

IMPROVEMENT OF OBJECT ORIENTED DESIGN QUALITY MEASUREMENT USING FUZZY-AHP

ABSTRACT

A new method for defining rank of quality over a number of object oriented software applications has been developed. The method is to interpret a number of metric values obtained from measuring object oriented properties of executable Java codes into a single quantitative value that represents its quality. OO metrics are treated as the multi criteria. Their values are converted to pairwise comparison matrix according to the AHP scheme. Fuzzy logic is applied to address the limitation of existing methods. It has been proved that Fuzzy-AHP method results in more accurate and more consistent judgment in defining relative quality compared to AHP.

Keywords: AHP, Fuzzy, OO Metrics, MCDM.

1. Introduction

The object paradigm requires a specific way to evaluate whether a software application poses good characteristics of object oriented (OO) design. It is examined by measuring a set of OO metrics. However, there should be a method to interpret those metric values to derive an estimate conclusion of the quality. The metrics are treated as multi criteria in defining OO quality. This paper proposes a combination of fuzzy set rules and AHP to overcome the lack of existing methods.

2. Literature Review

AHP's pairwise comparison is a powerful method introduced by Saaty for deriving relative preferences resulting from human's subjective perceptions [1]. AHP has been utilized to define ranking of software applications [2] by treating MOOSE [3] and MOOD [4] OO metric values as the multi criteria, upon which decision must be made. In [5] the metric values must be converted to preference matrix that represents the relative ranking of importance. Combined with Promethee, AHP has also been applied to define ranking of quality over a number of Java library components [6].

3. Hypotheses/Objectives

Fuzzy logic was designed to deal with uncertainty and impreciseness resulting from human perception represented into mathematical form. In other words, fuzzy logic is a precise logic of imprecision and approximate reasoning [7]. Hypothetically, uncertainty and vagueness from existing perception of OO metric values can be effectively addressed to a more effective decision by using Fuzzy-AHP.

4. Research Design/Methodology

A number of Java applications has been used as experimental samples in this research. These samples are students' works from three different assignments that are increasing in complexity and gradually covering concepts of encapsulation, inheritance and polymorphism. OO metrics measurement of those three sets of samples were evaluated by applying AHP and Fuzzy-AHP. The OO metrics values were treated as the multi criteria; their weights were adjusted according to the main OO characteristics being implemented for every stage of the assignments. Comparisons of the results from every stage were examined to evaluate their accuracy and consistency.

5. Data/Model Analysis

The hierarchical structure MOOSE and MOOD are depicted by Figure 1. Applying triangular fuzzy number to pairwise comparison process in AHP results in a number of representative matrices, which is partially shown in Table 1. All representative matrices produced consistency ratio under 10%, and hence valid for the AHP process.

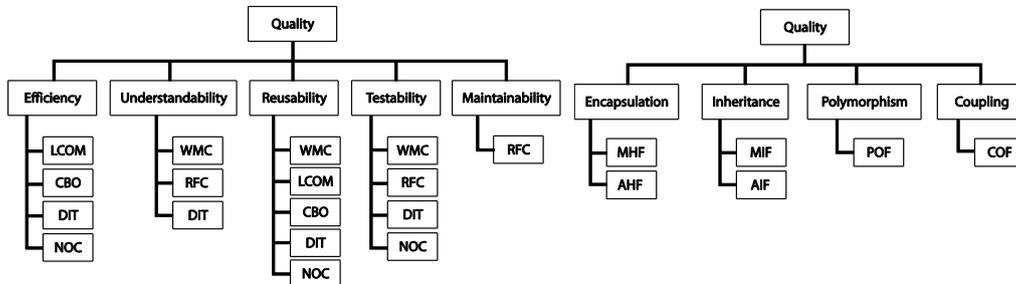


Fig 1a. MOOSE hierarchical criteria Fig 1b. MOOD hierarchical criteria

	LCOM			CBO			DIT			
Design A	1.00	2.43	9.00	1.00	3.32	9.00	1.00	6.14	11.00	...
Design B	1.00	4.88	11.00	1.00	5.01	11.00	1.00	2.58	9.00	...
Design C	1.00	4.49	11.00	1.00	4.05	11.00	1.00	3.85	11.00	...
...

Table 1. Representative Matrix Design over Efficiency (partial)

6. Limitations

The proposed method is not intended to produce an absolute value of an application’s quality. However, it is meant to measure the relative quality among a number of applications. Hence, the deliverable obtained is a list of applications sorted by their quality relatively from one to another.

7. Conclusions

It has been shown that applying fuzzy to AHP process delivers more accurate and more consistent judgment compared to the results of applying AHP only. Accurate means that the difference between any pair of two consecutive ranks somehow represents relative degree of their quality. Consistent means that any sample’s position in the rank remains constant relative to the others.

8. Key References

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