Tailoring Programs for Static Analysis via Program Transformation

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Carnegie Mellon University

institute for SOFTWARE RESEARCH

spotbugs / **spotbugs**

facebook / **infer**

uber / **NullAway**

Static analyzers approximate

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Static analyzers approximate

Theoretically

- Decidability
- Soundness

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Specify `fclose` closes a file

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rsyslog

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Pull out constant

→ No False Positive

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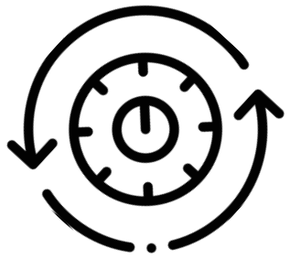

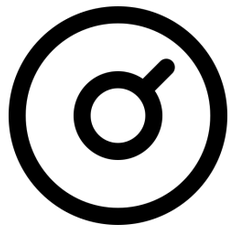

Icons made by Smashicon and Freepik from www.flaticon.com

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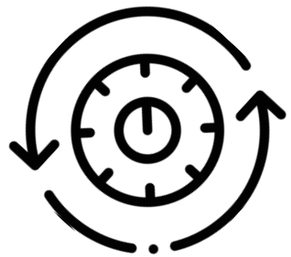

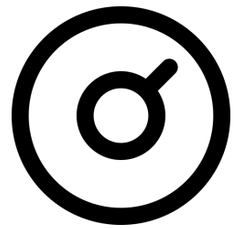

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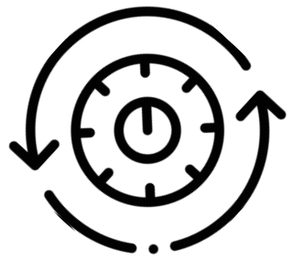

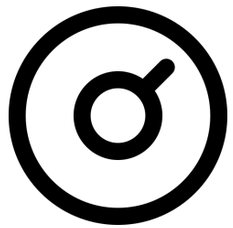

Analysis knobs are insufficient

- Command line flags
- Supress with code comments

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Analysis authors implement these

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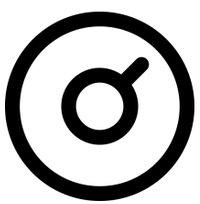

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- Syntax rewriting with declarative templates

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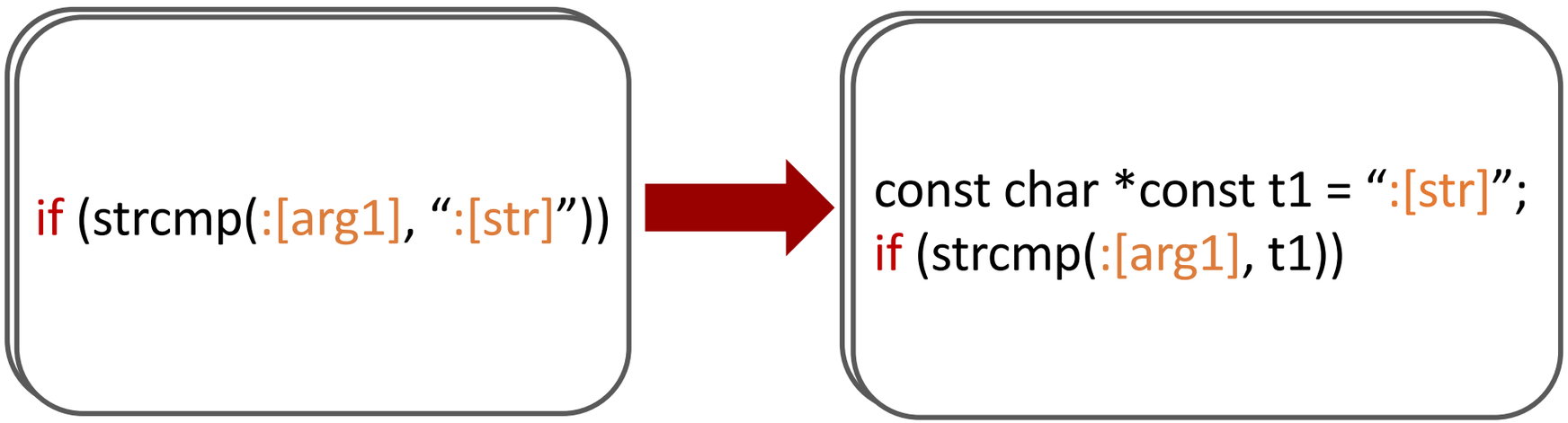

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Tooling:

https://comby.dev 

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if (strcmp(:[arg1], “:[str]”))
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```
const char *const t1 = “:[str]”;
if (strcmp(:[arg1], t1))
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Our approach: Tailor analysis via program transformation

- Lightweight
- Many languages
- Fast

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- Temporary modification

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- Five analyzers, three languages

  PHP, Java, C

  PHPStan, Infer, SpotBugs, Clang Static Analyzer, CodeSonar

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- Longstanding open false positive issues on GitHub
  - Developer-reported issues
  - Commit search

Results

Analyzer	Lang	Proj	KLOC	Anlyz	Rewr	Δ FP	# R
PHPStan	PHP	WordPress	5.7	2.5s	0.3s	-44	16
PHPStan	PHP	Codesniffer	1.6	1.1s	0.1s	-3	3
Infer	Java	Drift	50.7	2m47s	1.0s	-1	1
Infer	Java	Presto	813.0	39m20s	3.3s	-1	1
Infer	C	OpenSSL	402.9	17m19s	1.6s	-6	3,735
Clang SA	C	rsyslog	145.0	16m20s	2.9s	-3	10
CodeSonar	C	swoole-src	96.8	6m40s	0.6s	-2	2
CodeSonar	C	Ioping	1.2	14s	0.2s	-2	2
SpotBugs	Java	hazelcast-jet	103.8	1m48s	1.3s	-1	45
SpotBugs	Java	Santulator	11.1	44s	0.5s	-2	8
⋮						⋮	

9 templates remove 111 false positives across 15 projects

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Large Projects

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False positive due to socket not closed by function

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Pattern reused and found in another project

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@rvtond @clegoues