Bachelor Thesis: Automatic Token Classification for Unknown Languages

Jan Kurš, Joel Guggisberg

1 Introduction

- Given code of an unknown programming language, attempt to automatically recognize which are the keywords of the language.

- To find said keywords assume that many programming languages have common constructs

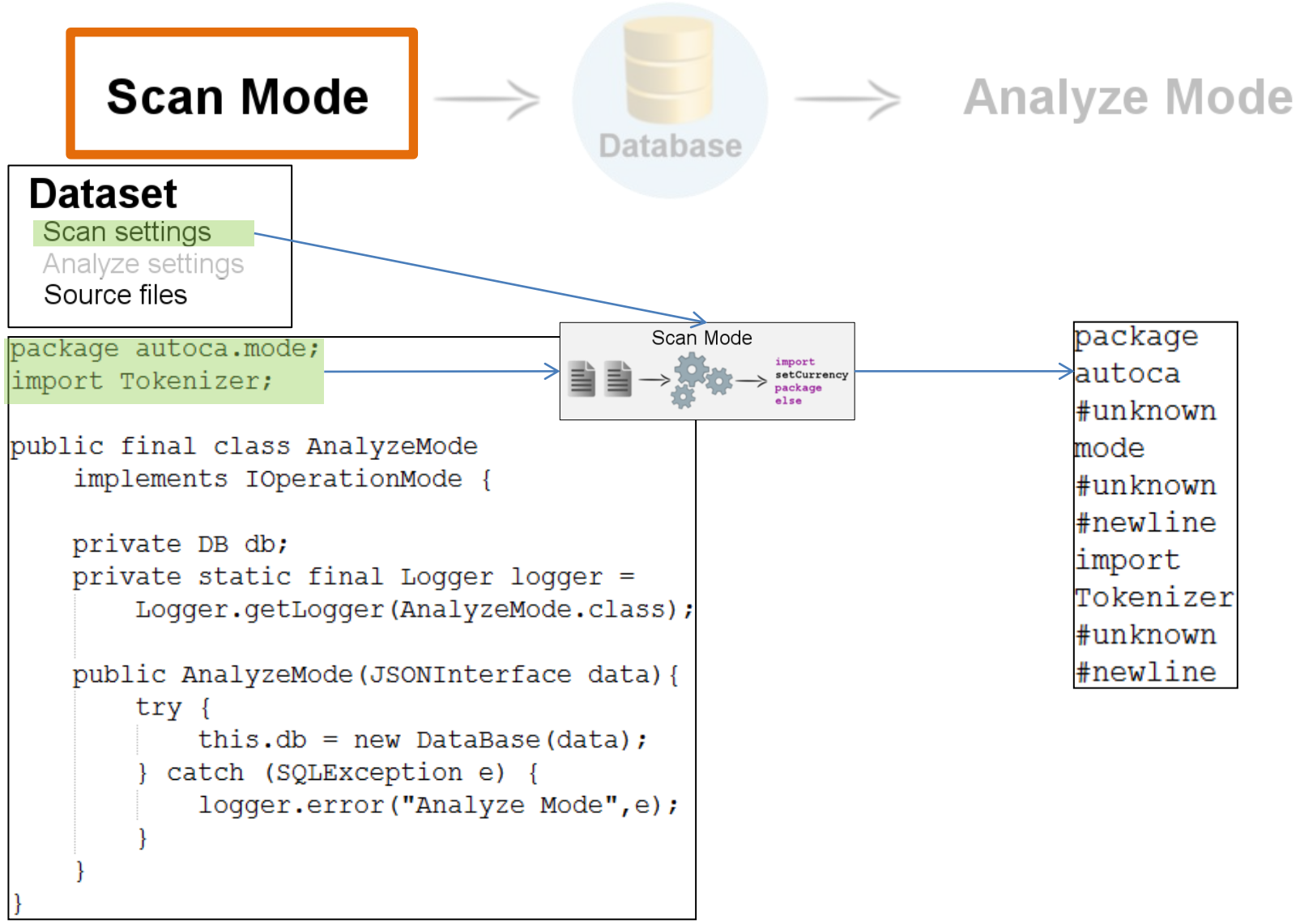
```
package autoca.mode;
import Tokenizer;

public final class AnalyzeMode
    implements IOperationMode {

    private DB db;
    private static final Logger logger =
        Logger.getLogger(AnalyzeMode.class);

    public AnalyzeMode(JSONInterface data){
        try {
            this.db = new DataBase(data);
        } catch (SQLException e) {
            logger.error("Analyze Mode",e);
        }
    }
}
```

2 Architecture



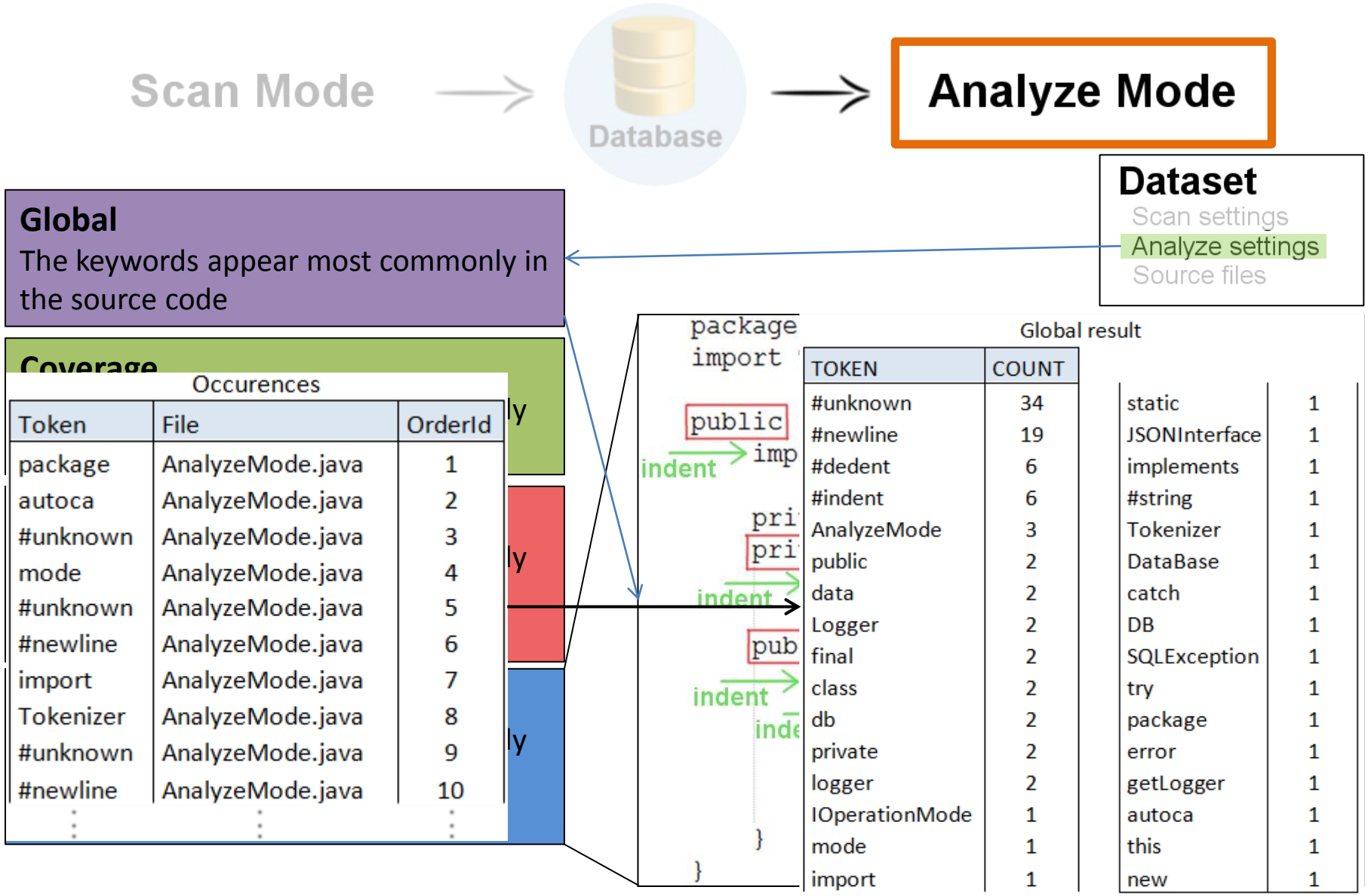
3 Database


```
package
autoca
#unknown
mode
#unknown
#newline
import
Tokenizer
#unknown
#newline
```

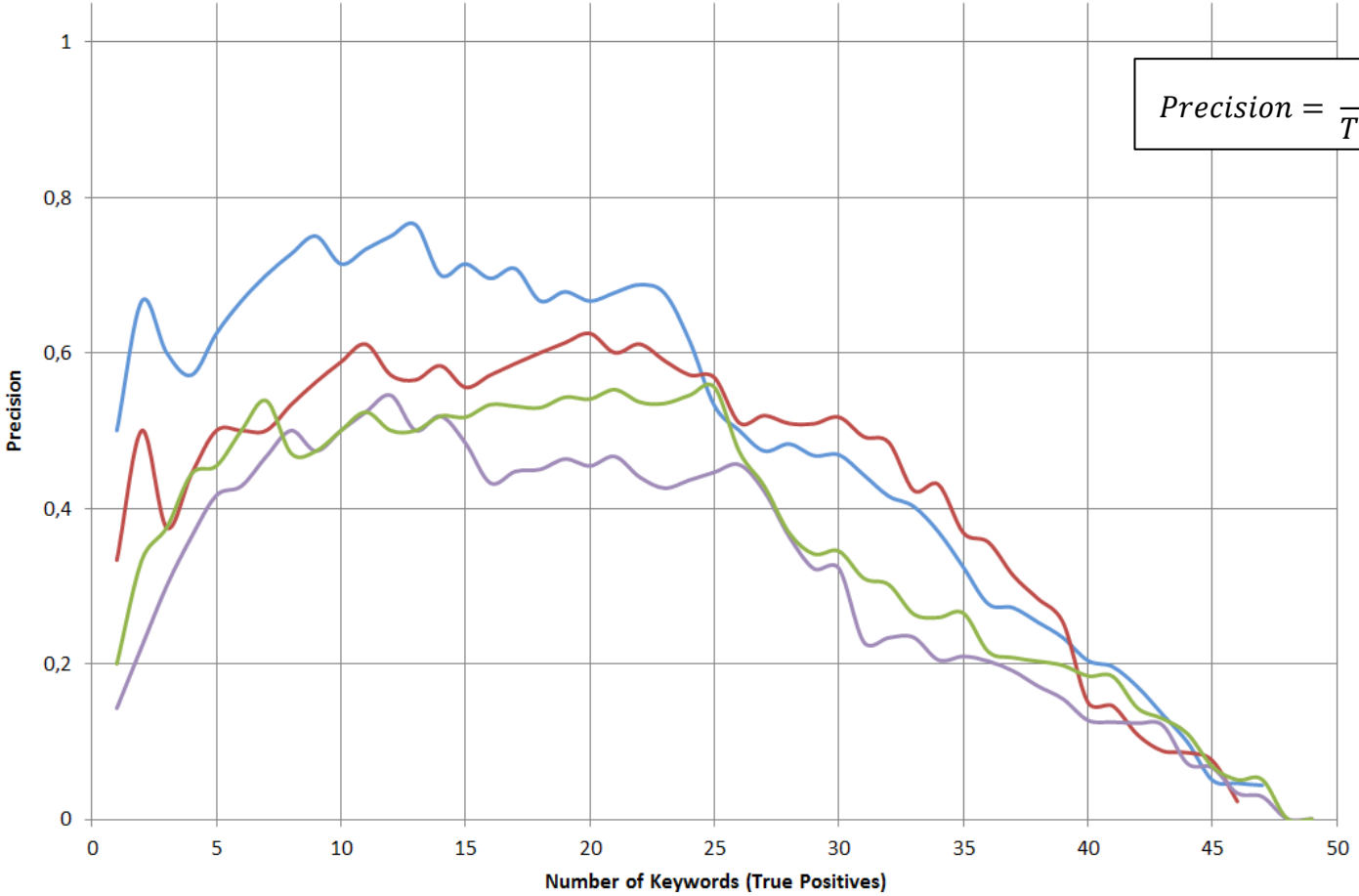
Occurences

Token	File	OrderId
package	AnalyzeMode.java	1
autoca	AnalyzeMode.java	2
#unknown	AnalyzeMode.java	3
mode	AnalyzeMode.java	4
#unknown	AnalyzeMode.java	5
#newline	AnalyzeMode.java	6
import	AnalyzeMode.java	7
Tokenizer	AnalyzeMode.java	8
#unknown	AnalyzeMode.java	9
#newline	AnalyzeMode.java	10

4 Analyze methods



5 Java result of the hypothesis



$$Precision = \frac{True\ Positive}{TruePositive + False\ Positive}$$

Keywords in Java: 50
Projects: 179
Files: 100’764
Distinct tokens: 414’334
Occurences of tokens: 92’036’362

Global
The keywords appear most commonly over all source code

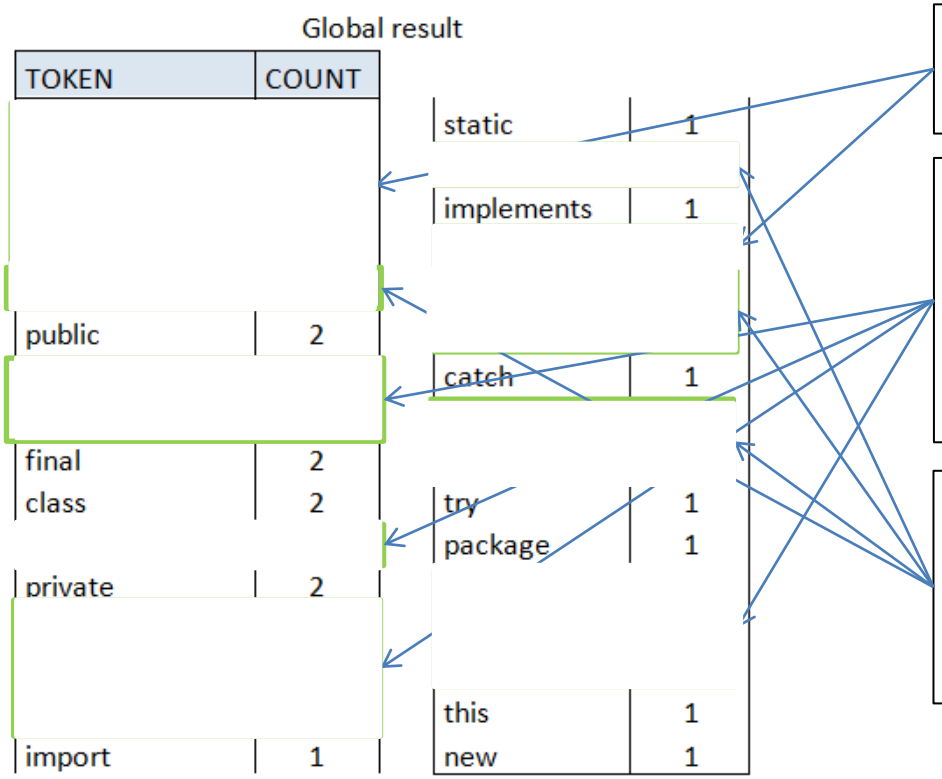
Coverage
The token that appear in most files are keywords

Newline
The token that appear in most files are keywords

Indent
The token at the beginning of a line before an indent are keywords

6 Filters

How can we improve those results?

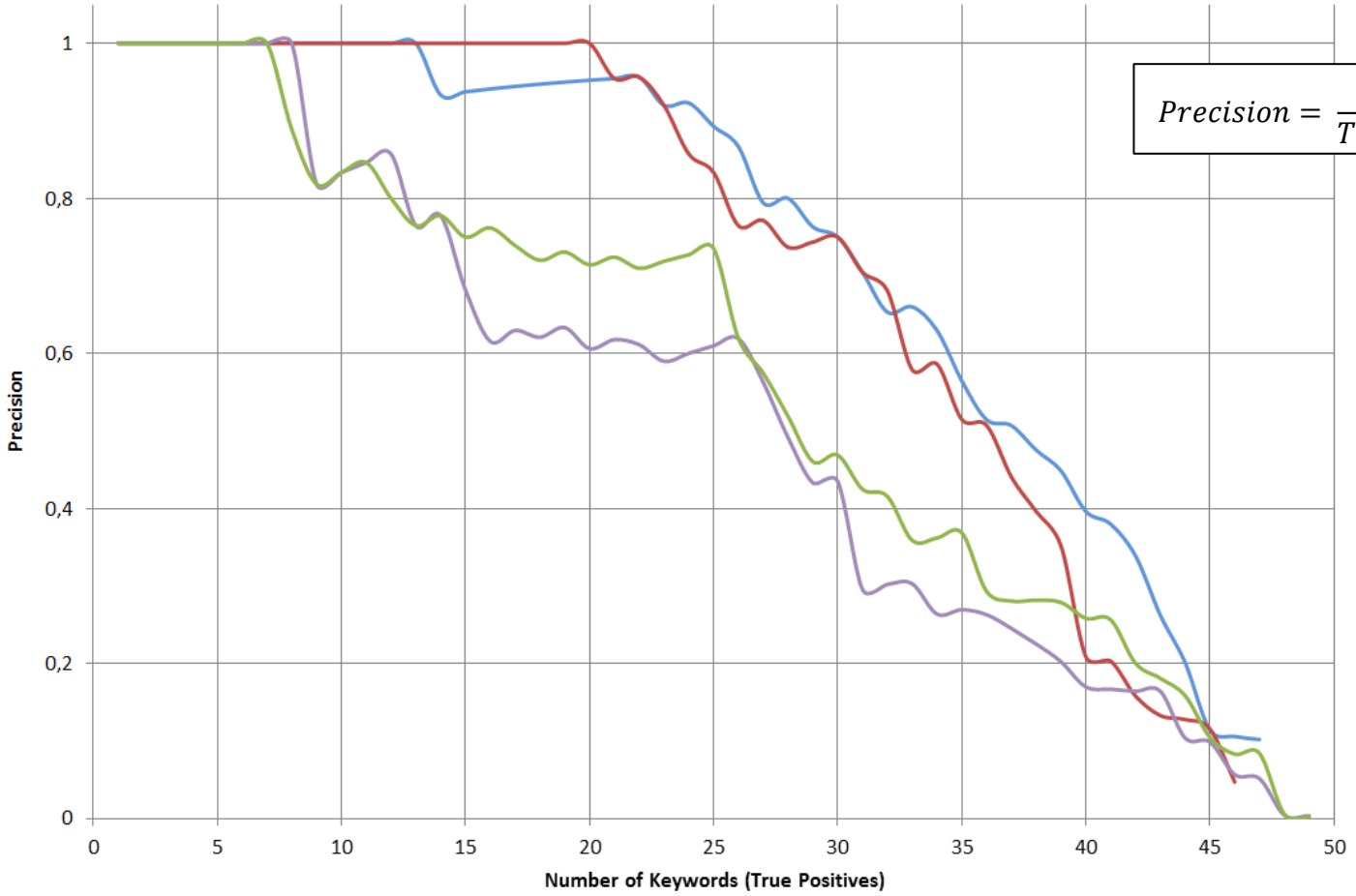


Scan mode filter: Removes all tokens marked by the scan mode.

Intersection filter: Counts in how many projects a token occurs and removes the tokens that don't occur in enough projects. Used to remove project specific pollution.

Upper case filter: Removes all tokens containing capital letters. Since in Java and many other languages keywords are written in lower-case letters.

7 Java results filtered



$$Precision = \frac{True\ Positive}{TruePositive + False\ Positive}$$

Keywords in Java: 50
Projects: 179
Files: 100’764
Distinct tokens: 414’334
Occurences of tokens: 92’036’362

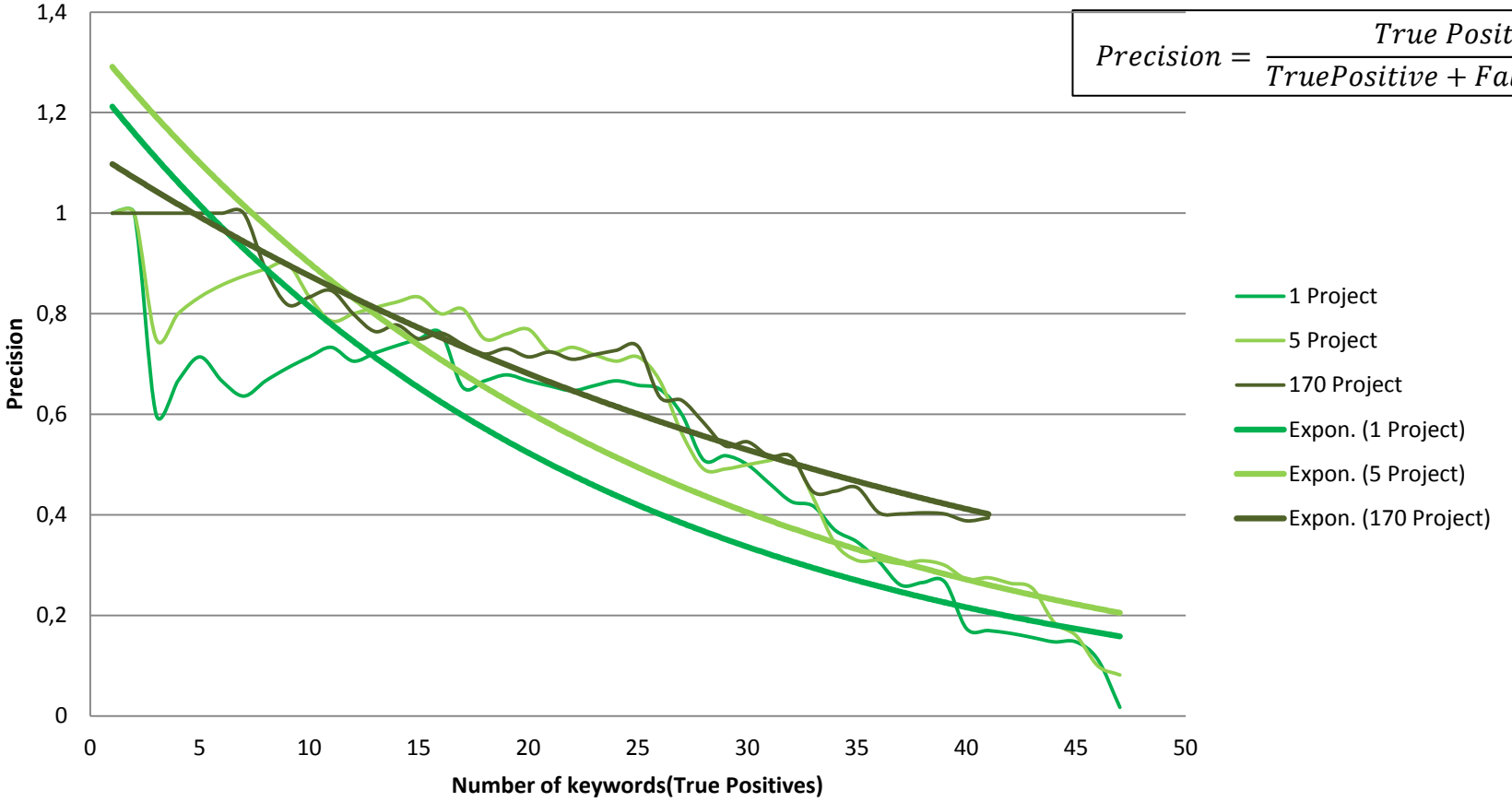
Global
The keywords appear most commonly over all source code

Coverage
The token that appear in most files are keywords

Newline
The token that appear in most files are keywords

Indent
The token at the beginning of a line before an indent are keywords

7 More data better Results?



$$Precision = \frac{True\ Positive}{TruePositive + False\ Positive}$$

Keywords in Java: 50
Projects: 179
Files: 100’764
Distinct tokens: 414’334
Occurences of tokens: 92’036’362

Coverage
The token that appear in most files are keywords

Intersection filter: Counts in how many projects a token occurs and removes the tokens that don’t occur in enough projects. Used to remove project specific pollution.

8 Summary