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Integration of Metric Tools for Software Testing

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Abstract: Software metric is a mathematical definition mapping the entities of a software system to numeric metrics values. Furthermore, we understand a software metrics tool as a program which implements a set of software metrics definitions. There are number of software metric tools available, use different methods to assess metric based software systems and hence project different results. The results are thus tool dependent and are in question for validation. Here an attempt is made to integrate four different object oriented free metric tools. A study has been done to calculate the metrics values using the same set of standard metrics for a software projects. The results have been presented and discussed here for showing the variations in results from different tools for same metrics. Measurements show that, for the same software system and metrics, the metrics values are tool depended. This paper will include two metrics which were not measured while integrating metrics tools. For this we will focus and study on integration of Vizz Analyzer and OOMeter metric tools with other metrics tools.

Keywords: Measurement, Verification, Software product Metrics and Software metric tool.

Introduction

Accurate measurement is the priority of any software metric tool. A large body of software quality metrics has been developed, and numerous tools exist to collect metrics from program representations. This large variety of tools allows a user to select the tool best suited. This paper will show that different metrics tools show different metrics values for same measurement and same project to overcome with this problem. We came with the integration of metric tools to get the optimized metric value. Option to select those tools whose license type is free.

Object Oriented Metrics

The metrics presented here are: class related metrics, method related metrics, inheritance metrics, metrics measuring coupling and metrics measuring general (system) software production characteristics. In this paper nine metrics are considered for optimization. These metrics are: DIT (Depth of Inheritance), NOC (Number of Children), CBO (Coupling Between Objects), RFC (Response for a Class), WMC (Weighted Method Complexity), WAC (Weighted Attributes per Class), LCOM-HS (Lack of Cohesion of Methods) (as proposed by Henderson-Sellers), LCOM-CK (Lack of Cohesion of Methods) (as originally proposed by Chidamber & Kemerer).

Software Metric Tool Selection

With the selection of software metrics tools, we limited ourselves to test systems written in Java (source and byte code). SourceForge.NET provides a large variety of open source software projects.

S.No.	Requirements	Type to suite requirement
1.	Supporting language	java
2.	measuring metrics	object oriented metrics
3.	license type	freely available
4.	characteristics	command line tool

Figure 1: Requirements as a basis for the selection of Tools

The selected tools are listed below:

A. CCCC (C and C++ code counter)

It is an open source command-line tool and analyzes C++ and Java files and generates reports on various metrics, including Lines Of Code and metrics proposed by Chidamber & Kemerer and Henry & Kafura. It is developed by Tim Littlefair of Edith Cowan University.

B. CKJM (Chidamber & Kemerer Java Metrics)

It is an open source command-line tool. It calculates the C&K object-oriented metrics by processing the byte-code of compiled Java files.

C. OOMeter

OOMeter is an experimental software metrics tool developed by Alghamdi et al. It accepts Java/C# source code and UML models in XMI and calculates various metrics.

D. Vizz Analyzer

VizzAnalyzer is a quality analysis tool. It reads software code and other design specifications as well as documentation and performs a number of quality analyses.

Metric Selection for Optimization

Six software metrics have been selected for this study. These metrics work on different program entities, e.g., method, class, package, program, etc.The tools and metrics are shown in Table 1. The crosses “#" marks that a metrics can be calculated by the corresponding metric tool. It follows a brief description of the metrics finally selected:

CBO (Coupling Between Object classes) is the number of classes to which a class is couple.

DIT (Depth of Inheritance Tree) is the maximum inheritance path from the class to the root class.

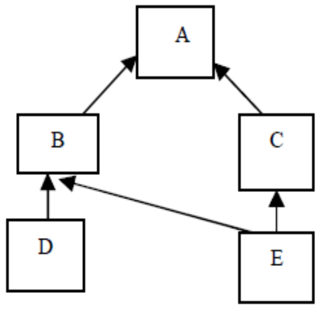

Figure 2: Sample measurement of DIT

LCOM-CK (Lack of Cohesion of Methods) (as originally proposed by Chidamber & Kemerer) describes the lack of cohesion among the methods of a class.

$$LCOM(C) = \begin{cases} P - Q & \text{if } P > Q \\ 0 & \text{otherwise} \end{cases}$$

• P = #pairs of distinct methods in C that do not share variables
• Q = #pairs of distinct methods in C that share variables

NOM (Number Of Methods) is the methods in a class.

RFC (Response For a Class) is the set of methods that can potentially be executed in response to a message received by an object of the class.

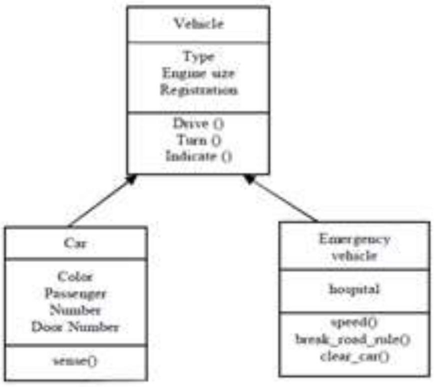

Figure 3: Sample Measurement of RFC

TCC (Tight Class Cohesion) The Tight Class Cohesion metric measures the cohesion between the public methods of a class

NDP– number of pairs of methods directly accessing the same variable
NIP – number of pairs of methods directly or indirectly accessing the same variable
NP – number of pairs of methods: n(n-1)/2
Tight class cohesion TCC = NDP/NP

Tools	Metrics					
Name	CBO	DIT	LCOM-CK	NOM	RFC	TCC
CCCC	#	#				
CKJM	#	#	#	#	#	
OOMeter	#	#	#			#
Vizz Analyzer	#	#	#	#	#	#

Figure 4: Tools and metrics used in evaluation

Conclusion and Future Scope

Today a large number of software metrics tools exist. But give different values for the same projects and hence none of them have been validated experimentally for the software metric values they measure. Most tools computed different values for the same metrics on the same projects. From the study it is observed that a new metric tool can be developed which covers metrics values which were emitted before. For more accurate values manual investigation can be done. Since metrics results are strongly dependent on the implementing tools, a validation in terms of manual investigation only supports the applicability of some metrics as implemented by a certain tool. All six different object oriented metrics measured by them have been optimized by investigating the results manually.

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