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DISSERTATION TITLE: *Evolutionary Computation Based Test Optimization of Large-Scale Systems*

Modern large-scale software systems are highly configurable requiring a large number of test cases to be implemented and revised for testing different system configurations. This requires a lot of time and effort to test the software, which is not feasible due to budget constraints (e.g., limited time available for testing). Thus, this thesis proposes a set of methods based on evolutionary computation for cost-effective testing to address the needs of our industrial partner, Cisco Systems Norway for testing their video conferencing systems.

Cost-effective testing in Cisco can be formulated into four major problems: 1) test case prioritization (TCP) to cost-effectively prioritize the existing test cases, 2) test case selection (TCS) to cost-effectively select a subset of test cases based on user preference for different objectives, 3) test case implantation (TCI) to modify existing test cases to cost-effectively test the untested configurations, and 4) dynamic test case prioritization (DTP) to dynamically prioritize test cases based on runtime execution results in order to further improve the results of test case prioritization.

To tackle the above-mentioned challenges, this thesis proposes a set of methods based on evolutionary computation through seven papers (four conferences sand three journals). It includes a: 1) Search-based prioritization approach to tackle TCP; 2) Search-based test case selection approach to select test cases within a time budget to address TCS; 3) Search-based test case implantation approach to automatically analyze and modify existing test cases to address TCI; 4) Rule mining and search-based approach to tackle DTP. In addition, this thesis proposes two cluster-based genetic algorithms to address the shortcomings of the current state-of-the-art search algorithms for multi-objective test optimization. The results of empirical evaluations showed that the proposed methods could significantly improve the performance for all the identified challenges as compared with the state-of-the-art, and thus, help in cost-effective testing.