International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Design and Analysis of Dynamic OO Metric Tool for Java Project

Sherry Chalotra

Assistant Professor, Pyramid College of Business & Technology, Phagwara, Punjab

Abstract: ***Dynamic OO Metric Tool is used for measuring different software metrics and characteristics of java programs by accessing class file or byte code and gives in-depth detail of the project in form of its number of packages, classes, their methods, constructors and fields. The metrics used in Dynamic Metric Tool are used to predict various characteristics at the earlier stages of software lifecycle by just compiling the completed modules and getting its detail by using the proposed tool in mathematical form. The evaluated metrics results are presented in a graphical user interface that gives exhaustive detail in a very clear and simple way. It establishes quality benchmarks to identify potential design problems at early stages of software lifecycle rather than putting it later ends. The overall aim of Dynamic OO Metric Tool is to calculate various software metrics and design attributes for java projects so as to reduce the complexity of maintenance and moving it towards design and coding phase.***

Keywords: Object Oriented, Object Oriented Programming, Software Maintenance, Java, Design attribute

1. Introduction

Software maintenance comes into existence when software gets operational after its deliverance in order to adapt the rapid changes in IT industry. It"s the most complex process that consumes 67% of overall cost of software development. Thus software engineering methods or tools are required[11]. Software metrics play a crucial role in software re-engineering process that gives numerical measurement of particular aspects of target software and helps in identification of complex parts of the softwarethat need restructuring [11]. In this paper software metrics are evaluated for Java software. A set of selected metrics are used to evaluate design attributes like, size, encapsulation, response from class, its communication and other class attributes and their relation to evaluate inheritance [1], [2].

Object Oriented Programming is typically based on objects, which are used to access the class, which accommodate data, field, attributes and methods in it.The most striking feature of OOP is the securitythat is being provided by encapsulation, information hiding, inheritance etc. by which methods can access the data of class to whom it is associated and the entire communication is only through objects by passing message to one another [4]. Encapsulation merges abstract data types with structured programming and divide entire system into modular objects which are responsible for their own behavior as each object has its state and behavior [4, 12]. Due to this object oriented programming gave such a platform toprogrammers where data is not directly accessible by the rest of the system and gave a secure way of programming as the data is accessed by calling specially written functions, called methods, which are bundled with the data [4]. The provision of re-usability of existing components and extending components as needed by defining new subclasses with specialized behaviors make a software modular which is known as inheritance or open-closed principle of OOP [9]. The module is said to be open if it supports extension while a module is said to be closed if has a well-defined stable state and further extension or interaction may lead to introduce errors in other modules.

„One name, multiple forms" is known as polymorphism which is being implemented by overloading functions and operators. It measure degree of method overriding [1]. The overloaded member functions are selected for invoking by comparing their arguments and its type. If the same things are known to compiler at compile time then it"s a static binding or compile time polymorphism else it"s late binding or run time polymorphism. Virtual functions are used to achieve run time polymorphism.

The main objective of this paper is to develop a tool that gives a set of result by calculating it dynamically and to play an extensive role in controlling software maintenance practices by detecting the problems at design and coding stages of SDLC with numerous parameters.

The whole paper is coordinated in different sections. Section 2 discusses methodology for proposed tool. Section 3 explains results and discussion. The paper conclusion and future scope is discussed in Section 4.

2. Methodology

2.1 Design of Dynamic OO Metric Tool

Dynamic OO Metric Tool is designed for java programs for measuring various object oriented metrics like, methods, classes, fields, encapsulation and inheritance. As it is designed for java programs only, the input given to this tool is .java files [10]. Java programs are first compiled so that the source files (.java file) get converted into the byte code (.class files). These object files (.class files) are feed as an input to the tool and the use of the .class file over .java file is to provide an efficient result as .java files are just text files that can easily be modified. Also .java files are not readable by Java Virtual Machine (JVM) so it becomes important to convert it in to its byte code. Dynamic OO Metric Tool works in three different phases by creating classes dynamically at run time only. The structure is shown in figure 1.

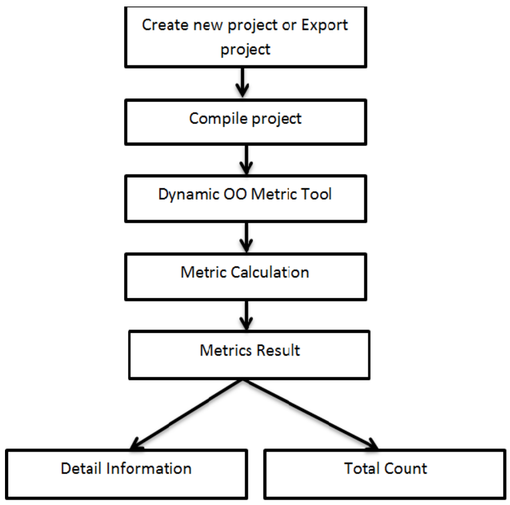


Figure 1: Flow Diagram of Dynamic OO Metric Tool

- **Phase 1: Compiling Java Programs:** Phase 1 of Dynamic OO Metric Tool is to import various java projects into the Netbeans IDE or Eclipse IDE or any other. Here the role of IDE is just to compile the java programs so that all source files get converted into byte code (*.class* files). Another way of compiling the java programs is through Command Prompt. One way of getting the programs is by importing it from the external sources and another way is to create a new program and then compile it. Compilation of programs completes the phase 1.
- **Phase 2: Metrics Calculator:** This component calculates the OO metrics. It takes the converted *.class* files from Phase 1 and calculates various object oriented metrics and individual project"s attributes based on the logic and formulas defined.
- **Phase 3: Metrics Results Viewer:**This component displays the metrics result in a graphical user interface. This GUI provides different options for detailed information. At the end, it gives the total count option which displays all result at one place.

2.2 Description of quality attributes

a) **Design Size:** A measure of the number of classes used in a design.
b) **Encapsulation:** Defined as enclosing of data and behavior within a single construct.In Object Oriented design the property specifically refers to designing classes that prevent access to attribute declarations by defining them to be private, thus protecting the internal representation of the objects.
c) **Response for a Class (RFC):** It is a class level design metric. Response for a class is a set of methods that can be executed in response to a message received by an object of that class [1, 12]. Response for a class is defined by the number of methods available in the class. The number of available methods in the class is the sum of the number of local methods in the class and the number of methods called by the local methods.

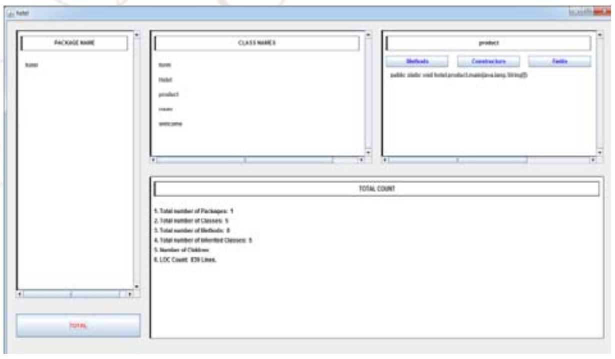
2.3 Metrics for Class

Class metrics concern with various characteristics of a class such as attribute, relationship and object instantiation.

a) **Number of packages:** This metric calculates the total number of packages in the given java project.
b) **Number of classes:** This metric calculates the total number of classes in the given java project.
c) **Number of methods:** This metrics calculates the total number of methods in the given java project.
d) **Number of inherited classes:** This metrics calculates the total number of inherited classes in the given java project or number of immediate subclass [1].
e) **Number of super classes:** This metrics calculates the total number of super classes in the given java project.
f) **Number of sub classes:** This metrics calculates the total number of sub classes in the given java project [1].
g) **Attributes in a class:** This metric calculates various attributes in a class. The attributes are its methods, constructors and fields used in the class.
h) **Line of Code:** This metric calculates total line of code of given java project.

3. Results & Discussion

The main goal of OO Metric Tool is to compute various metrics for class for the java projects that is created dynamically. This tool provides an automated way for measuring the metrics from *.class* files of the java projects and gives in-depth detail of the project in form of its number of packages, classes, their methods, constructors and fields. Along with that, it measures other object oriented metrics and provides the result mathematically. It also computes design quality attributes. The representation of project"s attributes and mathematical count of metrics are represented in a graphical user interface. The GUI provides the better interaction between the user and the software. The results so generated are also very easy to understand as it is displayed in a friendly graphical user interface that provides options for the detailed information of the classes. This helps the team leaders and developers to have detailed view of all the attributes related java projects.



public static void hotel.product.main(java.lang.String[])

1. Total number of Packages: 1
2. Total number of Classes: 5
3. Total number of Methods: 8
4. Total number of Inherited Classes: 5
5. Number of Children
6. LOC Count: 839 Lines.

Figure 2: View of different attributes calculation

4. Conclusion

It is clear that to measure the quality of software at design level as well as code level, different tools are available. To measure different quality attributes each tool includes different set of metrics. The Dynamic OO Metric Tool allows the user to interact with the software and to measure project"s attributes and object oriented metrics mathematically by considering the object files of java programs. It also provides the facility of measuring the design attributes like inheritance, encapsulation, size, response etc. that helps the team leaders and developers to have detailed view of all the attributes related java projects.

5. Future Scope

This research concentrates on calculating various metrics of class for the java projects only that are dynamically created. The future scope of this work is as follows:
1) It can be designed for software running on different platforms like C++, PHP etc.
2) It can be designed for software running mobile application platforms also like Android.
3) It can be designed for measuring the metrics of default packages.

References

[1] Aggarwal, K.K., Singh, Y., Kaur, A. and Malhotra, R. (2006) “Empirical Study of Object-Oriented Metrics”, Journal of Object Technology, Vol.5, No. 8.
[2] Alghamdi, S.J., Rufai, A.R. and. Khan, M.S. (2005) “OOMeter: A Software Quality Assurance Tool”, Proceedings of the Ninth European Conference on Software Maintenance and Reengineering (CSMR‟05), pp.190-191.
[3] Basili, R.V., Briand, L. and Melo, L.W. (1995) “A Validation of Object-Oriented Design Metrics as Quality Indicators”, IEEE Transactions of Software Engineering, Vol.22, No. 10, pp. 751-761.
[4] Booch, G. (1994) “Object Oriented Analysis and Design with Applications”, The Benjamin/Cummins Publishing Company Inc, Redwood City, California 1994.
[5] Dr. K.P. Yadav, Ashwani Kumar, Sanjeev Kumar (June 2012): “Object Oriented Metrics Measurement Paradigm”, International Journal of Management, IT and Engineering Vol 2,No.6, pp. 198-208.
[6] Li, W. and Henry, S. (1993) “Object-Oriented Metrics that Predict Maintainability”, In Journal of Systems and Software, Vol.23, No.2, pp. 111-122.
[7] Lincke, R., Lundberg, J. (2008) "Comparing software metricstools”. Proceedings of the international symposium on Software testing and analysis (ISSTA‟08), pp. 131-142.
[8] Rumbaugh, J. (1991) “Object-Oriented Modeling and Design”, Englewood Cliffs, Prentice Hall, 1991.
[9] Seyyed Mohsen Jamali (2006): “ Object Oriented Metrics”,Sharif University of Technology.
[10] Singh, p., Singh, H. (2008) “Dyna Metrics: A Runtime Metric-Based Analysis Tool for Object-Oriented Software Systems”, SIGSOFT Software Engineering Notes, Vol. 33, Issue 6, pp. 1-6.
[11] Systä, Tarja, and Ping Yu. "Using OO Metrics and Rigi to evaluate java software." 1999.
[12] Snyder, Alan. "Encapsulation and inheritance in object-oriented programming languages." In ACM Sigplan Notices, vol. 21, no. 11, pp. 38-45. ACM, 1986.