Improving Code Readability Models with Textual Features

Simone Scalabrino, Mario Linares-Vásquez, Denys Poshyvanyk, Rocco Oliveto
Software maintenance accounts for 70% of the costs of a project.
for (int i=1; i<=100; i++) {
    int a = ((528 >> i%15 - 1) & 1) * 4;
    int b = ((-2128340926 >> (i%15)*2) & 3) * 4;
    System.out.println("FizzBuzz".substring(a, b) + (a == b ? i : ":"));
}
Not really clear...
for (int i=1; i<=100; i++) {
    String fizzBuzz = "";
    if (i % 3 == 0)
        fizzBuzz += "Fizz";
    if (i % 5 == 0)
        fizzBuzz += "Buzz";
    if (fizzBuzz.isEmpty())
        fizzBuzz += i;
    System.out.println(fizzBuzz);
}
Why is it easier to understand?
Code readability
Learning a Metric for Code Readability
Raymond T.L. Bau, Wesley Skirvin

1. INTRODUCTION

It is well established that a human’s judgment of how easy a text is to understand. The readability of a text is related to its understanding, and it is thus important to measure the quality of software. Typically, maintenance would involve more than 20% of the total development cost of a software product [1]. A closely related measure is code maintainability [5]. It is important to ensure that the software is easy to understand and that it is easy to modify. However, the readability of software is often assessed qualitatively through subjective methods. Therefore, it is necessary to develop a metric that can quantify the readability of software.

ABSTRACT
Software readability is a property that describes how easy it is to read and understand. In the previous decades, many software metrics have been proposed to measure the readability of software. However, these metrics are often difficult to interpret and are not always effective. In this paper, we propose a new metric for code readability, which we call the “Code Readability Index.” The metric is based on the concept of the “normative reading time,” which is the time it takes a reader to read a piece of code. The metric is designed to be simple, easy to use, and effective in measuring the readability of software.

1. INTRODUCTION

Readability is a property that is related to the ease of understanding a text. It is an important property for software, as it affects the ease of understanding and the ease of modifying the software. There are many software metrics that have been proposed to measure the readability of software. However, these metrics are often difficult to interpret and are not always effective. In this paper, we propose a new metric for code readability, which we call the “Code Readability Index.” The metric is based on the concept of the “normative reading time,” which is the time it takes a reader to read a piece of code. The metric is designed to be simple, easy to use, and effective in measuring the readability of software.

Categories and Subject Descriptions
2.1 Software Engineering, Theory, Measurement

General Terms
2.1 Software Engineering, Theory, Measurement

Readability, Reliability, Empirical Evaluation
Code readability prediction
Code readability prediction
Introduction

We often rely on our own judgments of how easily a text is to understand. The quality of a document is related to its understandability, and in this case, its understandability is a measure of the text's quality. Typically, maintainability improves as 70% of the total length of a text. The use of text readability prediction models is essential for understanding the contents of a text. This study proposes a novel approach to predict readability using a combination of text features, including syntactic and semantic features.

Methods

We propose a novel approach to predict readability using a combination of text features, including syntactic and semantic features. The proposed model is trained on a diverse dataset consisting of articles from various domains. The model is evaluated using standard metrics such as accuracy, precision, recall, and F1-score. The results show that the proposed model outperforms existing models in terms of accuracy and F1-score.

Results

The proposed model achieves an accuracy of 92.7% on the test dataset, which is significantly higher than existing models. The model also achieves a high F1-score of 91.5%, indicating excellent performance in terms of both precision and recall.

Conclusion

In summary, we propose a novel approach to predict readability using a combination of text features. The proposed model outperforms existing models in terms of accuracy and F1-score, making it a promising tool for predicting the understandability of a text. Future work will focus on extending the model to other languages and domains.

Code readability prediction

Code readability prediction is a critical aspect of software development. It involves assessing the quality of code to ensure that it is easy to understand, maintain, and modify. This is important because poorly written code can lead to bugs, increased development time, and decreased productivity.

Recent research has shown that using code readability prediction models can improve the quality of software. These models analyze code metrics such as cyclomatic complexity, Halstead's complexity, and maintainability index. By predicting the readability of code, developers can identify areas that need improvement and make necessary changes to enhance the quality of the code.

These models can be used at different stages of software development, including pre-commit checks, code reviews, and maintenance. They help developers identify code that is difficult to understand and suggest ways to improve it. This not only enhances the quality of the code but also improves the overall productivity of the development team.

In conclusion, code readability prediction is a vital tool in software development. It helps developers write better code, improve maintainability, and enhance the overall quality of software. As technology continues to evolve, the importance of code readability prediction models is likely to increase, making them an essential part of the software development process.
Learning a Metric for Code Readability

A Simpler Model of Software Readability

A General Software Readability Model

Visual features

Structural features

Code readability prediction
Learning a Metric for Code Readability

Raymond F. L. Soares, Bradley Shirmohammadi

Abstract: In this paper, we present an algorithm for learning a metric for code readability from a large corpus of source code. Our approach is based on a deep learning model that takes into account various factors such as code structure, comments, and the usage of best practices.

A Simpler Model of Software Readability

Dennis D. Poirier, Daniele F. Spinello

Abstract: We propose a new model for software readability that is based on a simpler set of factors compared to previous models. Our model is easier to compute and still achieves comparable results.

A General Software Readability Model

Jonathan Zinz, Department of Computer Science

Abstract: We present a comprehensive model for software readability that includes a wide range of factors, including code complexity, structural features, and comments. Our model outperforms previous models in terms of predictive accuracy.

Code readability prediction

Two datasets

Structural features

Category and Subject Descriptions:

- Software Engineering
- Machine Learning
- Natural Language Processing

Code readability prediction

- Code structure
- Comments
- Best practices

Code readability prediction

- Complexity
- Structure
- Comments

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Code readability prediction

- Complexity
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Something is missing...
Code is text!
New features
Comments readability
Comments and identifiers consistency
Identifier terms in dictionary
Narrow meaning identifiers
Number of meanings
Textual coherence
New dataset

200 Java snippets

9 annotators

New dataset
Do textual features complement the others proposed in the literature?
Overlap metrics
Textual Features vs Buse's

- TF ∩ BWF: 66%
- TF \ BWF: 18%
- BWF \ TF: 16%
Textual Features vs Posnett’s

- TF ∩ PF: 62%
- TF \ PF: 17%
- PF \ TF: 21%

Legend:
- Red: TF ∩ PF
- Blue: TF \ PF
- Green: PF \ TF
Textual Features vs Dorn’s

- TF \ DF: 17%
- DF \ TF: 12%
- TF ∩ DF: 71%
Textual Features vs Dorn’s

Readability of 12%-21% of snippets can be explained only using textual features.
What is the accuracy of a readability model based on structural and textual features?
Dataset by Buse and Weimer

- ALL-F: 79%
- T-F: 74%
- D-F: 80%
- P-F: 78%
- BW-F: 81%
Dataset by Dorn

- ALL-F: 84%
- T-F: 77%
- D-F: 80%
- P-F: 73%
- BW-F: 79%
New dataset

- ALL-F: 80%
- T-F: 68%
- D-F: 76%
- P-F: 66%
- BW-F: 71%
New dataset

A model which includes all features achieves an higher accuracy on 2 datasets
In summary...

Code readability prediction

Code is text!

Case study

200 Java snippets by 9 annotators

New dataset

Textual Features vs Dorn's

Readability of 12%-21% of snippets can be explained only using textual features:

- TF \ DF
- DF \ TF

71%

New dataset

A model which includes all features achieves an higher accuracy on 2 datasets:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td>ALL</td>
<td>76%</td>
</tr>
<tr>
<td>DF</td>
<td>66%</td>
</tr>
<tr>
<td>TF</td>
<td>71%</td>
</tr>
<tr>
<td>DF \ TF</td>
<td>80%</td>
</tr>
</tbody>
</table>
Code readability for defect prediction
Thanks.