# Stakeholder Negotiation and Case Based Ranking method to Software Requirements Prioritization

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*Abstract*— There will be set of requirements where we need to make decision among these which are the requirements we need to evaluate in an orderly manner. One of the frequently used technology in recent times and machine learning approach methodology is Case-Based Ranking Method. In the current system is also following same method .in the current system it is dynamically evaluating the requirements prioritization in Dynamic manner rather than statically inputting all the information in initial stage .while the prioritization process in progress at any instance we can add new requirement to the already existing set of requirements and this addition won't impact the prioritization process. Evaluations performed on these method proved accuracy in ranking in exploiting the domain knowledge. Case Based Ranking method is also supporting the non monotonic case in more sophisticated way.

***Keywords***— requirements prioritization, machine learning, non monotonic, case based Ranking

## I. INTRODUCTION

Prioritization of software needed to rank the set of features of intended software along with desired functionalities along with business constraints such as market competition [1] and regulation ,satisfaction of the customer

Prioritization of the requirements plays pivotal role in every aspect of software development for an instance in budget management and scheduling as well as in market strategies

Cutting edge technologies share a following steps for a common model

- definition of target
- the specification of requirement attributes
- the specific values for those attributes
- composition of rankings produced by requirement attributes.

Any prioritization of ranking can be solved in two approaches one is ex-post and ex-ante. expost derives problem solving paradigm from the case-based reasoning. previously there are many methods are the to prioritize requirements such as win-win, AHP, Triage, Cost-Value , Planguage, Fairness Analysis, Planning game but these are preferable when set of requirements are minimum. Analytical hierarchy method is mostly preferred one when requirements are minimum.

## II. RELATED WORK

It contains the analyzing of requirement prioritization role in software development and of variety of approaches to perform requirement prioritization and number of empirical studies intended to comparisons providing what are the advantages and disadvantages. in ranking we usually allow integration of candidates for a single evaluation criterion, which will ranking technologies and aim at taking various criteria into account ,which may corresponding to various goals of project stakeholder.

Raking is performed by designate stakeholders in the project such as customers, users, system architects [2] in different ways. General approach consist of assigning rank to a particular requirement in requirement set for particular aspect such as value for the customer, development cost. The rank for that requirement can be calculated its relative position with respect to other requirements in the requirements set. one more method pair wise comparison consist of assigning preference value to a pair candidate requirements.

If we concern scalability ,the number of requirements for prioritization in the requirements set there will be corresponding growth in the information requested from human decision [3] maker namely elicitation effort .if we take n requirements to be prioritized then computational complexity varies accordingly.

Ranking technologies already discussed above are used in structured requirement prioritization. there are number of well known approaches for prioritization .these includes quality function deployment –QFD, Win-Win method ,AHP, Triage, Cost-Value, Planguage, Fairness Analysis, Planning Game, Wiegers method and finally CBRank.

In quality Function Deployment [4] will concern the criteria such as customer goals and design requirements .the preferred Ranking technique is numerical assignment. In Win-Win method will concern the criteria such as various business values, development effort..the preferred Ranking technique is Analysis Hierarchy method.

In Analytical hierarchy method concerns the criteria such as pair wise evaluation on alternatives and hierarchies of criteria. the preferred ranking method is Analytical Hierarchy process. In triage methodology includes the criteria such various business goals such as development resources. the most preferred Technique used in this requirement prioritization method is numerical assignment and basic ranking

In cost-value analysis method includes the criteria for the evaluation of candidate ranks such as development cost ,value for customer. the preferred technique in this methodology is AHP. In Planguage methodology [5] of software requirement prioritization main criteria is stakeholder goals and ranking technology used in prioritization of the requirements is any basic ranking.

In fairness Analysis the main concerns while ranking requirements are stakeholder intended goals and the most preferred ranking technique in this process of prioritization of the requirements in the requirements set is the parent optimal Search Based Software engineering.

In Planning game requirement prioritization method main concern in the prioritization are customer preferences and development time.

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The most preferred technique in this prioritization of the requirements in the given requirement set are basic numerical assignment and method rules.

In Wiegers method of prioritization of the requirements in the requirement set main criteria for evaluation of the requirements are value for the customer, implementation cost and risk. the most preferred technique in the process of software requirement prioritization for the given set of requirements are numerical assignment and method rules.

Finally in the Case-Based Rank method criteria evaluation for the requirements prioritization for the given set of requirements are domain adaptive knowledge. the most Preferred Technique for the requirement evaluation in the Case-Based Ranking method are Rank Boost technique and Machine learning technique.

CR Rank can be used both single-criterion ranking technique and multi criterion prioritization method [6]. stakeholder priorities on the set of requirements rather than on their attributes in the CB Ranking requirement prioritization. Further CR Rank aims at to reduce a loss function which minimize disagreement in pair wise priority and exploring technique to minimize the set of pairs needed to be elicited.

On comparison with other prioritization methods the CB Rank method explicitly allows the approximated rank as a result of prioritization process and that allows for the expressing the domain knowledge as partial requirement ranking along different elicitation criteria. the quality of final rank might have different levels of accuracy depending on the t amount of elicitation information acquired from the stakeholder. CB Rank is highly adaptable to different domains and also supporting minimum requirement pairs for the priority evaluation through the exploitation of available knowledge on the requirements in the requirement set.

## III. PROPOSED SYSTEM

The CB Rank method which is based on framework and is used for decision making for ordering set of items such as product features and software requirements. the framework can handle single and multiple human decision makers and different ordering criteria through multiple an iterative prioritization process. Distinctive feature of this framework is the use of machine learning approach to reduce the elicitation effort required for prioritization. This framework can also be used in prioritization of test cases in test cases.

### *A. Concepts:*

Let we consider set requirements be Req ={$r_1$,$r_2$,$r_3$,....$r_n$} that has to be ranked and universe pairs as a set of requirements U={($r_i$,$r_j$);i<j}.we define function as decision maker Q(($r_i$,$r_j$),where Q:U→{-1,0,1} which have following meanings.

$$Q(ri,rj) = \begin{cases} -1, if\ rj > ri, \\ 1, if\ ri < rj, \\ 0, if\ there\ is\ no\ order\ relation \\ between\ ri\ and\ rj \end{cases}$$

An Unordered pair is a pair of requirements($r_i$,$r_j$) which doesn't have any assigned priority that is priority is not known. while describing the prioritization we need to consider ordered requirements pairs.

We define Ranking Functions based on attributes such as estimated cost for its implementation and important for the user. let F be the requirements ranking function then F={$f_1$,$f_2$,$f_3$,.....$f_m$} where $f_1$ is the first ranking function and $f_2$ be the second ranking function. we define final approximated Rank as the rank produced as output by CB Rank process. normally the approximated rank is a function of H:Req→IR where $r_i$ has lower rank than $r_j$.

The density function can be defined as D:Req*Req→IR or it can be written as follows
$D(r_i, r_j)$= max({0,$Q(r_i,r_j)$}).

### *B. Prioritization Process:*

The prioritization process is as shown in following figure, where three steps are represented as round corner rectangles .the basic input and output in this process are the requirements set (Req),the decision maker's Priorities ($Q_t$), the requirement Ranking Function (F),encoding requirement attributes and approximate Rank($H_t$) and Final Approximated Rank (H) when t represents the last process iteration. Even some additional artefacts are produced in the internal activities of process steps such as Sampled Requirements Pairs that is set of requirements that the end user not known and have been selected for priority elicitation. The set of Ordered Requirements Pairs is set of requirements pairs decided by the stakeholder and the decision maker.

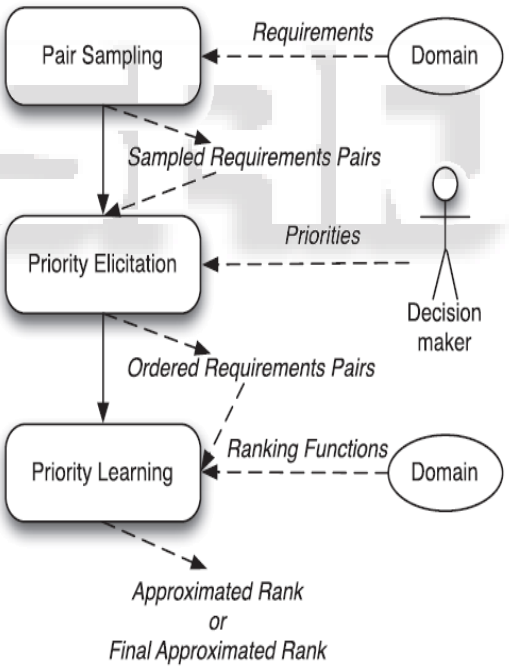


Fig. 1: Basic steps of the requirements prioritization process in CB Rank Dynamic process

The process is based on following iterations:

- Pair Sampling .an automated procedure selects the set of requirements pairs and whose relative preference is unknown that is called as unordered requirements pairs. A sampling policy can be selected can be a random choice or it may consider rank in the previous section
- Priority elicitation .for this priority elicitation this takes output from the pair sampling step such as sampled pair of requirement pairs and this also

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takes the priorities assigned by the decision maker for that corresponding pair. By taking into this priorities into consideration this process will give set of order requirements as output.

– Priority Learning .this process takes output of previous process that is ordered requirements pairs .this is also takes as input the ranking functions exploited by domain knowledge. By taking these two as input this will give approximated Rank [7].

Approximated Rank is the output of every iteration and represent the approximation of the exact ranking. note that first and three steps process are automatic. Final approximated Rank H (r) such that for all values of $r_i$, $r_j$ ,$H(r_i)>H(r_j)$ if $K(r_i)>K(r_j)$ where K(r) is unknown prioritization ranking that is target ranking

*C. The Priority Learning Techniques:*

The priority learning step in the above process is adopting the boosting approach that is rank boost algorithm. the boosting able to produce highly accurate ranking by combining many partial ordering which may not be completely accurate [8].

*1) Algorithm*

A sketch of the RankDynamic algorithm

*2) Input*

Req ={$r_1$,$r_2$,$r_3$,….$r_n$}
The set of requirements
F ={$f_1$,$f_2$,…….$f_n$}
Partial orders defining priorities and constraints upon Req
Q={($r_i$ , $r_j$);i<j|ϕ($r_i$,$r_j$)!=0}
A subsample of elicited pair wise preferences

*3) Output*

H(r) (H:Req→IR)
A ranking function defined upon Req

*4) Begin*

1: W = initialize(Q)
Uniform weighting of elicited pairs Q
2: T = maxNumberOfCycles
Definition of parameter for the number of learning cycles
3: For t = 1 To T
4: ht(r) = LearningWeakClassifier(Req,Q,F,W)
Training a weak (e.g., binary) classifier with respect to a weighted set of pairs and most promising f $\epsilon$ F
5: $\alpha_t$= ComputeAlpha(h1,W)
Computation of the coefficient for the linear Combination of weak classifiers
6: W = WeightingCriticalPairs(Q,W,h1)
Weighting of elicited pairs Q according to misclassification error of ht
7: End for
8:$h(r) = \sum_{t=1}^{T} \alpha_t h_t(r)$
Synthesis of ranking function as composition of weak binary classifiers
9: return H(r)

*5) End*

The basic cycle t will performs following the three steps shown in below:

(1) computes the partial order h1:Req→IR ,called weak classifier based on set of requirements Req and set of elicited Pairs Q and the ranking function F.

(2) computes value for the parameter α1 ,which is chosen to minimize the error between H ,the user preference and the function F.

(3) computes the set of critical pairs W which is passed to the nest cycle of the procedure in order to produce partial ordering $h_{t+1}$.

Thus in the current system it takes one more argument in the rank boost algorithm in order to dynamically update the ranking procedure in order to accommodate any new requirement added to the already existing requirements in requirement set which is going to be prioritized.

## IV. RESULTS

| N | 25 | 35 | 50 | 75 | 100 |
|---|---|---|---|---|---|
| $TDA_{AHP}$ | 31 | 71 | 208 | 693 | 1584 |
| $TDA_{CBDYNAMIC}$ | 20 | 43 | 108 | 402 | 930 |
| Difference | 11 | 28 | 100 | 291 | 654 |

Table 1: The following represent the disagreement for 25,35,50,100 Requirements ,with 100 elicited pairs computed as Average on 10 runs in AHP and CB Rank

In the above table first column n represent the number of requirements and second row represents the disagreement for the corresponding number of requirements and third row represents the disagreement in the dynamic updating requirements in CB.

The graph for the above Table 1 as follows:

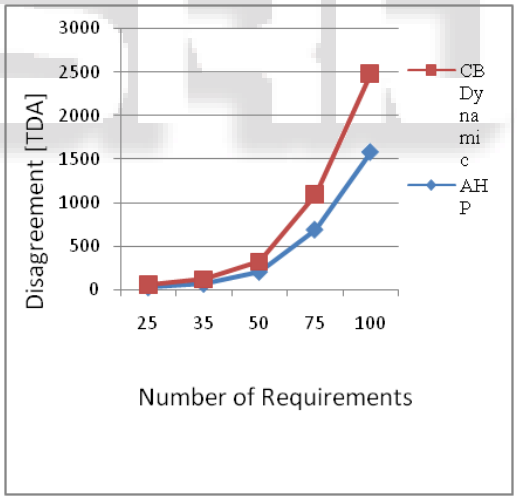


Fig. 2: Plot of disagreements

| Target | Disagreement [NDP%]Ranking attribute | Disagreement[NDP%] estimated |
|---|---|---|
| Secure | 15% | 12% |
| bug | 22% | 38% |

Table 2: Average of Partition Disagreement

In the above Table first column represent disagreement ranking attribute, second column represent disagreement estimated.

## V. CONCLUSION AND FUTURE WORK

CB Rank Dynamic follows case-based paradigm for problem solving according to which solution to new

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problem can be derived from previous examples solutions which similar to current context. Here we assuming priorities which are being taken from the stakeholder preference for that particular requirement. It could have better if you we come across the method which will required less elicitation efforts for the pairs being ordered and prioritized before being the requirements prioritized.

The current system is just dealing with monotonic case only that is if particular candidate pair taken into consideration once only. If the pair is taken into consideration more than once it is not working in that scenario. So Future work would have mighty worth if it is dealing with requirements prioritization which can also accommodate non monotonic case also. The future work also should handle the coordination among the different stakeholders. It might have more preferable to analysing the integration of current system CB Rank with AHP or with Planning game .

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