Smarter Merge Tool for Structured Java Code

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1 Abstract

Software merging is a necessity for large-scale software development and while there are many code version systems to help with this, many of them don't take the structure of the code into account. We propose to develop a merge tool that will utilise the PDStore[1] database to maintain and analyse the structure of the data.

The aim of the tool is to utilise information related to the structure of a file stored in PDStore and highlight the conflicts that arise in merging. The proposal highlights the requirements, milestones and possible evaluation methods for the research project.

2 Motivation

Developing a merge tool that maintains information in a structured form, gives scope to improve the way that conflicts and changes are showed. This motivated us to explore the effectiveness and usability of such merge tools and how they compare to existing merge tools.

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[1]PDStore is a Triplestore database developed at the University of Auckland

3 Related Work

[1] proposes a novel method for merging code clones and presents a successful case study conducted by using the Aries tool which uses to identify code clones and merge them. The method described in [1] consists of a two phase process, where code clones that can be refactored are quickly detected, and the metrics are measured which indicate how the detected code clones should be merged.

[2] describes a tool called "Semantic diff" and techniques used in that tool to show the effect of modifications. The tool aims at providing the user with a summarised report of semantic changes between two versions of a procedure, and focuses on minimising any spurious differences such as, renaming local variables. While the tool provides knowledge of variable dependences within a procedure, it is not very helpful when considering an entire program because the tool does not maintain any relationship between method invocation and method definition.

In [3] a technique for performing a 3 way structured XML merge is described. The technique involves defining merge rules derived from common use cases of XML editing. While there are similar problems, a few differences exist. By the nature of XML, the local structure is important. However with Java code the structure can vary

and still present the same semantic definition. Thus some of the rules made in [3] become invalid for flexible structured data such as code.

[4] describes the problems associated with common textual based merging. It proposes a solution that can be applied to software artefacts of different types. The solution involves representing information with extra information such as namespaces appended with UIDs. Once the data is represented in this special structure, the job of analysing two structures should be made easier.

4   Requirements

A successful execution of the research endeavour should meet the following requirements:

1. To be able to successfully identify simple changes in method body but not necessarily code structure

2. To be able to successfully identify and common sections of code in two structures with slight variations

3. Identify changes in structure, such as method location being shifted

4. Successfully merge two differing versions of code following from the examples in 1 and 2

The following optional requirements would also be attempted to met during the execution of this research endeavour

1. To integrate this additional functionality into the existing PDStore versioning application.
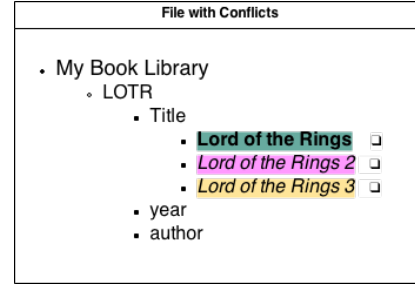

Figure 1: Identification of changes and merged result

5   Design and Implementation

The underlying technology used in the proposed method involves using PDStore to be able to form a structured view of the code. The merging logic will be written in Scala, while the GUI will be designed in Swing.

Figure 1 is an example that illustrates a possible GUI for three way merge involving PD Tree Views. The title string belonging to the LOTR book in the My book library database has differing values in each of the three existing versions(Base, Version A and Version B). We hope to colour code information such as modified items and or items in conflict to help better inform the user of the types of changes. The user can select items from different versions to be included in the merged representation by clicking on the checkbox beside the items

6   Evaluation

This evaluation will consist of an usability testing and comparative analysis with existing merge tools.

As part of the usability testing, paper prototypes will be used to evaluate the feasibility of

the design of the User Interface of our tool. This study will reveal both fundamental and minor flaws in the UI that would need to be fixed before the final milestone. Specific scenarios will be constructed outlining various use cases that will then be run through by the participants on multiple different UI designs. The participants will be asked to think out loud, so that their thought process can be observed and evaluated. Feedback will then be collected from the participants at the end through the use of a questionnaire which will then be used to measure the usefulness of each design.

Any identified flaws will then be corrected and the test will then be undertaken again so as to verify that the flaws are indeed fixed.

The comparative analysis will consist of test cases outlining major scenarios will be laid out at the start of the project and will later be run against existing merge tools and our developed merge tool. The outcome of these test scenarios will help determine the effectiveness of the tools under different scenarios

7 Project Plan

Listed below are the three milestones for this project

Milestone One: Successfully identify the type of simple structural changes

This involves defining rules and defining a notion of "sameness" for two code artefacts. The PDStore database will be used to compare the two different versions of the code. Completion criteria involves being able to generate output that clearly identify the changes.
Due Date: 15th April 2014

Milestone Two: Perform merging of simple structural changes

After being able to identify the changes, we need to define appropriate rules for merging. To complete the milestone, the merger will be required to successfully merge files for a few defined scenarios.
Due Date: 30th April 2014

Milestone Three: Integrate the added functionality to existing PDStore based versioning tool

Integrating the added functionality will allow us to conduct our evaluation on users. This will be key in determining the usefulness and effectiveness of the changes.
Due Date: 12th May 2014

References

[1] Yoshiki Higo, Shinji Kusumoto, and Katsuro Inoue. A metric-based approach to identifying refactoring opportunities for merging code clones in a java software system. *J. Softw. Maint. Evol.*, 20(6):435–461, November 2008.

[2] D. Jackson and D.A. Ladd. Semantic diff: a tool for summarizing the effects of modifications. In *Software Maintenance, 1994. Proceedings., International Conference on*, pages 243–252, Sep 1994.

[3] Tancred Lindholm. A three-way merge for xml documents. In *Proceedings of the 2004 ACM Symposium on Document Engineering*, DocEng '04, pages 1–10, New York, NY, USA, 2004. ACM.

[4] Albert Zündorf, Jörg Wadsack, and Ingo Rockel. Merging graph-like object structures. In *Proc. of 10th International Workshop on Software Configuration Management, Toronto, Canada*, 2001.