Operationalizing Threats to MSR Studies by Simulation-Based Testing

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Motivation

- Empirical questions on SE can be answered by analyzing repository data.
- The methodology of such studies is often very complicated.
- ***How do we know that the methodology and answers are “correct”?***

Background

Some **existing ideas** to assure “correct” methodology and answers:

- **Our intuition** as a software developer helps us to judge answers.
- **Meta-analysis** checks the consistency of answers with previous work.
- We can **stick to** the methodology of **previous work**.
- **Model comparison** with a protection against under- and overfitting helps.

We will present a fresh idea on this topic.

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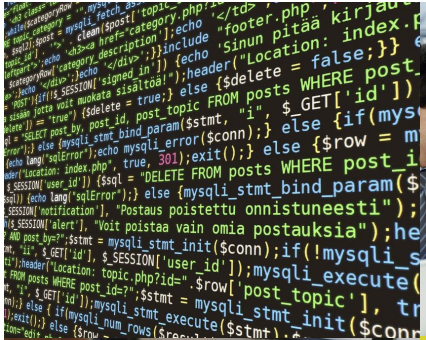
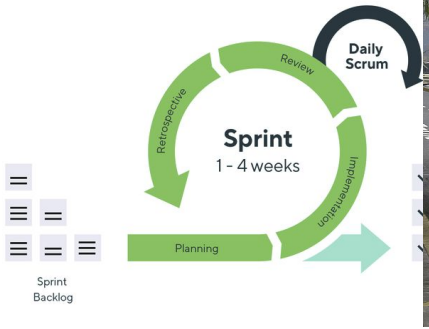
We start with the typical methodology in MSR/ESE

(that you probably know…)

The typical methodology

Variables interesting for MSR/ESE.





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The typical methodology

Relationships between variables interesting for MSR/ESE.

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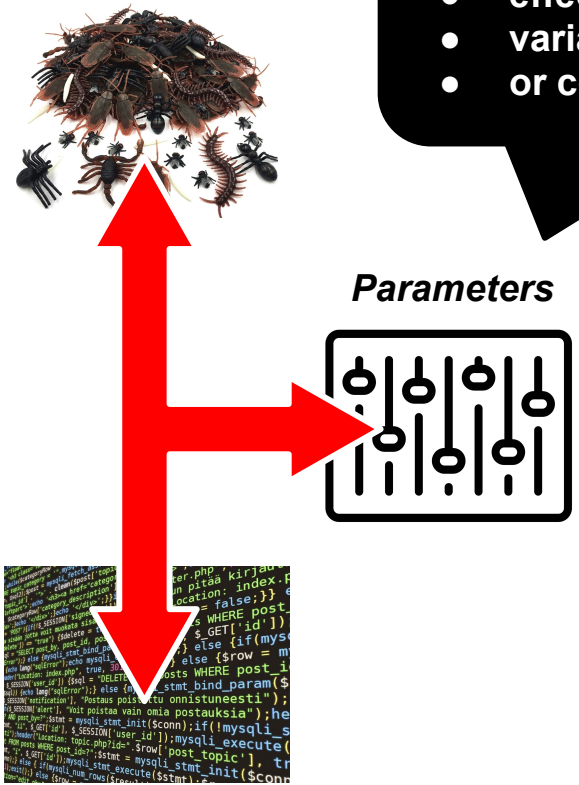
The typical methodology

Models interesting for MSR/ESE.

Parameters are variables too, e.g.,:

- **effect strength,**
- **variance,**
- **or correlation.**



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What can we do with this model?

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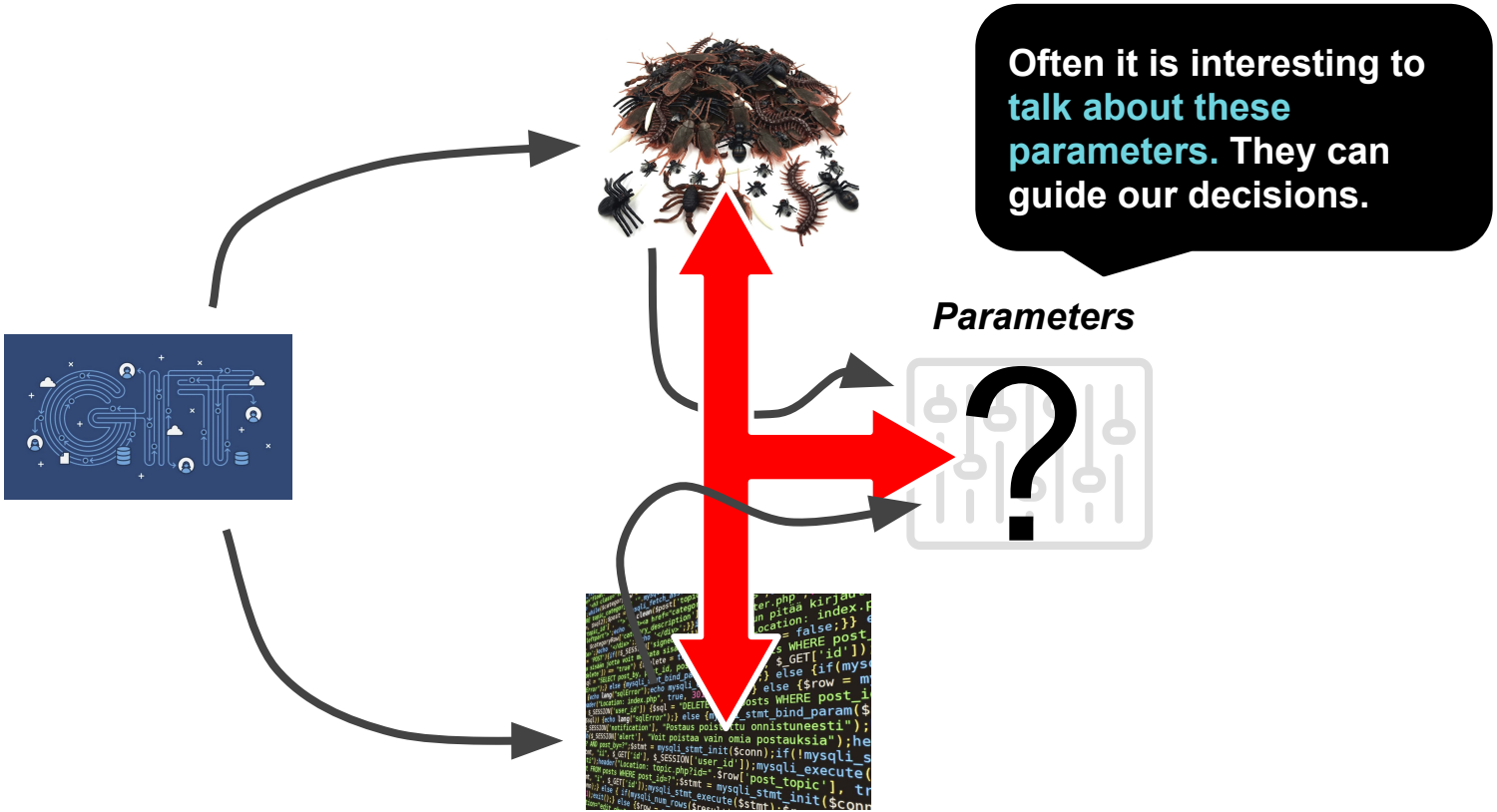

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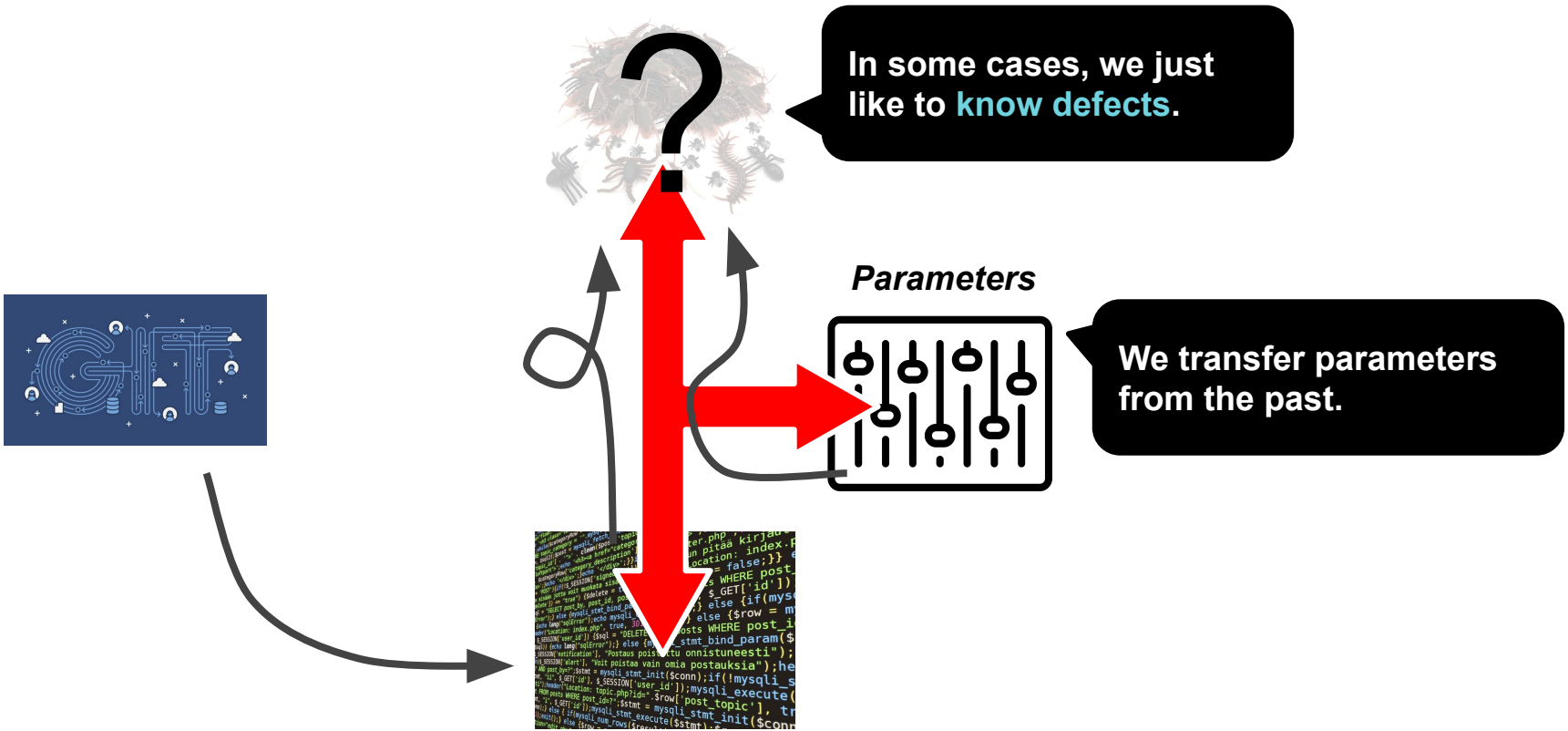

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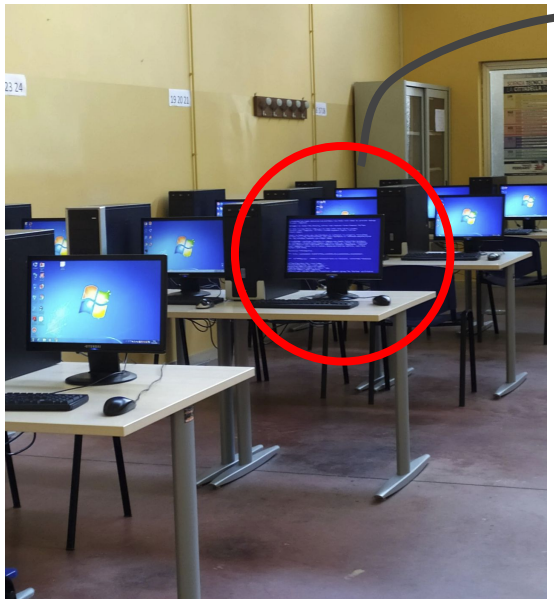
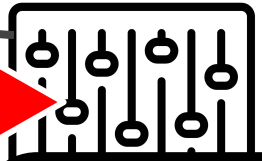


Parameters



While never seen the code, we still have an impression of its complexity because we see defects.

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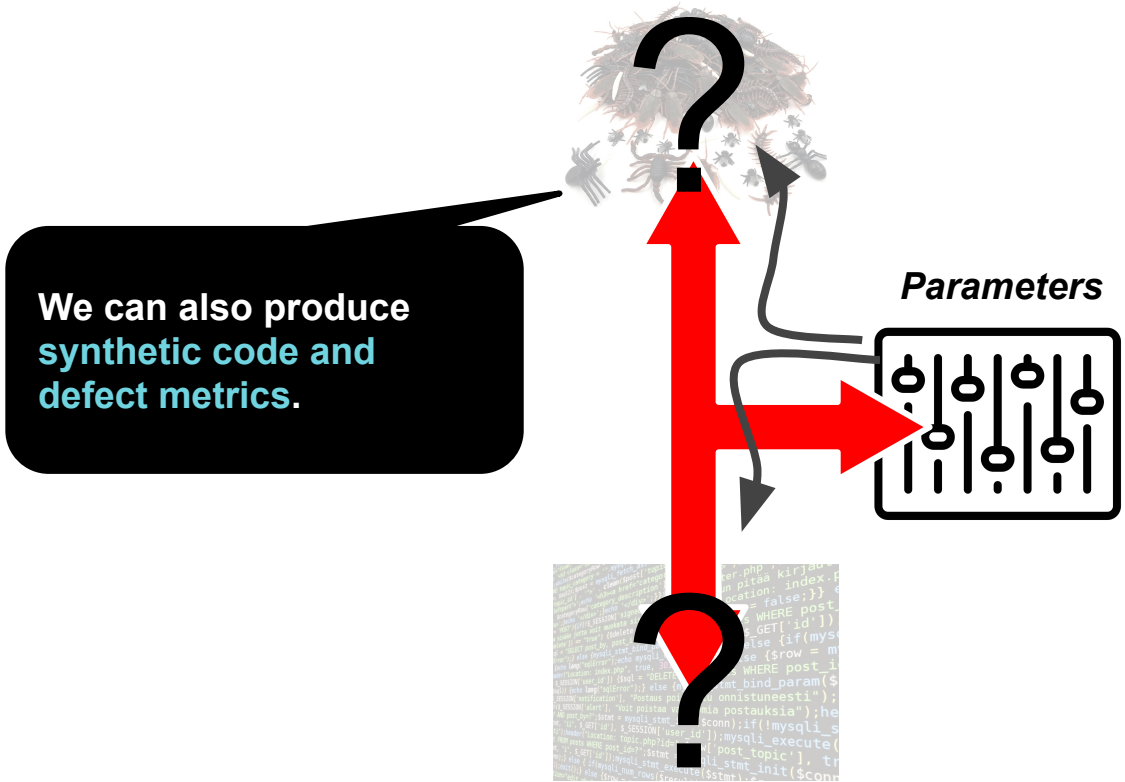
What can we do with this model?



The starting point for Simulation-based Testing

(the topic of our paper)

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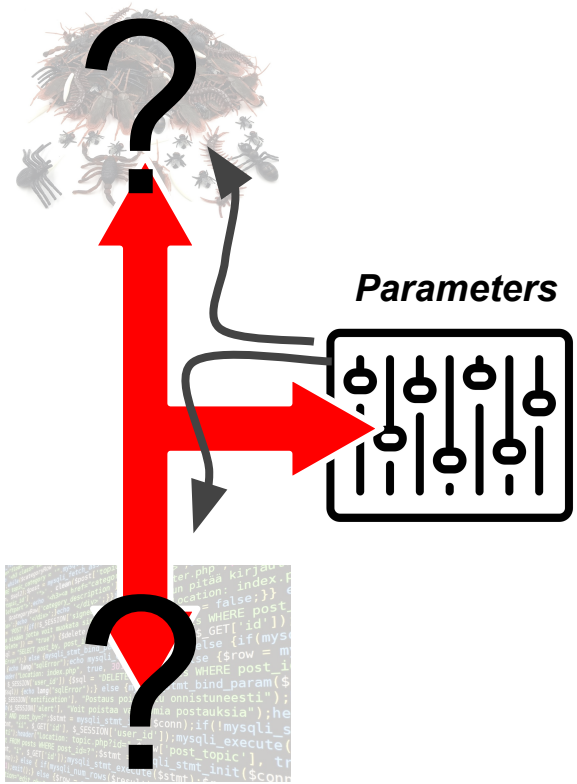
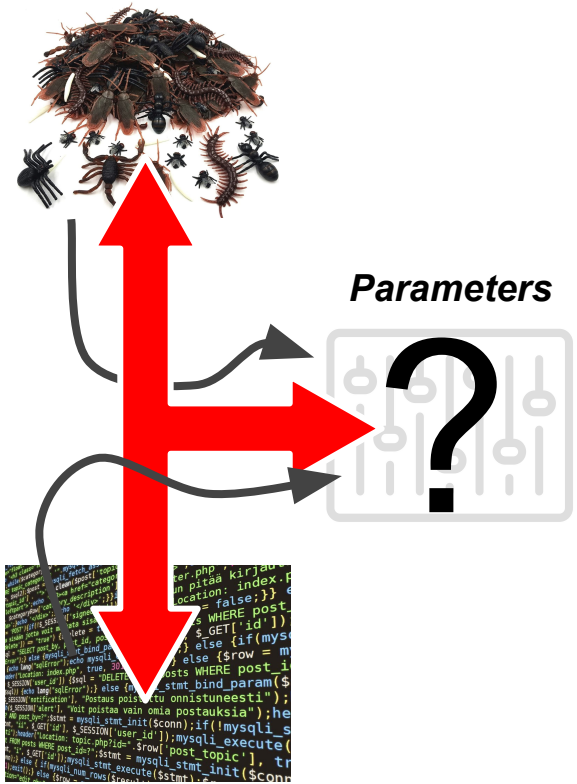
Symmetry (0)

We expect a **correspondence** for those two workflows:

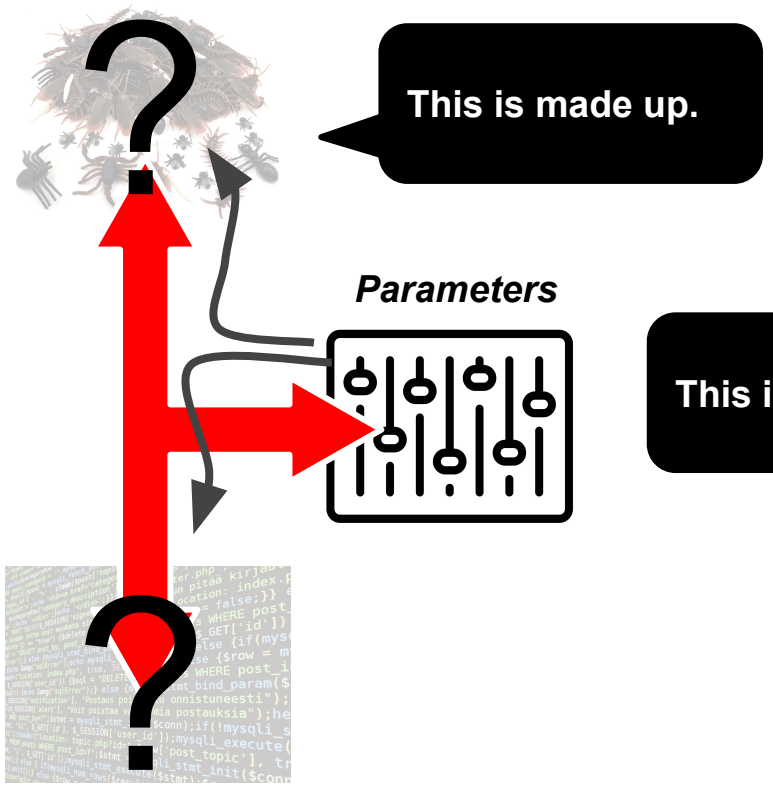


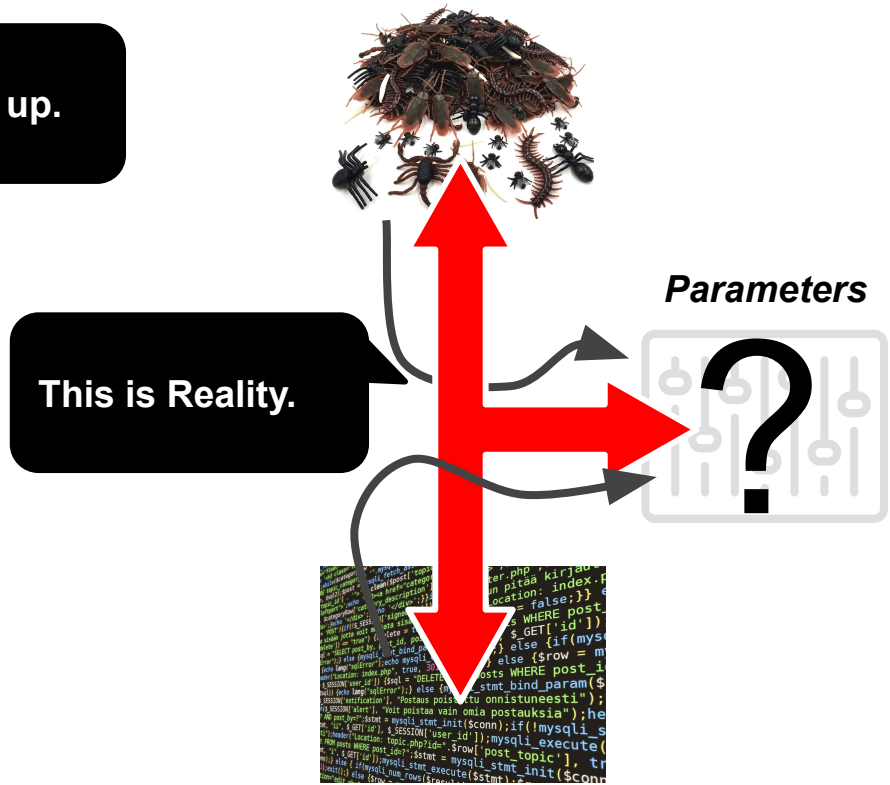


Symmetry (1)

We expect a **correspondence** for those two workflows, **and call them…**

Simulation





Original Methodology

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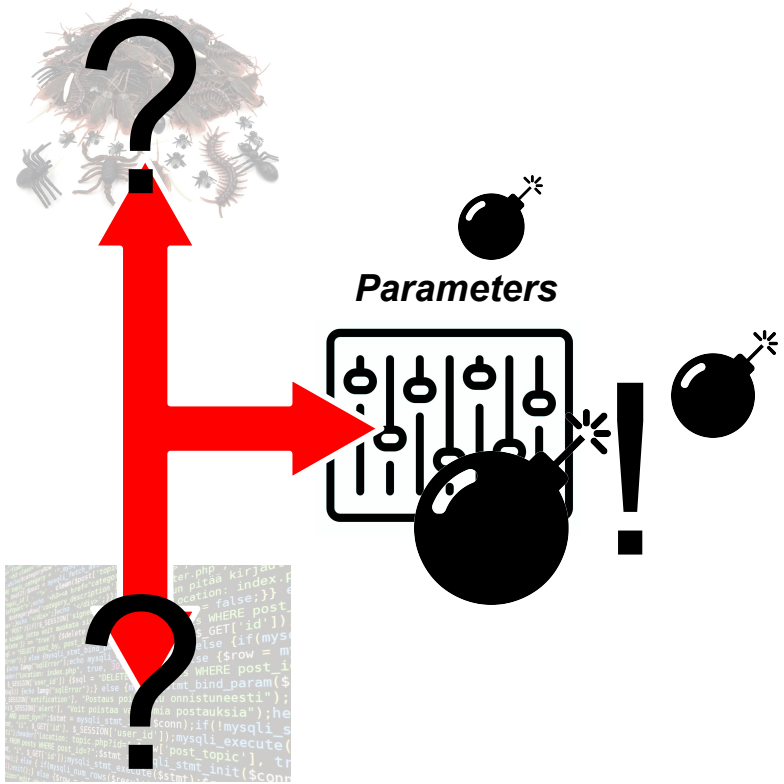
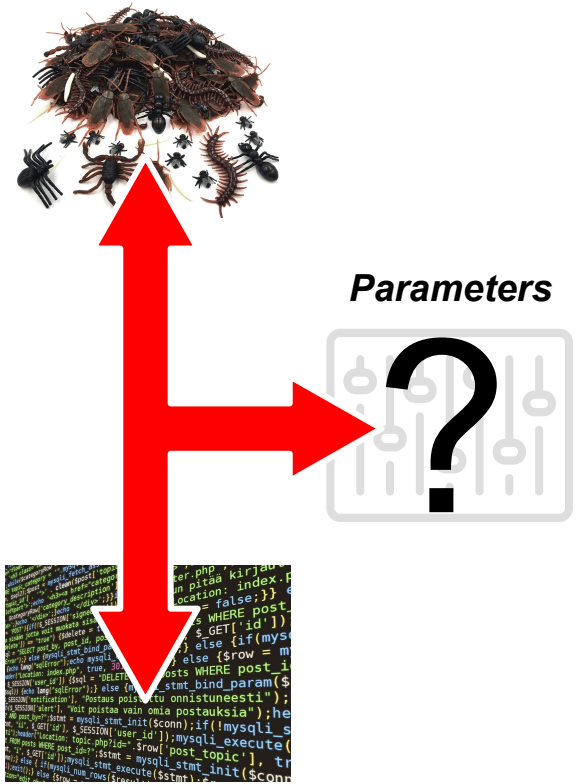
Symmetry (2)

We **set** plausible but challenging **simulation** parameters.

Simulation





Original Methodology

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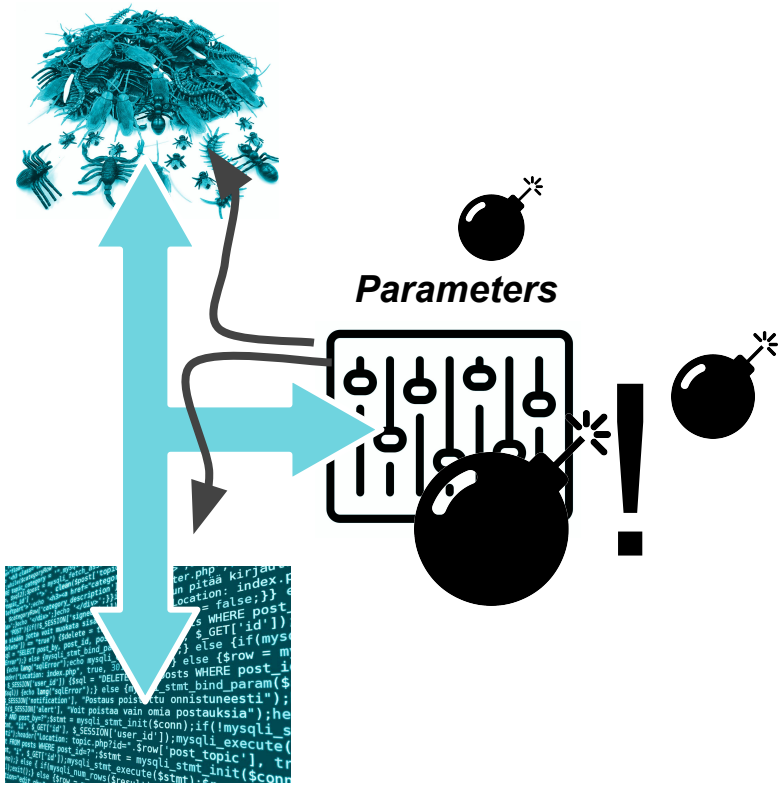
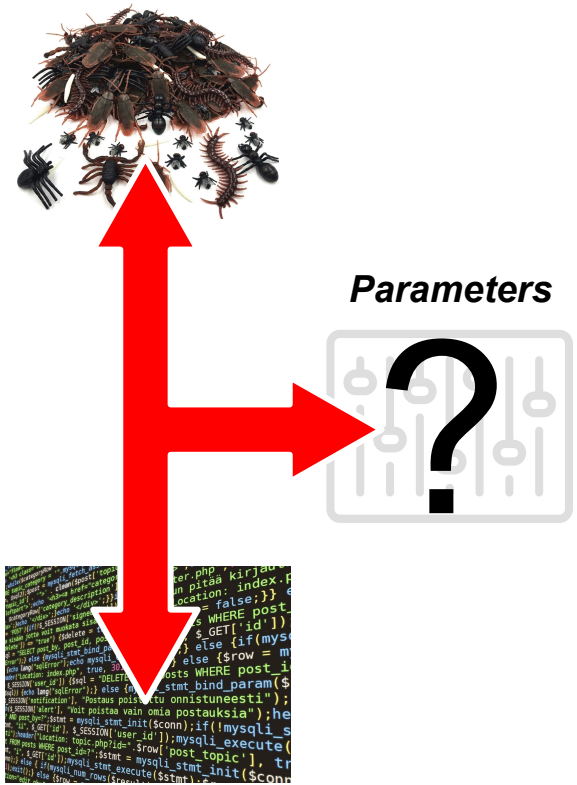
Symmetry (3)

We use relationships in revers to produce **artificial defects and code metrics**.

Simulation





Original Methodology

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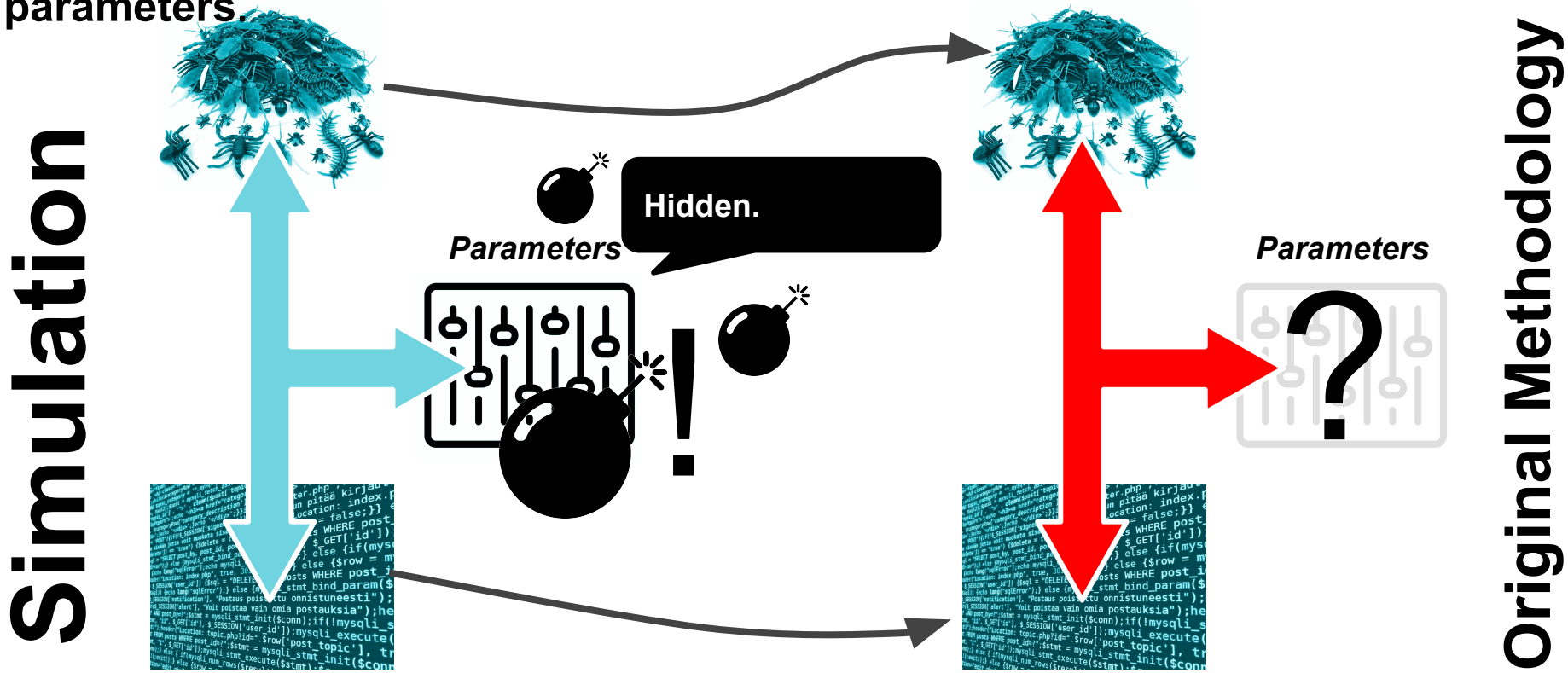
Symmetry (4)

We **substitute the real variables** with the synthetic variables, **except the parameters.**



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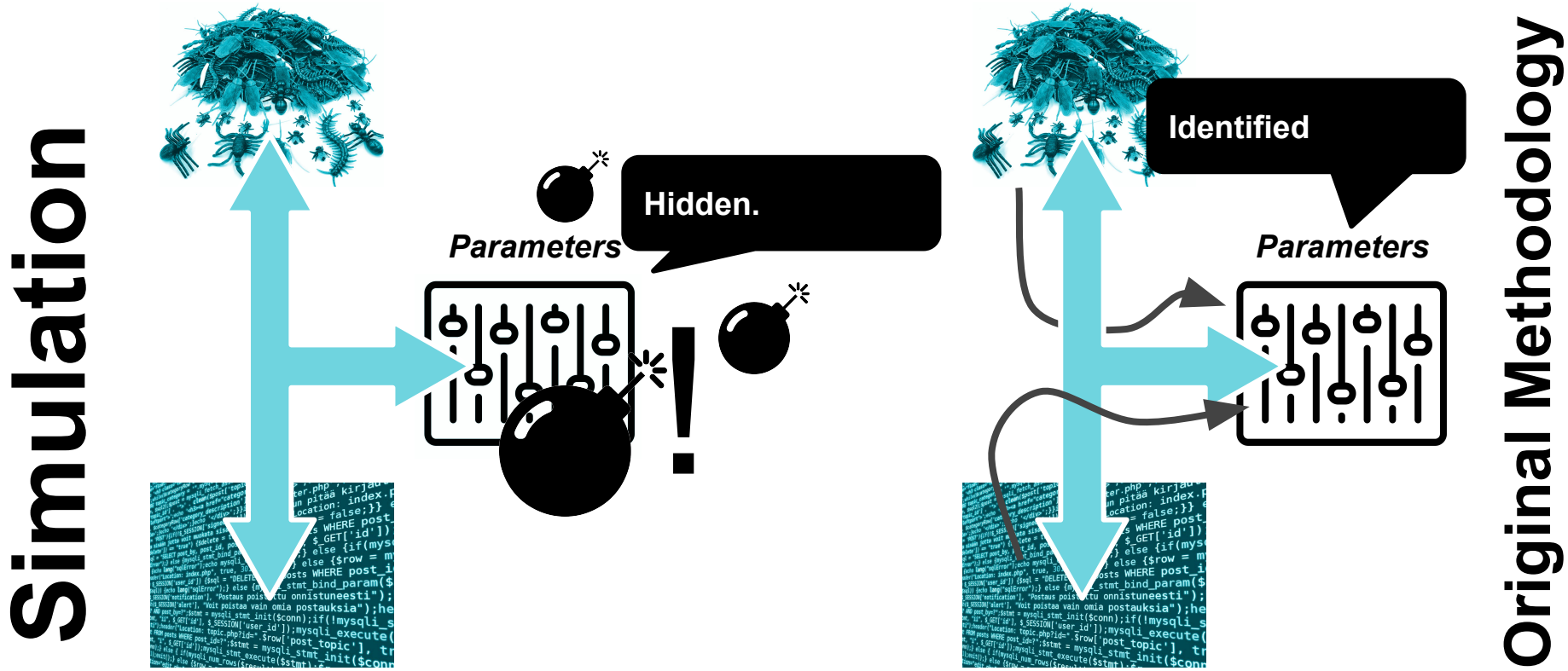
Symmetry (5)

We **run the original methodology** to identify parameters again.



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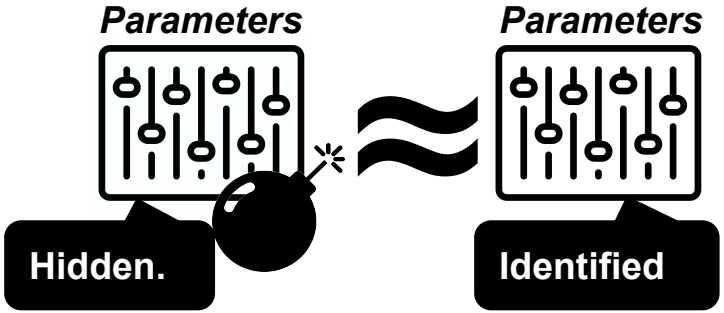
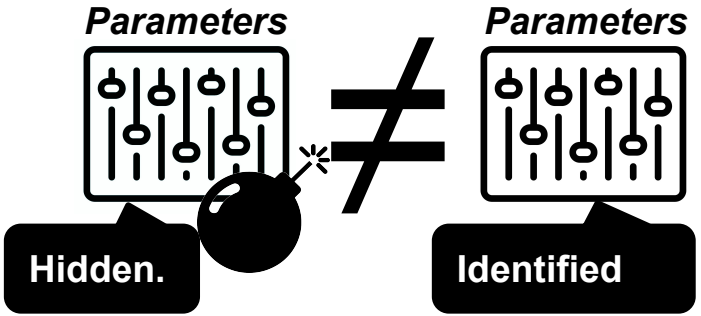
Symmetry (6)

We can **check correspondence**.





Nice to know that results are **correct**, I will relax now.

It is **a threat** to the study, I will relax, but list it in the paper.

I will **admit impossibility** and report on this.

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Applying Simulation-based Testing
(our evaluation)

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What kind of bombs do we have?

Dependent observations

Causation vs. prediction

Control of variables

Correlated variables

… (needs to be continued by you)

We used simulation-based testing to pinpoint threats in real studies (as an evaluation).

Try the simulations that we provide online.

https://github.com/topleet/MSR2022