Model-based Ideal Testing of Sequential Systems

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Abstract. The crucial problem of testing as a validation technique is that it usually shows the *presence* of faults but not their *absence* [1]. In 1975, Goodenough and Gerhart (GG) showed that properly structured tests are capable of demonstrating the absence of errors in a program [2]. The phrase *properly* entails precisely defined criteria for selecting test cases. However, GG focus on the *implementation* (source code) of a program rather than its *specification* as a model, thus considerably limiting the scope of their approach to program codes only.

The present approach proposes to extend GG's approach to *model-based* analysis and testing sequential systems *in toto* (hardware and software), based on their formal specification, using the concepts of holistic testing and mutation testing to satisfy GG's criteria. *Holistic* testing, in this context, comprises *positive* testing to show that the system under consideration (SUC) functions the way the user desires, and *negative* testing to show that SUC does not do anything the user would not desire [3]. *Mutation* testing, on the other hand, modifies the SUC to generate its faulty versions to model undesirable situations to be checked against the original one [4]. Thus, the proposed *model-based ideal testing* (MBIT) enables us to show both the presence and the absence of the faults in the scope of the specification of the SUC.

The approach is evaluated analytically and experimentally on various types of case studies: mobile communication and computing, graphical user interfaces, and sequential circuits. Their results show that the proposed approach effectively provides us with the set of test suites required to test the presence and absence of faults with the ideal testing.

Keywords: Fundamental Test Theory, Model-Based Testing, Finite-State Machines, Regular Expressions, Sequential Systems, Mutation Analysis and Testing

References

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