The Potential of Sampling for Dynamic Analysis

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Dynamic Security Analysis

- Finds flaws in programs as they run
  - Makes programs more robust
- Insert checks around instructions

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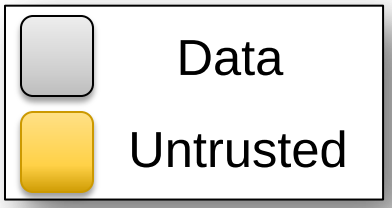
Dynamic Information Flow Tracking



1. Inputs are untrusted
2. Propagate untrusted status while executing
3. Check trustedness for safety

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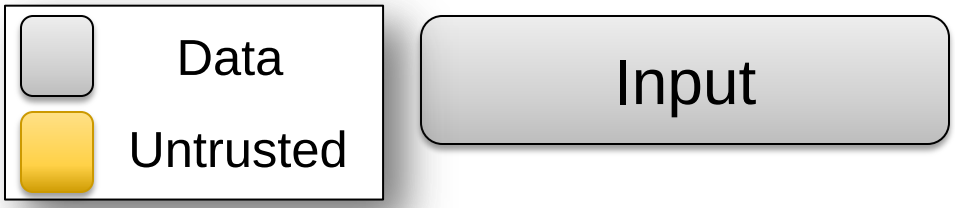

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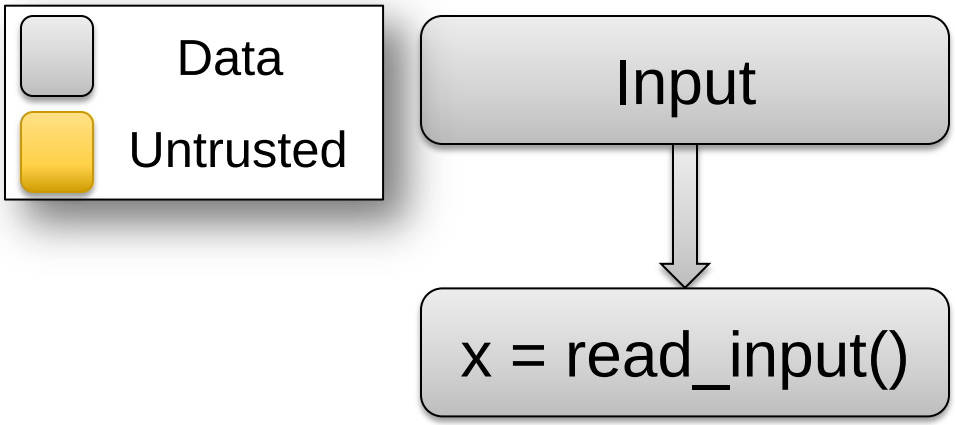

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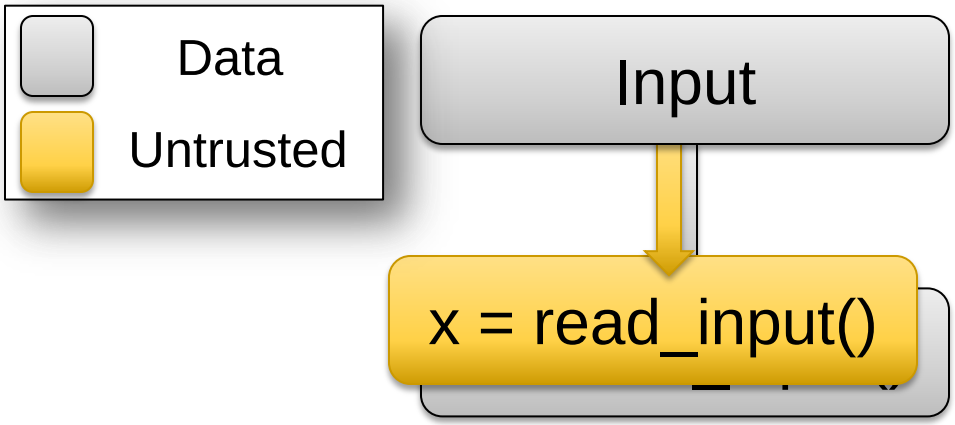

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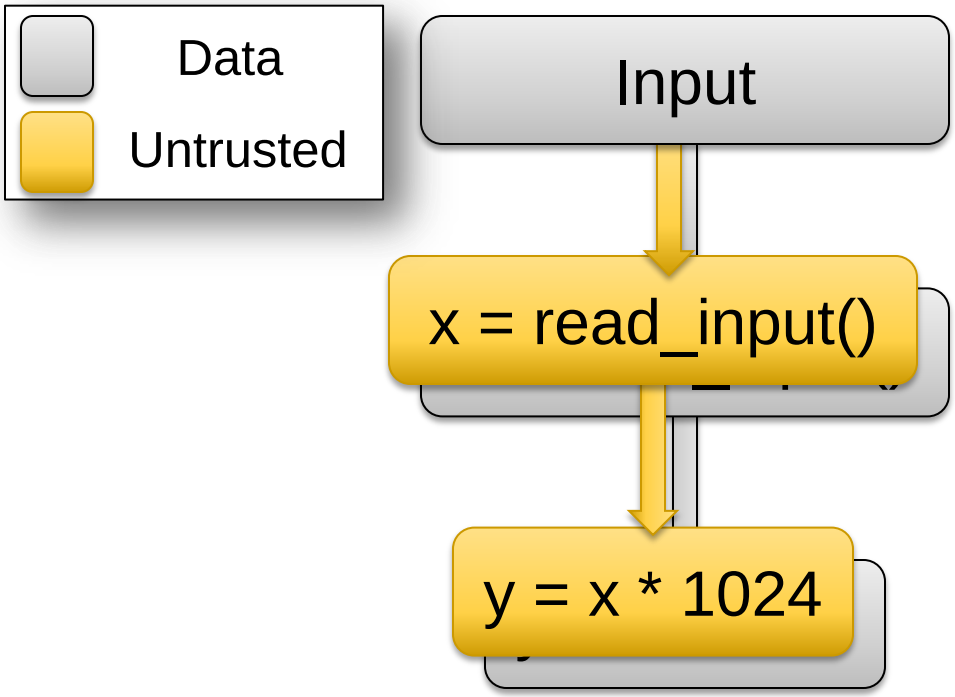

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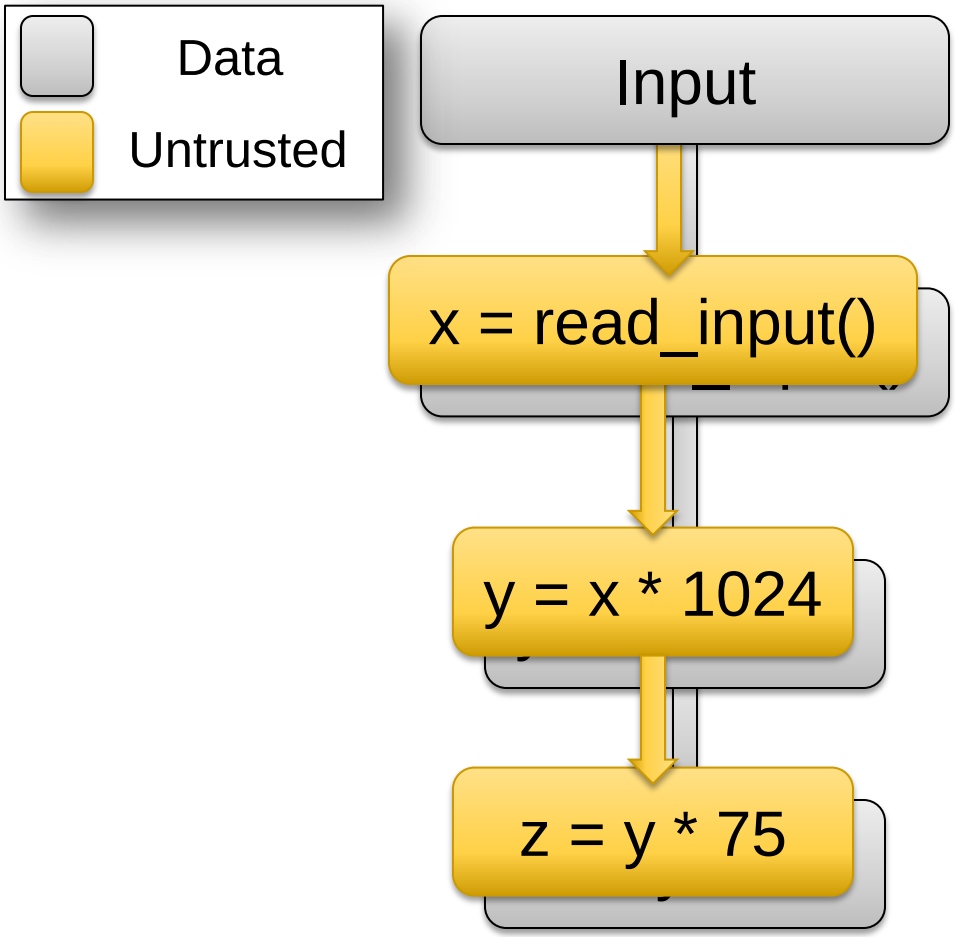

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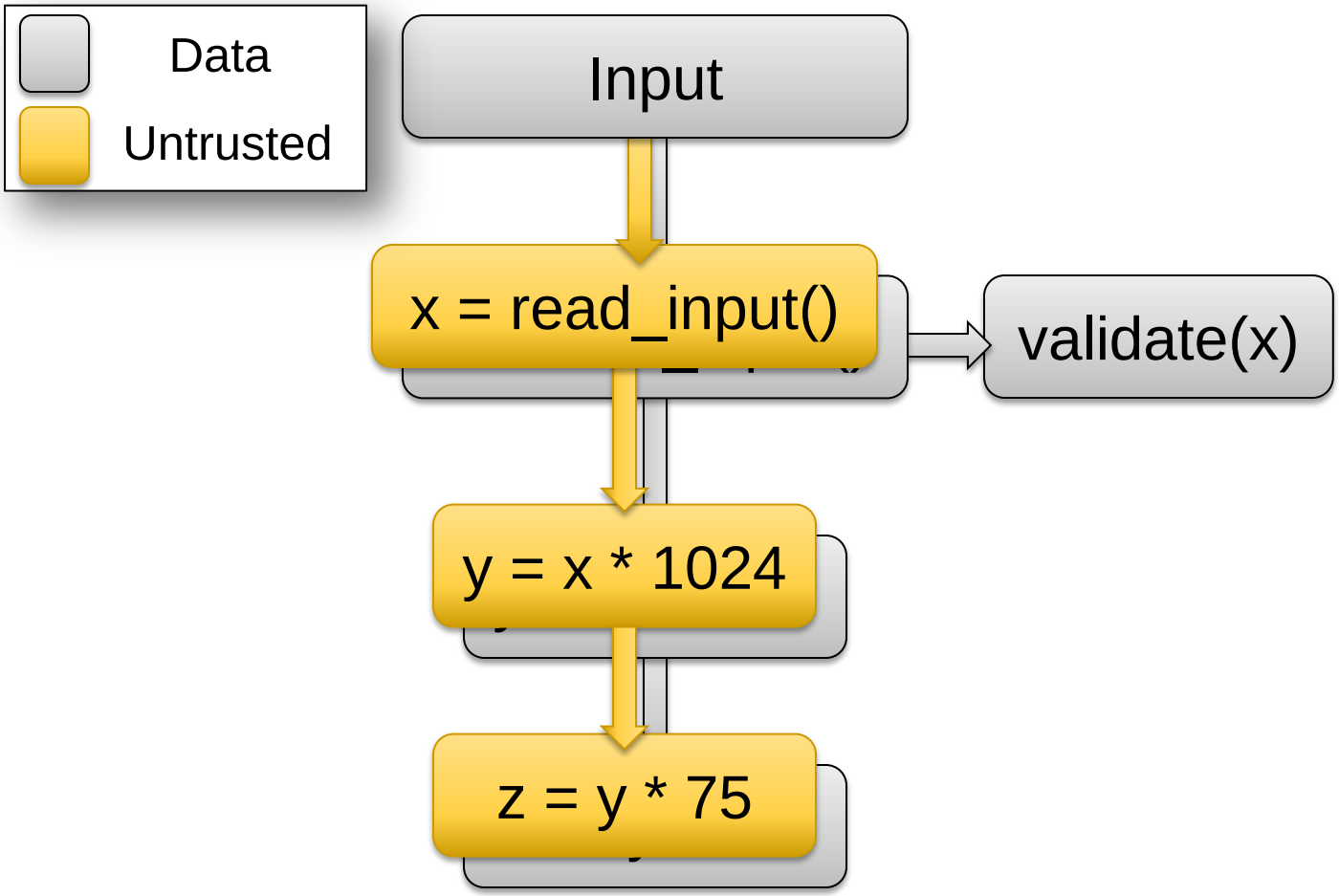

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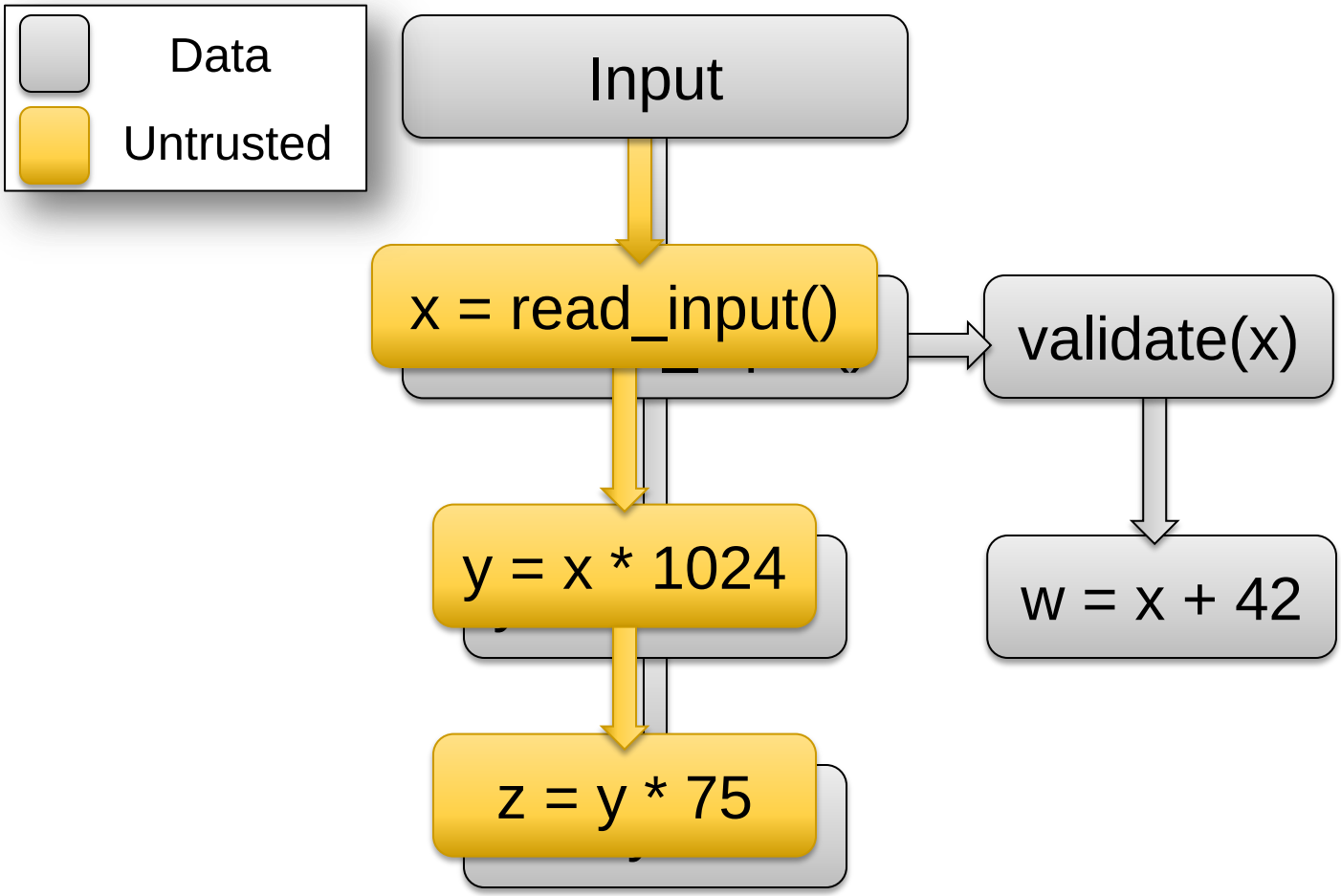

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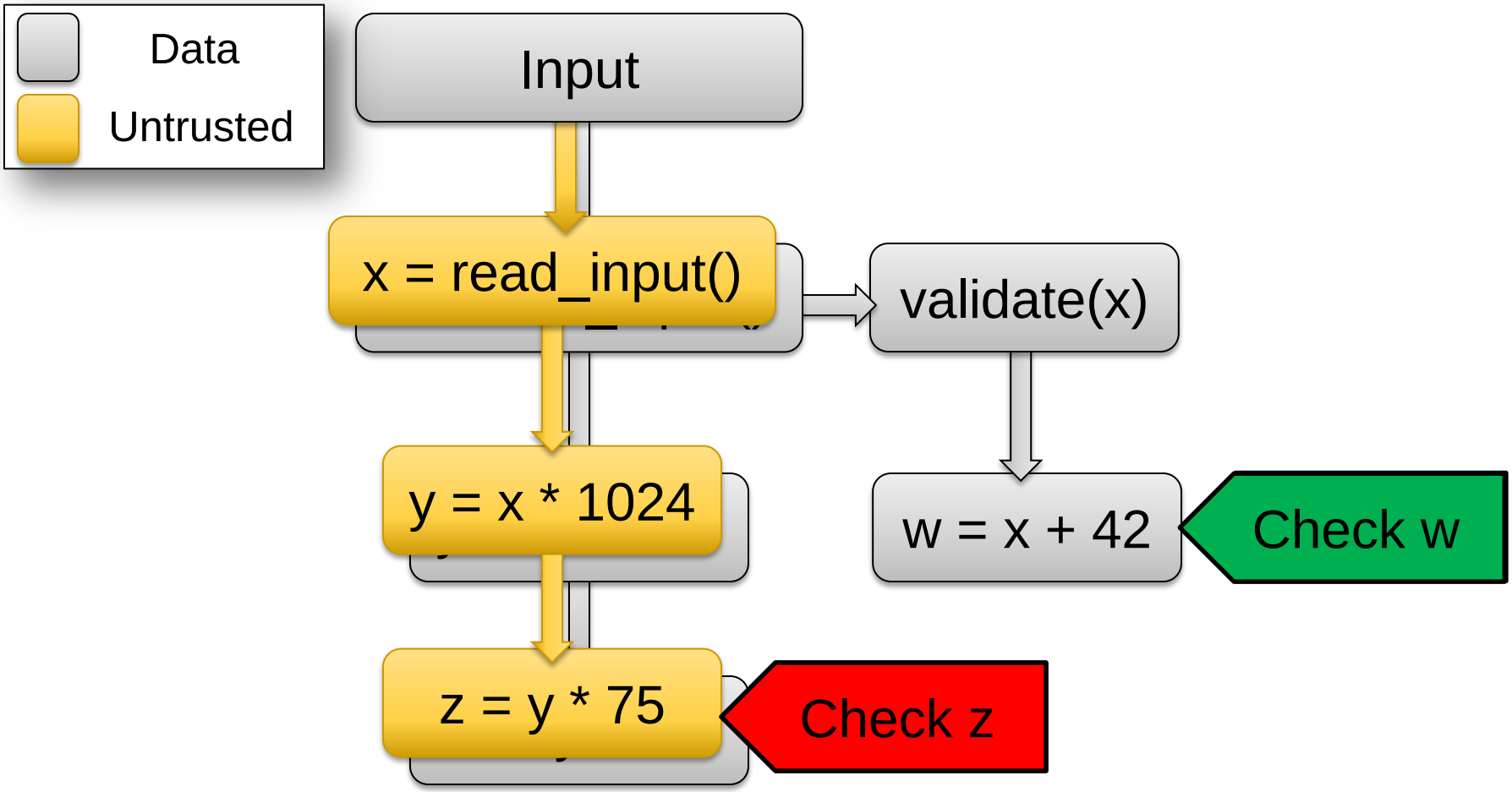

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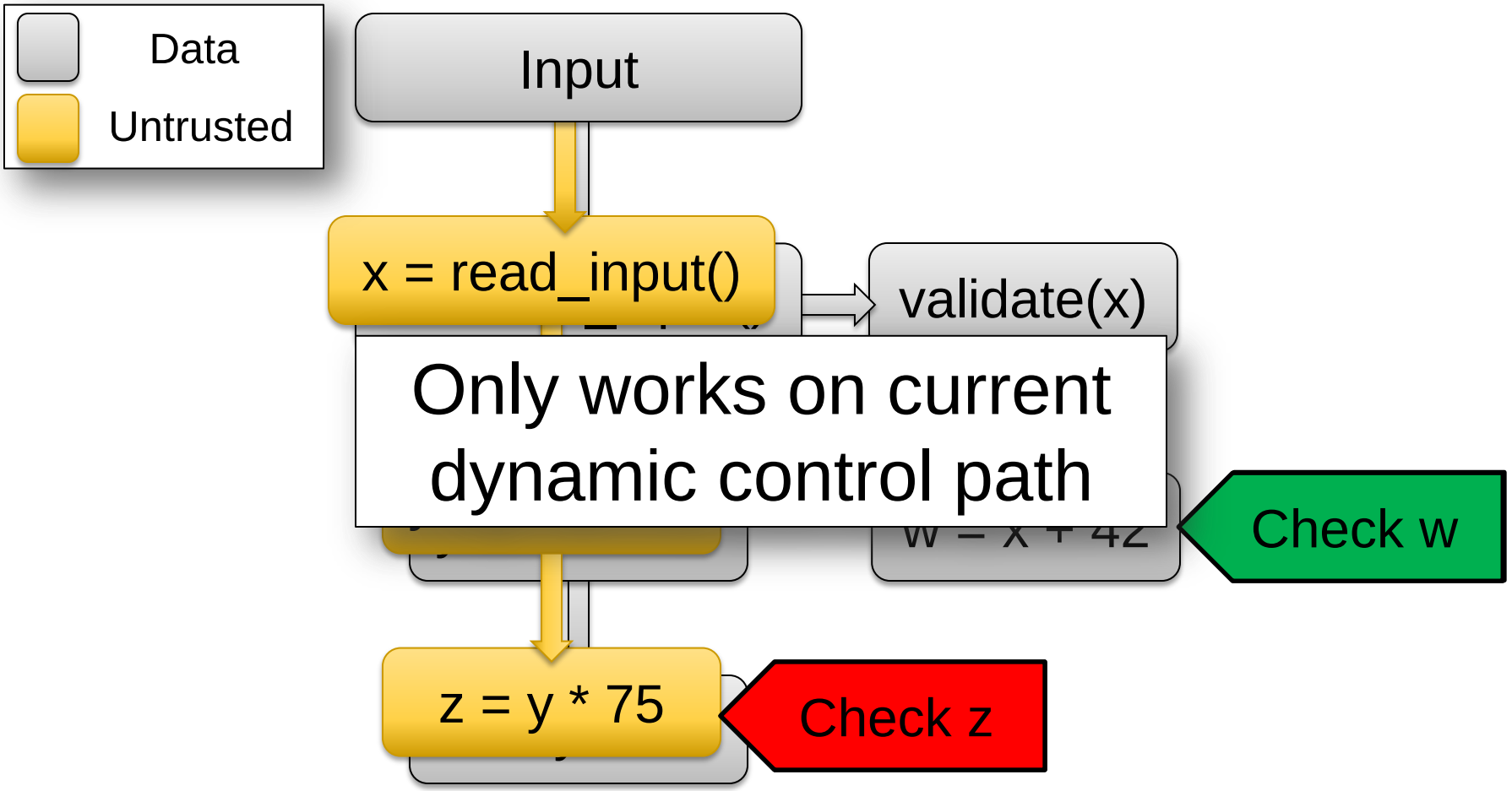


Problem: Dynamic Analyses are Slow

Assertion Checking

2x

Race Detection

100x

DIFT

150x

Symbolic Execution

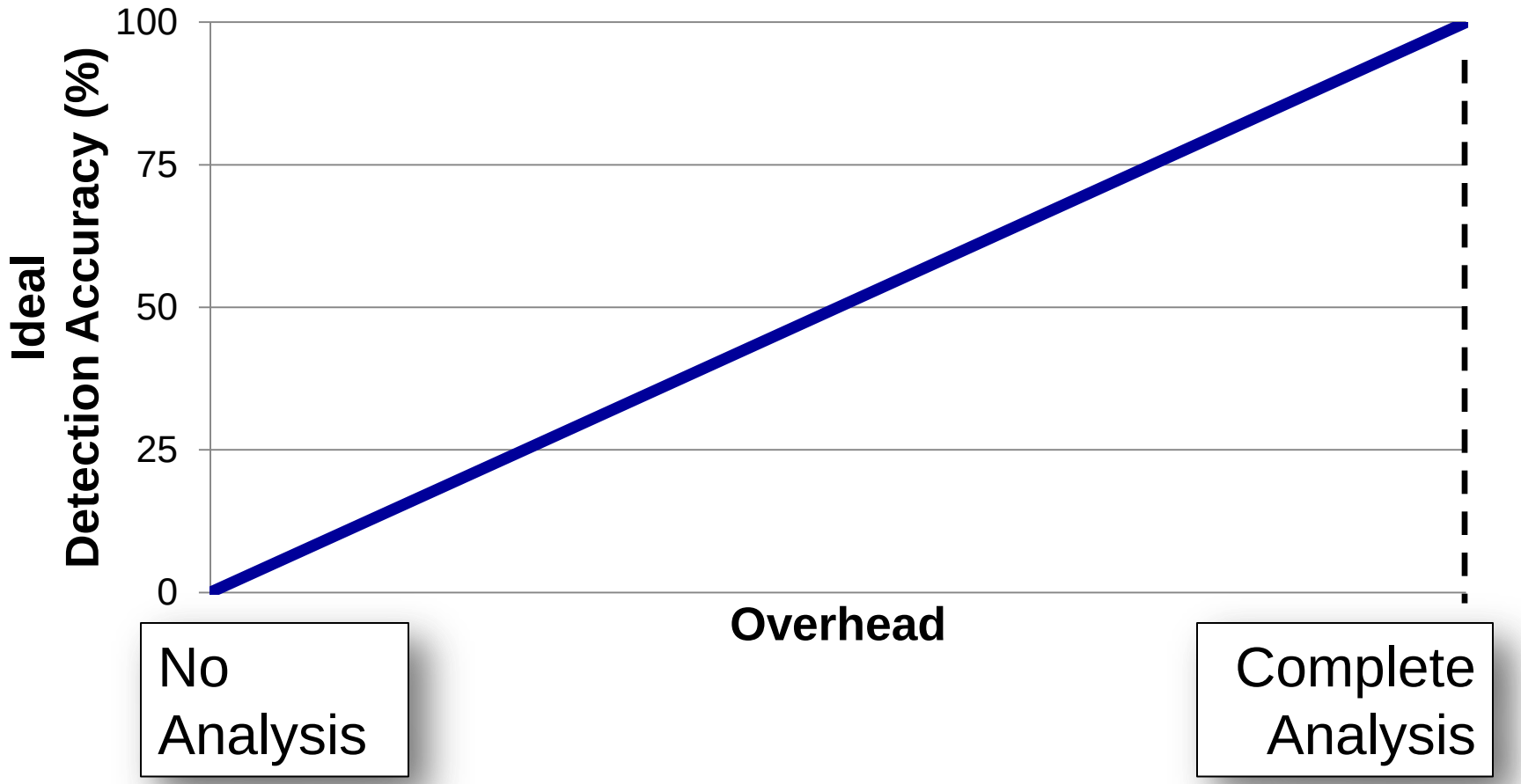
200x

Atomicity Checking

400x

Dynamic Analysis Sampling

- Lower overheads by skipping some analyses



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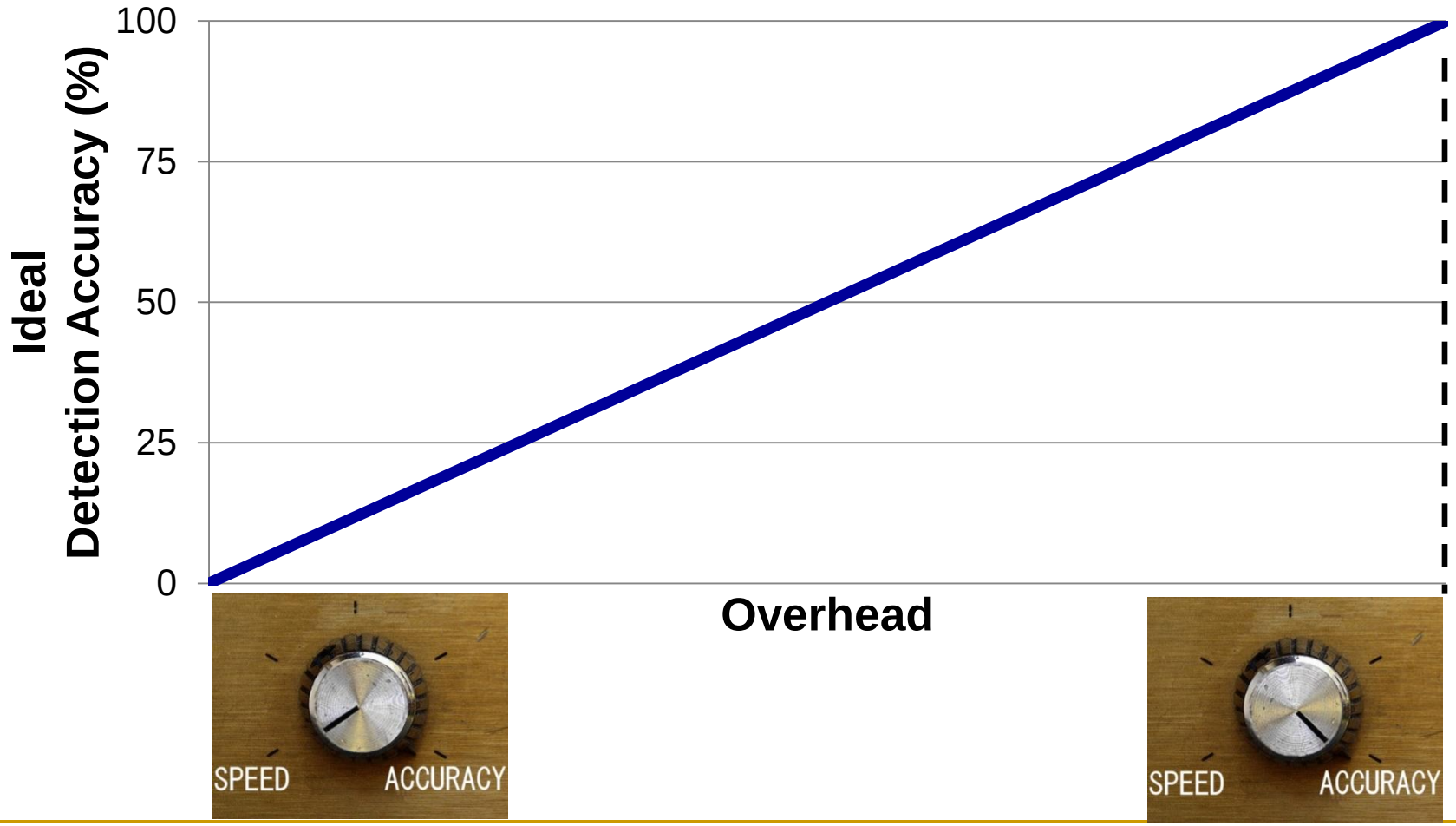
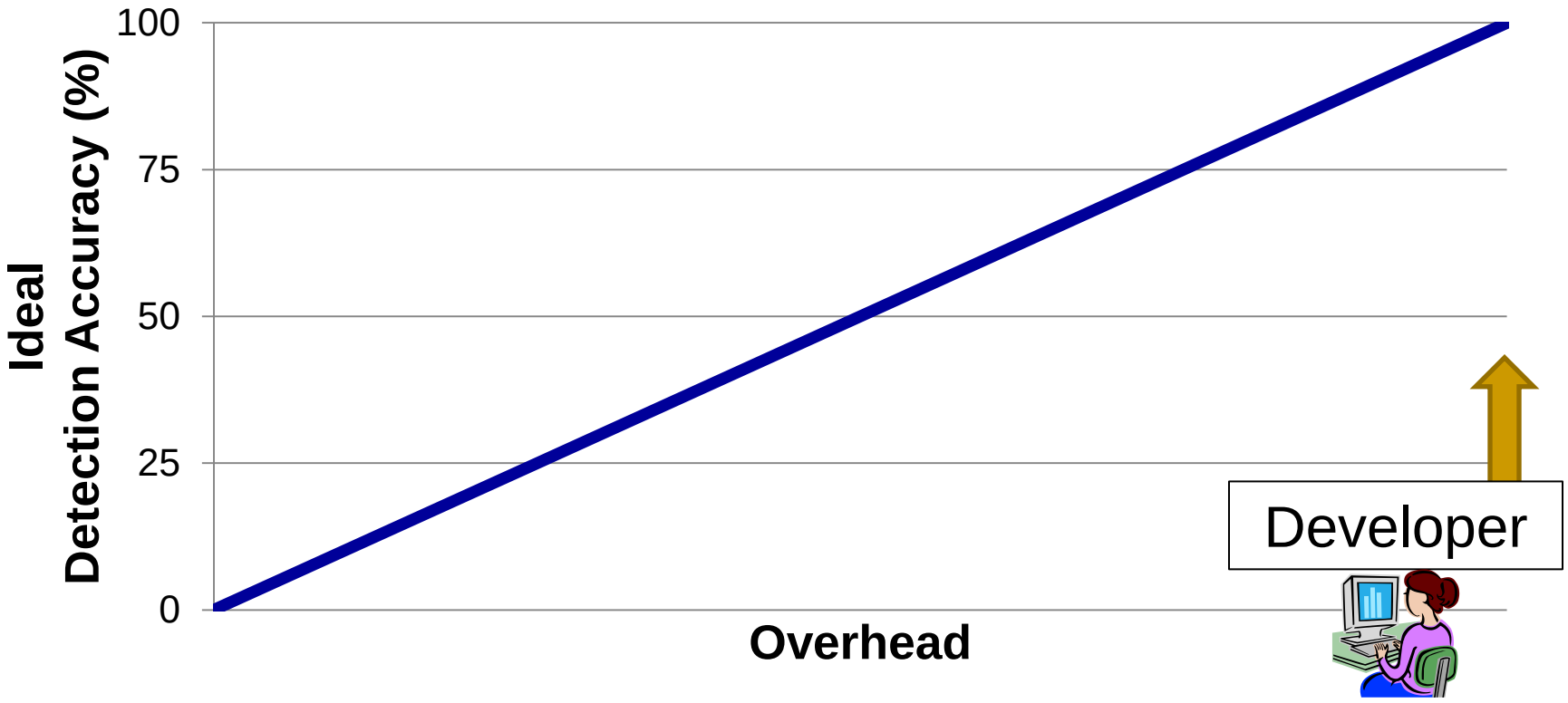


Sampling Allows Distribution



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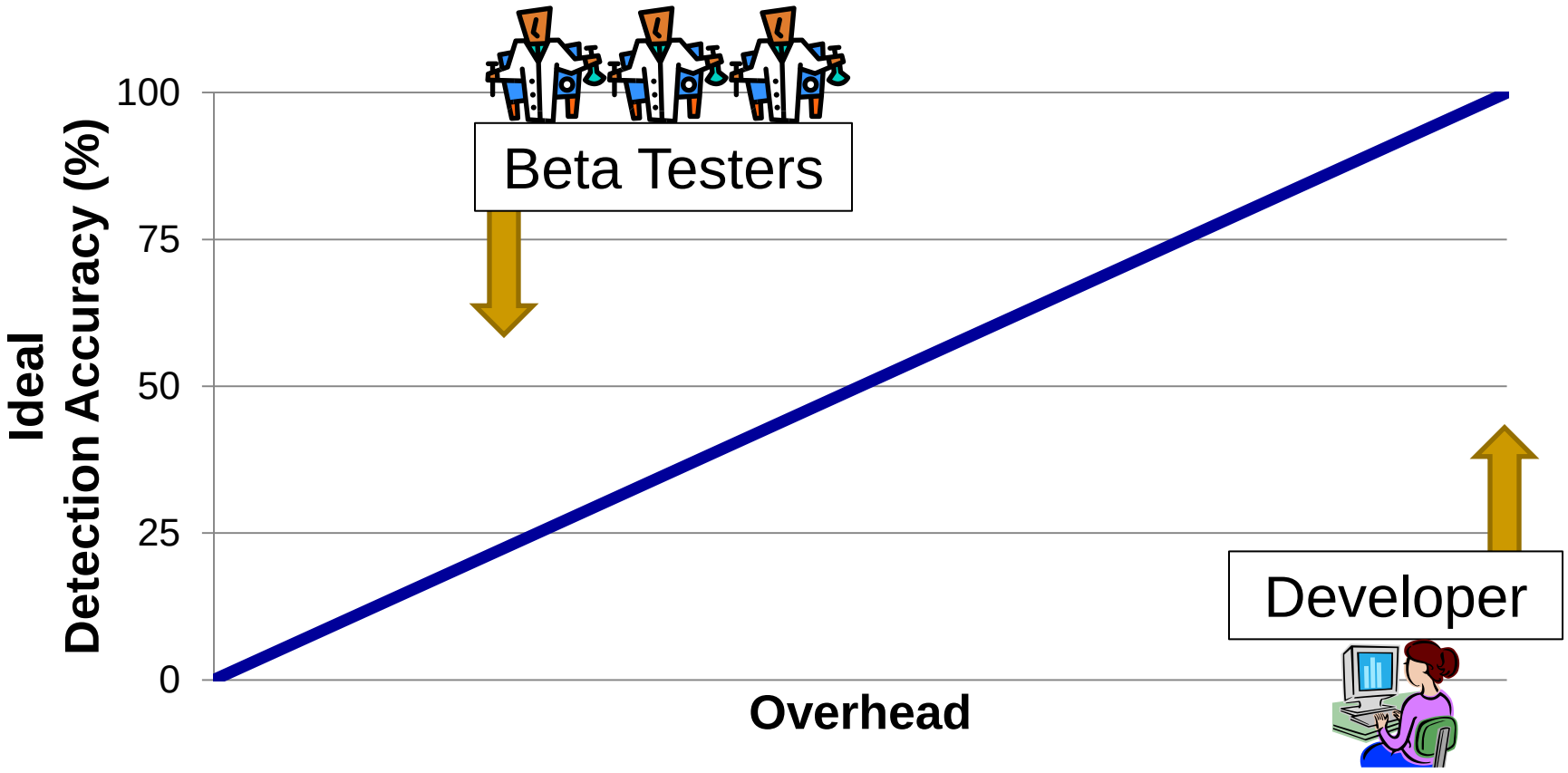

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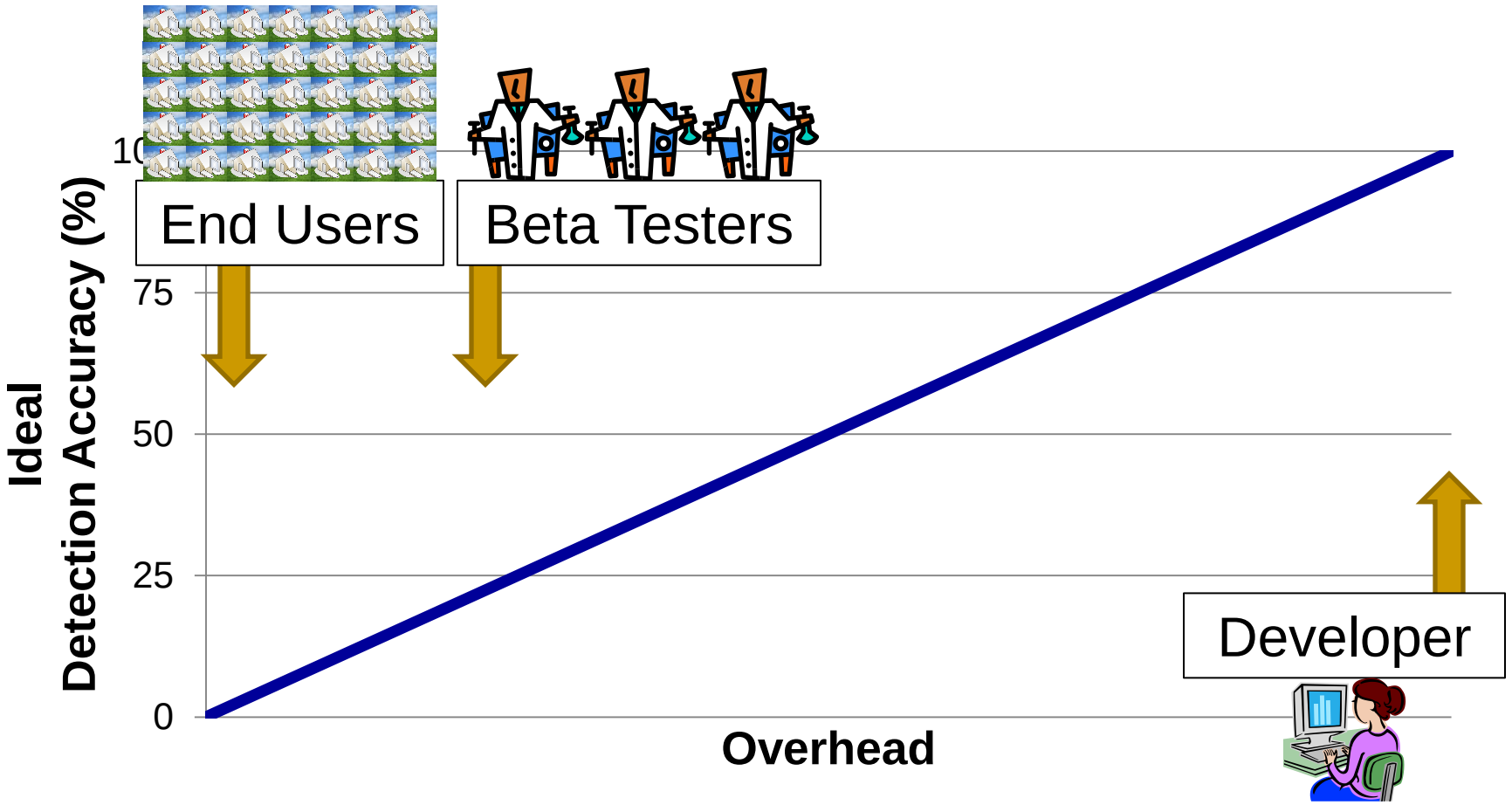

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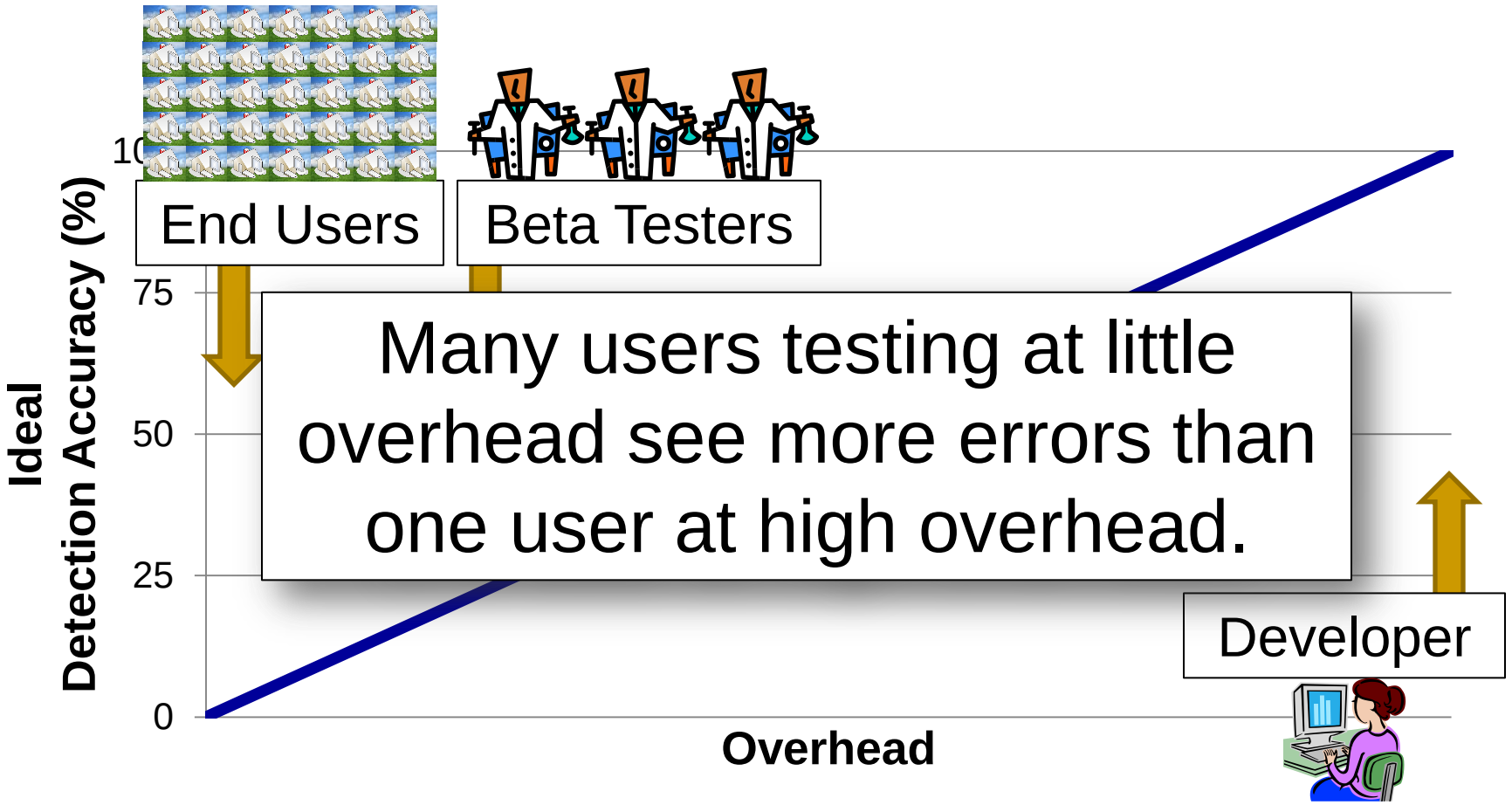

Sampling Assertion Checking

- Perform a random subset of checks

Static Code

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- 1/1000 checks: ~3x slowdown→30% overhead

Sampling DIFT

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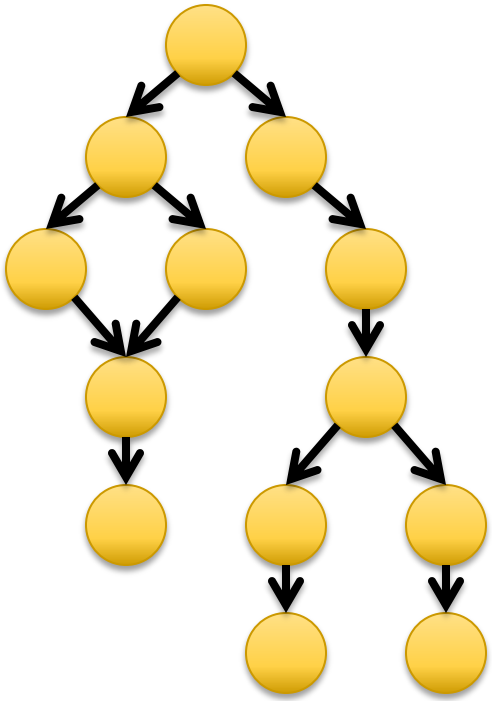

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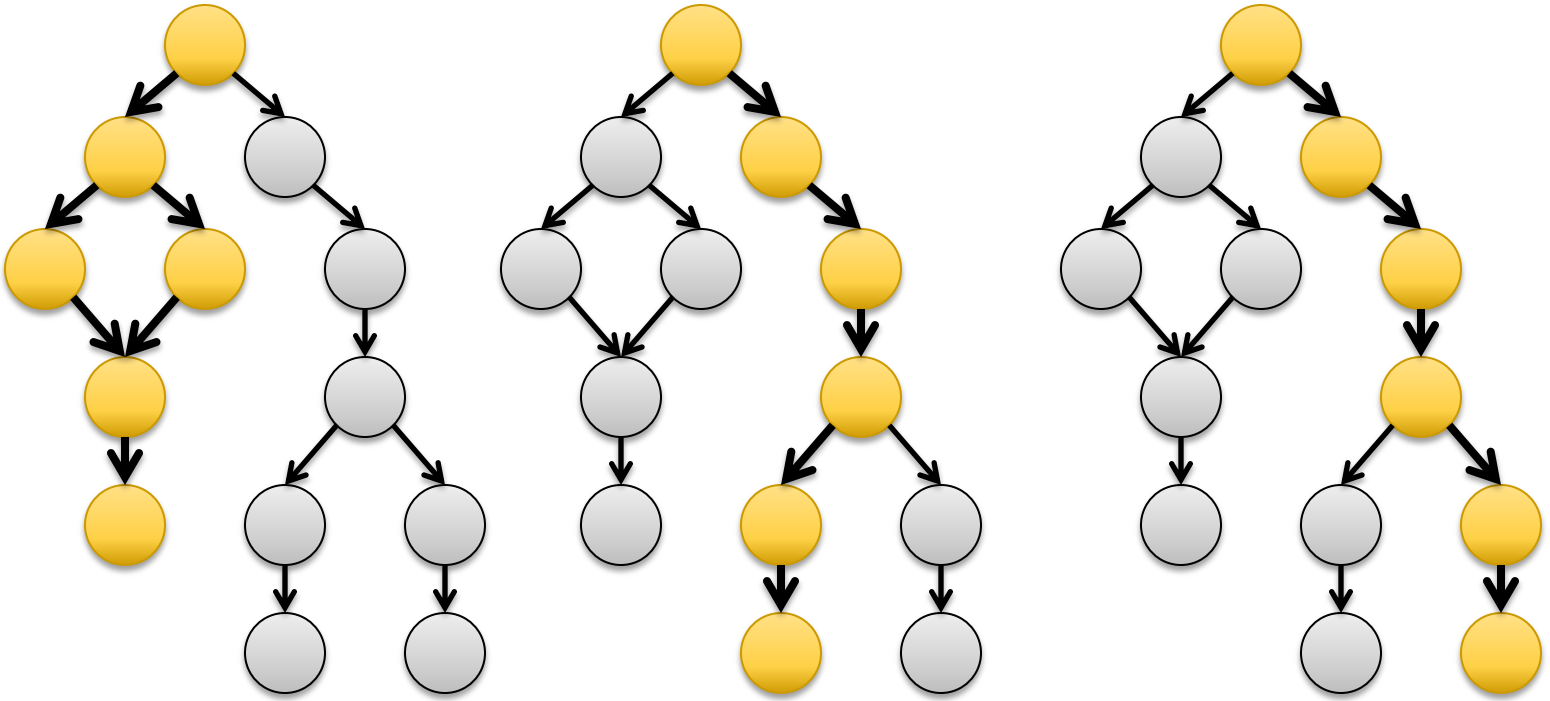

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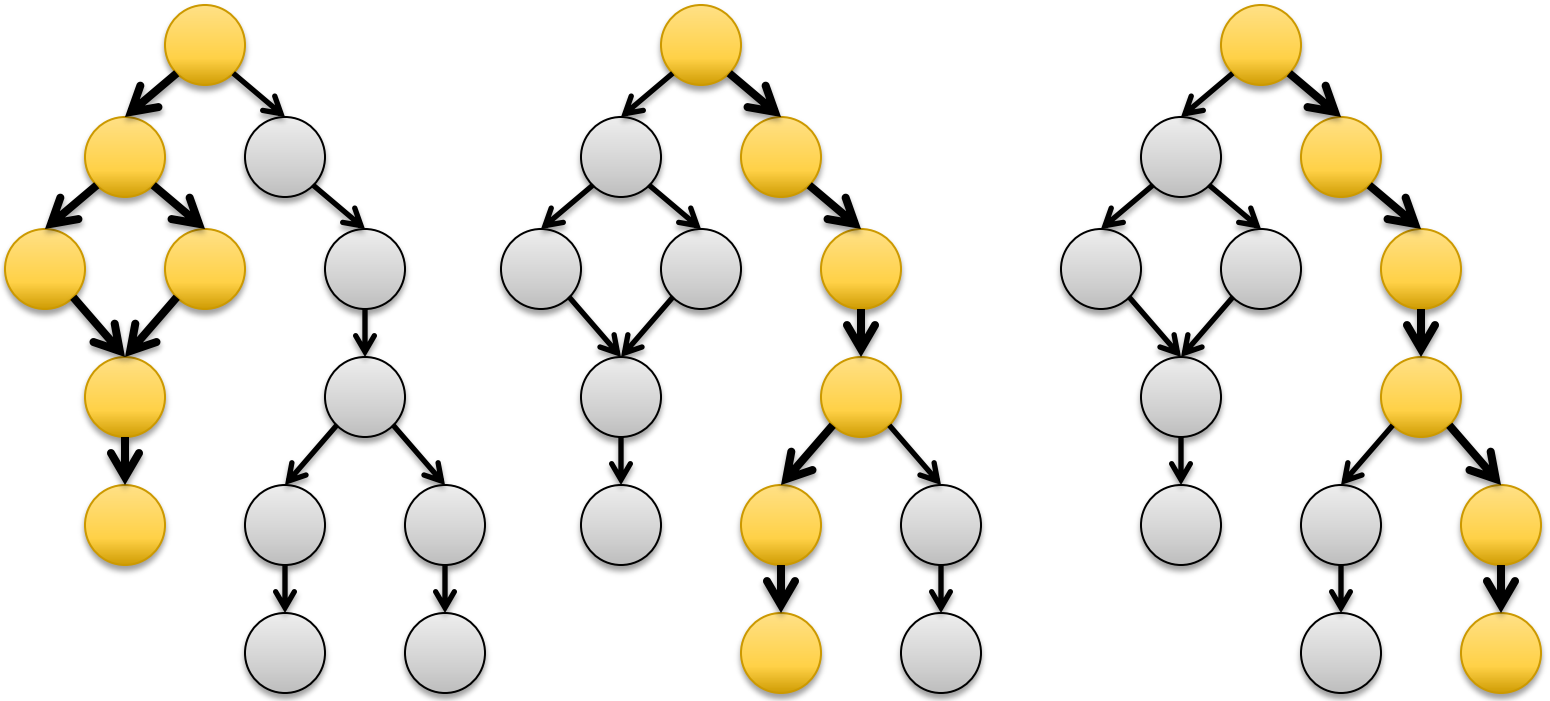

- 0.1-10% of faults: 10% overhead

Advanced Sampling Techniques

- Cold region Hypothesis
  - Sample “cold” code at higher rate
- New atomicity violation detection
  - Trace atomic regions and correlate crashes

Future Research Directions

- Sampling for more dynamic analyses
- New types of analyses because of sampling
- Studies on users slowdown acceptance

BACKUP SLIDES

Needed Engineering Efforts

- Push-button sampling mechanisms for Valgrind, DynamoRIO, Pin, etc.
- Libraries to integrate bug reporting into analysis tools
- Back-end infrastructure for handling distributed, sampled bug reports