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# Bachelor/Master Thesis Topic

## Search-Space Classification for Test Case Selection and Prioritization Problems

### Motivation and Background

As the complexity of software increases, designing and developing new software systems becomes more challenging. To handle this complexity, there is a trend to partially automate software development tasks supported by optimization methods. This area is known as Search Based Software Engineering (SBSE) [Har07a].

Test case selection and prioritization techniques are usually applied during regression testing [YH12], which is a quality assurance activity that provides confidence that code changes and the resulting evolution steps do not break the current functionality of the system. The goal of regression testing is to uncover behavioral changes from one software version to the next. These changes are known as regression errors. Since test suites grow during the evolution of a software systems because more and more functionality is covered by the test cases, large projects cannot re-run the complete test suite for every build of the system. As a result, it is the goal of a search process to minimize the test suite [REM<sup>+</sup>04, SYGM15], select the most suitable test cases [YH07] or to prioritize the test cases [DRK06, DMTR10, EMR02, KKT07, LHH07, LLC<sup>+</sup>16, MIA<sup>+</sup>16, SYGM15] with the goal to have a highest chance to uncover regression errors in a limited testing time budget [YH12]. Generally, SBSE techniques are suitable for these problems, since regression testing provides a clear oracle when a test case has failed. This oracle is constructed by the test results of the previous and the current software version. If both are identical no regression error has been revealed.

### Goals

The goal of this project is to analyse the search space for common test case selection and prioritization problems.

### Description of the Task

- Understand the current problems in test case selection and prioritization
- Run and analyse experiments in the area of test case selection and prioritization
- Provide information/characterization about the search spaces in this area

### Research Type

Theoretical Aspects: \*\*\*\*\*

Industrial Relevance: \*\*\*\*\*

Implementation \*\*\*\*\*

### Prerequisite

The student should be enrolled in the bachelor/master of computer science program, and has completed the required course modules to start a bachelor/master thesis.

### Skills required

Programming skills in Java or C++, understanding of, or willingness to learn, the software engineering and software analysis foundations needed for the project.

### Contacts

Lars Grunske, Humboldt-Universität zu Berlin, Institut für Informatik, Lehrstuhl Software Engineering, Unter den Linden 6, 10099 Berlin, Germany

### Application

Please contact me during my office hours or send me an email with the title: “[ThesisProject]-SC4SBSE-TestSelectPrio” to [se-career@informatik.hu-berlin.de](mailto:se-career@informatik.hu-berlin.de)

## References

- [DMTR10] Hyunsook Do, Siavash Mirarab, Ladan Tahvildari, and Gregg Rothermel. The effects of time constraints on test case prioritization: A series of controlled experiments. *IEEE Trans. Software Eng.*, 36(5):593–617, 2010.
- [DRK06] Hyunsook Do, Gregg Rothermel, and Alex Kinneer. Prioritizing junit test cases: An empirical assessment and cost-benefits analysis. *Empirical Software Engineering*, 11(1):33–70, 2006.
- [EMR02] Sebastian G. Elbaum, Alexey G. Malishevsky, and Gregg Rothermel. Test case prioritization: A family of empirical studies. *IEEE Trans. Software Eng.*, 28(2):159–182, 2002.
- [Har07a] Mark Harman. The current state and future of search based software engineering. In *International Conference on Software Engineering, ISCE 2007, Workshop on the Future of Software Engineering, FOSE 2007*, pages 342–357, 2007.
- [KKT07] Bogdan Korel, George Koutsogiannakis, and Luay Ho Tahat. Model-based test prioritization heuristic methods and their evaluation. In *3rd Workshop on Advances in Model Based Testing, A-MOST 2007*, pages 34–43. ACM, 2007.
- [LHH07] Zheng Li, Mark Harman, and Robert M. Hierons. Search algorithms for regression test case prioritization. *IEEE Trans. Software Eng.*, 33(4):225–237, 2007.
- [LLC<sup>+</sup>16] Yafeng Lu, Yiling Lou, Shiyang Cheng, Lingming Zhang, Dan Hao, Yangfan Zhou, and Lu Zhang. How does regression test prioritization perform in real-world software evolution? In *Int. Conf. on Software Engineering*, 2016.
- [MIA<sup>+</sup>16] Alessandro Marchetto, Mahfuzul Islam, Waseem Asghar, Angelo Susi, and Giuseppe Scanniello. A multi-objective technique to prioritize test cases. *IEEE Trans. Software Eng.*, online first(accepted), 2016.
- [REM<sup>+</sup>04] Gregg Rothermel, Sebastian G. Elbaum, Alexey G. Malishevsky, Praveen Kallakuri, and Xuemei Qiu. On test suite composition and cost-effective regression testing. *ACM Trans. Softw. Eng. Methodol.*, 13(3):277–331, 2004.
- [SYGM15] August Shi, Tiffany Yung, Alex Gyori, and Darko Marinov. Comparing and combining test-suite reduction and regression test selection. In *Foundations of Software Engineering, ESEC/FSE 2015*, pages 237–247. ACM, 2015.
- [YH07] Shin Yoo and Mark Harman. Pareto efficient multi-objective test case selection. In *ACM/SIGSOFT International Symposium on Software Testing and Analysis, ISSTA 2007*, pages 140–150. ACM, 2007.
- [YH12] Shin Yoo and Mark Harman. Regression testing minimization, selection and prioritization: a survey. *Softw. Test., Verif. Reliab.*, 22(2):67–120, 2012.