

Generalized Algorithmic Debugging and Testing

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Abstract

This paper presents a version of generalized algorithmic debugging integrated with the category partition method for functional testing. In this way the efficiency of the algorithmic debugging method for semi-automatic bug localization can be improved by using test specifications and test results. The long-range goal of this work is a semi-automatic debugging and testing system which can be used during large-scale program development of non-trivial programs.

The method is generally applicable to procedural languages, and is not dependent on any ad hoc assumptions regarding the subject program. The original form of algorithmic debugging, introduced by Shapiro [Shapiro-83], is however limited to small Prolog programs without side-effects. Another drawback of the original method is the large number of interactions with the user during bug localization.

To our knowledge, this is the first method which uses category partition testing to improve the bug localization properties of algorithmic debugging. The method can avoid irrelevant questions to the programmer by categorizing input parameters, and match these against test cases in the test database. In addition, we use program slicing, a data flow analysis technique, to dynamically compute which parts of the program are relevant for the search, thus further improving bug localization.

We believe that this is the first generalization of algorithmic debugging for programs with side-effects written in imperative languages such as Pascal. These improvements together makes it more feasible to debug larger programs.

A prototype generalized algorithmic debugger for Pascal, and a test case generator for real size application programs in Pascal, C, dBase and LOTUS have been implemented.

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1. Introduction

Debugging has always been a costly part of software development, and several attempts have been made to provide automatic computer support for this task [Seviora-87]. The Algorithmic Debugging Technique, introduced by Shapiro [Shapiro-83] was the first attempt to lay a theoretical framework for program debugging and to take this framework as a basis for a partly automatic debugger. In this system, the programmer supplies a partial specification of the program during the bug localization process, by answering questions. However Shapiro's model cannot handle side-effects or loops, and has only been applied to Prolog programs. This restriction prevents the system from being practically useful for programs written in imperative languages.

Furthermore, a major drawback of algorithmic debugging is the great number of user interactions during the debugging process. Thus, an important improvement would be to supply the debugging system with some information which can reduce this number.

An algorithmic debugging method for imperative languages is discussed in [Shahmehri, Fritzson-89]. A major improvement in the bug-localization process is demonstrated in [Shahmehri, et al-90] by combining program slicing and algorithmic debugging. Program slicing, as presented by [Weiser-84] is a method for automatically decomposing programs by analyzing their data flow and control flow. This method isolates individual computation threads within a program. The size of a slice is usually program and input dependent. However in practice, a slice is often much smaller than the original program, especially for block-structured languages.

In this paper we present a further improvement in the bug-localization process by combining the category partition testing method [Ostrand, Balcer-88] with the algorithm introduced in [Shahmehri, et al-90]. The main concept of the improvement is the following: During the debugging of a real program the user has to answer a great number of "difficult" questions. For example, suppose that the program contains a procedure which computes the sum of an array and this procedure is called with an actual parameter which is an array

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Übersetzung objektorientierter Programmiersprachen Bernhard Bauer, Riitta Höllerer, 2013-03-07 Dieses Lehrbuch vermittelt Studierenden und Praktikern die Grundlagen für die Entwicklung von Übersetzern für objektorientierte Programmiersprachen. In einem Theorieteil werden zunächst ausführlich und anschaulich die Konzepte dieser Sprachen und ihrer Übersetzung behandelt, so dass der Leser einen umfassenden Überblick über die verschiedenen Übersetzungstechniken erhält. Die Übersetzung von Smalltalk 80, Java und C wird über eine einfache abstrakte virtuelle Maschine vereinheitlicht. Im Praxisteil des Buches wird dann die Spezifikation eines Übersetzers für Java entwickelt. Diese kann als Eingabe für einen Übersetzergenerator verwendet werden, der daraus ein lauffähiges C-Programm erzeugt. In einem abschließenden Praktikum mit Aufgaben und Lösungen. Gesamtumfang im WWW wird der vermittelte Stoff am Beispiel der Entwicklung eines Java Compilers eingetbt.

Proceedings of the ACM SIGPLAN'91 conference on programming language design and implementation, Toronto, Ontario, Canada, June 26-28, 1991, 1991 [Proceedings of the ACM SIGPLAN '91 Conference on Programming Language Design and Implementation](#), 1991 [Engineering a Compiler](#) Keith D. Cooper, Linda Torczon, 2011-01-18 This entirely revised second edition of *Engineering a Compiler* is full of technical updates and new material covering the latest developments in compiler technology. In this comprehensive text you will learn important techniques for constructing a modern compiler. Leading educators and researchers Keith Cooper and Linda Torczon combine basic principles with pragmatic insights from their experience building state-of-the-art compilers. They will help you fully understand important techniques such as compilation of imperative and object-oriented languages, construction of static single assignment forms, instruction scheduling and graph coloring, register allocation. In-depth treatment of algorithms and techniques used in the front end of a modern compiler. Focus on code optimization and code generation, the primary areas of recent research and development. Improvements in presentation including conceptual overviews for each chapter, summaries and review questions for sections, and prominent placement of definitions for new terms. Examples drawn from several different programming languages. *Proceedings of the 1994 International Conference on Computer Languages*, 1994

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