$PART_{PW}$

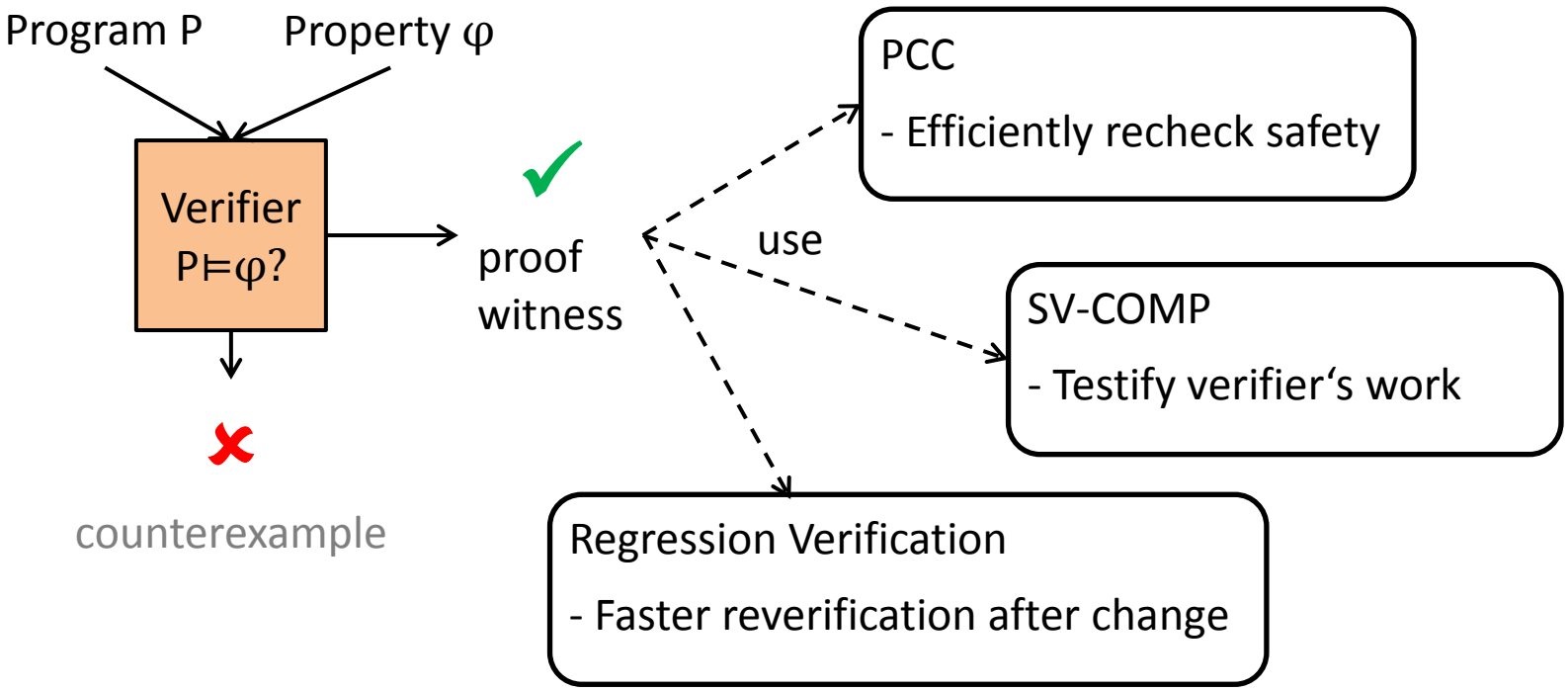
From Partial Analysis Results to a Proof Witness

Marie-Christine Jakobs

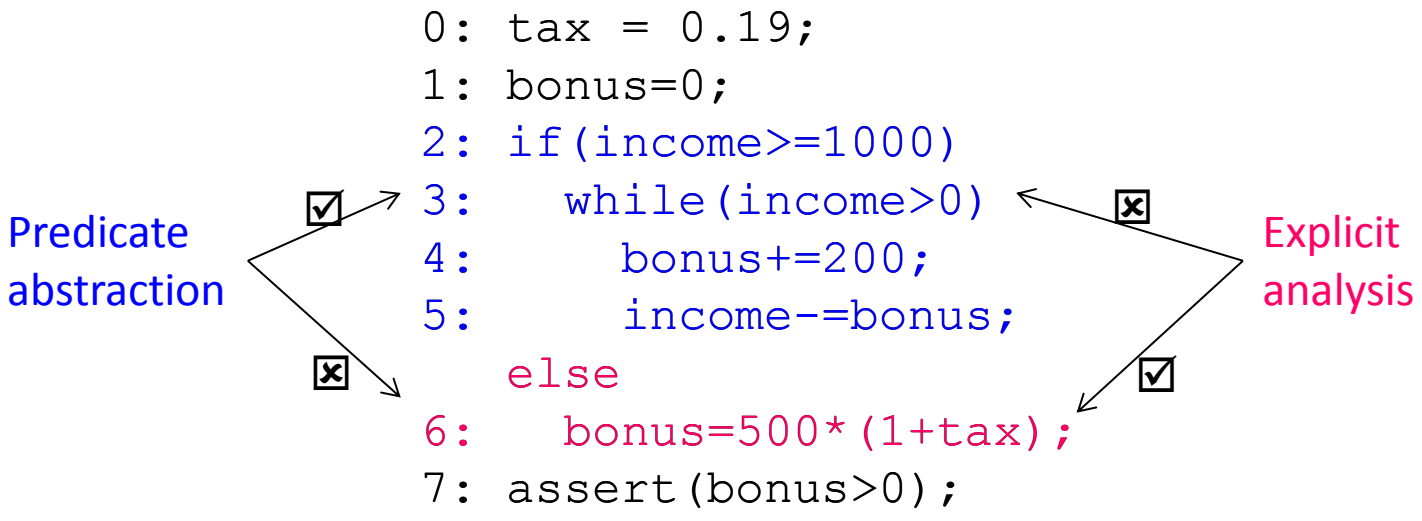
SFB 901
ON-THE-FLY COMPUTING

UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

Use Cases for Proof Witnesses



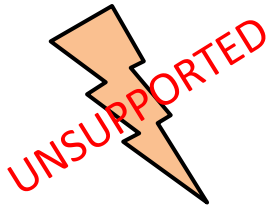
Problem: Complementary Analyses



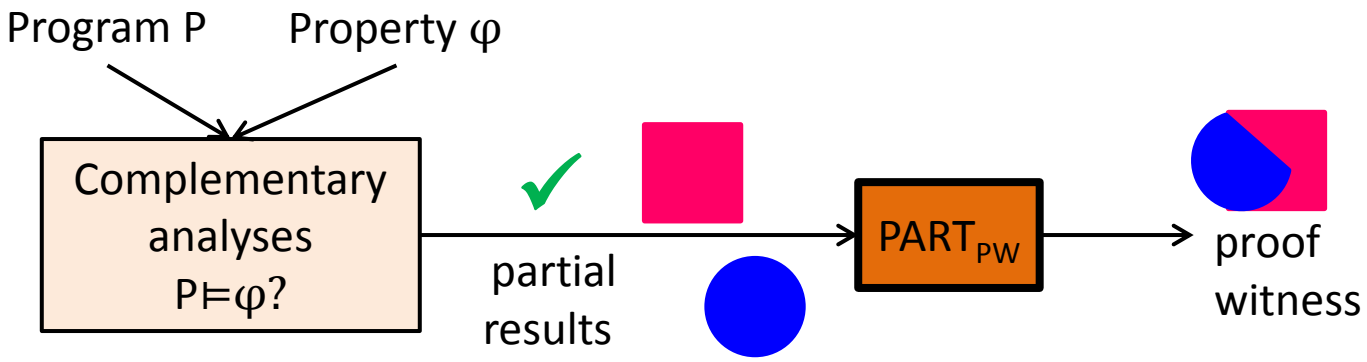
if branch: verify with predicate abstraction

else branch: verify with explicit analysis

➔ 2 partial analysis results



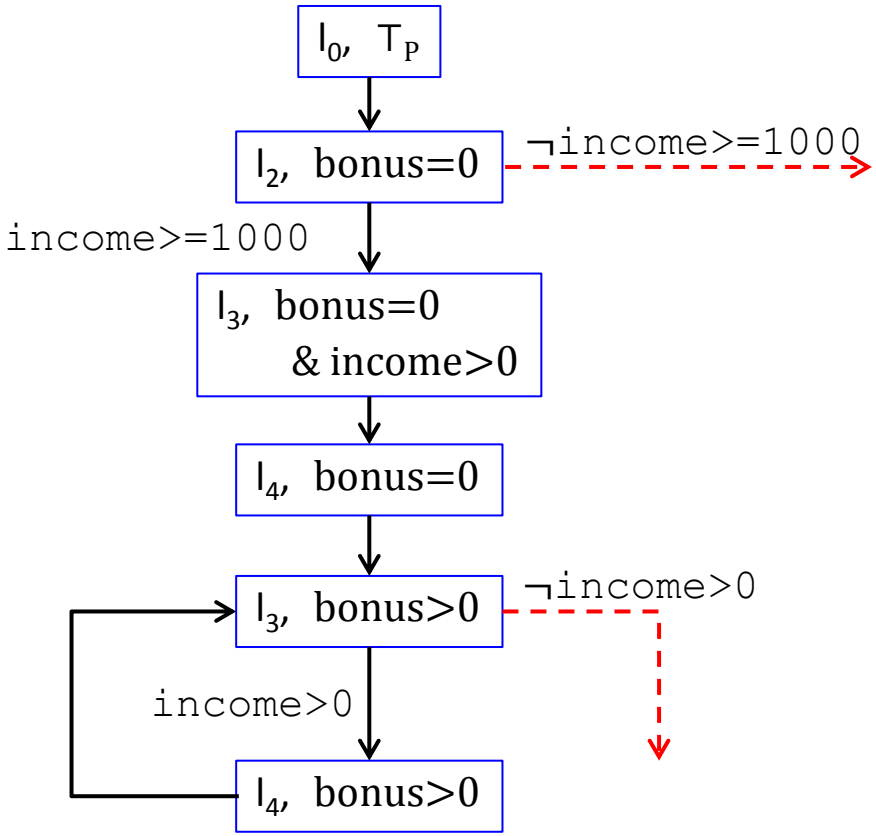
The $PART_{PW}$ Solution



- Benefits
  - Reuse of existing proof witness approaches
  - Complex analysis hidden from witness checker

(Partial) Proof Witnesses

Here: in form of abstract reachability graphs



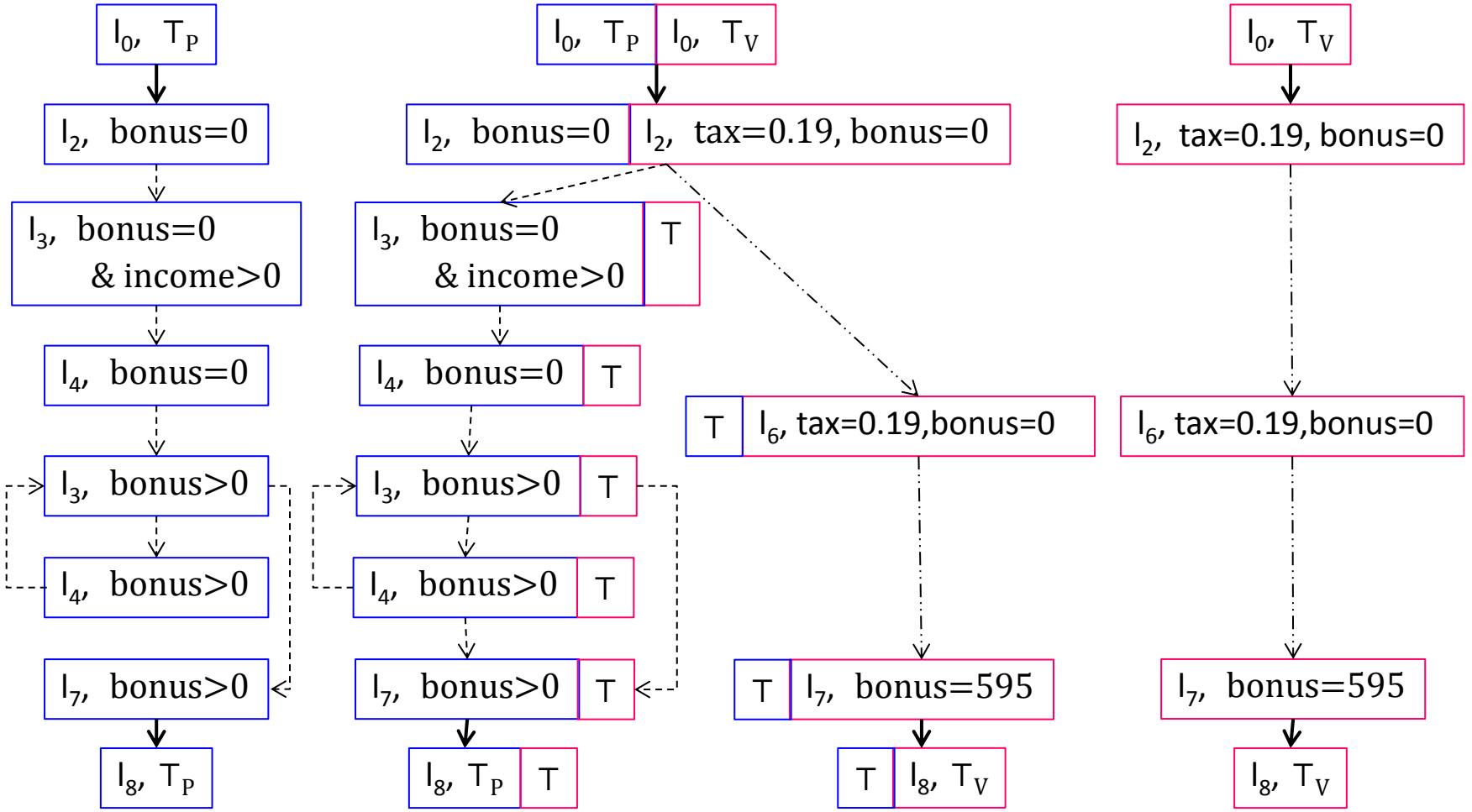
Valid Partial Proof Witness

- Root covers the initial states
- For each node, statement either
  a) Abstract successors covered
  b) No successors for statement
- Safe

Valid Proof Witness

- Valid partial proof witness,
- but no missing successors

An ARG from a Set of Partial ARGs



Theoretical Result

Goal: $Part_{PW}$ constructs valid proof witnesses

Require: Partial ARGs must cover all execution paths

→ Use complete set of partial ARGs (stronger, abstraction based)

Theorem (proven)

- Let S_{pARG} be complete set of partial ARGs. Then, $Part_{PW}(S_{pARG})$ is a valid proof witness.

Experiments

Questions

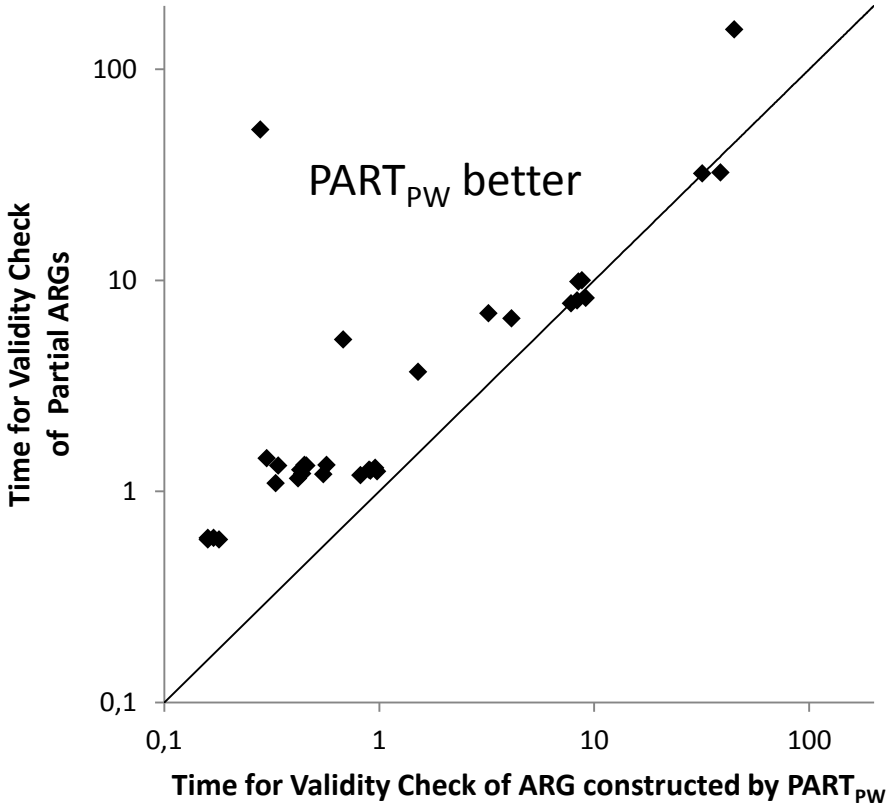
1. Is Part_{PW} + standard witness approach better than checking set of partial ARGs?
2. Is Part_{PW} + standard witness approach better than verification?
3. How costly is Part_{PW}?

Set Up

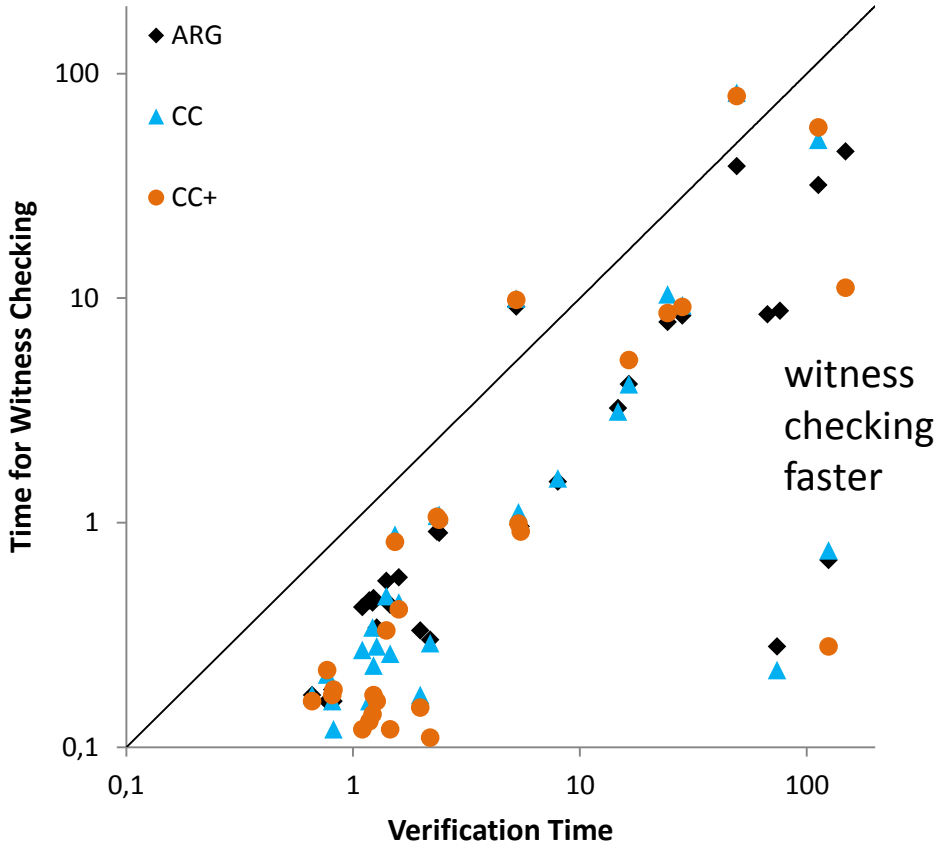
- Construction of Partial ARGs
  - Conditional model checking[1]
  - Different combinations
  - Restrict to tasks for which combinations beneficial
- Witness Approaches
  - ARG as witness
  - ARG nodes as witness
  - Structured subset of ARG nodes as witness
  - Set of partial ARGs as witness

[1] Beyer et al., Conditional model checking: a technique to pass information between verifiers, FSE, 2012.

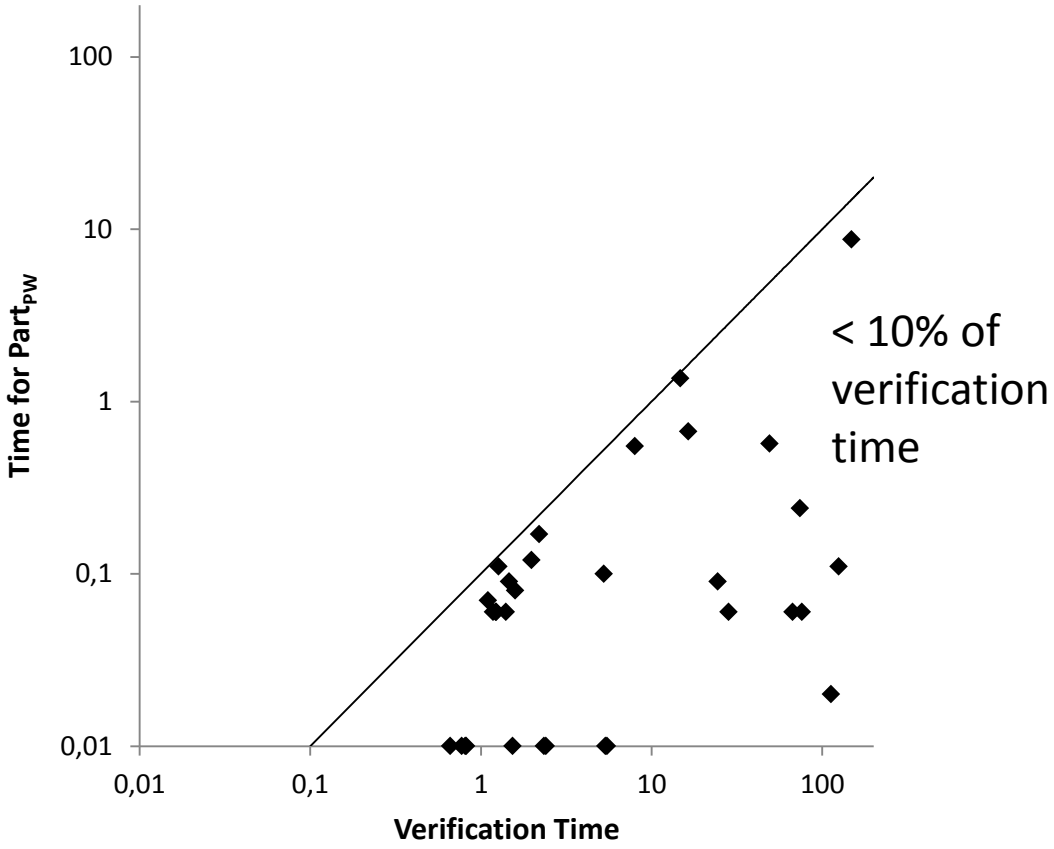
Q1: $PART_{PW}$ vs. Specific Solution



Q2: Witness Checking vs. Verification

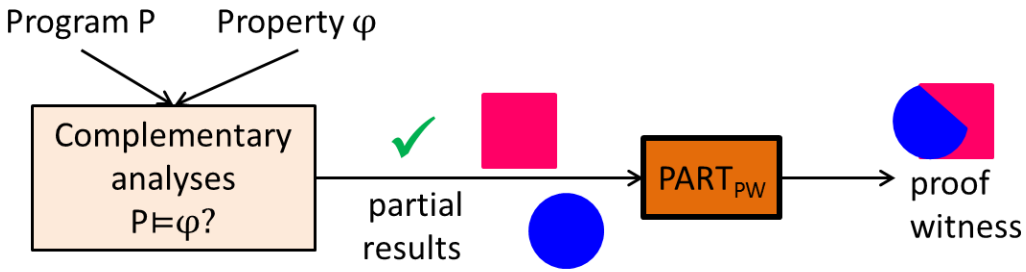


Q3: Overhead of $Part_{PW}$



Conclusion

- Technique $PART_{PW}$



  - Provably constructs valid proof witnesses
- Experiments
  - Seamless integration into existing approaches
  - More efficient than specific solution
  - $PART_{PW}$ overhead small