Toward Sustainable Software for Science - Implementing and Assessing Systematic Testing Approaches for Scientific Software

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INTRODUCTION

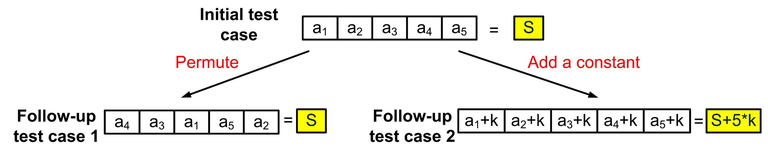
Custom scientific software is widely used in science and engineering. Often such software plays an important role in critical decision making. But, due to the lack of systematic testing in scientific software, subtle faults can remain undetected. One of the greatest challenges for systematic testing of scientific software is the *oracle problem*. We aim to develop automated testing techniques to overcome this challenge. These techniques will be implemented in **METtester:** a publically available testing tool that can be used in the day-to-day scientific development process.

RESEARCH OBJECTIVES

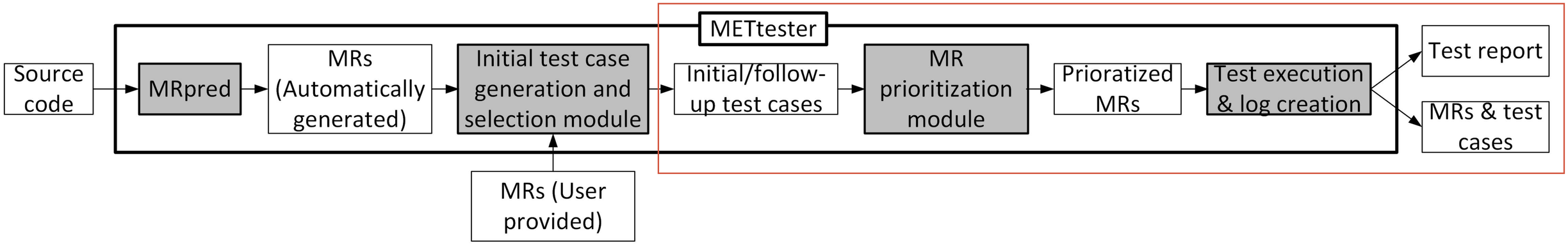
- Develop and evaluate techniques for creating automated test oracles for scientific programs.
- Develop approaches for automatically generating and selecting test cases to improve the effectiveness of partial oracles.
- Develop inexpensive automated methods for evaluating the effectiveness of test oracles.
- Develop a publicly available automated testing tool: METtester for scientific software.

METAMORPHIC TESTING

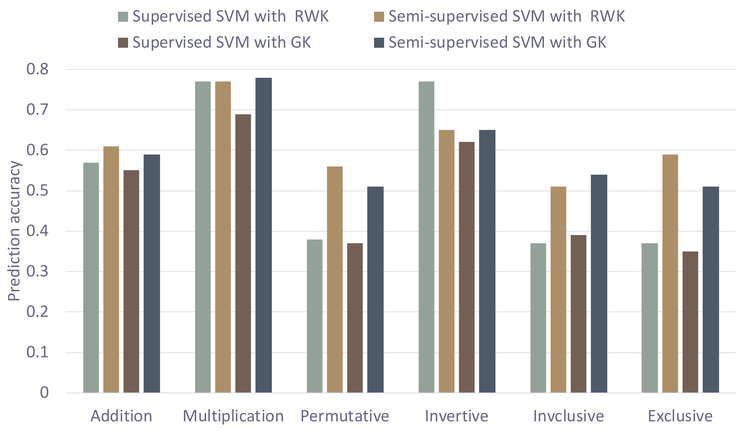
Operates by checking whether the program under test behaves according to an expected set of properties known as *metamorphic relations (MRs)*.



METTester

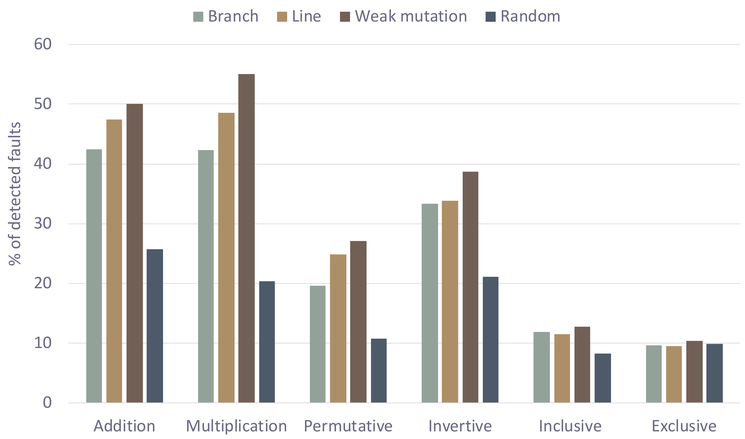


SEMI-SUPERVISED MR PREDICTION



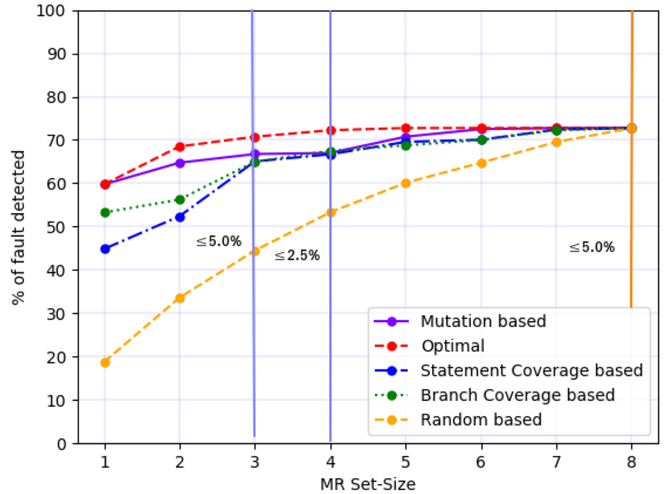
Prediction accuracy comparison of supervised SVM vs semi-supervised SVM using random walk kernel (RWK) and graphlet kernel (GK) for predicting six commonly used MRs

INITIAL TEST CASE GENERATION



Variation of % faults detected with automated initial test generation strategies for six commonly used MRs

MR PRIORITIZATION



% of faults detected with the number of MRs used for testing BBMap