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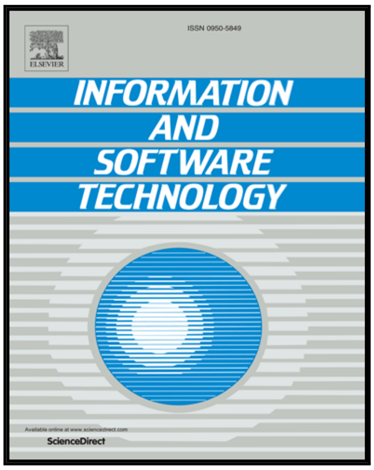

KD-ART: Should we intensify or diversify tests to kill mutants?

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KD-ART: Should we intensify or diversify tests to kill mutants?

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Abstract

Context: Adaptive Random Testing (ART) spreads test cases evenly over the input domain. Yet once a fault is found, decisions must be made to diversify or intensify subsequent inputs. Diversification employs a wide range of tests to increase the chances of finding new faults. Intensification selects test inputs similar to those previously shown to be successful.
Objective: Explore the trade-off between diversification and intensification to kill mutants.
Method: We augment Adaptive Random Testing (ART) to estimate the Kernel Density (KD–ART) of input values found to kill mutants. KD–ART was first proposed at the 10th International Workshop on Mutation Analysis. We now extend this work to handle real world non numeric applications. Specifically we incorporate a technique to support programs with input parameters that have composite data types (such as arrays and structs).
Results: Intensification is the most effective strategy for the numerical programs (it achieves 8.5% higher mutation score than ART). By contrast, diversification seems more effective for programs with composite inputs. KD–ART kills mutants 15.4 times faster than ART.
Conclusion: Intensify tests for numerical types, but diversify them for composite types.

Keywords: mutation analysis, adaptive random testing, intensification and diversification

1. Introduction

Kernel Density Adaptive Random Testing (KD–ART) is a new approach for improving the effectiveness of random testing by taking advantage of run-time test execution information. KD–ART has two stages: it starts by applying the traditional ART algorithm to generate test inputs that cover the input domain as evenly as possible, whilst collecting information about the run-time properties of these tests; then it applies Kernel Density Estimation (KDE) [1] to generate new test inputs according to the distribution of tests that were found to have useful run-time properties. Random Testing (RT) aims to reveal faults by executing a wide range of values from the input domain of the program under test [2]. Although this idea is simple, research and industry suggest RT can be effective and scalable [3, 4]. Its biggest drawback is the cost of evaluating all the test cases. We address this problem by using KD–ART to select test inputs which are more likely to find faults.

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