

# A Code Clone Detection DSL for Java

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## Abstract

Duplication in source code is generally considered an undesirable pattern, because it unnecessarily increases system volume and is prone to cause bugs. Many studies propose definitions and techniques to detect such duplication issues. The clones detected by these definitions and techniques differ greatly. This is because there is a trade-off between completeness and number of false-positives. Additionally, clone detection may have different purposes, which may require different clone detection techniques.

We propose a DSL for clone detection, that allows for the specification of clone definitions. Using this DSL, code clone definitions can be easily expressed, whilst not having to worry about the actual clone detection algorithm and its optimization. Our DSL allows to exclude expressions, statements and declarations from clone matching. Our DSL supports line-based and AST-based clone detection approaches. The DSL can also take into account context information of expressions.

We use the DSL to express type 1, 2 and 3 clone definitions. We then use these definitions to validate the DSL over a corpus of open-source Java projects. We compare these results with established clone detection tools. We find that our DSL matches the output of the control tools, while allowing for a much wider spectrum of configurations.

**Keywords** clone detection, domain specific language, language engineering, meta-programming

## 1 Introduction

Code clones argue about the duplicate code present in the source code of software systems. An abundant number of clone detection tools and techniques have been proposed in the literature due to the many applications and benefits of clone detection [15]. Clones are most often the result of code reuse by copying and pasting existing code, among other reasons [14]. Clones are often seen as harmful [8, 12, 14], but can also have positive effects on system maintainability [1, 10, 14].

Clone detection is applied in various domains. This includes (automated) refactoring, education (plagiarism detection) [19], (legacy code) modernization [11] and maintainability analysis [4]. For these varying purposes, many clone detection tools have been proposed: a 2013 survey by Rattan et al. [13] surveyed more than 70 clone detection tools. Comparisons show large differences in recall and precisions of these tools [16].

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To allow easy experimentation with code clone definitions and methods, we propose a DSL to configure clone detection.

## 2 Background

We describe code clone definitions and techniques that are commonly used in code clone detection.

### 2.1 Clone type definitions

Most modern clone detection tools detect clones by the following clone type definitions [16]: **Type 1**: Code fragments that are syntactically identical, except for differences in white space, layout and comments. **Type 2**: Code fragments that are syntactically identical, except for differences in identifier names, literal values, white space, layout and comments. **Type 3**: Code fragments that are syntactically similar with differences at the statement level. The fragments may differ by the addition, removal or modification of statements.

### 2.2 Clone detection techniques

## 3 Clone Detection Techniques Survey

As an initial step towards creating a clone detection DSL, we surveyed clone detection techniques and tools to extract common functionalities.

## 4 Language Design

We propose Clone Detection DSL (CDD)<sup>1</sup>, a DSL that allows to build a clone detection script to analyze Java systems.

### 4.1 Clone Size

An important feature of many clone detection tools, to be able to find clones that have a high relevance, is to be able to configure what characteristics clones should have for them to be considered. Some clone detection tools use a threshold that specifies the minimum number of lines [2, 3, 7, 18]. Other clone detection tools specify the minimum number of tokens [6, 9, 17]. Some AST-based clone detectors use the minimum number of statements [5].

Based on such thresholds, clones that are too small are filtered. How these thresholds are configured has a big impact on the results and their relevance [14]. Our DSL allows for any combination of metric values to configure the minimum size of a clone. For this, we introduce the **Size** keyword. This is an example of how the **Size** keyword can be configured: **Size (4 lines & 50 tokens) | (6 lines & 40 tokens)**

<sup>1</sup>Link to the GitHub repository is omitted to adhere to the double-blind review rules. Link to full source code of the DSL will be included in the camera-ready version.

## 4.2 Match Granularity

## 4.3 Exclusions

## 4.4 Compare Rules

## 5 Example scripts

## 6 Results

## 7 Discussion

## 8 Conclusion

### 8.1 Threats to validity

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