Dynamic symbolic execution (concolic execution)

Seminar: Understanding of configurable software systems

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1 Abstract

Concolic execution [6] is a software verification technique that performs symbolic execution together with concrete input values. Concrete values are selected with the help of a constraint solver to guide a program flow in a particular direction. The selection of concrete values helps to scale the verification to a larger program as it makes the symbolic constraints smaller by selecting specific branches in the program. Compared to random execution, this allows us to guide the analysis in a direction likely to have bugs which makes this technique powerful. However, in doing so we sacrifice the completeness of the analysis in favor of the depth of analysis. The sheer number of branches in a large program makes it difficult to perform a complete analysis, so we have to prioritize the branches likely to contribute to finding a bug. There have been a lot of studies to deal with this path explosion problem. In this paper, I have presented state-of-the-art methods to deal with this problem.

2 Introduction

- What is it?
- Where did it start?
- How does it work?
- Give an example
- Why is it important?
- It's contributions
- It's limitations

3 Different catagorical bodies

- summerize, give an overview of the main points of each source and combine them into a coherent whole
- Analyze and interpret: don't just paraphrase other researchers—add your own interpretations where possible, discussing the significance of findings in relation to the literature as a whole

– Critically evaluate: mention the strengths and weaknesses of your sources
– Write in well-structured paragraphs: use transition words and topic sentences to draw connections, comparisons and contrasts

4 Conclusion

5 Papers

– 2006: they worked on backtracking algorithms for search heuristics [16]
– 2007: they combined the fuzzing techniques to improve the coverage [10] [5] [7]
– 2008: Heuristic based approach to select the branches [1]
– 2009: they worked on the fitness guided approach to improve the coverage [15]
– 2013: they boosted concolic testing by subsuming paths that are guaranteed to not hit a bug with their interpolation technique [8]
– 2014: they introduced a concept of context guided search strategy [12]
– 2018: automatic selection of suitable heuristic [2]
– 2018: template guided approach [3]
– 2018: based on probability of program paths and the cost of constraint solving [13]
– 2018: they improved the speed of SMT solver by removing the IR layer making it more practical to keep bigger constraints [17]
– 2019: fuzzy search strategy [11]
– 2019: adaptably changing search heuristics [4]
– 2021: Pathcrawler: proposed different strategies to improve the performance of concolic execution on exhaustive branch coverage [14]
– 2022: Dr. Pathfinder [9] combined concolic execution with deep reinforement learning to prioritize deep paths over shallow ones for hybrid fuzzing

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