Model-based, mutation-driven test case generation via heuristic-guided branching search

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Abstract
This work introduces a heuristic-guided branching search algorithm for model-based, mutation-driven test case generation. The algorithm is designed towards the efficient and computationally tractable exploration of discrete, non-deterministic models with huge state spaces. Asynchronous parallel processing is a key feature of the algorithm. The algorithm is inspired by the successful path planning algorithm Rapidly exploring Random Trees (RRT). We adapt RRT towards test case generation by introducing parametrized heuristics for start and successor state selection, as well as a mechanism to construct test cases from the data produced during search. With our new algorithm, we are now able to produce test cases for models consisting of over 2300 concurrent objects.

Contributions
- Branching Search For Test Case Generation
  - Fully leverage parallelism
  - Flexibility through set of heuristics
  - Shorter and more effective tests
  - Extensive evaluation on large models

MoMuT
- Automated and Model Based Test Case Generation Tool
- Developed at AIT and TU Graz
- www.momut.org

Supported modelling formalisms
- UML
- Event-B
- Object Oriented Action Systems (OOAS)

Why Model Based Testing?
- Model reflects requirements
  - Verify high level correctness instead of properties of code
  - Split roles of test- and the system- designer
- Domain independence
- Essential during model-driven development

Why Mutation Coverage?
- Tests directly relate to implementation faults
- Cover much high level behaviour per test case
- Prune irrelevant test steps
- Fine tunable due to choice of mutants

Branching Search for Test Case Generation

Algorithm Sketch & Example
- Initial state
- Random state
- Rare state
- Distance based
- Round robin
- Heuristics
  - Distance
  - Rare
  - Init

Explore model in parallel
- Analyse mutants in parallel
- Branching Search Test Case Quality
- No Branching
- Average Test Length

Future Work
- Semi-symbolic exploration techniques
- Concilic execution
- Distance based on mutant constraints
- Static analysis to improve heuristics
- Translate OOAS to Petri Nets

Related Publications

Publication

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