliana Ibrahim [11] assign weights to requirements using simple linguistic variables parameterized with triangular fuzzy numbers (TFNs). The process to determine prime requirements involve generating requirements, recording requirements, discussing requirements and then rating requirements. Next, they rank the requirements as follows a). Requirements are assigned numeric weights for preference b). Weights are then converted to their TFNs and decision matrix is constructed c). The TFNs are summed up using local weights d). Then sum is divided by the number of stakeholders e). Final rank is computed by taking the square root of previous step's result.

3 OBSERVATIONS AND INVESTIGATION

Below are some important enumerations of literature work in Fuzzy logic area requirements prioritization.

- The work done in the past does not focus much on the dynamic behavior of requirements; still there is lot of work to be done in this regard.
- For requirements prioritization various factors are been considered like cost, benefit, risk, time etc. Further study is required to look into various factors and also interdependence among different
- There is need for work on reprioritization of requirements.
- Some of the previous work may give effective results only for small set of requirements, but becomes inefficient as the number of requirements become large.
- Future work has to focus on scalability, i.e. a particular technique should be applicable to different types of projects.
- In future work may involve fusion of fuzzy logic with artificial intelligence in particular neural networks to reap the benefits of both the approaches (Fuzzy Neural Networks).

4 CONCLUSION

This paper offered a review of literature on Fuzzy logic-based requirements prioritization and discussed about the related findings. Prioritization of requirements is vital as requirements phase act as a foundation stone for other subsequent stages of software development. After perusal of existing methods we have introduced some areas which future research should focus on.

REFERENCES

- [1] A. Watson, "Reflections on Requirements Engineering", 2008 12th International IEEE Enterprise Distributed Object Computing Conference, Munich, 2008, pp. xxxiii-xxxiii. doi: 10.1109/EDOC.2008.57
- [2] John Yen and W. Amos Tiao, "A Systematic Tradeoff Analysis for Conflicting Imprecise Requirements", 1997, IEEE, ISBN:0-8186-7740-6, pp.87, ISBN:0-8186-7740-6
- [3] Achimugu, Philip & Selamat, Ali & Ibrahim, Roliana & Mahrin, Mohd. (2014). "A systematic literature review of software requirements prioritization research. Information and Software Technology". 56. 10.1016/j.infsof.2014.02.001
- [4] Neha Mishra, M.Akheela Khanum, Kavita Agrawal, "Approach to Prioritize the Requirements Using Fuzzy Logic", ACEIT Conference Proceeding 2016, IJCSIT-S42
- [5] Bhagyashri B. Jawale, Girish Kumar Patnaik, Ashish T. Bhole, "Requirement Prioritization using Adaptive Fuzzy Hierarchical Cumulative Voting", 2017 IEEE 7th International Advance Computing Conference (IACC)
- [6] Vibha Gaur, Anuja Soni, "An Integrated Approach to Prioritize Requirements using Fuzzy Decision Making", IACSIT International Journal of Engineering and Technology, Vol.2, No.4, August 2010 ISSN: 1793-8236
- [7] Gerogiannis, Vassilis C. and Georgios Tzikas. "Using Fuzzy Linguistic 2-Tuples to Collectively Prioritize Software Requirements based on Stakeholders' Evaluations." PCI (2017).
- [8] Ramzan, Muhammad & Jaffar, Arfan & Ali Shahid, Arshad. (2011). "Value based intelligent requirement prioritization

- (Virp): Expert driven fuzzy logic-based prioritization technique". International Journal of Innovative Computing, Information and Control. 7.
- [9] Sadiq, Mohd. (2017). "A Fuzzy Set-Based Approach for the Prioritization of Stakeholders on the Basis of the Importance of Software Requirements". IETE Journal of Research. 63. 1-14. 10.1080/03772063.2017.1313140.
- [10] Lima D.C., Freitas F., Campos G., Souza J. (2011) "A Fuzzy Approach to Requirements Prioritization". In: Cohen M.B., Ó Cinnéide M. (eds) Search Based Software Engineering. SSBSE 2011. Lecture Notes in Computer Science, vol 6956. Springer, Berlin, Heidelberg
- [11] Achimugu, Philip & Selamat, Ali & Ibrahim, Roliana. (2015). "Using the fuzzy multi-criteria decision-making approach for software requirements prioritization". Jurnal Teknologi. 77. 10.11113/jt.v77.6321.