

# Generalized Algorithmic Debugging and Testing

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This paper presents a method for semi-automatic bug localization, generalized algorithmic debugging, which has been integrated with the category partition method for functional testing. In this way the efficiency of the algorithmic debugging method for 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 nontrivial 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, was however limited to small Prolog programs without side-effects, but has later been generalized to concurrent logic programming languages. 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 then match these against test cases in the test database. Additionally, 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. However, additional improvements are needed to make it handle pointer-related side-effects and concurrent Pascal programs.

A prototype generalized algorithmic debugger for a Pascal subset without pointer side-effects and a test case generator for application programs in Pascal, C, dBase, and LOTUS have been implemented.

**Categories and Subject Descriptors:** D.2.5 [Software Engineering]: Testing and Debugging—debugging aids; D.2.6 [Software Engineering]: Programming Environments

**General Terms:** Algorithms, Experimentation, Performance

**Additional Key Words and Phrases:** Algorithmic debugging, automated debugging, category partition testing, program slicing

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# Generalized Algorithmic Debugging

**Conference on Software Maintenance**



## **Generalized Algorithmic Debugging:**

**Generalized Algorithmic Debugging**, 1991      **Generalized Algorithmic Debugging** N. Shahmehri, 1991 Abstract  
This thesis presents a novel method for semi automatic program debugging the Generalized Algorithmic Debugging Technique GADT The notion of declarative algorithmic debugging was first introduced for logic programming However this is the first algorithmic debugging method based on the principle of declarative debugging which can handle the debugging of programs written in an imperative language including loops and side effects In order to localize a bug the debugging algorithm incrementally acquires knowledge about the debugged program The knowledge is supplied by the user The algorithm terminates when the bug has been localized to within the body of a procedure or an explicit loop The generalized algorithmic debugging method uses program transformation and program flow analysis techniques to transform the subject program to a largely side effect free internal form which is used for bug localization Thus this algorithm defines two views of a program 1 The user view which is the original program with side effects and 2 the transformed view which is the transformed side effect free version of the original program Transparent program debugging is supported by maintaining a mapping between these two views The bug localization algorithm works on the transformed version whereas user interactions are defined in terms of the user view We have presented a general technique which is not based on any ad hoc assumptions about the subject program The flexibility of this method has made it possible to further improve the bug localization algorithm by employing a number of other techniques i e program slicing and test database lookup thus increasing the degree of automation provided by GADT These extensions are topics for ongoing research projects and future work A survey and evaluation of a number of automated debugging systems and the techniques behind these systems are also presented We have introduced several criteria for comparing these techniques with GADT A prototype implementation of the generalized algorithmic debugging technique has been carried out to verify its feasibility and to provide feedback for further refinement of the method This has already resulted in a more efficient set of transformations described in the thesis compared to the initial prototype

**Generalized Algorithmic Debugging and Testing** Linköping University. Dept. of Computer and Information Science, P. Fritzson, T. Gyimothy, Mariam Kamkar, Nahid Shahmehri, 1990

**Logic-Based Program Synthesis and Transformation** Germán Puebla, 2007-03-16 This book constitutes the thoroughly refereed postproceedings of the 16th International Symposium on Logic Based Program Synthesis and Transformation LOPSTR 2006 held in Venice Italy July 2006 in conjunction with ICALP 2006 PPDP 2006 and CSFW 2006 The 14 revised full papers cover tools for program development partial evaluation and program transformation security and synthesis debugging and testing as well as termination and analysis

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software technology software engineering distributed systems data management knowledge based systems Programming Language Implementation and Logic Programming Maurice Bruynooghe, Martin Wirsing, 1992 This volume contains the papers accepted for presentation at the Fourth International Symposium on Programming Language Implementation and Logic Programming PLILP 92 held in Leuven Belgium August 26 28 1992 The aim of the symposium was to explore new declarative concepts methods and techniques relevant for implementation of all kinds of programming languages whether algorithmic or declarative The symposium gathered researchers from the fields of algorithmic programming languages as well as logic functional and object oriented programming The topics discussed in the volume include Declarative implementation techniques Implementation of declarative concepts and modules Compiler specification and construction Program transformation Programming environments for declarative languages Amalgamation of logic programming with algorithmic functional or object oriented techniques Executable specification PUBLISHER S WEBSITE Principles and Practice of Declarative Programming ,2006 **Journal of Programming Languages** ,1995 **Proceedings** Conference on Software Maintenance,1990 **Proceedings of the ... International ACM SIGPLAN Conference on Principles and Practice of Declarative Programming** ,2009 ICOIN the 15th ,2001 IEEE Computer Society Order Number PR00951 Verso of t p **Inductive Logic Programming** ,1998 ACM SIGPLAN notices ,1991 Proceedings, 1993 ACM Computer Science Conference Stan C. Kwasny, John F. Buck, 1993 **Report CS-R** ,1994 Automated and Algorithmic Debugging Peter A. Fritzson, 1993-11-10 Debugging has always been a costly part of software development and many attempts have been made to provide automatic computer support for this task Automated debugging has seen major developments over the last decade One successful development is algorithmic debugging which originated in logic programming but was later generalized to concurrent imperative and lazy functional languages Important advances have also been made in knowledge based program debugging and in approaches to automated debugging based on static and dynamic program slicing based on dataflow and dependence analysis technology This is the first collected volume of papers on automated debugging and presents latest developments tutorial papers and surveys

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