“These results must be false“: A usability evaluation of constant-time analysis tools

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It All Started a Long Time Ago...

Timing Attacks on Implementations of Diffie-Hellman, RSA, DSS, and Other Systems

1996

Paul C. Kocher

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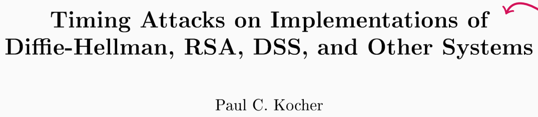

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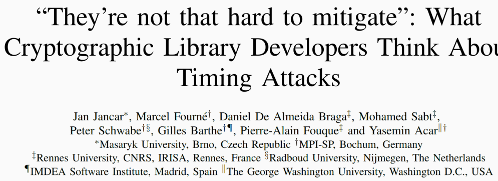

“They’re not that hard to mitigate”: What Cryptographic Library Developers Think About Timing Attacks

Jan Jancar[*], Marcel Fourné[†], Daniel De Almeida Braga[‡], Mohamed Sabt[‡], Peter Schwabe[†§], Gilles Barthe[†¶], Pierre-Alain Fouque[‡] and Yasemin Acar[∥†]
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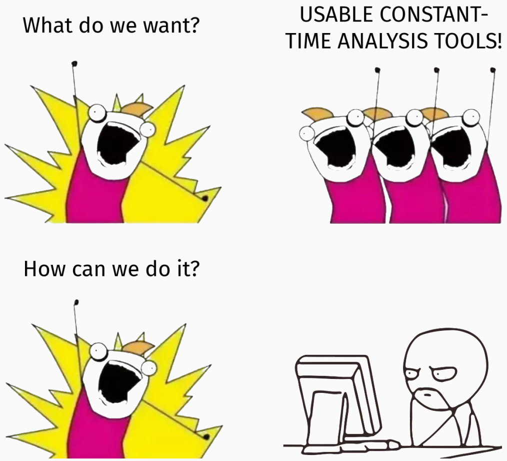
2022

Common complain: tools *“not really usable by mere mortals yet”*

Let's Make a Usable Tool!



Let’s Make a Usable Tool!

1. What are the pain points when using CT tools?
2. How effective are the tools at discovering and fixing problems?
3. How can we support potential users in using these tools?

Objectives: Assess usability of CT tools and provide recommendations.

Let's Make a Usable Tool!

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Usable according to

- Setup and familiarization
- Secret designation and target building
- Identifying and fixing issues

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Methodology

- **Approach:** Two-part usability study with busy crypto developers
- **Tasks:** Participants worked on repair tasks and real-world library audits.

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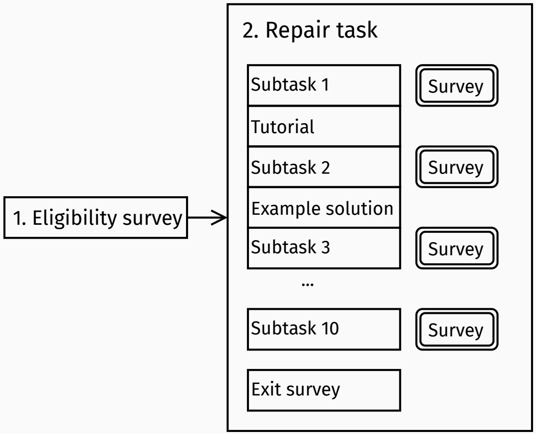
Selected tools

- MemSan
- timecop
- dudect
- ctverif
- Binsec/Rel
- haybale-pitchfork

Selected libraries

- OpenSSL
- GNUTLS/Nettle
- mbedTLS

Study Workflow



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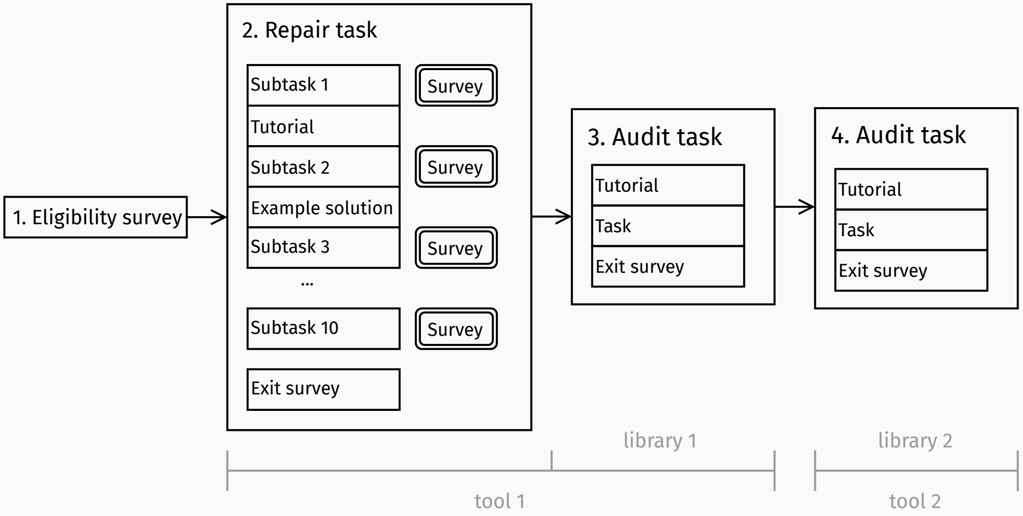
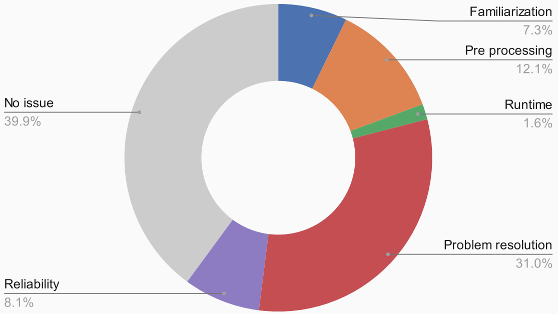


Key Findings - Repair tasks

Overall complaints:

- Detecting leakage seems doable
- Fixing leakage is tricky
- Participants were not experts

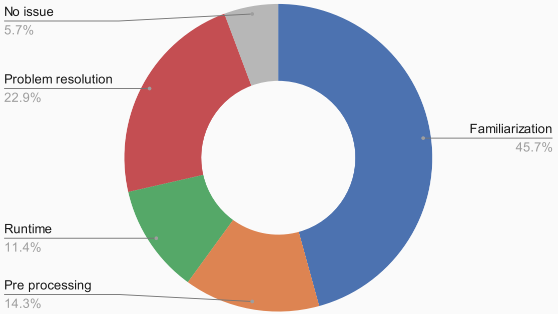
Let's look at the evolution of these complaints



Key Findings - Repair tasks

Task 1: Branch on secret

- Issues with familiarization
- Elephant in the room: bad documentation!
- What if we provide a short and effective tutorial?

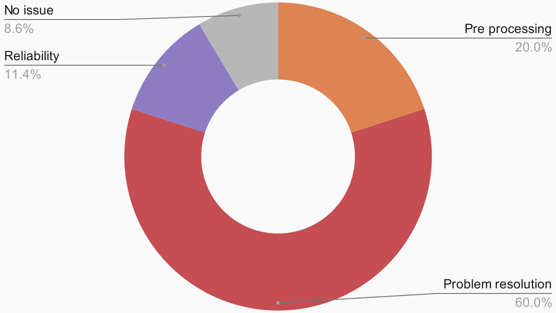


Key Findings - Repair tasks

Task 3: Memory access on secret

- Much better with our tutorial!
- Lingering pre-processing issues

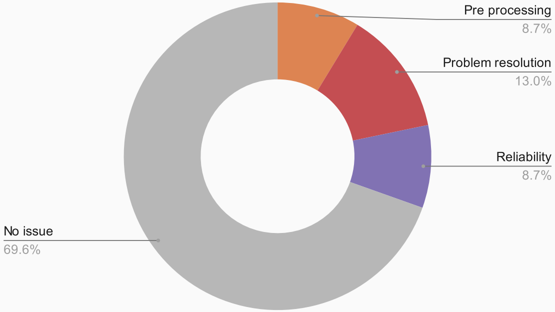
"At this point, I was using pitchfork somewhat routinely."



Key Findings - Repair tasks

Task 7:

Participants doing task 7
You know, I'm something of a constant-time developer myself



Key Findings - Audit tasks

Blocking points at each step of the road

Compile the library with specific options

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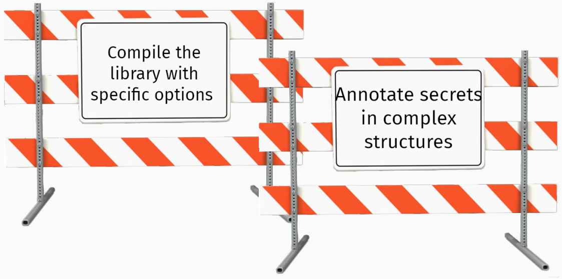
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Annotate secrets in complex structures

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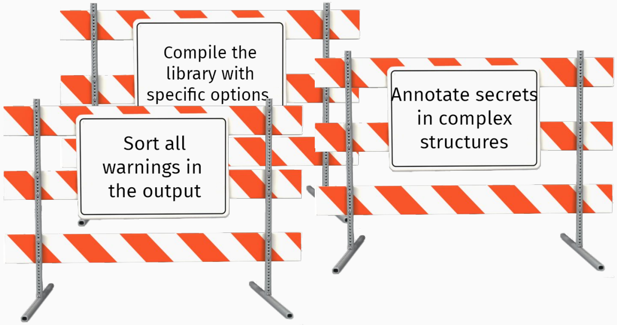
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Sort all warnings in the output
Annotate secrets in complex structures

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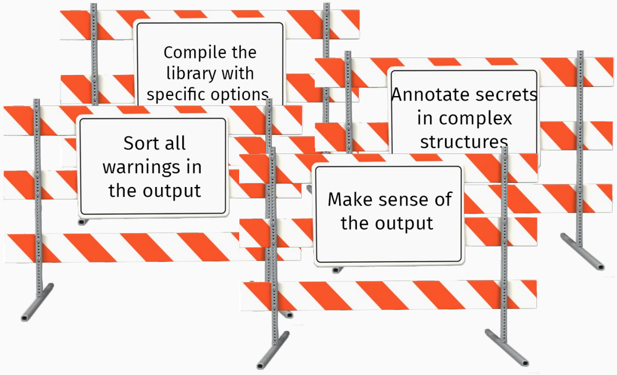
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Sort all warnings in the output
Make sense of the output

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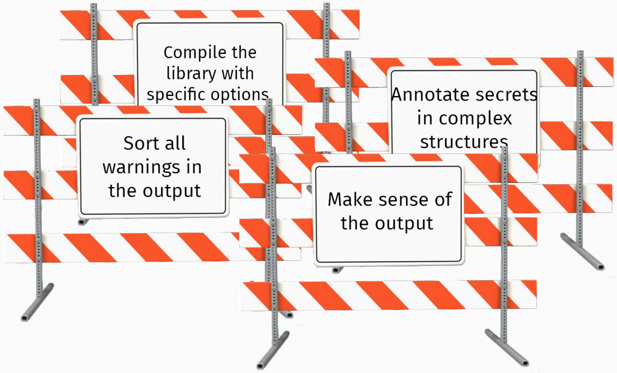
Compile the library with specific options
Annotate secrets in complex structures
Sort all warnings in the output
Make sense of the output

If they manage to run the tool, they have low confidence in the results

Recommendations

Setup and familiarization

- Straightforward installation
- Documentation **covering all** aspects
- Prioritize ease of use

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Integrating to developement pipeline

- Integration in CI
- Output extraction to bug-tracking tools
- Δ-mode for bug fixing

Talk to the people you are trying to help

Full paper

Artifact

Codebook, installation scripts, tutorials and more!

A huge thanks to all participants, tool developers and collaborators who made it possible