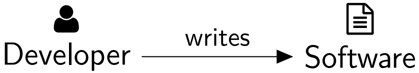
CoVeriTest

Cooperative Verifier-Based Testing

Dirk Beyer and **Marie-Christine Jakobs**

FASE 2019

Testing for Software Quality Assurance



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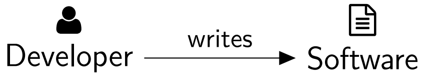

Quality?

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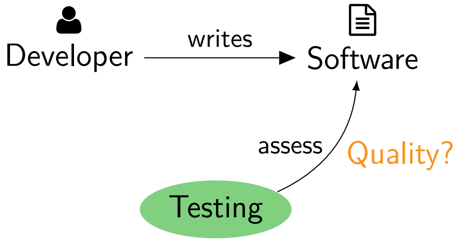

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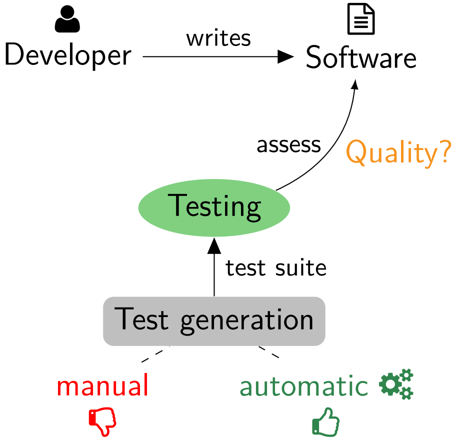

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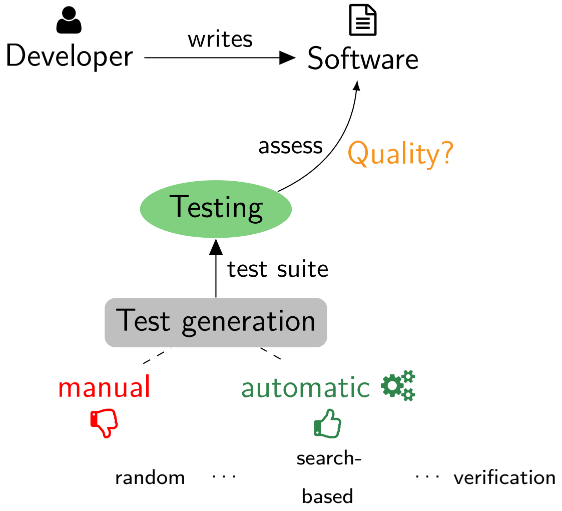

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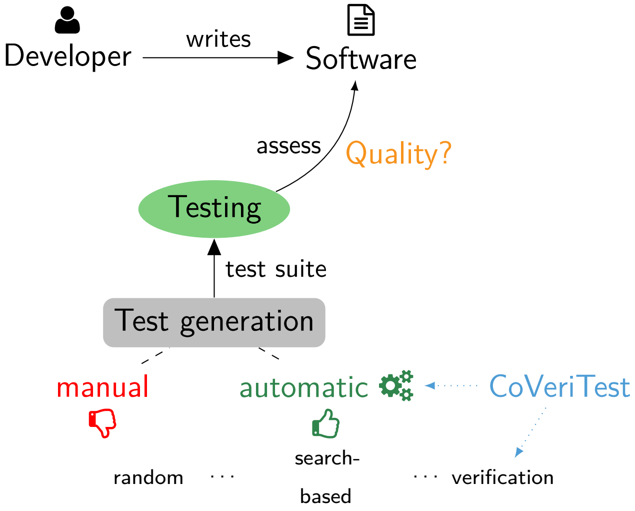

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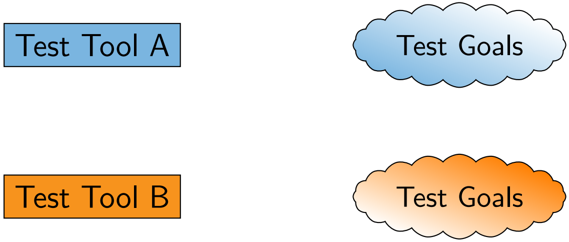

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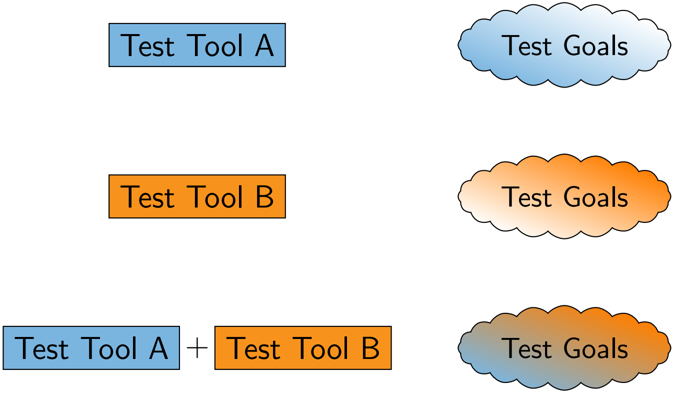

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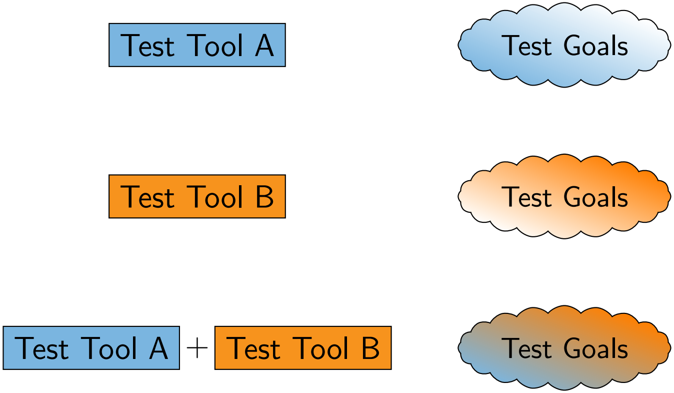
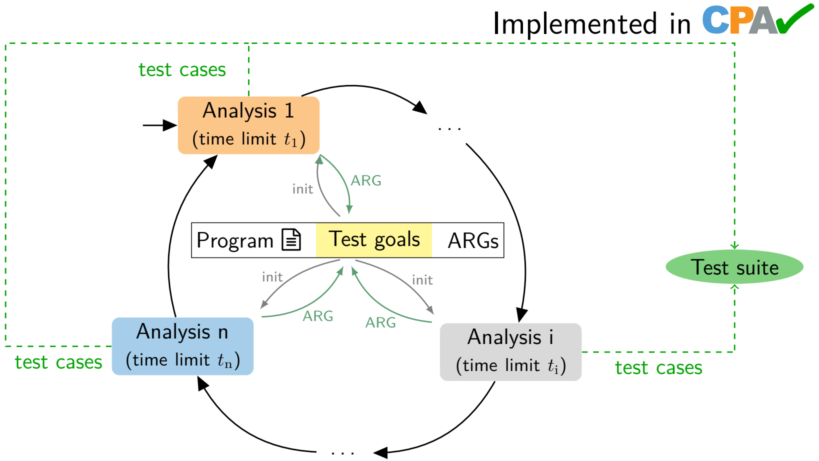


Need to combine different test tools $\Rightarrow$ Use CoVeriTest

Overview of CoVeriTest Approach



Information exchange realized with ARGs and init procedure

ARG: graph representation of explored, abstract state space

One Analysis Run in CoVeriTest – Initialization

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     - Reuse abstraction level π
     - Continue exploration, i.e., reuse ARG

One Analysis Run in CoVeriTest – Execution

Perform reachability analysis of uncovered goals

$$\begin{tikzcd} q_0 \arrow[loop left, "g \notin \text{uncovered goals}"] \arrow[r, "g \in \text{uncovered goals}"'] & q_e \end{tikzcd}$$

Feasible counterexample $\Rightarrow$ uncovered goal reached

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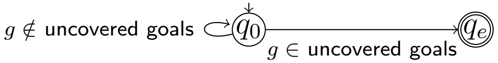

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- Goals for which a test cases is constructed become covered

- Stops if goals covered, total or analysis time limit exceeded

Output: test cases + explored state space (ARG)

Research Questions

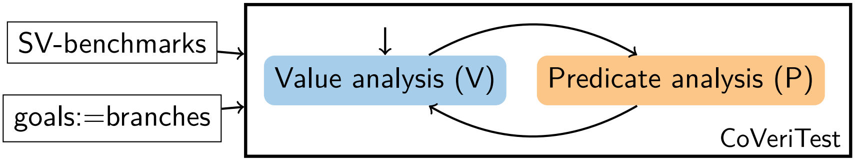
Internal comparison

1. How to configure CoVeriTest?
   time limits, information exchange
2. Does CoVeriTest's interleaving improve over
   - its single analyses,
   - their parallel combination?

External comparison

3. How does CoVeriTest compete with state-of-the-art?

Evaluation Set Up



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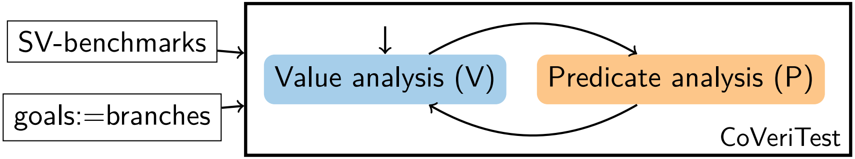

- Resources
  - 15 GB of memory, 900 s in total
  - Analysis limits (V,P) in (s)
    (10,10) (50,50) (100,100) (250,250) (80,20) (20,80)

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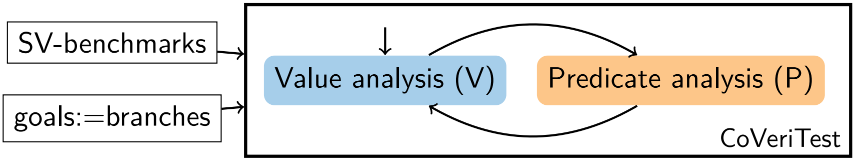

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- Information exchange mode

	Reuse own knowledge		
Coop.	None	Abstraction level	Continue exploration
None	✓	✓	✓
V→P	✓		✓
V←P	✓		✓
V↔P	✓	✓	✗

CoVeriTest Configuration: Which Time Limit?

Per mode m consider

- all 6 configurations C_i with mode m, **but** different limits
- distribution of relative coverage (i.e., relative to best result)

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Computing relative coverage of a task

	C_1	C_2	C_3	C_4	C_5	C_6	Maximum
# covered	7	13	4	16	9	11	16
relative coverage	$\frac{7}{16}$	$\frac{13}{16}$	$\frac{4}{16}$	$\frac{16}{16}$	$\frac{9}{16}$	$\frac{11}{16}$	

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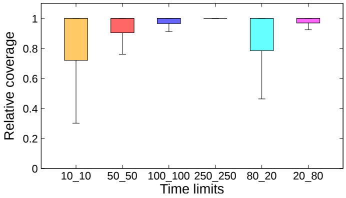

Boxes closer to one that are small are better

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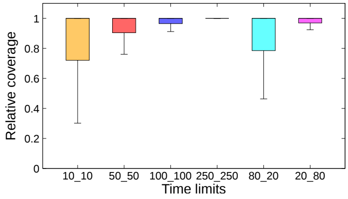

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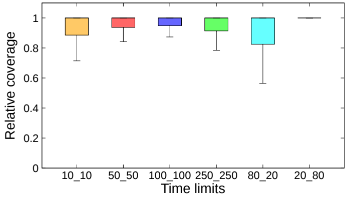

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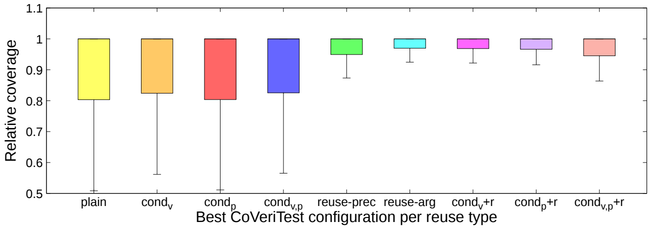

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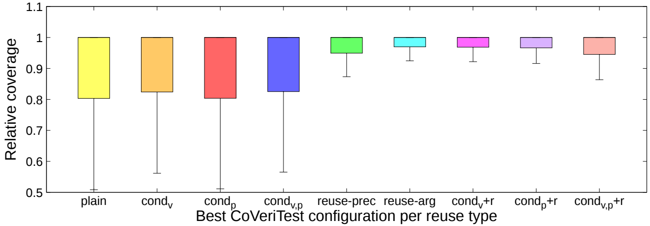

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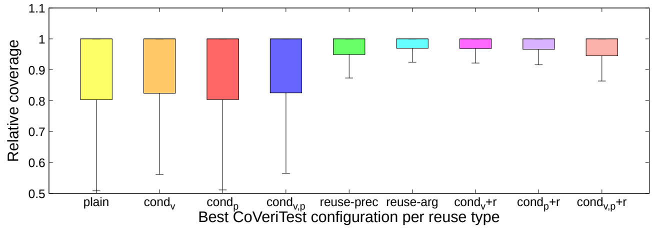
Best

$\downarrow$



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Alone vs. Use in CoVeriTest Interleaving

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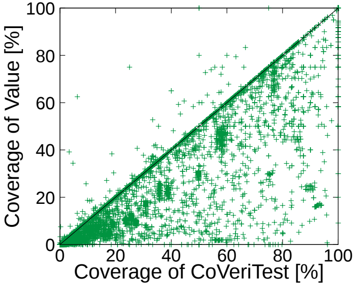
CoVeriTest better for points in lower right half



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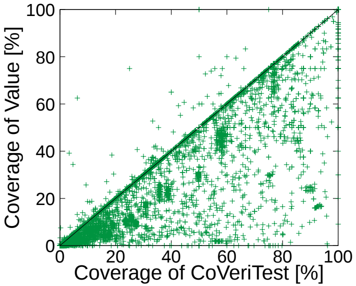

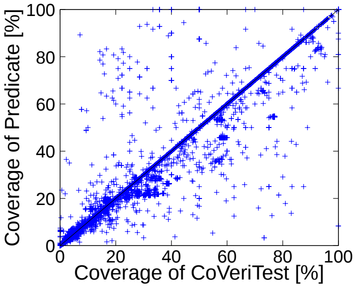

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Parallel vs. Interleaving with CoVeriTest

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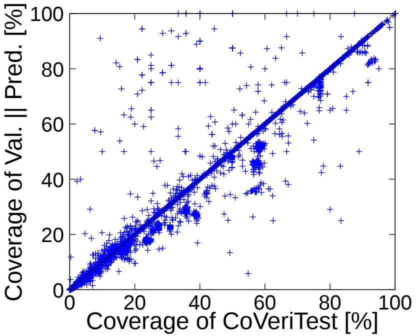

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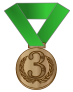

Complements other participants, e.g.,

- Compare coverage measured by `gcov`

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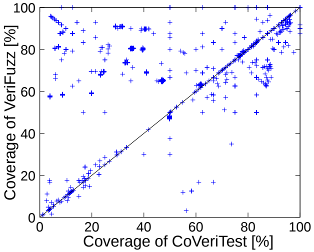
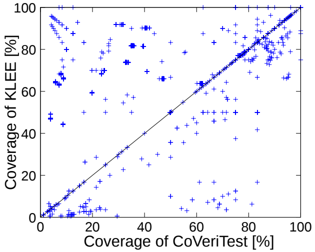
first winner (VeriFuzz)



second winner (KLEE)



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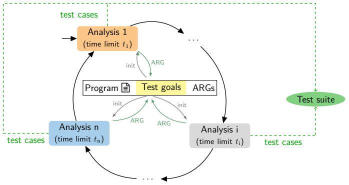

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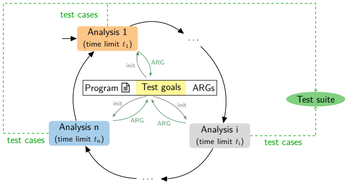

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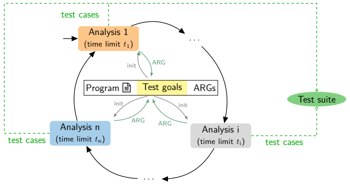

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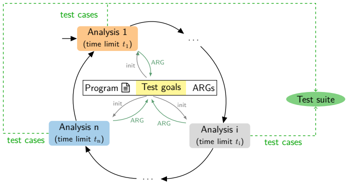

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`https://www.sosy-lab.org/research/coop-testgen/`

DOI 10.5281/zenodo.2566735