

A Bug-Fix Metarepository for Developers and Researchers

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ABSTRACT

In recent years, mining bug report (BR) and their related fixes has perhaps been one of the most active software engineering research fields. There exists many open source and many open source and proprietary bug tracking and source code versioning systems that developers and researchers can use to examine bug reports so as to reason about software quality. The issue is that these repositories use different interfaces and ways to access and represent data, which hinders productivity and reuse. To address this, we introduce a large dataset of 700,000 fixed bugs belonging to 1,900 different projects. This dataset follows a clear infrastructure and allows developers and researchers interested in mining data from different (and heterogeneous) repositories to do so easily.

Keywords

Bug tracking systems; Source code versioning systems; Bug Reports; Mining software repositories

CCS Concepts

• **Software and its engineering** → *Software libraries and repositories*;

1. INTRODUCTION

Bug tracking systems such as Bugzilla and Jira have grown to contain hundreds of thousands of bugs, providing a vast amount of data to several active research fields including bug reproduction, bug triaging, and empirical studies. The analysis of BRs can provide useful insight that can help with many maintenance tasks such as bug fixing [19, 3, 18], bug reproduction [2, 4, 8, 17], bug prediction [5, 9, 11], and fault analysis [6].

Today, there exist many bug tracking and source code versioning tools (e.g., Bugzilla, Jira, SVN, Git, etc.) that can be used by practitioners and researchers to conduct large-scale studies on the causes and distribution of bugs in software

systems. The problem is that these systems have different interfaces to access data. The data is not represented in a uniform way either. This is further complicated by the fact that bug tracking tools and code versioning systems are not necessarily connected. The former follows the life of the bug itself and not its fixes, which are managed by the latter. Analyzing the bugs and their fixes from different sources require going back and forth between diverse tools, creating parsers, mapping data from a repository to another, etc. These tasks are not only time consuming but add no value to the analysis itself.

For the time being, our dataset, which is available for download at <https://bumper-app.com/msr16>, aggregates bug report and fixes from Eclipse¹, Gnome², the Apache Software foundation³ and Netbeans⁴. Moreover, our dataset associates each bug report (bug description, reporter, assignee, comments, ...) and its related fixes. These systems use Bugzilla⁵ or Jira⁶ as their bug report system and Git⁷ or Mercurial⁸ as their source code versioning engine.

2. DATA COLLECTION

Figure 1 illustrates how we extracted data from various bug report tracking and code versioning systems. In this example, we extract raw data from two bug tracking systems, Bugzilla and Jira with their corresponding source code versioning systems, Git and Mercurial. The extracted data is consolidated into one database where we associate each bug report with its fix. Note that this association is based on the general practice where developers create a link between the bug tracking system and their source versioning tool by either writing the bug #ID in their commit message or adding a link towards the changeset as a comment in the bug report system. Algorithms for linking these two entities in the absence of explicit linkage can also be used such as the one presented by Wu et al. [20] in their tool, Relink.

Currently, our dataset includes five bug report management systems, namely, Gnome, Eclipse, Netbeans and the Apache Software Foundation that are composed of 512, 190, 39 and 349 projects respectively, bringing the total of projects to 1,930. These projects cover 16 years of development from

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¹<https://www.eclipse.org/>

²<https://www.gnome.org/>

³<http://www.apache.org/>

⁴<https://netbeans.org/>

⁵<https://www.bugzilla.org/>

⁶<https://www.atlassian.com/software/jira>

⁷<https://git-scm.com/>

⁸<https://www.mercurial-scm.org/>

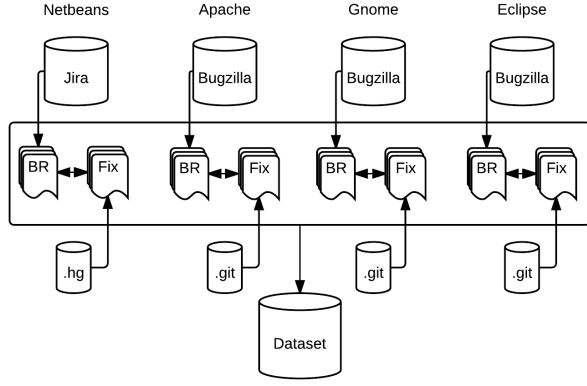


Figure 1: BUMPER Data Collection

Table 1: RESOLVED/FIXED BUG (R/F BR), CHANGESETS (CS), AND PROJECTS BY DATASET

Dataset	R/F BR	CS	Files	Projects
Gnome	550,869	1,231,354	367,245	512
Netbeans	53,258	122,632	30,595	39
Apache	49,449	106,366	38,111	349
Eclipse	78,830	184,900	21,712	190
Total	732,406	1,645,252	457,663	1,930

1999 to 2015. Gnome is a free desktop environment, mainly developed in C and C++. Eclipse and Netbeans are integrated development environments (IDEs) for developing with many programming languages, including Java, PHP, and C/C++. Finally, The Apache Software Foundation (ASF) is a non-profit public charity established in 1999, that provides services and support for many like-minded software project communities of individuals who choose to join the ASF. The extracted data is consolidated in one database where we associate each bug report with its fix. The fixes are mined from different types of version control systems. Gnome, Eclipse and Apache Software Foundation projects are based on Git (or have git-based mirrors), whereas Netbeans uses Mercurial. The characteristics of the five aggregated datasets are presented in Table 1.

We chose to use with these systems to have data coming from diverse code versioning and bug tracking systems. Also, Gnome, Eclipse, Netbeans and the Apache Software Foundation exhibit a great deal of diversity in terms of the programming languages used to build applications, development teams, location of the development teams, utility, and maturity. Moreover, they use different tools, Bugzilla, JIRA, Git, and Mercurial. This said, we can and plan to integrate other datasets that use any combination of these tools.

As we can see from in Table 1, our consolidated dataset contains 732,406 bugs, 1,645,252 changesets, 457,663 files that have been modified to fix the bugs and 1,930 distinct software projects belonging to four major organizations. We also collected more than two billions lines of code impacted by the changesets, identified tens of thousands of sub-projects and unique contributors to these bug report systems.

3. DATASET DESCRIPTION

Figure 2 shows the core BUMPER metamodel, which captures the common data elements used by most existing bug tracking and control version systems. An issue (task) is characterized by a date, title, description, and a fixing time.

Issues are reported (created) by and assigned to users. Also, issues belong to a project that is in a repository and might be composed of subprojects. Users can modify an issue during life cycle events which impact the type, the resolution, the platform, the OS and the status. Issues are resolved (implemented) by changeset that are composed of hunks. Hunks contain the actual changes to a file at a given revision, which are versions of the file entity that belongs to a project.

Our dataset contains information found in many common bug reporting and source code versioning systems. More particularly, it revolves around three main entities (1) Bug reports, (2) Changesets, and (3) Hunks. Bug reports can contain zero or many changesets—some bug reports such as duplicates do not require changesets. A changeset may contain one or many hunks. We carefully examined a large set of tools to define the characteristics of each entity so as to provide support for various types of analyses. A bug report is characterized by the following features:

- **ID:** A unique identifier
- **Dataset:** The dataset where the bug is extracted from
- **Date:** The bug submission date
- **Title:** The title of the bug report
- **Description:** The description of the bug
- **Project:** The project affected by this bug
- **Sub_project:** The sub-project that this bug affects.
- **Version:** the version of the project that this bug affects
- **Impacted_platform:** The platform that this bug affects
- **Impacted_OS:** The operating system that this bug affects
- **Bug_status:** The status of the bug
- **Resolution:** A description on how the bug was resolved
- **Reporter_pseudo:** The pseudonym of the person who report the bug
- **Reporter_name:** The name of the person who reported the bug
- **Assigned_to_pseudo:** The pseudonym of the person who has been assigned to fix the bug
- **Assigned_to_name:** The name of the person who has been assigned to fix the bug
- **Bug_severity:** The severity of the bug
- **Fixing_time:** The time in minutes it took to fix the bug

hope that the community embraces this dataset and evolve it with even more bug and projects.

5. CONCLUSION

In this paper, we presented a dataset that we built to offer developers and researchers the ability to access various bug-related data from diverse repositories in a single dataset. This paper contributes also with a large dataset with 732,406 bugs, 1,645,252 changesets, 457,663 files that have been modified to fix the bugs and 1,930 distinct project related to Netbeans, the Apache Software foundation's software, Eclipse and Gnome. The dataset is publicly available at <https://bumper-app.com/msr16>.

As future work, we want to improve our dataset by adding more projects such as project hosted on Github and the Mozilla Foundation datasets. Also, we intend to add other features such as the number of times a bug is reopened, the number of times a bug has been duplicated, etc.

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