

# RefactoringAnalyzer Project Report

Niko Hokkanen

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## 1 INTRODUCTION

This report is part of the coursework for the **Software Development, Maintenance, and Operations** course (811372A) in Fall 2024. The project involves mining refactoring activities from a set of software projects and analyzing the developer effort and bug-fixing commits associated with those refactorings.

The analysis uses several tools, including RefactoringMiner for identifying refactorings, and additional Python scripts to collect data on developer effort and issue tracking. This document provides an overview of the project, the data collected, and the methodology used.

## 2 REPOSITORY STRUCTURE

The project repository includes Python scripts and tools designed to perform the following tasks:

- `DeveloperEffort.py`: Tracks the effort exerted by developers during the refactoring process by counting touched lines of code (TLOC).
- `DividedProjects.py`: Handles project division tasks, potentially for parallel analysis.
- `GetBugIssueData.py`: Collects issue tracking and bug-fixing commit information from GitHub's API.
- `RefactoringRunner.py`: Runs RefactoringMiner on each cloned repository to collect refactoring data.
- `ProduceUniqueRepos.py`: Gathers unique repositories for analysis from the dataset.

These files work together to produce the necessary output in the form of JSON, CSV, and other data formats as required by the coursework instructions.

## 3 METHODOLOGY

The methodology follows the project steps outlined in the coursework, including:

### 3.1 Data Collection

The dataset provided in the coursework is used to identify and clone the relevant GitHub repositories. Once cloned,

RefactoringMiner is applied to analyze the refactoring history of each project. The CLI options of RefactoringMiner are used to mine all commits in each repository.

### 3.2 Commit Differences

For each refactoring commit (RC), the differences between the current commit and the previous commit are calculated. This data includes the modified lines of code (ADD, DEL) and the textual content of the diffs. Python's pydriller library is used for this analysis.

### 3.3 Developer Effort

Developer effort is measured by collecting the total number of touched lines of code (TLOC) for each refactoring. The scc tool is used to measure LOC in the refactoring commit and its predecessor.

### 3.4 Bug-fixing Commits

For projects using GitHub as an Issue Tracking System (ITS), the GitHub REST API is used to mine bug-fixing commits. The `GetBugIssueData.py` script collects the necessary issue data.

## 4 RESULTS

The project produces several outputs, including:

- Refactoring data in JSON format, with attributes such as refactoring type, commit hash, and inter-refactoring period.
- Commit diffs for each refactoring commit, including numerical data on the differences and the modified code content.
- Developer effort data, with attributes such as refactoring hash, previous hash, and TLOC.
- Bug-fixing commit data from GitHub's issue tracking system.

These results are compiled into a structured dataset, which forms the basis for the analysis performed in this report.

## 5 CONCLUSION

The RefactoringAnalyzer project successfully mines and analyzes refactoring activities in software projects. By combining tools like RefactoringMiner and Python scripts, the project provides valuable insights into developer effort and bug-fixing activity, supporting the broader application of refactoring in practice.

## A REPOSITORY LIST

The following is the list of 381 Apache repositories used for the analysis in this project:

- <https://github.com/apache/fineract>
- <https://github.com/apache/sling-org-apache-sling-feature-karaf>
- <https://github.com/apache/sling-org-apache-sling-committer-cli>

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- <https://github.com/apache/hadoop-ozone>
- <https://github.com/apache/sling-org-apache-sling-commons-content-processing>
- <https://github.com/apache/sling-org-apache-sling-testing-osgi-mock>
- <https://github.com/apache/sling-org-apache-sling-feature-api-regions-model>
- <https://github.com/apache/sling-org-apache-sling-repo-init>
- <https://github.com/apache/sling-org-apache-sling-hc-support>
- <https://github.com/apache/sling-org-apache-sling-resourcesolver>
- <https://github.com/apache/sling-org-apache-sling-starter>
- <https://github.com/apache/sling-org-apache-sling-feature-api-regions>
- <https://github.com/apache/openmeetings>
- <https://github.com/apache/sling-org-apache-sling-engine>
- <https://github.com/apache/sling-org-apache-sling-distribution-journal-kafka>
- <https://github.com/apache/sling-org-apache-sling-repo-init-parser>
- <https://github.com/apache/sling-org-apache-sling-commons-cache-container-test>
- <https://github.com/apache/sling-org-apache-sling-api>
- <https://github.com/apache/sling-org-apache-sling-scripting-sightly-repl>
- <https://github.com/apache/sling-org-apache-sling-jcr-oak-server>
- <https://github.com/apache/sling-org-apache-sling-launchpad-startupmanager>
- <https://github.com/apache/submarine>
- <https://github.com/apache/sling-org-apache-sling-adapter>
- <https://github.com/apache/sling-org-apache-sling-extensions-webconsolesecurityprovider>
- <https://github.com/apache/sling-org-apache-sling-provisioning-model>
- <https://github.com/apache/sling-org-apache-sling-fsresource>
- <https://github.com/apache/jspwiki-builder>
- <https://github.com/apache/sling-org-apache-sling-contentparser-json>
- <https://github.com/apache/sling-org-apache-sling-i18n>
- <https://github.com/apache/sling-org-apache-sling-models-caconfig>
- <https://github.com/apache/sling-org-apache-sling-testing-resourcesolver-mock>
- <https://github.com/apache/sling-org-apache-sling-scripting-java>
- <https://github.com/apache/plc4x>
- <https://github.com/apache/sling-org-apache-sling-servlets-post>
- <https://github.com/apache/sling-org-apache-sling-sitemap>
- <https://github.com/apache/poi-parent>
- <https://github.com/apache/sling-project-archetype>
- <https://github.com/apache/sling-org-apache-sling-commons-threads>
- <https://github.com/apache/sling-org-apache-sling-jcr-jackrabbit-accessmanager>
- <https://github.com/apache/sling-org-apache-sling-xss>
- <https://github.com/apache/sling-org-apache-sling-testing-sling-mock>
- <https://github.com/apache/sling-org-apache-sling-feature-modelconverter>
- <https://github.com/apache/sling-org-apache-sling-scripting-sightly>
- <https://github.com/apache/sling-org-apache-sling-resourceaccesssecurity>
- <https://github.com/apache/sling-kickstart-maven-plugin>
- <https://github.com/apache/sling-initial-content-archetype>
- <https://github.com/apache/sling-org-apache-sling-karaf-integration-tests>
- <https://github.com/apache/sling-org-apache-sling-security>
- <https://github.com/apache/commons-statistics>
- <https://github.com/apache/sling-scriptingbundle-maven-plugin>
- <https://github.com/apache/sling-org-apache-sling-distribution-journal-it>
- <https://github.com/apache/sling-org-apache-sling-feature-launcher>
- <https://github.com/apache/sling-org-apache-sling-scripting-jsp-api>
- <https://github.com/apache/sling-org-apache-sling-servlets-get>
- <https://github.com/apache/sling-org-apache-sling-scripting-jsp>
- <https://github.com/apache/sling-org-apache-sling-scripting-freemarker>
- <https://github.com/apache/sling-org-apache-sling-starter-content>
- <https://github.com/apache/sling-org-apache-sling-resource-presence>
- <https://github.com/apache/sling-org-apache-sling-junit-teleporter>
- <https://github.com/apache/sling-org-apache-sling-karaf-configs>
- <https://github.com/apache/sling-content-package-archetype>
- <https://github.com/apache/sling-maven-plugin>
- <https://github.com/apache/sling-org-apache-sling-auth-core>
- <https://github.com/apache/incubator-hop>
- <https://github.com/apache/isis>
- <https://github.com/apache/sling-org-apache-sling-adapter-annotations>
- <https://github.com/apache/sling-org-apache-sling-scripting-el-api>
- <https://github.com/apache/sling-org-apache-sling-contentparser-xml>
- <https://github.com/apache/cxf>
- <https://github.com/apache/sling-org-apache-sling-scripting-sightly-testing-content>
- <https://github.com/apache/sling-org-apache-sling-rewriter>
- <https://github.com/apache/ofbiz-plugins>
- <https://github.com/apache/groovy>
- <https://github.com/apache/sling-feature-converter-maven-plugin>
- <https://github.com/apache/sling-org-apache-sling-scripting-javascript>
- <https://github.com/apache/sling-org-apache-sling-installer-provider-file>
- <https://github.com/apache/sling-org-apache-sling-testing-clients>

- <https://github.com/apache/sling-org-apache-sling-nosql-launchpad>
- <https://github.com/apache/sling-org-apache-sling-feature>
- <https://github.com/apache/incubator-iotdb>
- <https://github.com/apache/sling-parent>
- <https://github.com/apache/sling-org-apache-sling-capabilities-jcr>
- <https://github.com/apache/commons-numbers>
- <https://github.com/apache/pdfbox-reactor>
- <https://github.com/apache/apache-dolphinscheduler>
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- <https://github.com/apache/struts>
- <https://github.com/apache/sling-org-apache-sling-scripting-sightly-testing>
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- <https://github.com/apache/sling-org-apache-sling-commons-jcr-file>
- <https://github.com/apache/sling-org-apache-sling-feature-extension-content>
- <https://github.com/apache/sling-org-apache-sling-commons-html>
- <https://github.com/apache/sling-whiteboard>
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- <https://github.com/apache/sling-org-apache-sling-commons-mime>
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- <https://github.com/apache/hop>
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- <https://github.com/apache/jackrabbit-filevault>
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- <https://github.com/apache/sling-org-apache-sling-installer-core>
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- <https://github.com/apache/sling-htl-maven-plugin>
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- <https://github.com/apache/sling-org-apache-sling-installer-factory-feature>
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- <https://github.com/apache/sling-org-apache-sling-discovery-commons>
- <https://github.com/apache/sling-org-apache-sling-commons-logservice>
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