Continuous Compliance

Martin Kellogg[a], Martin Schäf[b], Serdar Tasiran[b], Michael D. Ernst[a,b]

[a]University of Washington [b]Amazon Web Services

What is compliance?

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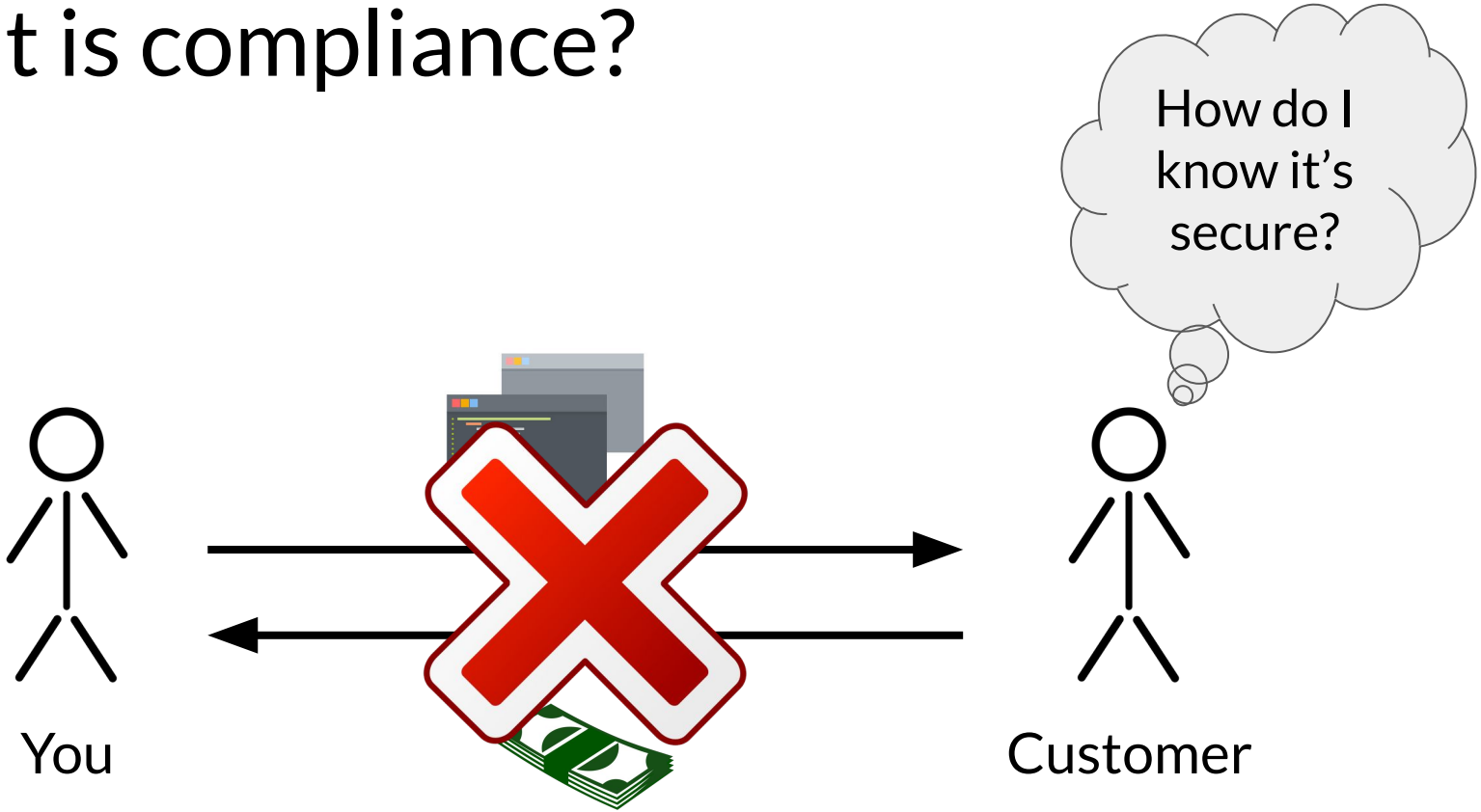

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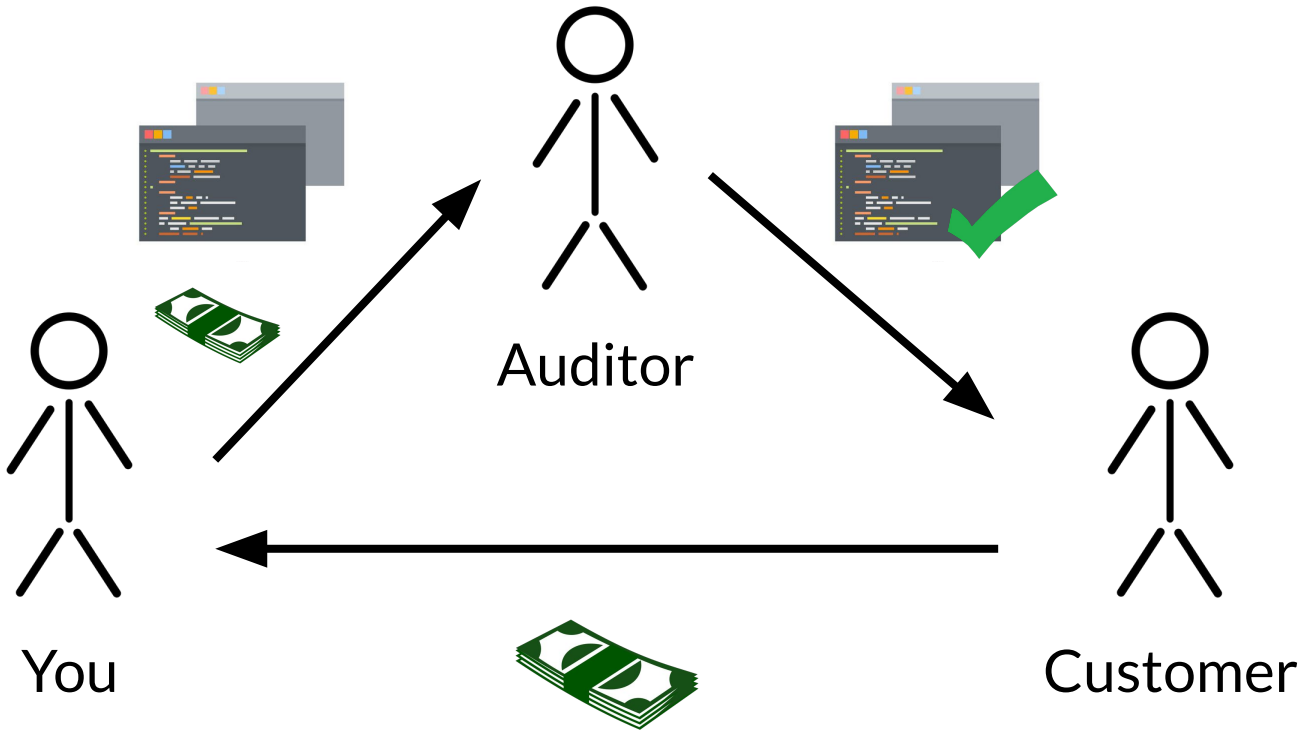

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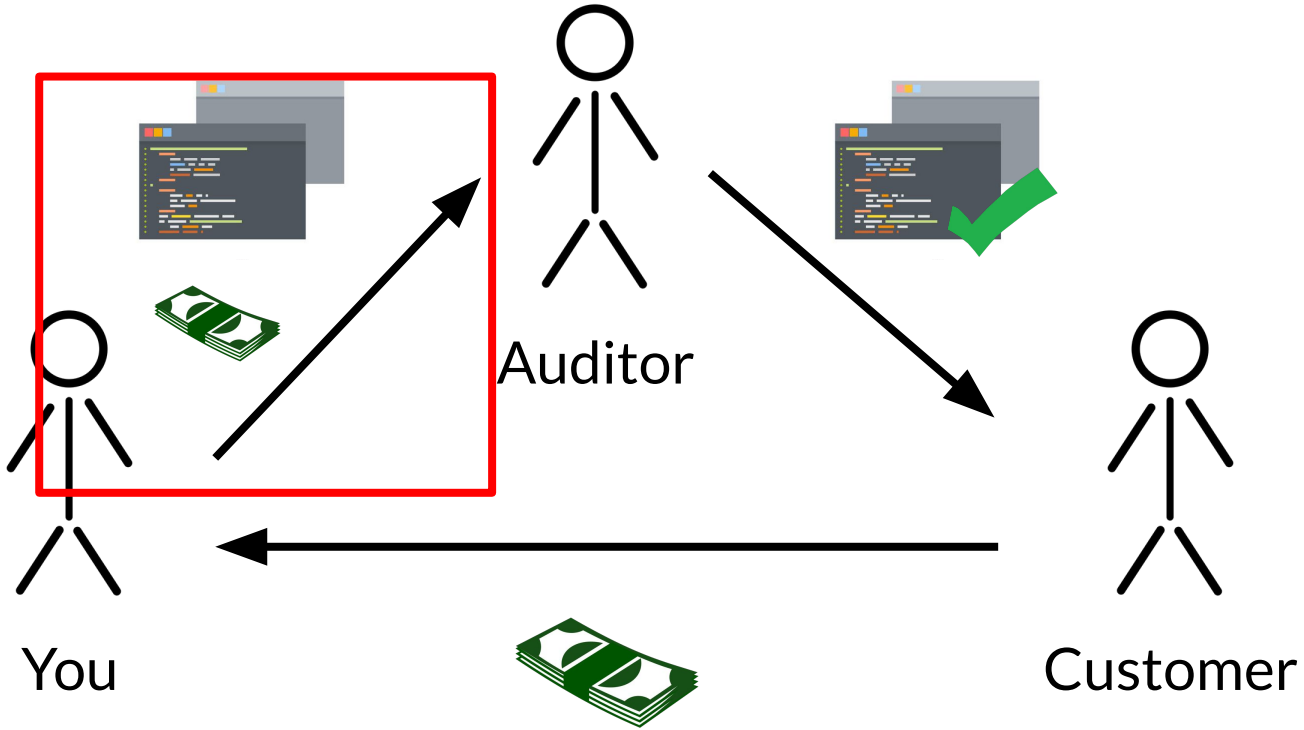

Audit workflow

	Traditional
Development	code review, keep compliance in mind
Preparation	
Review	

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Problems:

Audit workflow

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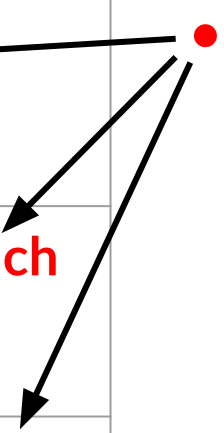
Review	randomly sample, **manually check evidence**

Problems:

- **Cost**



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Problems:

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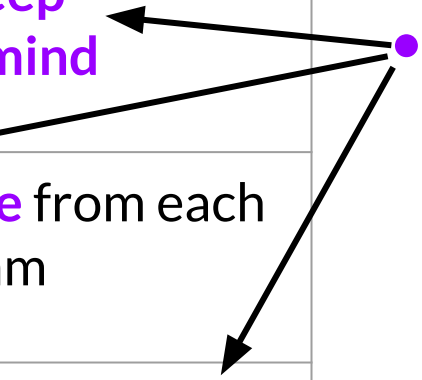

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Problems:

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- **Judgment**
- **Sampling**

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Problems:

- Cost
- Judgment
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- Regressions

Continuous Compliance

- Build verification tools for compliance controls
- On each commit, run verifier in continuous integration
- Report failures directly to developers

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Contributions

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- **Experiential**: verifiers in the compliance process at AWS

Compliance controls

Controls:

- HTTP vs HTTPS
- Cryptographic key length
- Cryptographic algorithm selection
- Cloud data store initialization
- Hard-coded credentials

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Techniques:

- Constant propagation
- + enum analysis
- + regex matching
- + accumulation analysis
- + dataflow

Analysis strategy

Analysis strategy: type systems

- Familiar to developers
- Predictable
- Scalable
- Sound

Evaluation

1. Run all verifiers on 492 open-source projects
2. Compare verifiers to existing tools
3. Case study of a verifier in a real, industrial compliance workflow
4. Case study of two verifiers as part of industrial security scans

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Open-source projects

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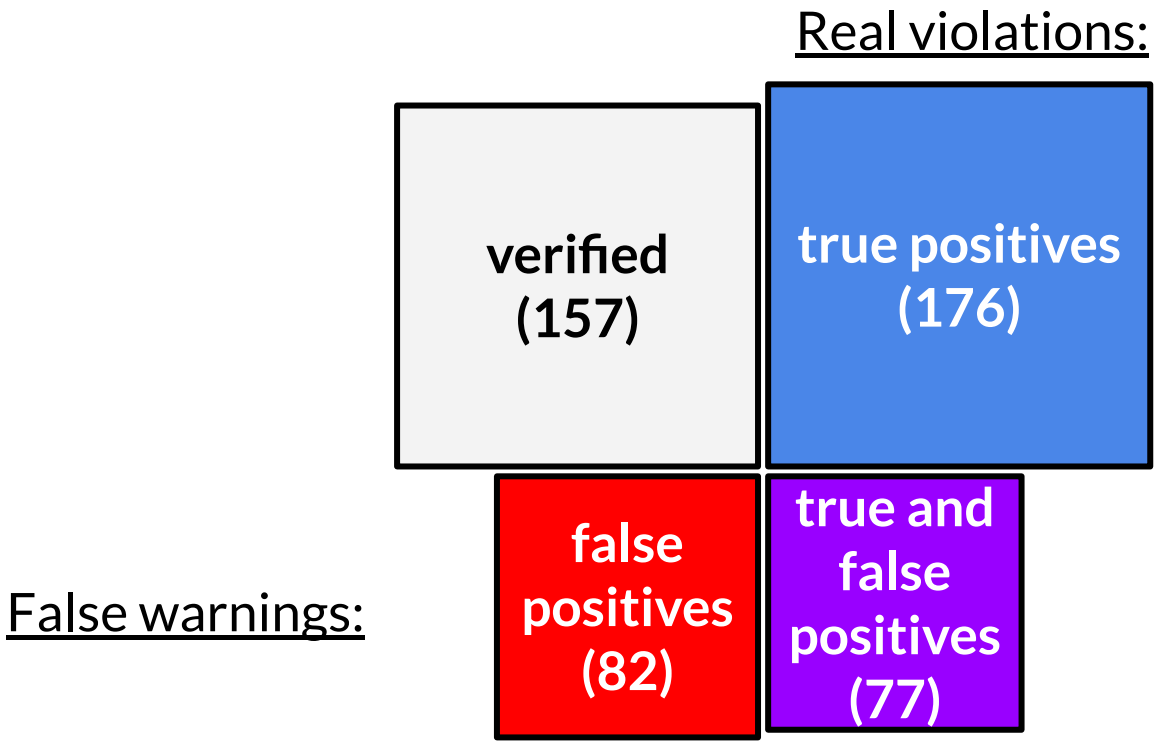
- Triage into 4 categories:

		Real violations:
	verified, no warnings	**true positives**: all warnings are real violations
False warnings:	**false positives**: warnings, no real violations	**true and false positives**: some warnings are real

Open-source projects



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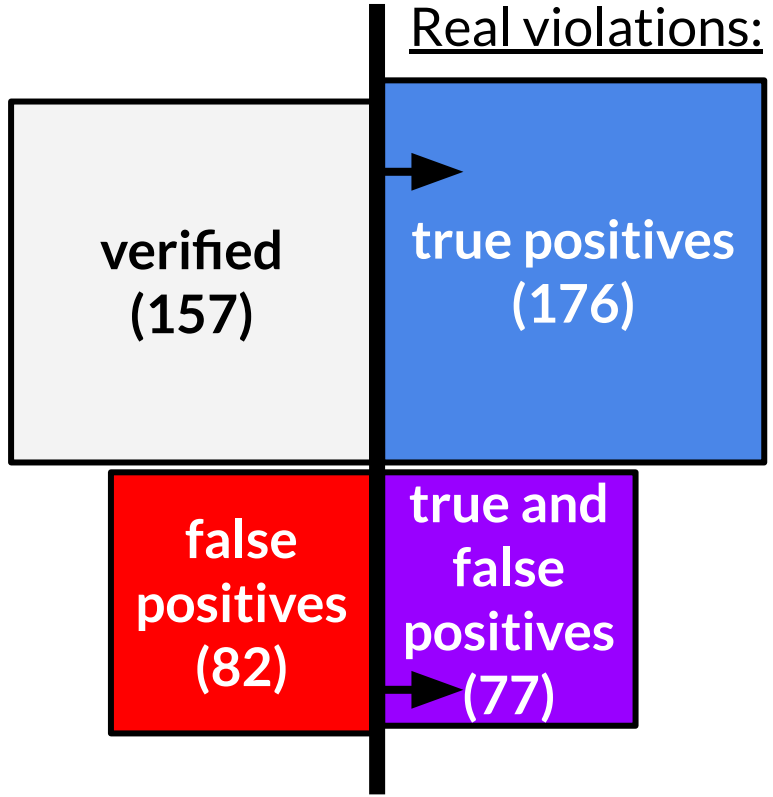
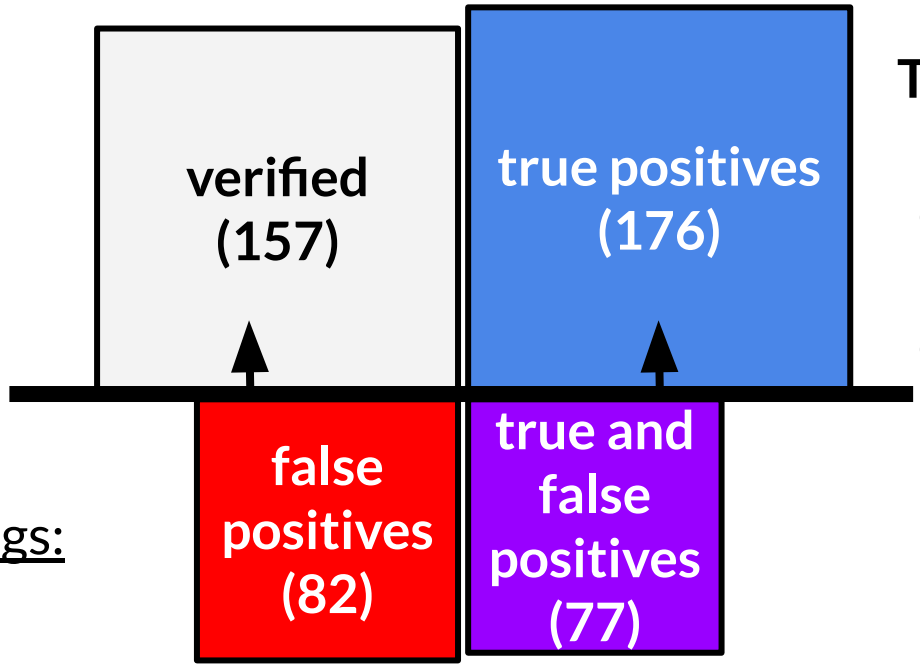


Takeaways:

- ~1/2 open-source projects have compliance violations

Open-source projects

Real violations:



False warnings:

Takeaways:

- ~1/2 open-source projects have compliance violations
- ~2/3 projects cause no false positives from our tools

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Comparison with other tools

- Used a CryptoAPIBench, a previously-published benchmark
- Only compared on categories covered by our tools (11/16)
- Four other tools:
  - SpotBugs
  - Coverity
  - $\text{CogniCrypt}_{\text{SAST}}$ (CrySL)
  - CryptoGuard

Comparison with other tools

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Only ours are suitable for compliance: auditors won't accept a tool that has **false negatives**

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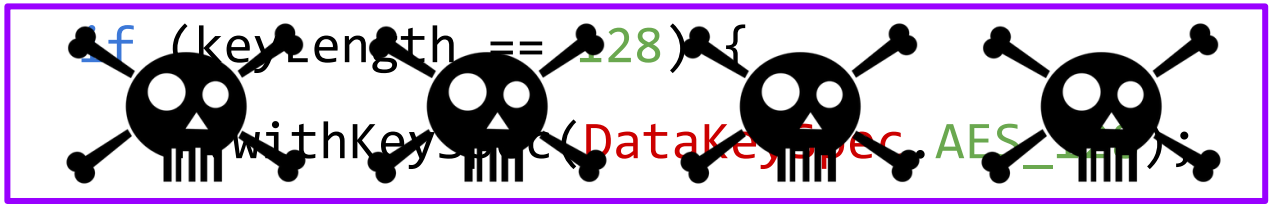

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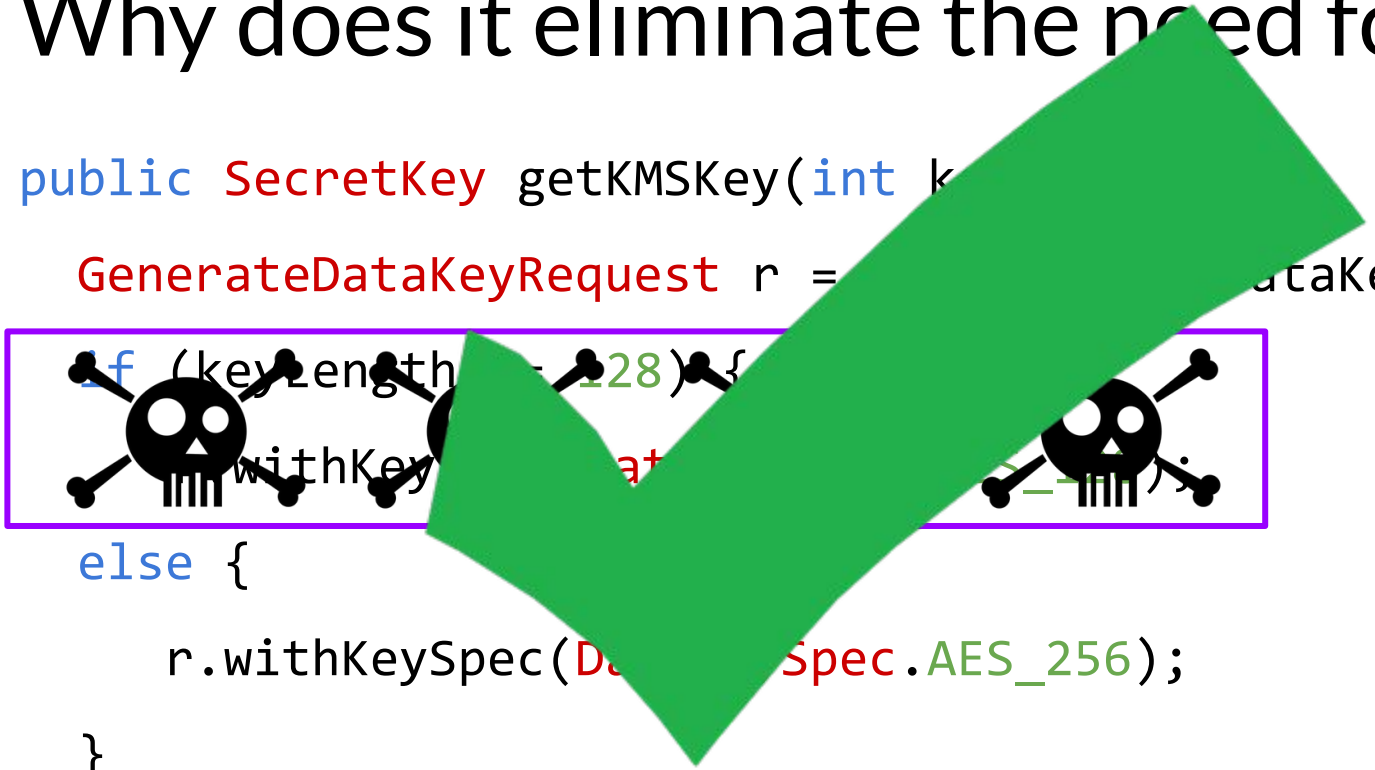

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per team,
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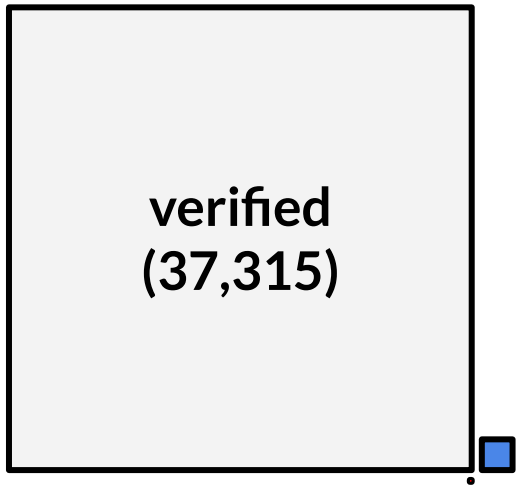
AWS case study 2: security scanning

- key-length and crypto-algorithm verifiers
- scan all security-relevant (not just compliance relevant) code

Industrial projects

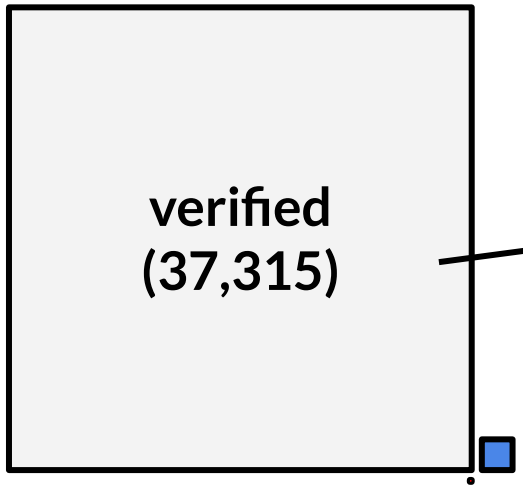
Real violations:



true positives (173)

False warnings: **false positives (1)** **true and false positives (0)**

Industrial projects



Real violations:

99.94% required no annotations

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Industrial projects

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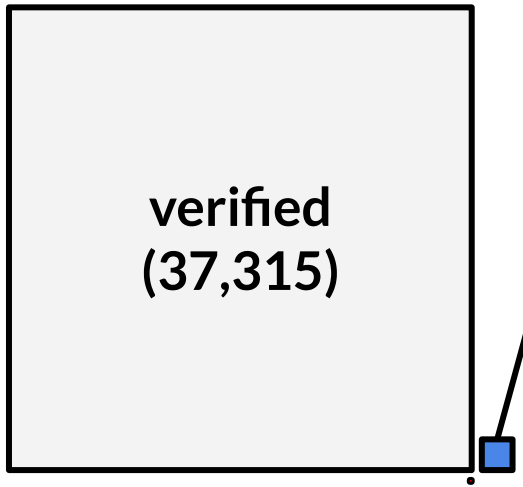

All validated by security engineers; none compliance relevant

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3. **Verification can save time for developers**
   a. don't add a new task, replace an existing task
   b. verification is easier than tasks developers already do

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Tools and data are publicly available: see paper for links

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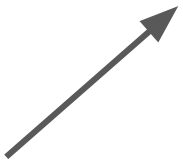

String

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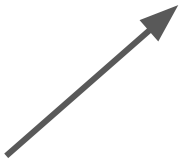

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