

Automating Metamorphic Testing in Large Scale Systems

Description

Software testing is a crucial part of software development. It enables assurance, of correctness, completeness, and reliability of software systems. Most state-of-the-art software testing techniques employ approaches that require the tester to have some kind of an oracle in order to evaluate the outcomes of the tests within the suite. Metamorphic testing[1] is specifically designed to test software without such an oracle. The idea is to identify and refine a set of metamorphic relations between the software inputs and outputs. Just to give an abstract example, for a square root function $\text{sqrt}(x)$ the relation $x = \text{sqrt}(x) \cdot \text{sqrt}(x)$ should hold under reasonable floating point accuracies.

With ever growing programs, finding a good enough oracle is becoming an ever harder problem, even for domain experts. Contrastingly, finding metamorphic relations is a task that domain experts can provide answers for. However, finding these highly domain dependant relations in an automated fashion is for many fields still an open research problem. Some approaches such as [2] or [3] have been developed and evaluated in the past.

In this seminar, the student is required to examine and discuss the state-of-art approaches that automatically generate or learn metamorphic relations. The student should compare different approaches and give insights into future research.

References

- [1] Tsong Yueh Chen, S. C. Cheung, and Siu-Ming Yiu. Metamorphic testing: A new approach for generating next test cases. *CoRR*, abs/2002.12543, 2020.
- [2] Upulee Kanewala and James M. Bieman. Using machine learning techniques to detect metamorphic relations for programs without test oracles. In *IEEE 24th International Symposium on Software Reliability Engineering, ISSRE 2013, Pasadena, CA, USA, November 4-7, 2013*, pages 1–10. IEEE Computer Society, 2013.
- [3] Fang-Hsiang Su, Jonathan Bell, Christian Murphy, and Gail E. Kaiser. Dynamic inference of likely metamorphic properties to support differential testing. In Hong Zhu, Dan Hao, Leonardo Mariani, and Rajesh Subramanyan, editors, *10th IEEE/ACM International Workshop on Automation of Software Test, AST 2015, Florence, Italy, May 23-24, 2015*, pages 55–59. IEEE Computer Society, 2015.

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