

Evolutionary Testing

- Overview -

Joachim Wegener

DaimlerChrysler AG, Research and Technology, Alt-Moabit 96a, D-10559 Berlin, Germany
Joachim.Wegener@daimlerchrysler.com

Abstract

Testing is the most important analytical quality assurance measure. It typically consumes 30-50 % of the overall development effort and budget. Essential to a good test quality is the systematic design of test cases. The test cases defined decide about kind and scope of the test. In most cases test case design is difficult to automate, e.g. for functional testing the generation of test cases is usually not possible since no formal specifications are applied in industrial practice, and for structural testing the limits of symbolic execution make an entire automation impossible. Furthermore, testing non-functional properties is only insufficiently supported by existing test methods. Therefore, in practice test cases are usually defined manually.

A promising approach to automate test case design for various test objectives is evolutionary testing. Evolutionary testing refers to the use of meta-heuristic search techniques for test data generation. The input domain of the system under test represents the search space in which test data fulfilling the test objectives under consideration are searched for. The Evolutionary test is generally applicable since it adapts itself to the system under test. Whenever a test objective may be expressed numerically, the deployment of evolutionary testing for the automation of test case design is possible. The appropriate formalisation of the test objective is the key to success. Each generated test datum is executed and its performance is evaluated with respect to the test objective. Good test data are selected and subjected to combination and mutation processes to generate new test data.

Because of the complete automation of evolutionary tests the system can be tested with a large number of different input situation. Commonly, more than several thousand test data sets are generated and executed within only a few minutes. Prerequisites for the application of evolutionary tests are extremely few. Only an interface specification of the system under test is needed in order to guarantee the generation of valid input values.

Application fields for evolutionary testing are, for instance, safety and robustness testing, testing the temporal behavior of systems as well as the automation of structural testing. Furthermore, applications to functional testing, mutation testing, and assertion testing have been reported by different authors.

The application of evolutionary test has been successfully proved in several case studies and first industrial applications. Effectiveness and efficiency of the test process can be clearly improved by evolutionary tests. Evolutionary tests thus contribute to quality improvement and to the reduction of development costs.