Automatic program bug fixing by focusing on finding the shortest sequence of changes

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Abstract

Automatic bug repair as the last step in program repair has attracted a lot of research attention. Various ideas and techniques have been presented in this field. Recent bug fixing techniques use machine learning and graphs to generate fixes. Despite the promising results of recent approaches, maintaining high speed and accuracy as well as recording a wide range of errors may still be a problem. In this paper, a new approach is presented in the field of automatic bug fixing based on graphs and model checking. For this purpose, we have used the graph transformation and model checking system to create a sequence of edits and produce fixes. Then, using meta-heuristic algorithms, we have selected the best solution and fix from the generated solutions. We use the extracted graphs from the buggy JavaScript code and their corresponding bug-free ones. In evaluating the effectiveness of the proposed method, we implement it in GROOVE, which is a toolbox used to design and check graph transformation systems. Experimental results on identical dataset demonstrate that the proposed method outperforms other related methods in generating fixes. Also, this method covers a wider range of bugs compared to previous methods.

Keywords Bug fixing · Graph transformation system · Model checking · Machine learning

1 Introduction

Automatic program repair operation includes detecting, locating and fixing bugs in the source code. A software bug is a flaw or error in the source code that produces unexpected results. The time interval when the first software bug is reported, as well as the time to correct the bug, has a main impact on the reliability of the software (Yousofvand et al. 2023).

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