

CAREER: Pseudo-Exhaustive Testing: Integration of Traditional Testing with Exhaustive Testing

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PROJECT SUMMARY

Traditional testing has been insufficient to prove the validity of critical softwares whose malfunction would have severe consequences. On the other hand Exhaustive testing, which is testing every element of the domain, is often unfeasible. We propose pseudo-exhaustive testing, where we integrate traditional testing with exhaustive testing, to solve this problem. We will use pseudo-exhaustive testing on a well documented system, in order to check whether this method catches errors which were not detected by the traditional testing. The approach involves defining the formal specification of the system from its documentation. Based on the formal specification, corresponding assertions would be embedded in the source code. These assertions can be used to act as "oracles", to validate the output from the test data sets. We will discuss the Pseudo-Exhaustive testing and review our preliminary results.

Intellectual Merit

The main goal of this research is to develop a testing methodology which is comparable to Exhaustive Testing but is feasible in large software systems.

In small software systems where the test data set is finite, it is possible to generate all possible test cases and Exhaustive Testing is practical. Unfortunately the functional domain is often infinite or sufficiently large, making Exhaustive Testing quite unfeasible or impossible. This is the case when traditional testing is normally used. In the case where the software system in question is of great importance to human life, traditional testing does not provide complete assurance that the system will function correctly every time. Ideally, Exhaustive testing would be used to verify every input, but this has been proven impractical and impossible at times. We propose a method of combining the ideas of traditional testing and Exhaustive Testing in the form of Pseudo-Exhaustive Testing. In this way, we hope to find a form of testing that will bring complete quality assurance for software systems in important real-life situations.

We do not yet know how to ensure the total reliability of software systems without completely testing every element of the test data set. We lack a method for generating every equivalence class of a given test data set in order to obtain the aforementioned total reliability of the system. It has been shown that there is no algorithm to find consistent, valid, and complete test criteria. This confirms that complete testing is a very difficult process. We propose developing an instance to find a test set that is large enough to span the domain and small enough that testing can be realistically performed for each element of the test set in order to solve this problem.

Broader Impact

This proposal seeks to address the problem of testing software at a reasonable cost and time. The research seeks to bolster the reliability of critical systems, whose failure can result in loss of time, revenue, or life. In addendum, Pseudo-Exhaustive Testing can have a significant impact on quality assurance of software systems, both in industry and in academia.