Lightweight Automated Testing with Adaptation-Based Programming

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Abstract: This paper considers the problem of testing a container class or other modestly-complex API-based software system. Past experimental evaluations have shown that for many such modules, random testing and shape abstraction based model checking are effective. These approaches have proven attractive due to a combination of minimal requirements for tool/language support, extremely high usability, and low overhead. These “lightweight” methods are therefore available for almost any programming language or environment, in contrast to model checkers and concolic testers. Unfortunately, for the cases where random testing and shape abstraction perform poorly, there have been few alternatives available with such wide applicability. This paper presents a generalizable approach based on reinforcement learning (RL), using adaptation-based programming (ABP) as an interface to make RL-based testing (almost) as easy to apply and adaptable to new languages and environments as random testing. We show that learned tests differ from random ones, and propose a model for why RL works in this unusual (by RL standards) setting, in the context of a detailed large-scale experimental evaluation of lightweight automated testing methods.