Regression Verification: Project Proposal

Dennis Felsing

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Introduction

Context

- Formal Methods of Software Development
- Project Group at KIT
- Student research project

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Main Question

How to prevent regressions in software development?
BILD Devolution

Introduction

Formal Verification

Formally prove correctness of software
$\Rightarrow$ Requires formal specification

Regression Testing

Discover new bugs by testing for them
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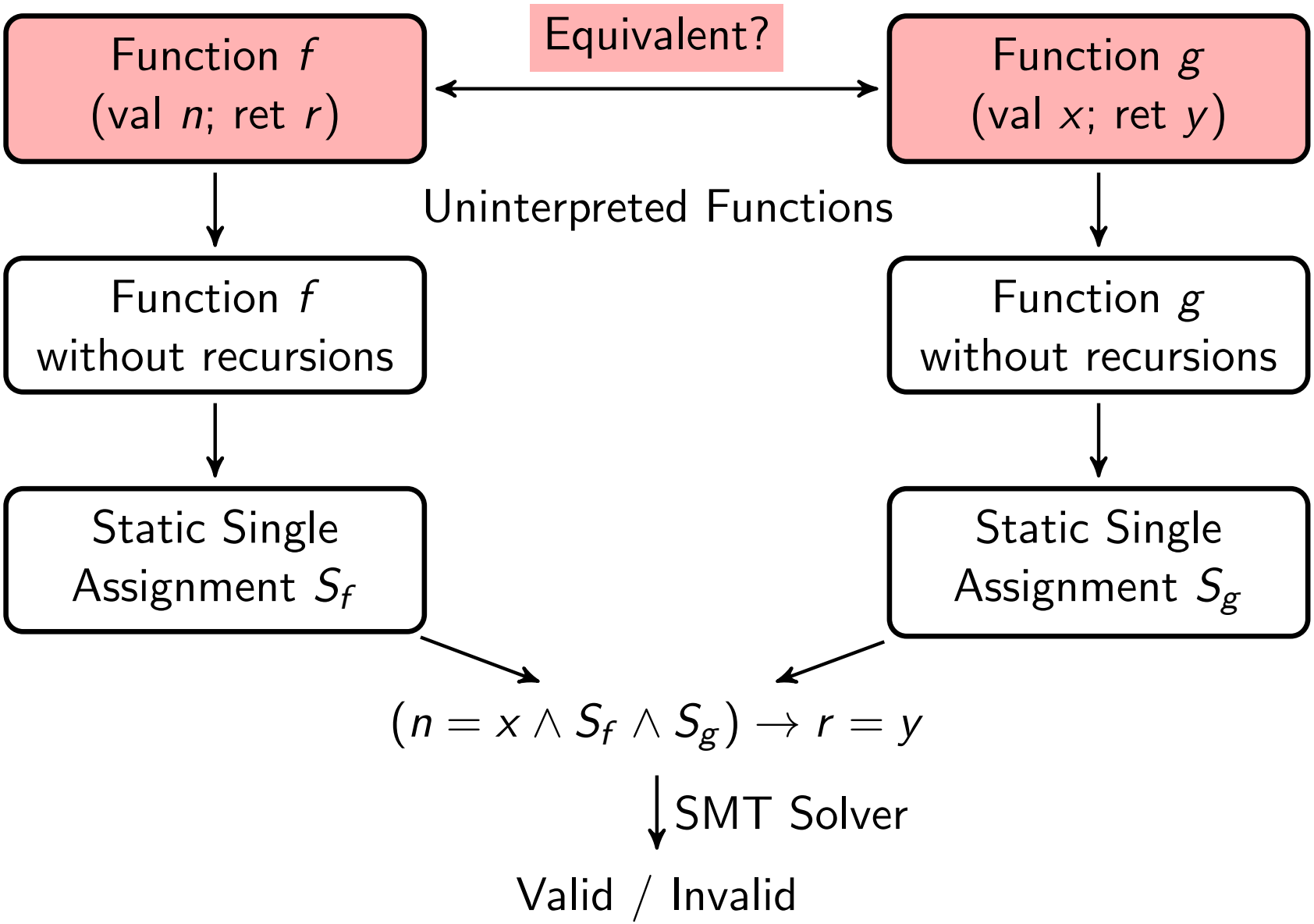
Regression Verification

Formally prove there are no new bugs

Regression Verification

Overview



Regression Verification

Formally prove there are no new bugs

- Goal: Proving the equivalence of two closely related programs
- No formal specification or test cases required
- Instead use old program version
- Make use of similarity between programs

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Uninterpreted Functions

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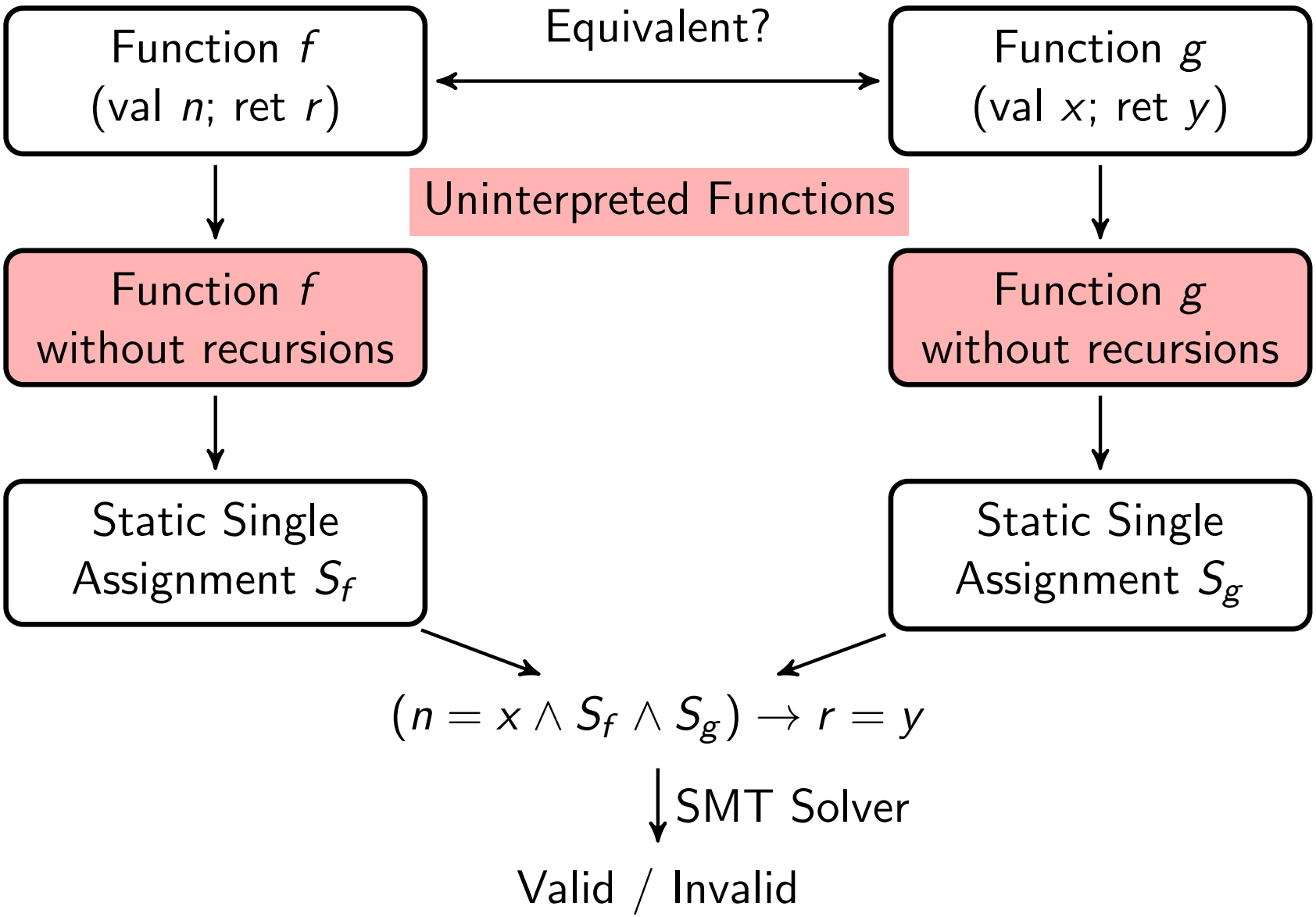

Uninterpreted Functions

- Given the same inputs an Uninterpreted Function always returns the same outputs.
- Motivation: Proof by Induction, to prove $f(n) = g(n)$ assume $f(n-1) = g(n-1)$

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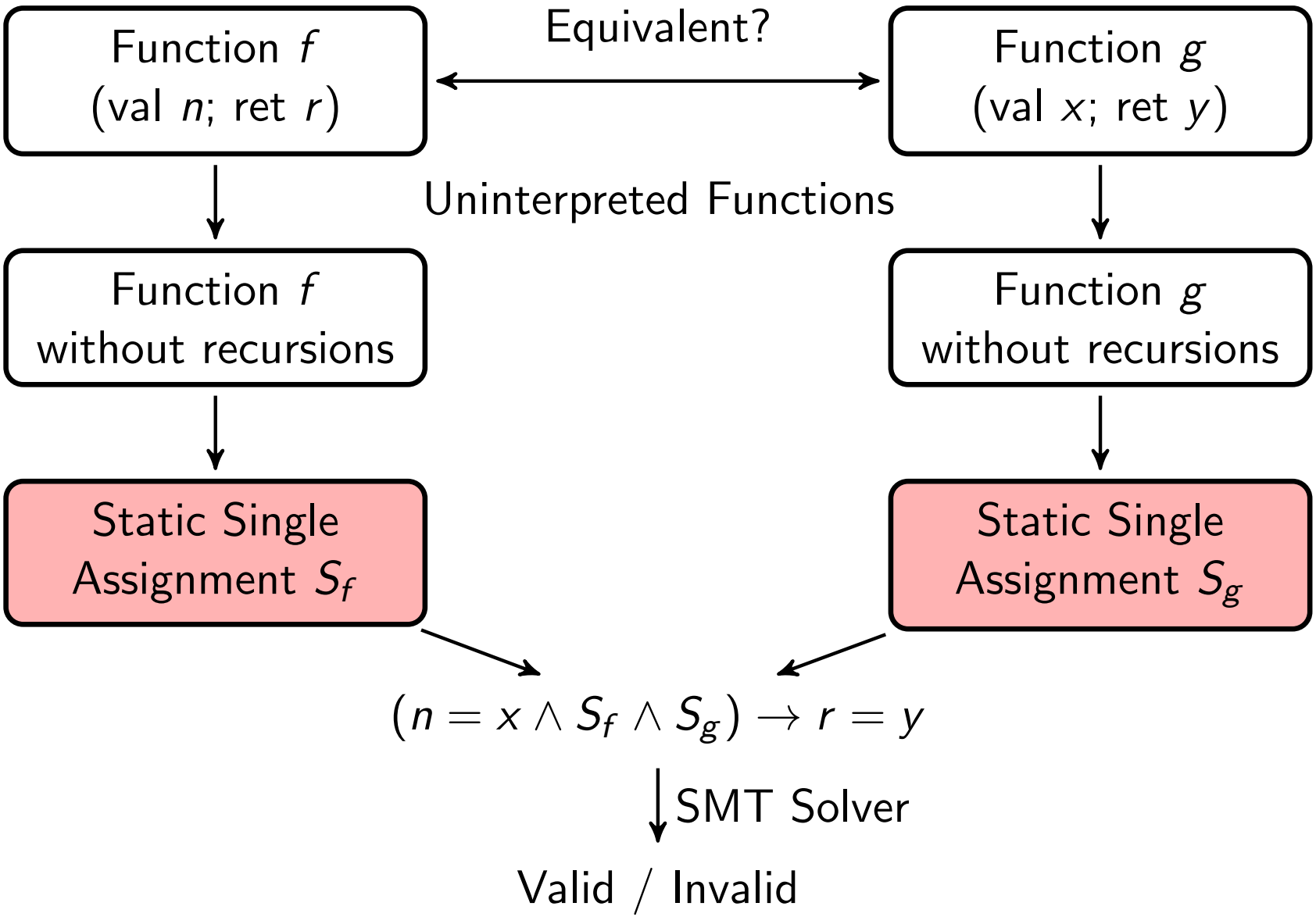

Static Single Assignment

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- Recursions: Abstraction by Uninterpreted Function
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- Represents the states of the program

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Formula

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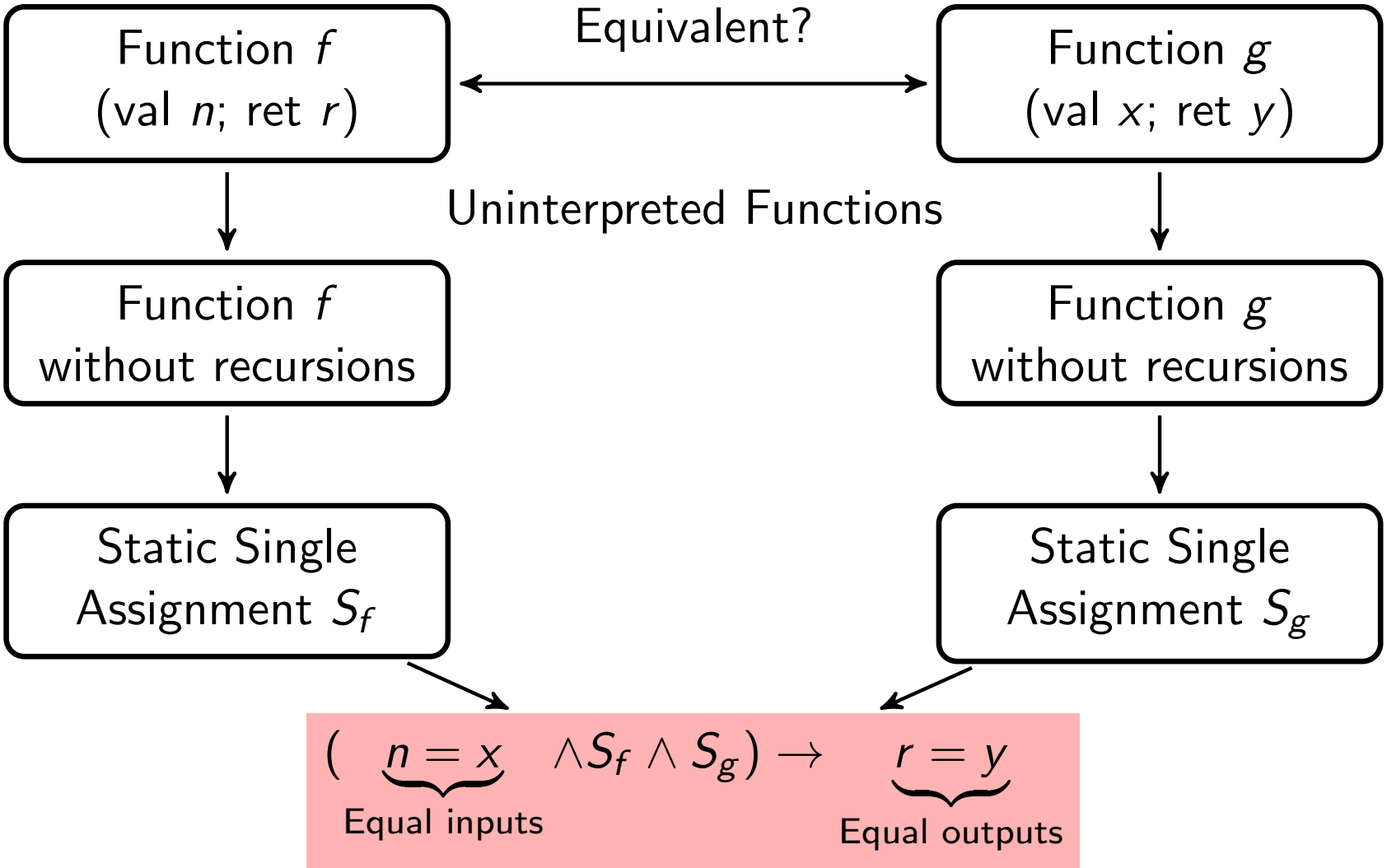
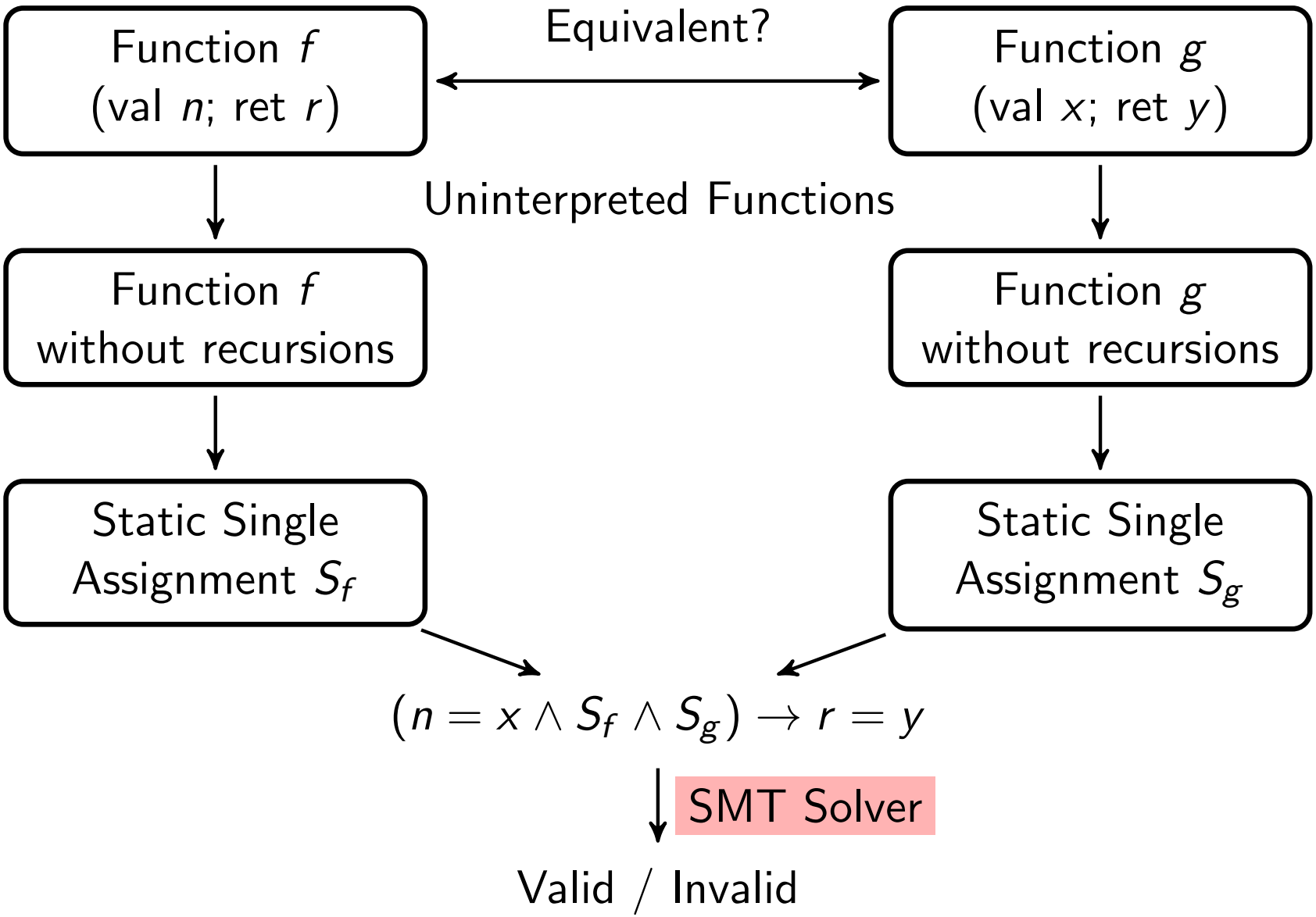


SMT Solver

Overview



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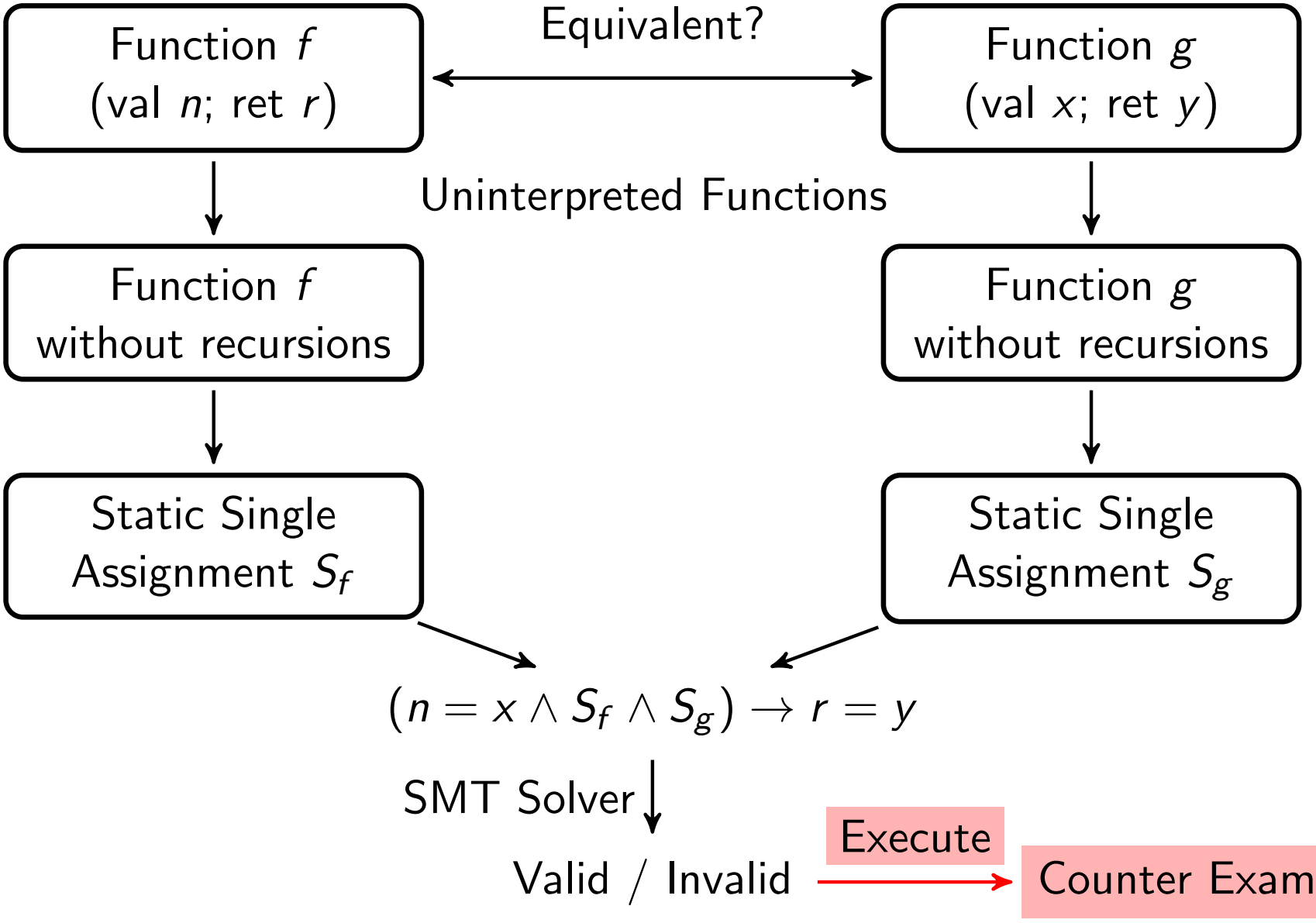
- But we can fix it:

$$f(0) = 0$$

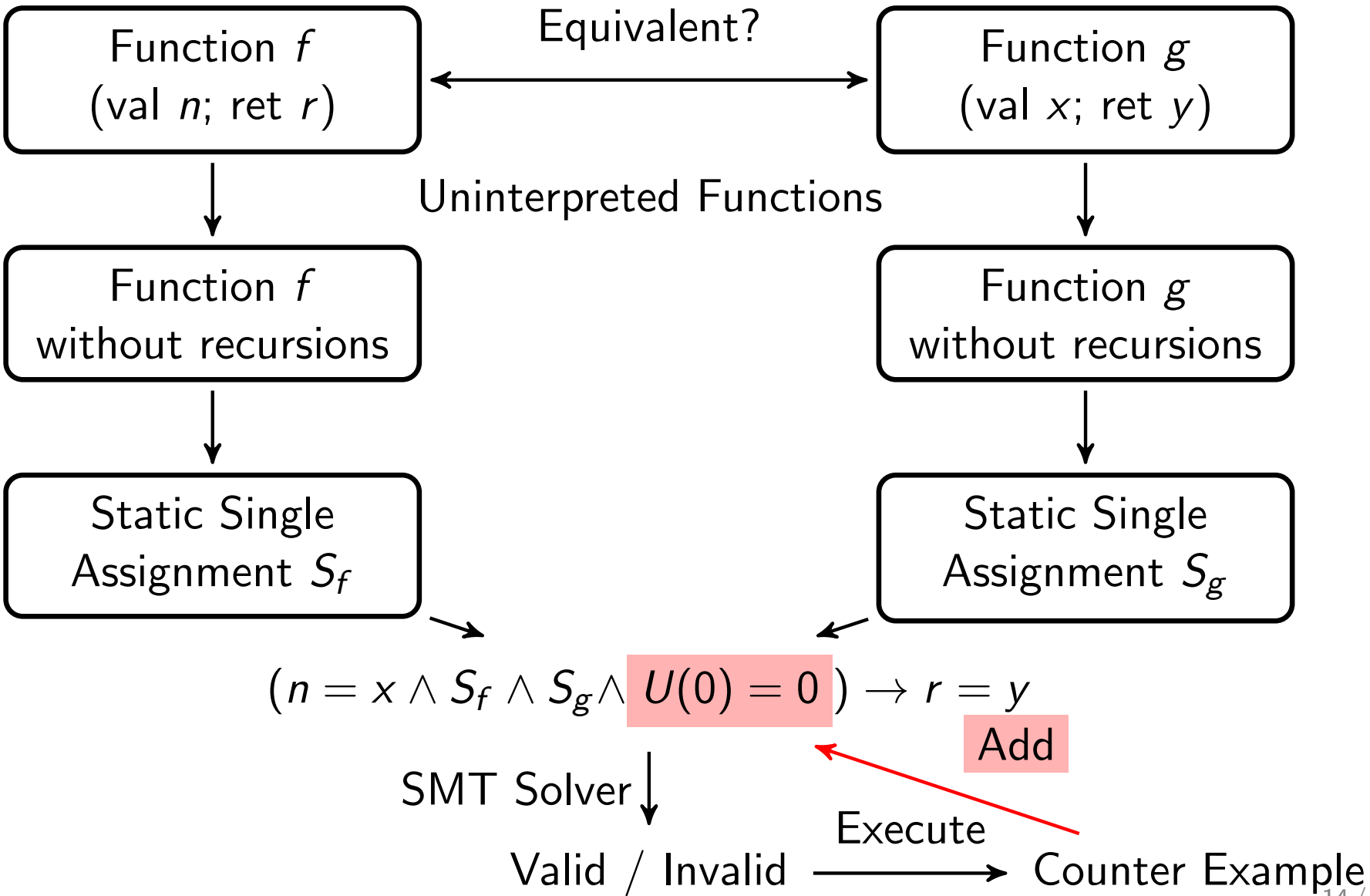
Extensions

Finding Counter Examples



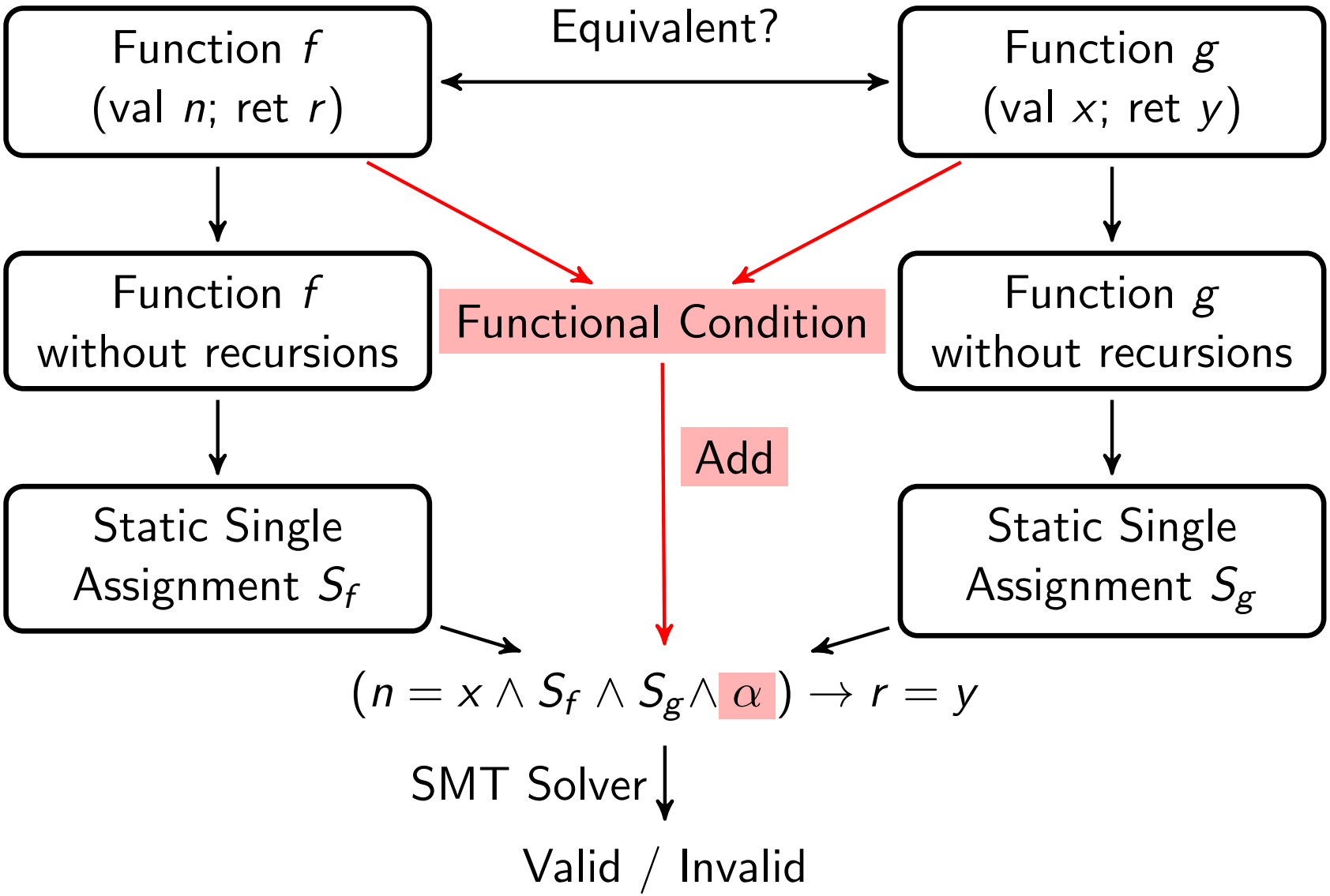
Extensions

Determining Corner Cases



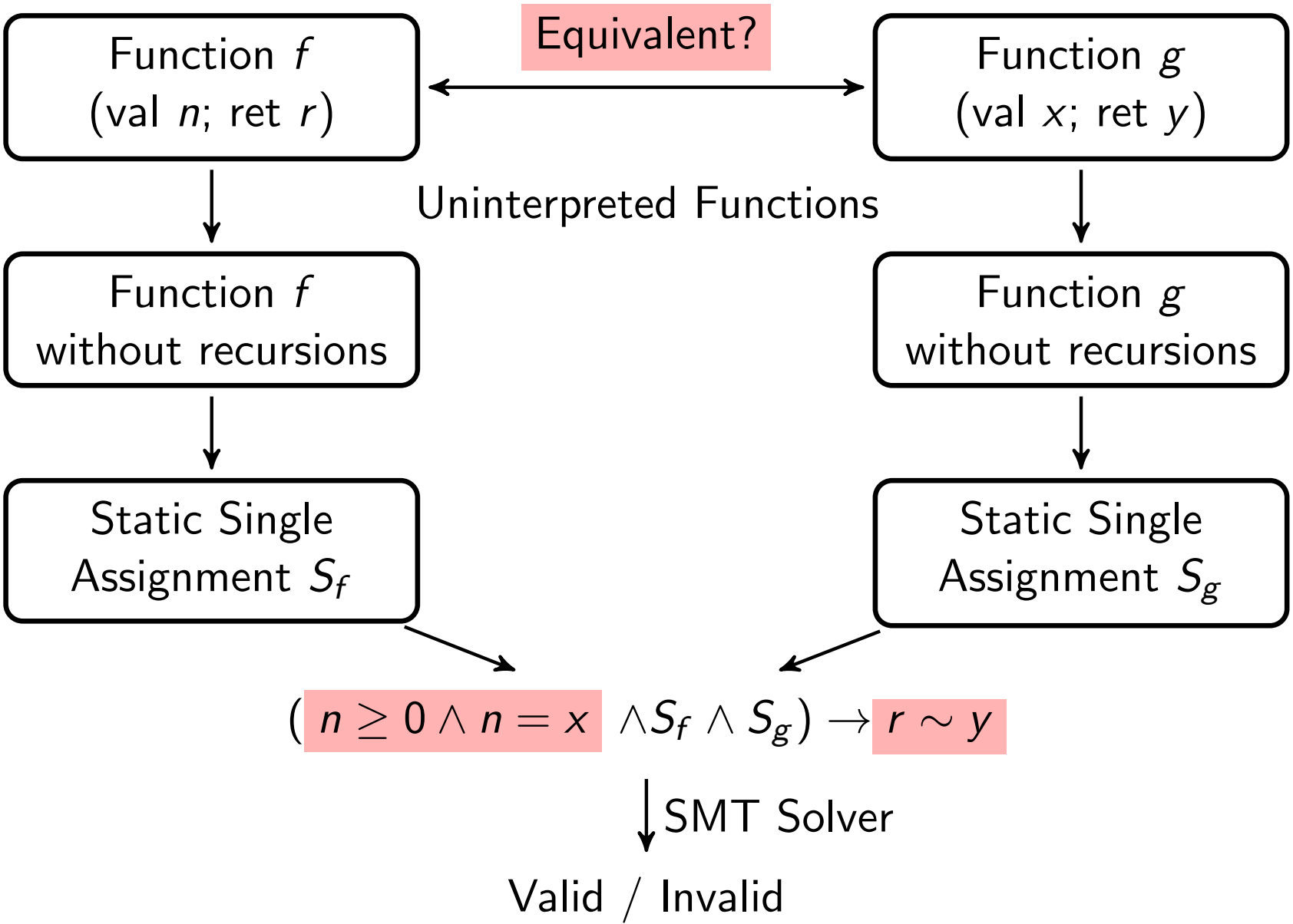
Extensions

Functional Condition Extraction



Extensions

Relational Equivalence



Example Catalog

- Collect examples: Papers, Refactoring Rules, ...
- 51 program pairs so far
- Test how well approach and extensions work

Conclusion

Regression Verification

- Better chance of being adopted than Formal Verification
- More powerful than Regression Testing

My Contributions

- Implementation for simple language
- Various extensions to cover more cases
- Example catalog for evaluation