Visual analysis of code security

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VizSec
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This effort was performed at

Applied Visions, Inc.

Secure Decisions division

for DHS Science & Technology

The Problem

More than **98% of all PCs** have one or more vulnerable programs

http://secunia.com/blog/56/

“**Software Assurance**: poorly written software is at the root of all of our security problems

Doug Maughan, CACM 53(2)
Top 10 Hard Problems in Cyber Security

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Lots of Bad Code

Software Assurance: poorly written software is at the root of all of our security problems

Doug Maughan, CACM 53(2)
Top 10 Hard Problems in Cyber Security

> ...**everybody should be using static analysis tools today**. And if you are not using them, then basically you are **negligent**, and you should prepare to be sued by the army of lawyers that have already hit the beach.
>
> Cigital's CTO Gary McGraw

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>
> Gartner

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Tools Exist Today

“**enterprises must adopt SAST** [Static Application Security Testing]

Gartner

“**No tool** stands out as an **uber-tool**.
Each has its **strengths** and **weaknesses**.

Kris Britton, Technical Director
NSA’s Center for Assured Software

84% of the vulnerabilities were identified by **one tool** and **one tool alone**

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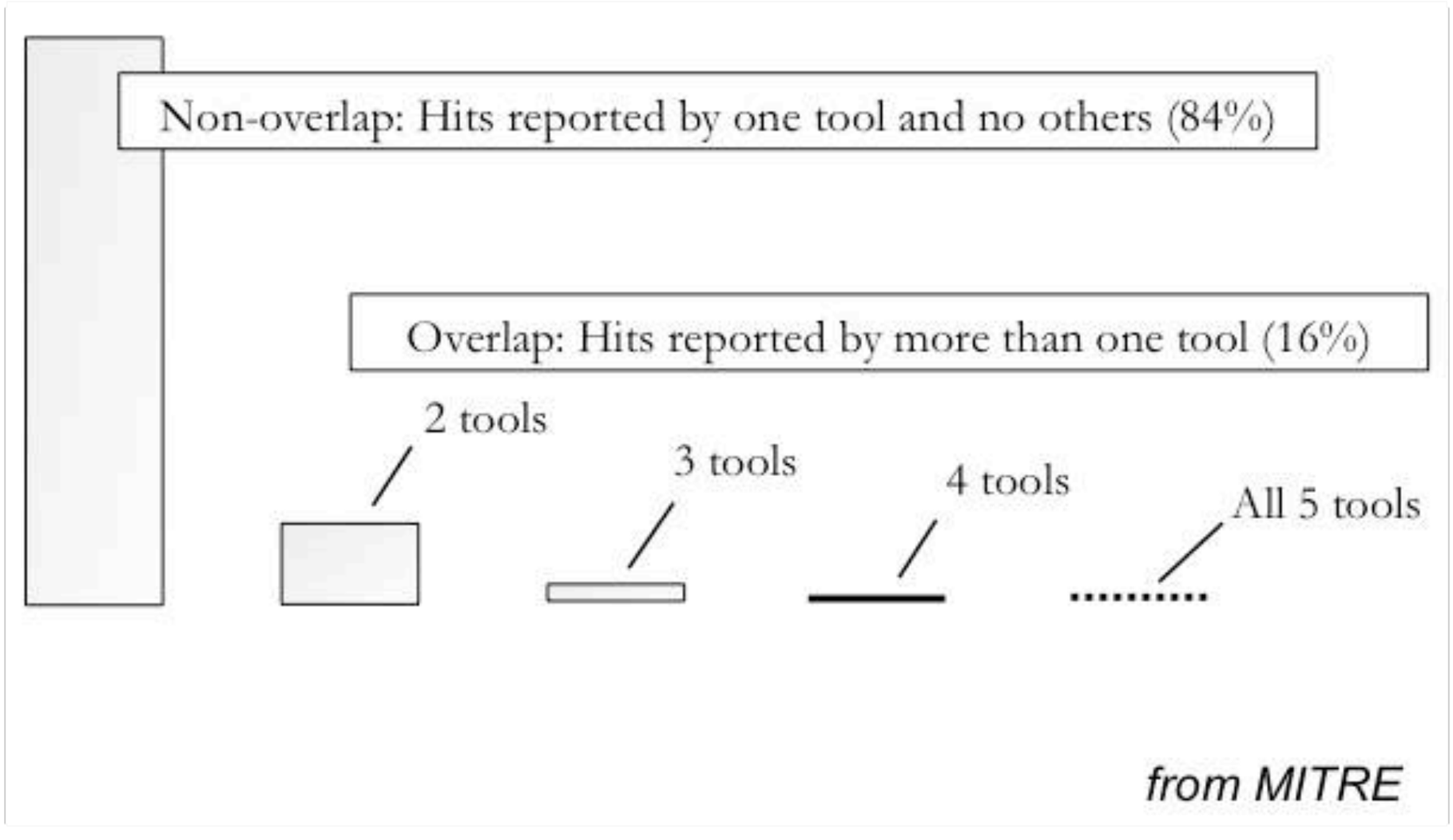
> NSA's Center for Assured Software

No Tool is Perfect

84% of the vulnerabilities were identified by **one tool** and **one tool alone**

Tools find different vulnerabilities



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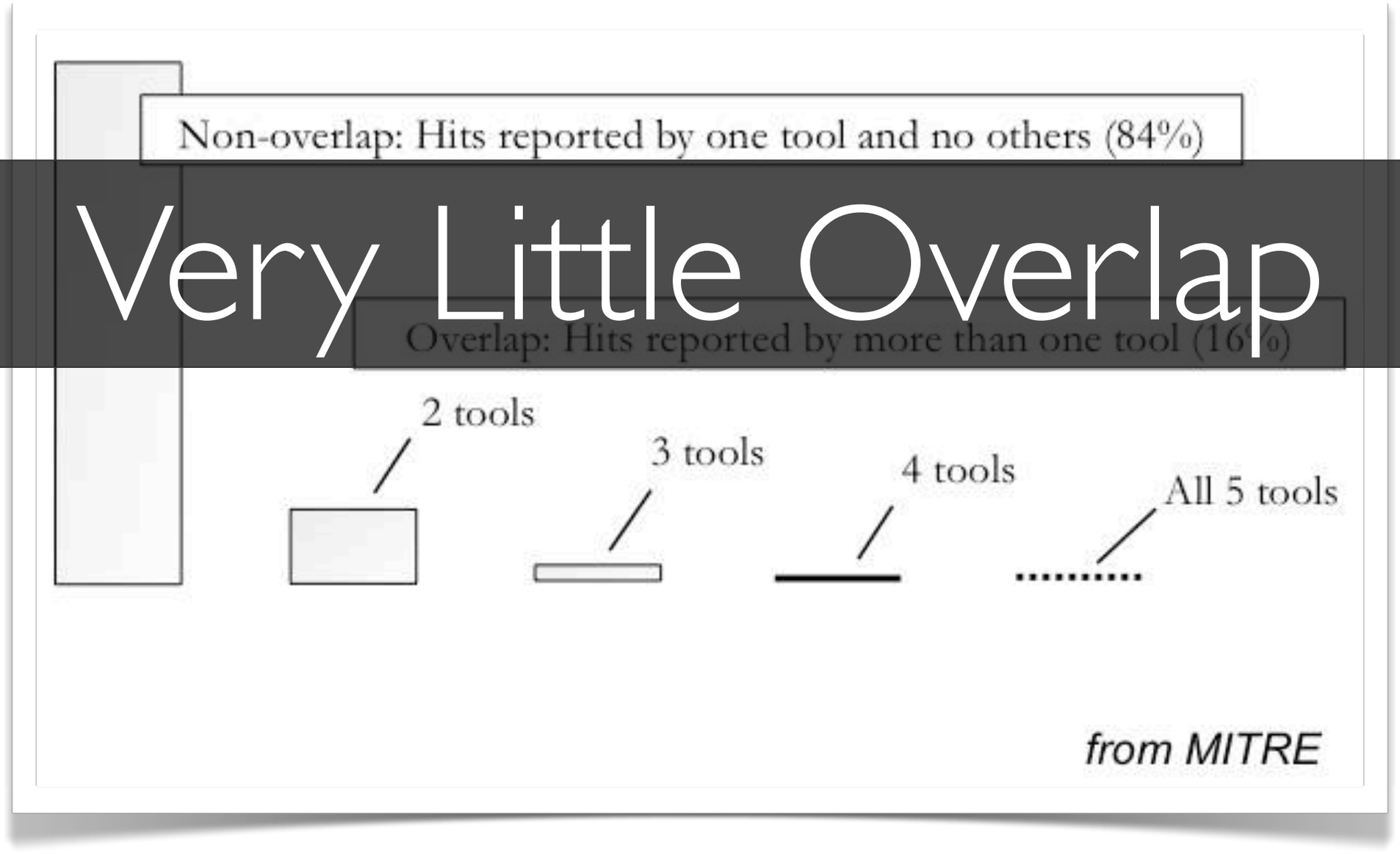

Very Little Overlap

... with different semantics

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Jim Bird, *Building Real Software*
http://swreflections.blogspot.com/2009_04_01_archive.html

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Different Semantics

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Jim Bird, *Building Real Software*
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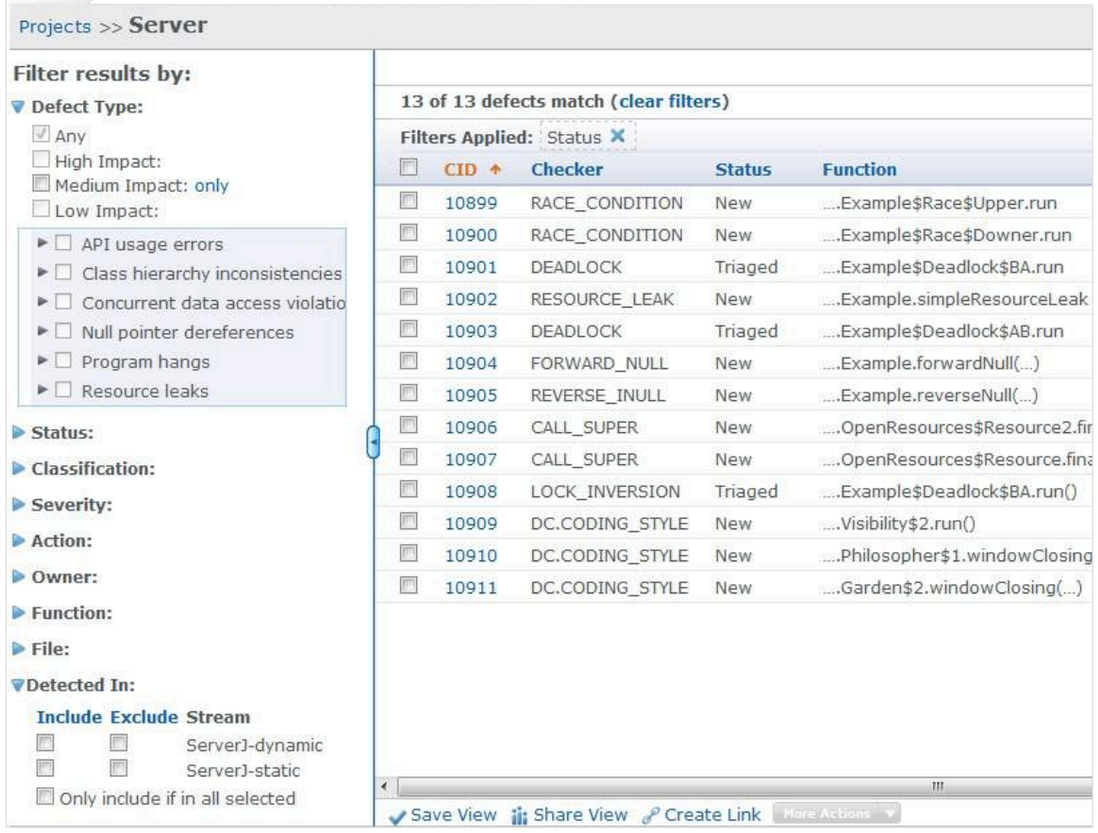
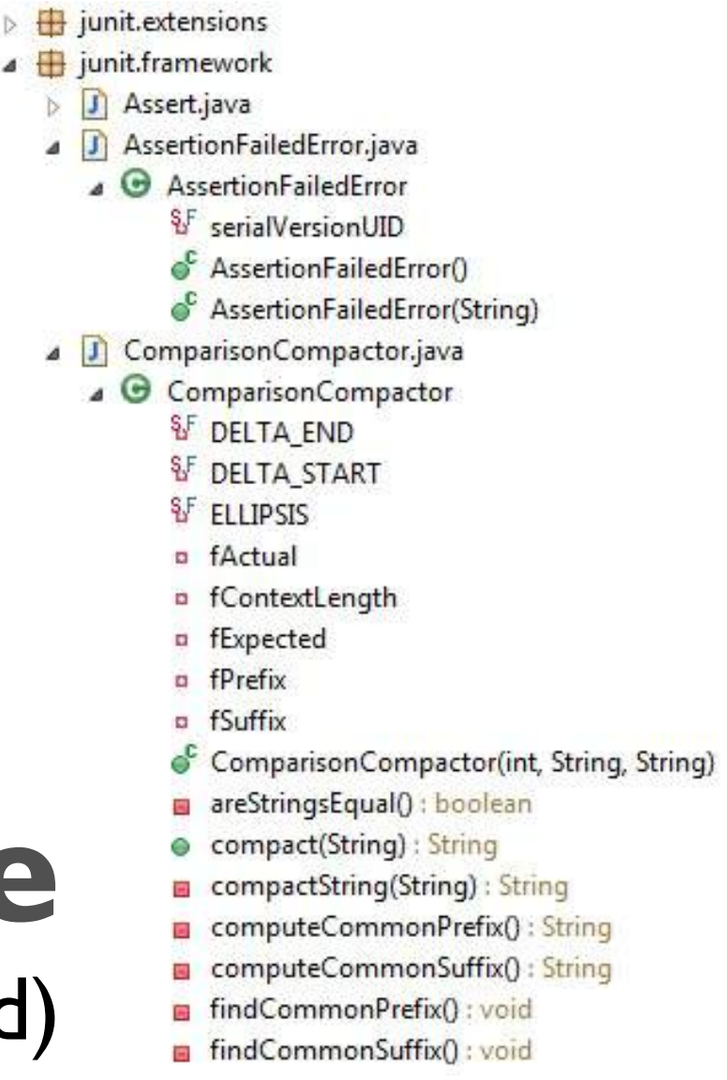
Tools present **vulnerabilities**





Developers think in **code**

(namespace/class/method)

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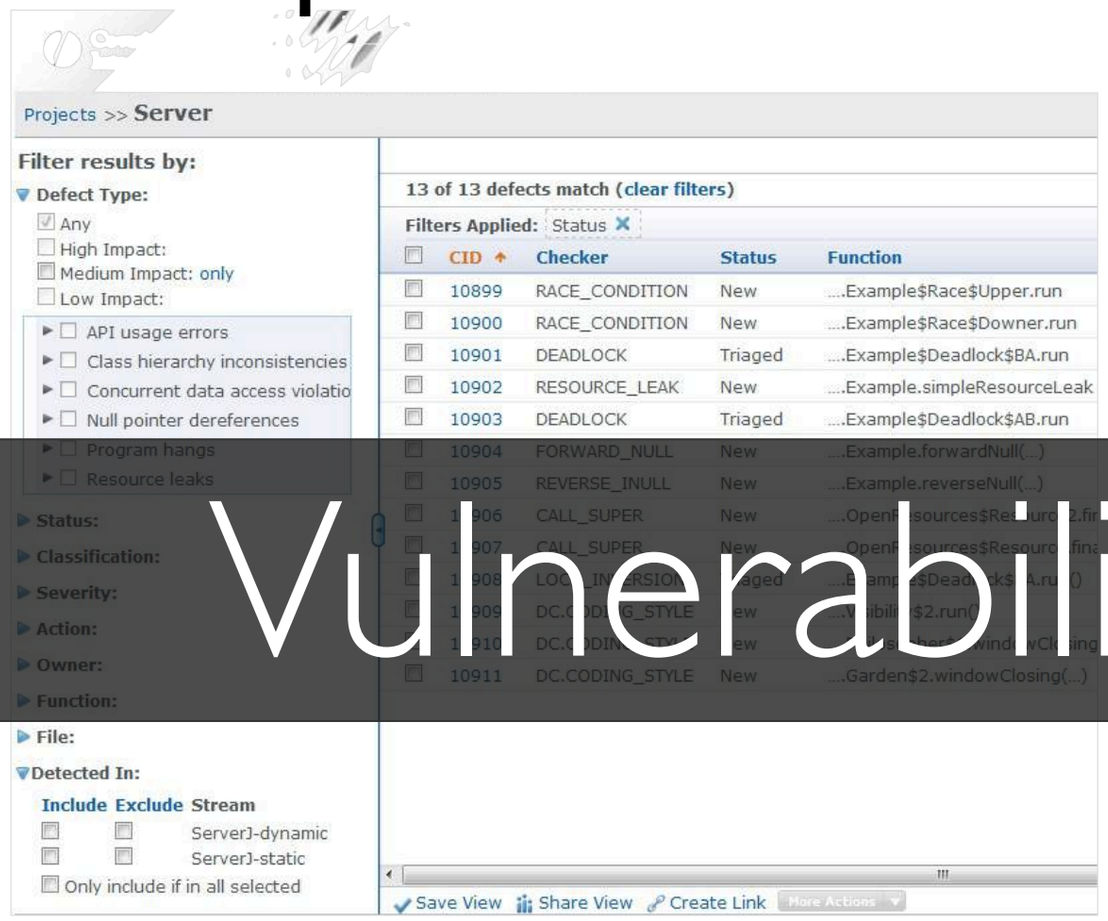

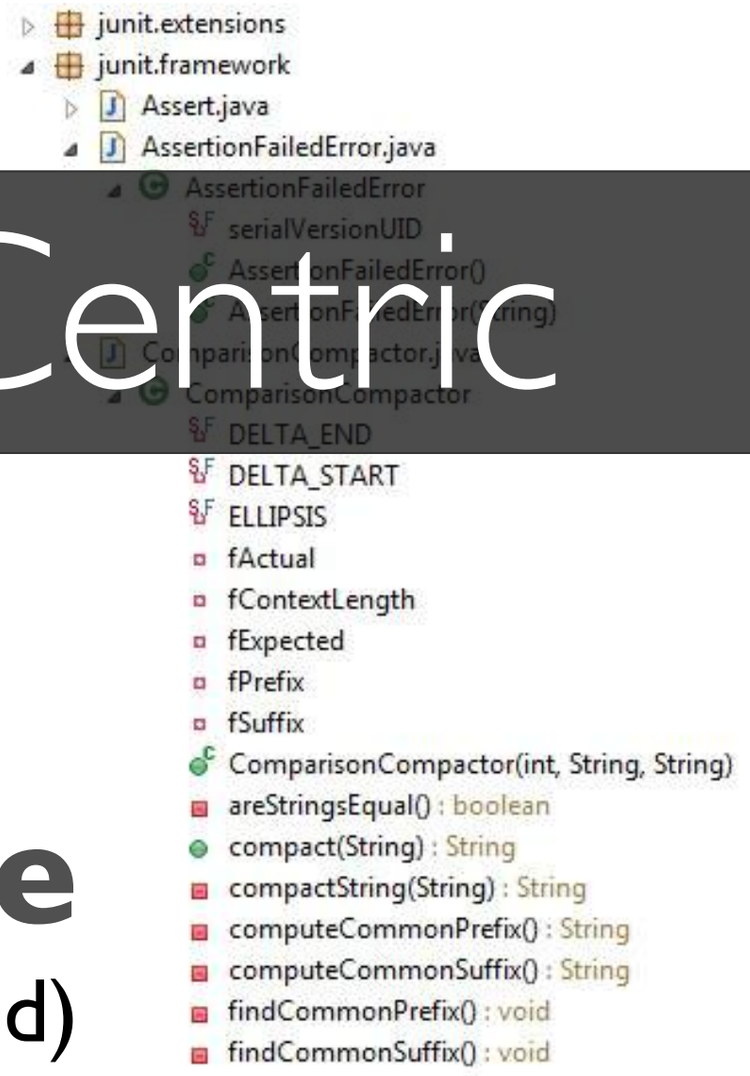

Vulnerability-Centric

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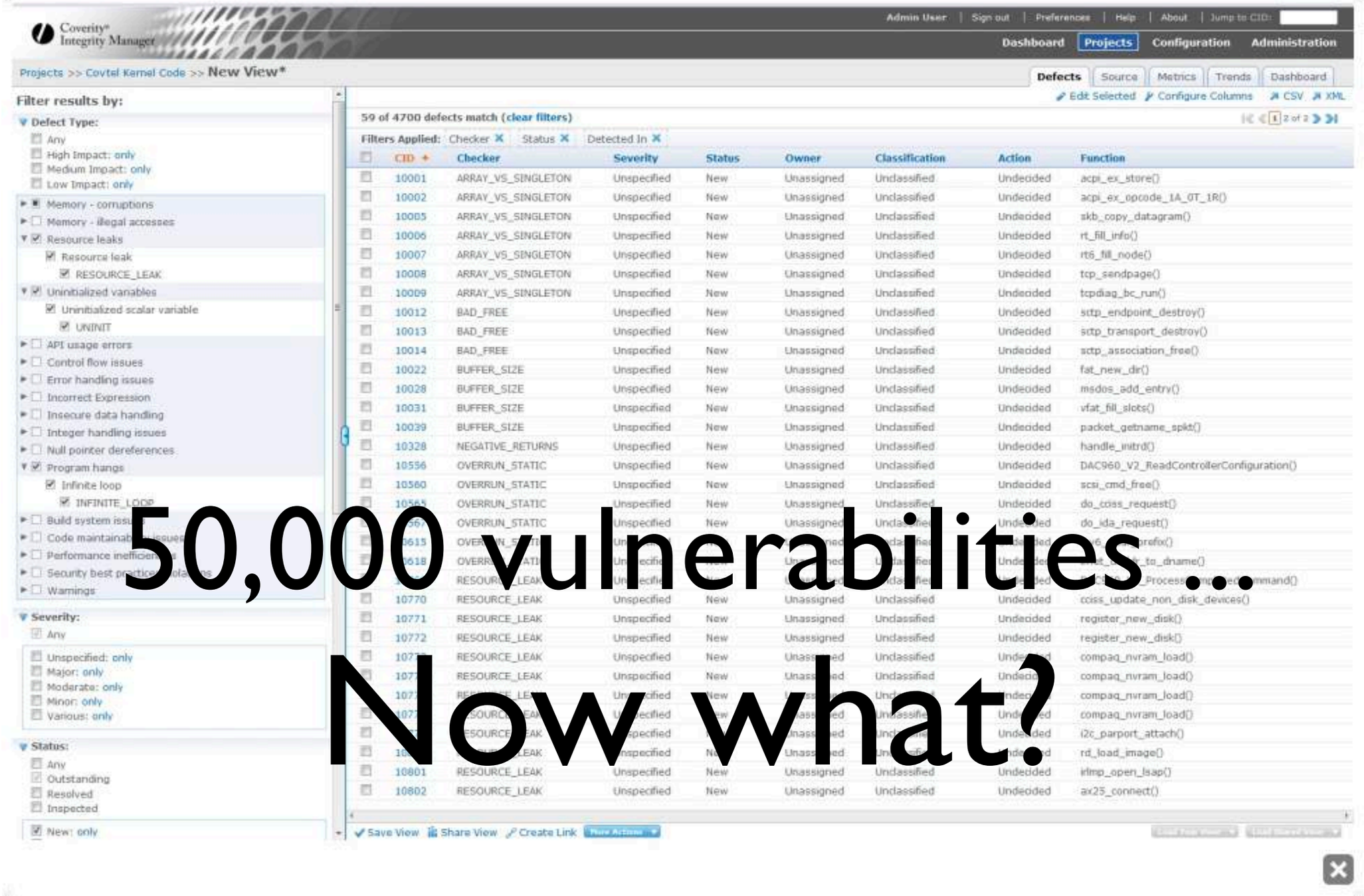
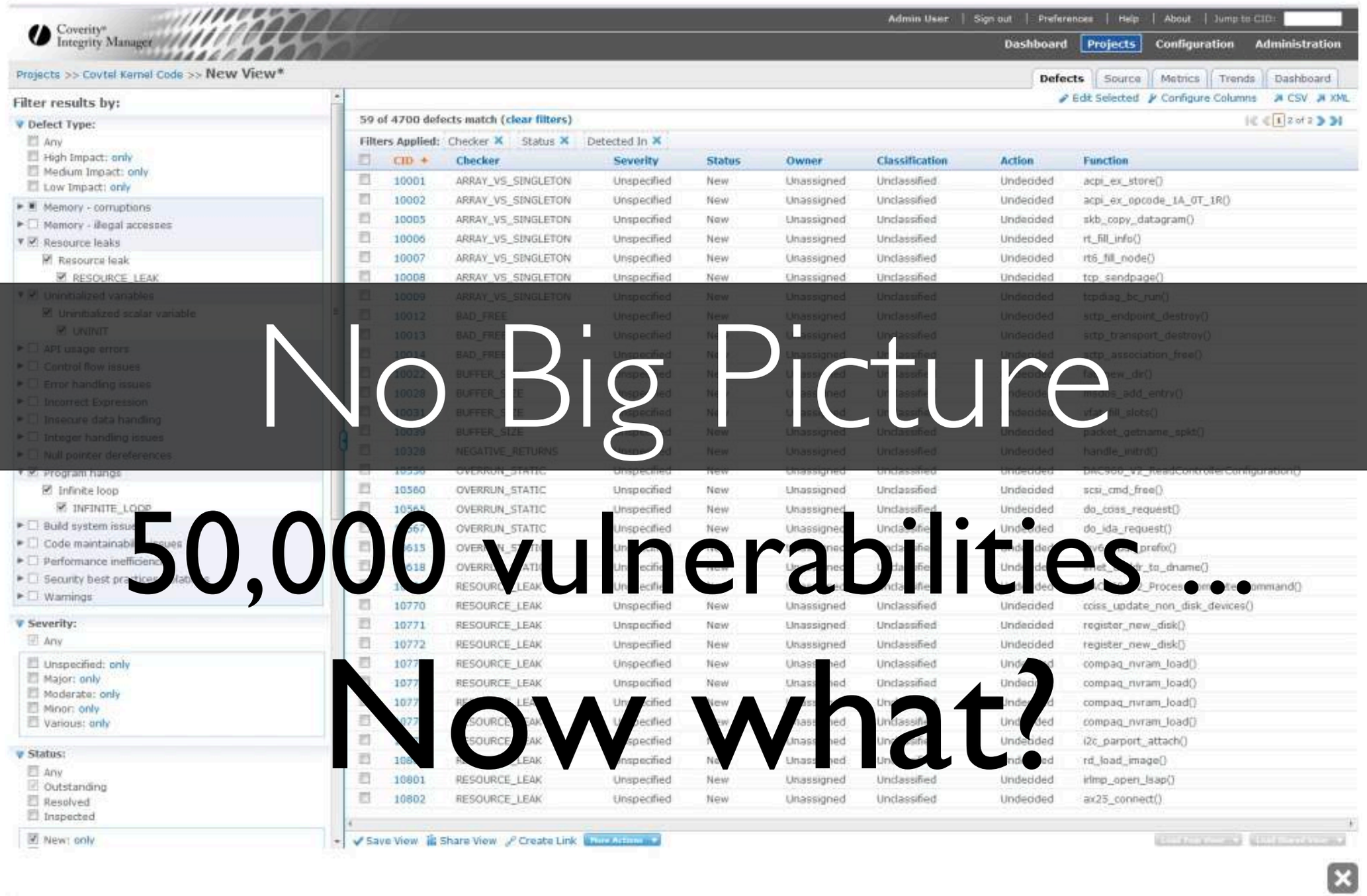


50,000 vulnerabilities…

Now what?



No Big Picture

50,000 vulnerabilities…

Now what?

Better Tools ≠ Total Security

- Tool results have very little overlap
- Tools use different semantics for results
- Tools present a vulnerability-centric view
- Tools offer no big picture overviews

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Better analysis tools are only a part of improving code security

Technical Approach

Technical Approach

SoftWare Assurance ViSual Analysis

Provide a **workflow** for developers to

bring together **disparate** security analysis results

visually **analyze** and **prioritize** those results

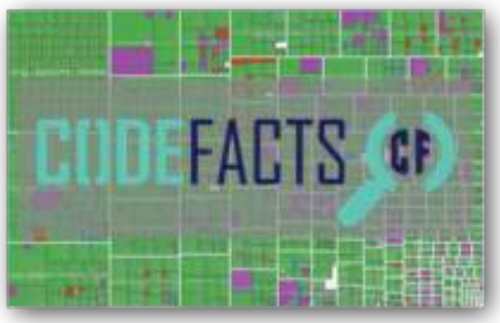
explore those results to uncover hidden trends

use code **context** to assess the impact of those results

see **who is responsible** for vulnerabilities

assign vulnerabilities to developers responsible


Pmd
DON'T SHOOT THE MESSENGER
FindBugs
coverity
a higher code
FORTIFY
SOFTWARE
PARASOFT
We make software work.
Klocwork


CODEFACTS
CF


SwA Vis

SDLC Tools

integrate / correlate / normalize

context

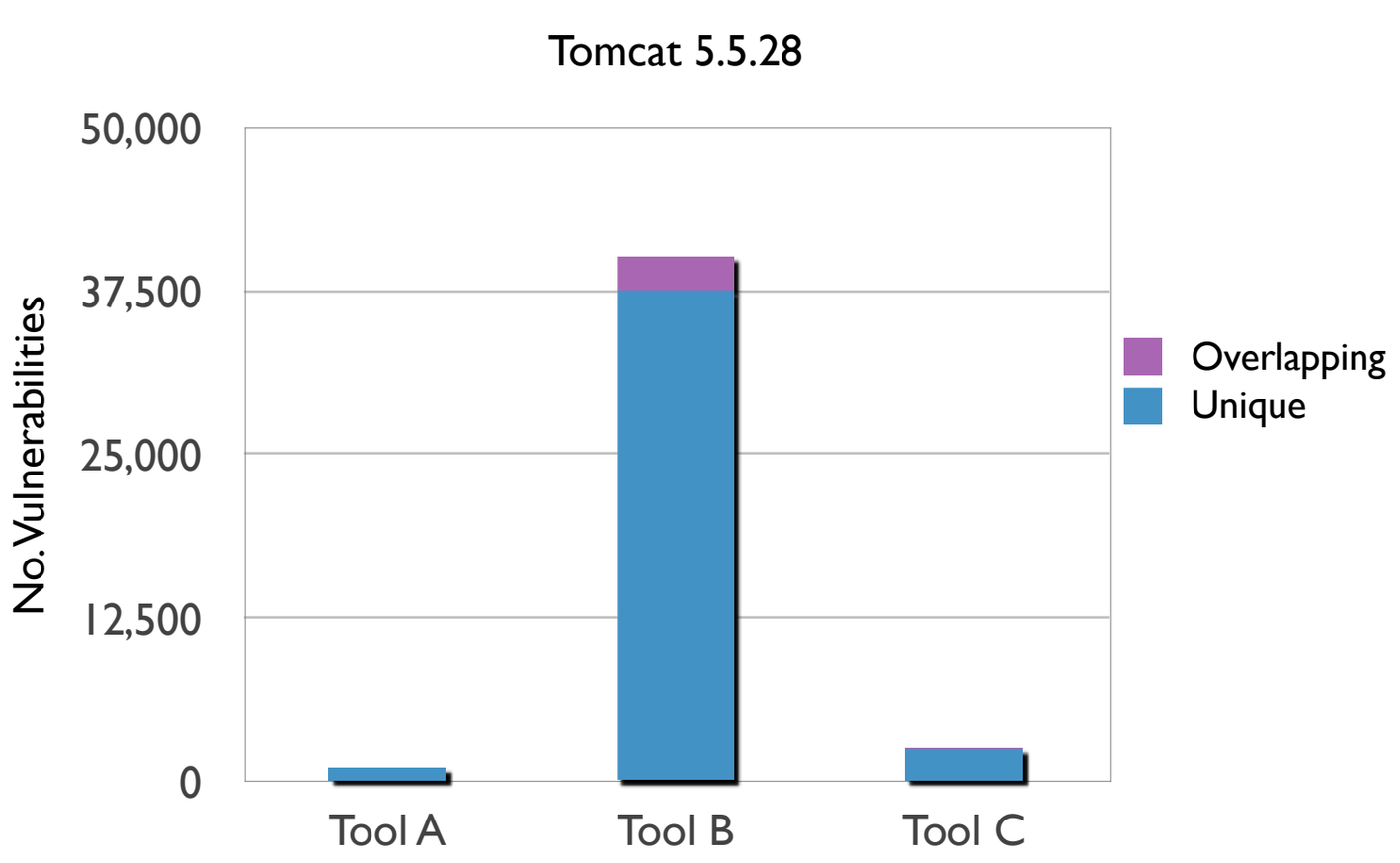
visual analysis

workflow

SDLC Tools

Test Data

- Three software analysis tools
- Two test data sets



SwA Tool Output

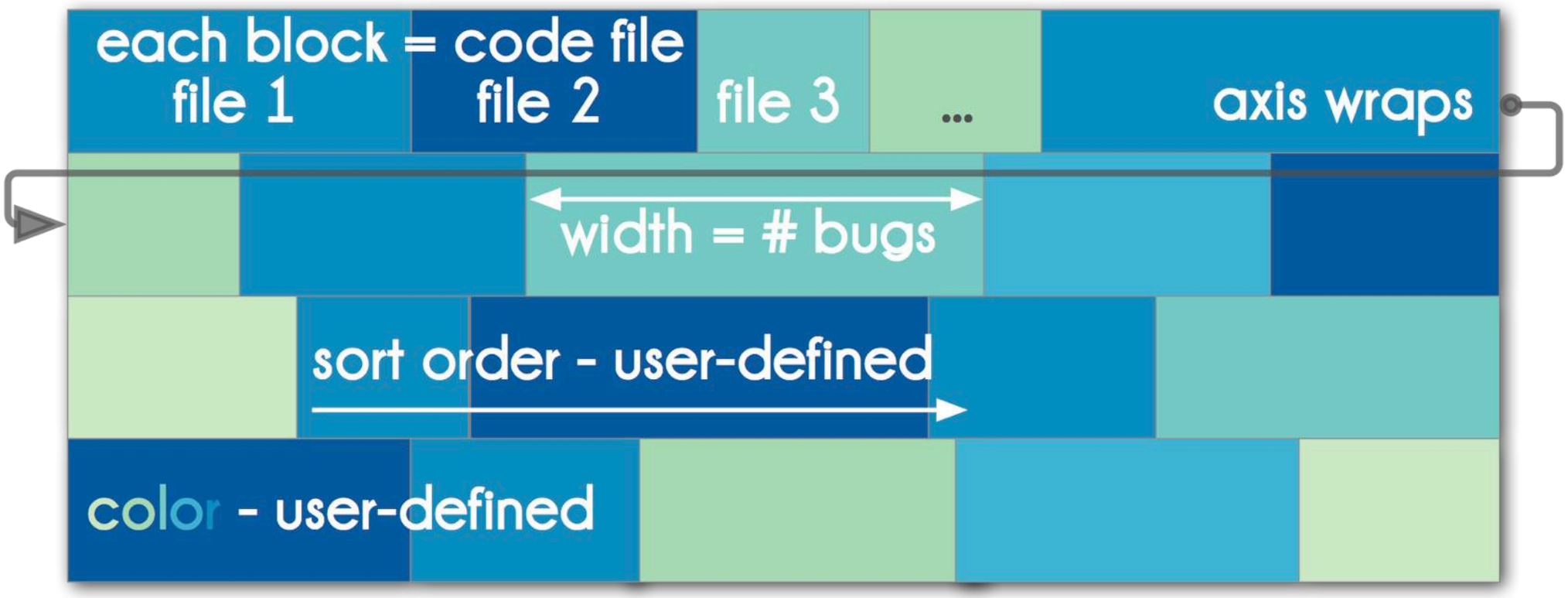
- Tool output is in varying XML schemas
- Results are parsed and correlated
- Severity and category are normalized

Use case : Triage

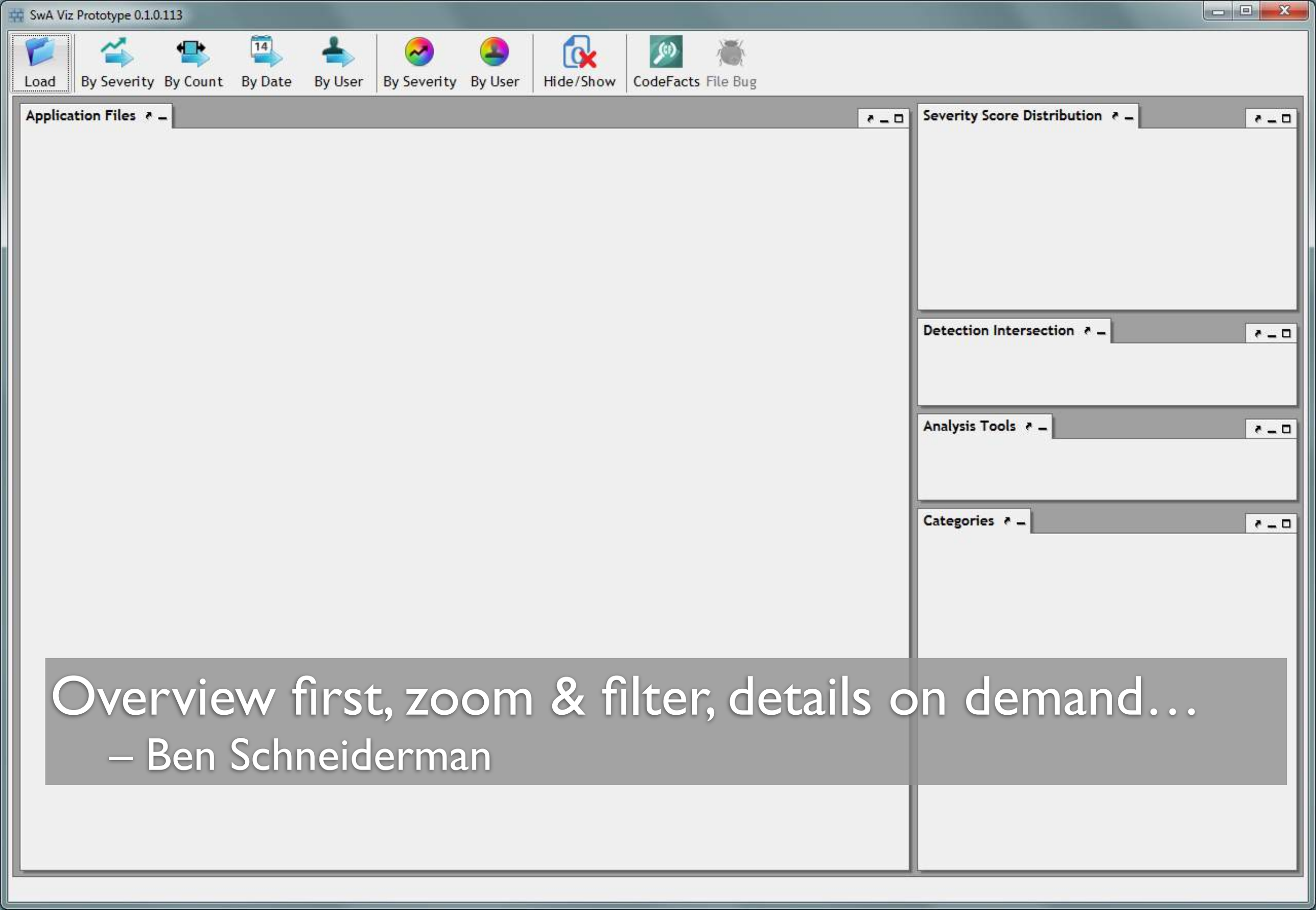
- Which vulnerabilities are noise / most important
- What vulnerability categories are most common
- What vulnerabilities are found by multiple tools
- Where in the code are the vulnerabilities
- Who do confirmed vulnerabilities get assigned to

Visualization

- Each source code file is represented as a block
- Each block aggregates the vulnerabilities found
- Very compact, space filling method
- Flexible (color/sort) data > visual mappings



Demonstration



Overview first, zoom & filter, details on demand…

– Ben Schneiderman

SwA Viz Prototype 0.1.0.113

Load | By Severity | By Count | By Date | By User | By Severity | By User | Hide/Show | CodeFacts | File Bug

Application Files

Severity Score Distribution

Open

Look in: data

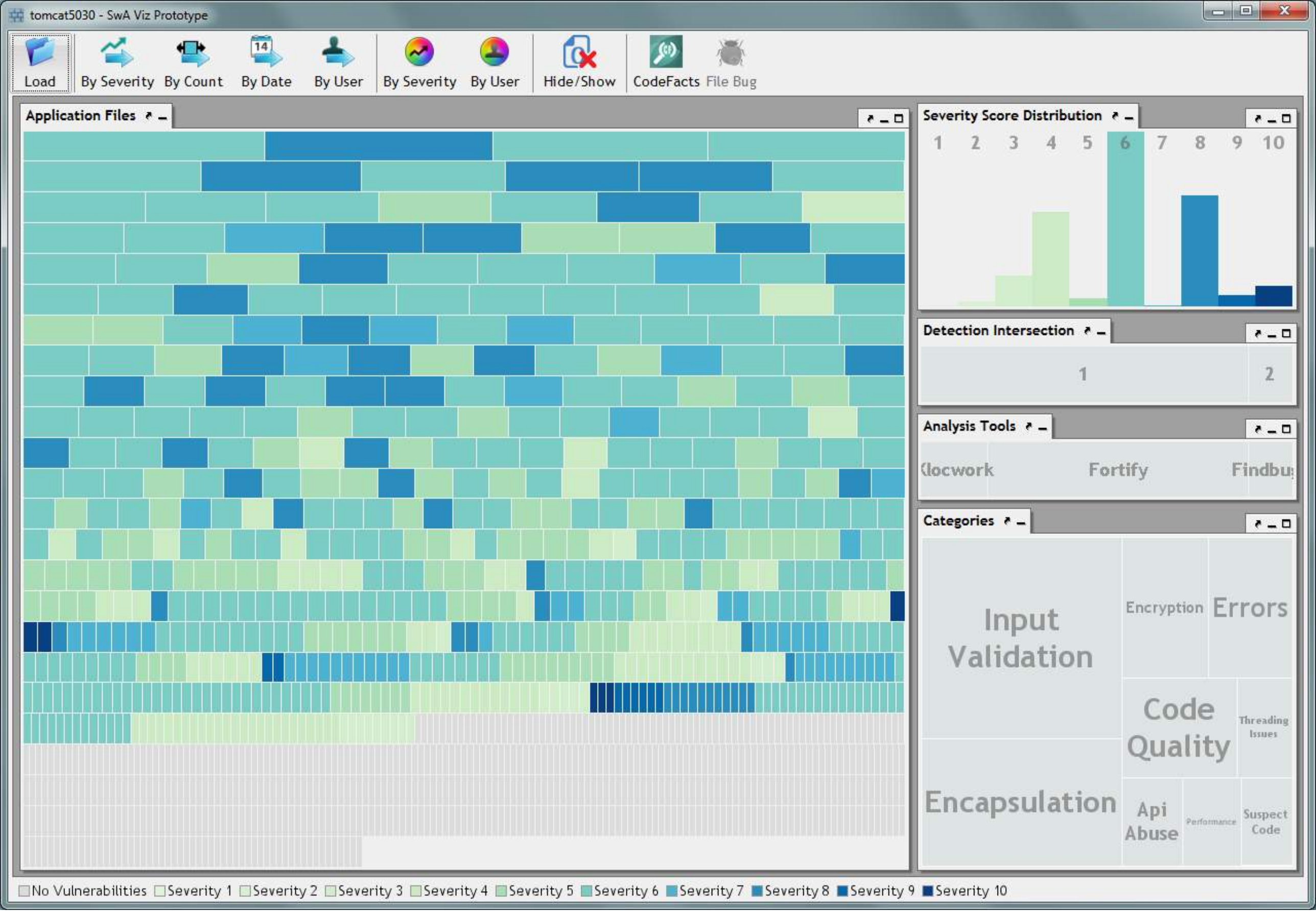
Recent Items
Desktop
My Documents
Computer
Network

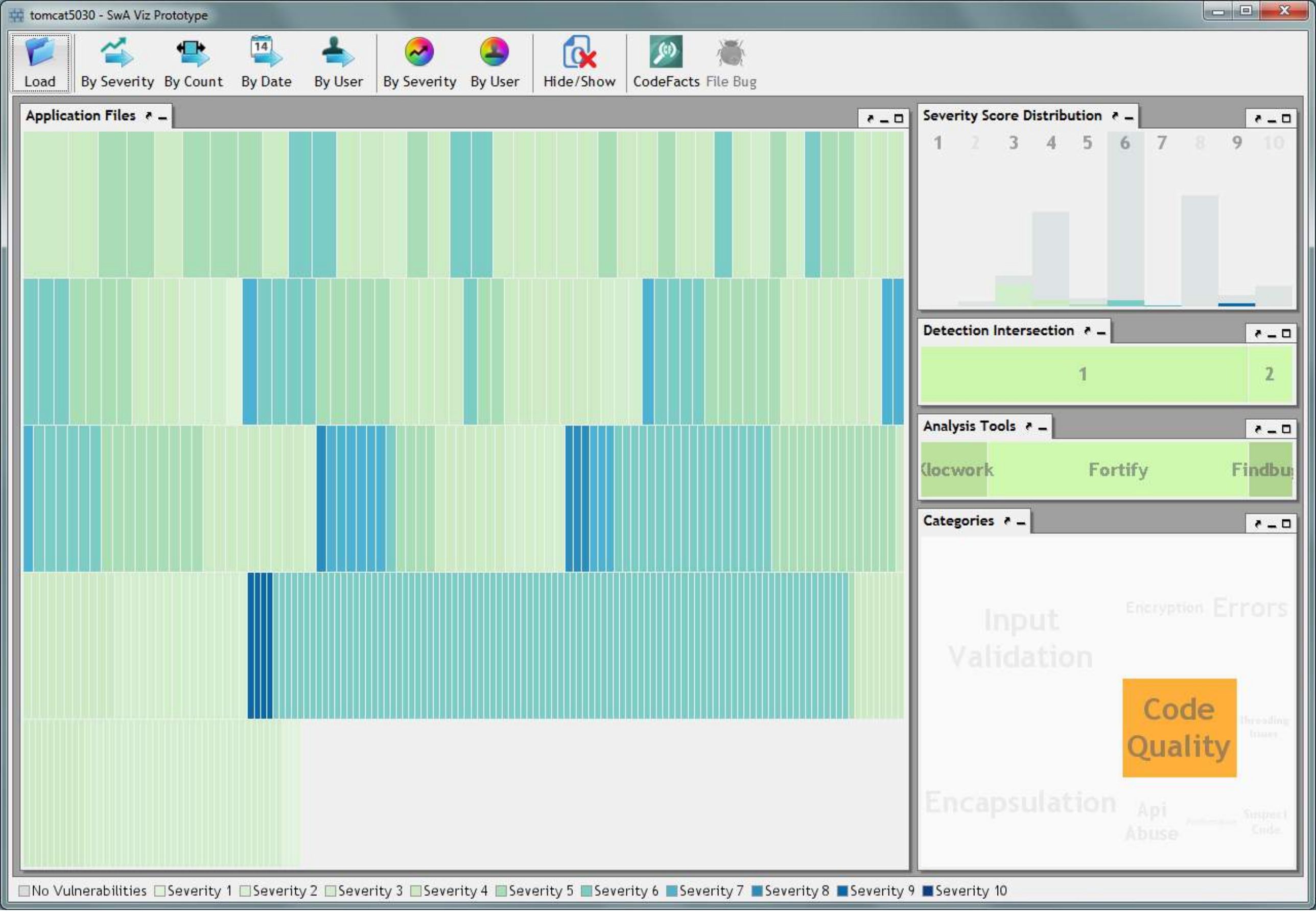
gmu200
gmu210
gmu212
gmu251
tomcat5000
tomcat5030
tomcat5500
tomcat5512
tomcat5528

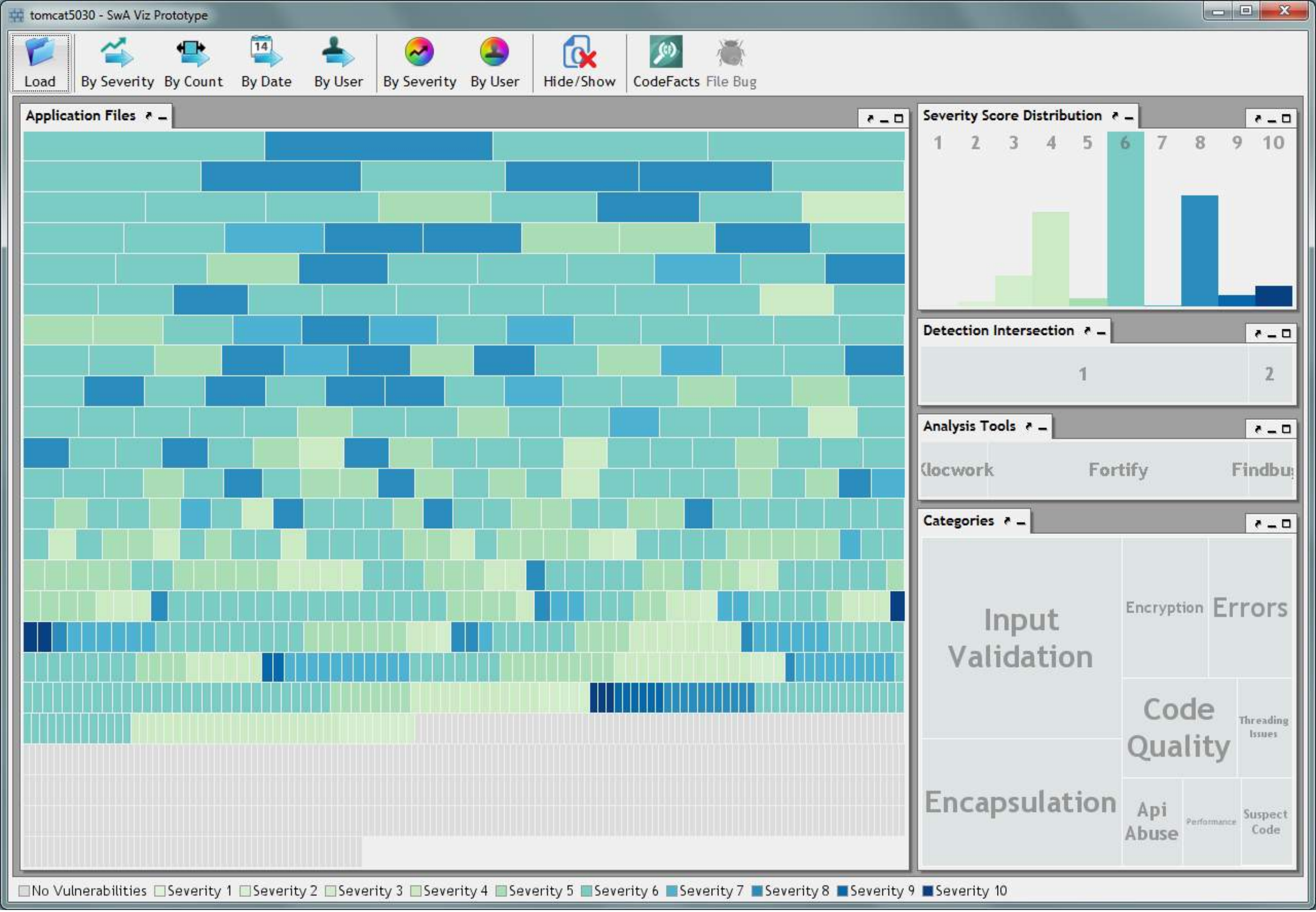
File name: anR\Projects\SwAVis\Releases\Phase 1 End\data\tomcat5030

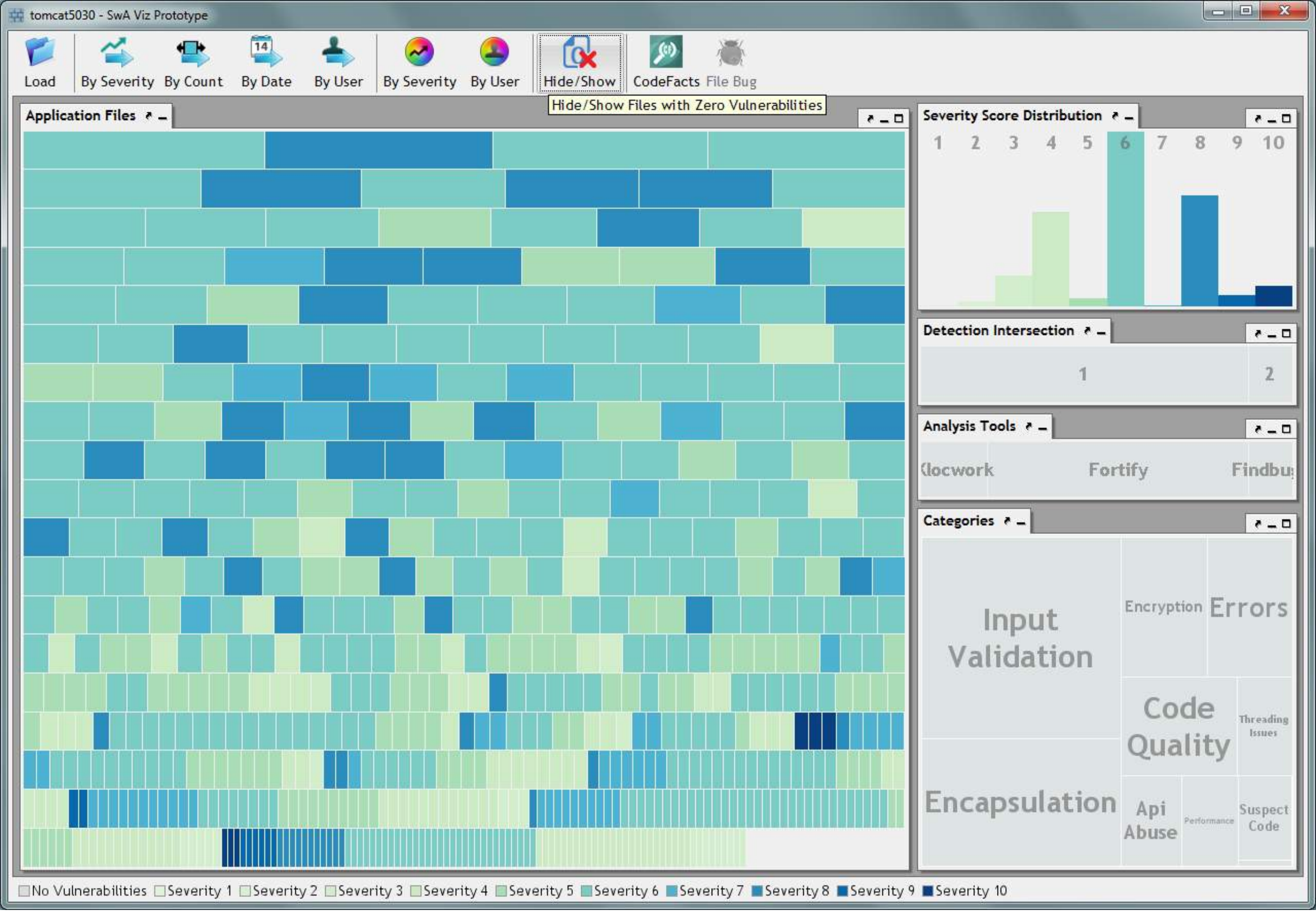
Files of type: All Files

Open
Cancel









tomcat5030 - SwA Viz Prototype

Load | By Severity | By Count | By Date | By User | By Severity | By User | Hide/Show | CodeFacts | File Bug

Sort by Weighted Severity Score

Application Files

Severity Score Distribution

1 2 3 4 5 6 7 8 9 10

Detection Intersection

1 2

Analysis Tools

Clocwork Fortify Findbu

Categories

Input Validation

Encryption

Errors

Code Quality

Threading Issues

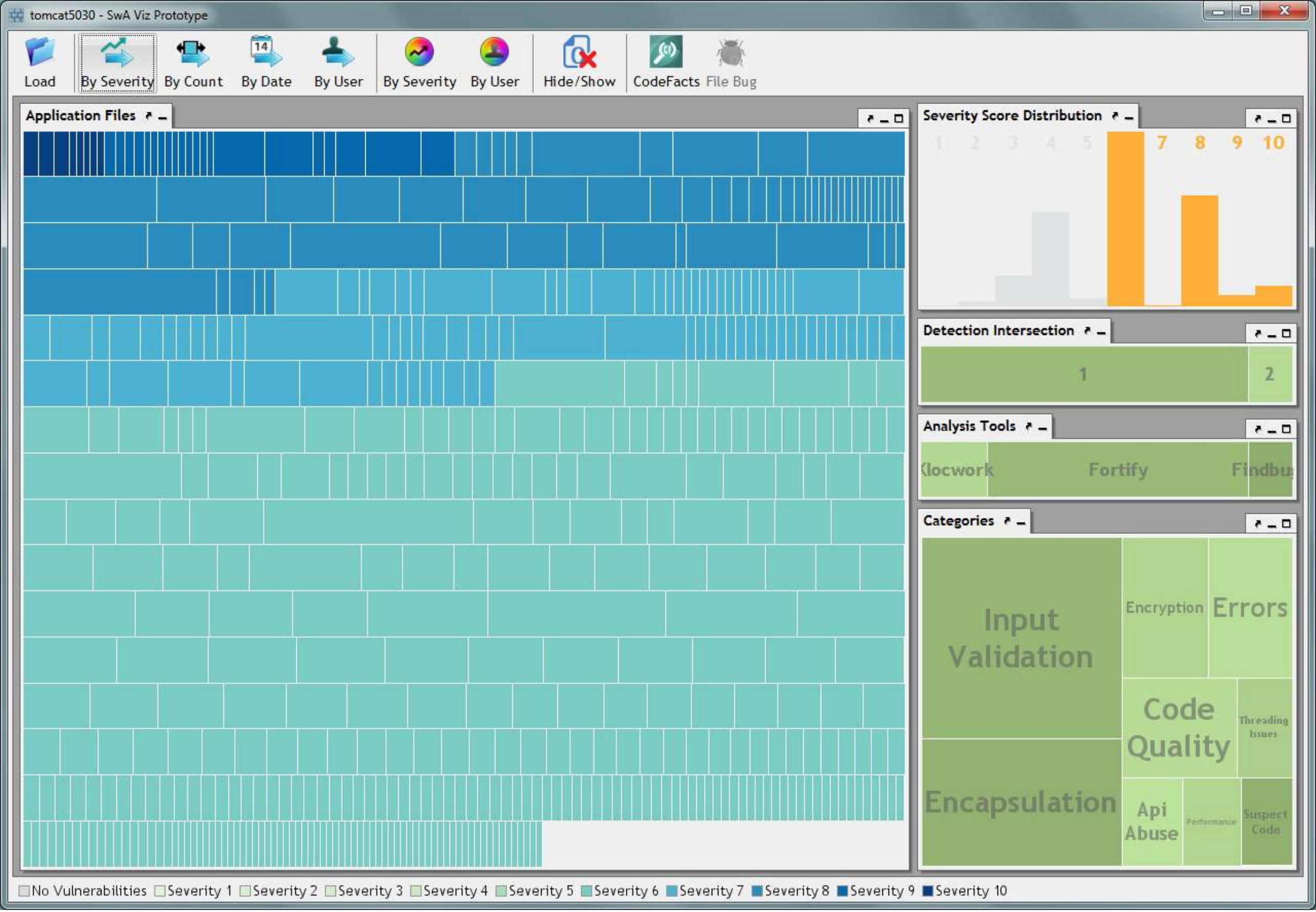
Encapsulation

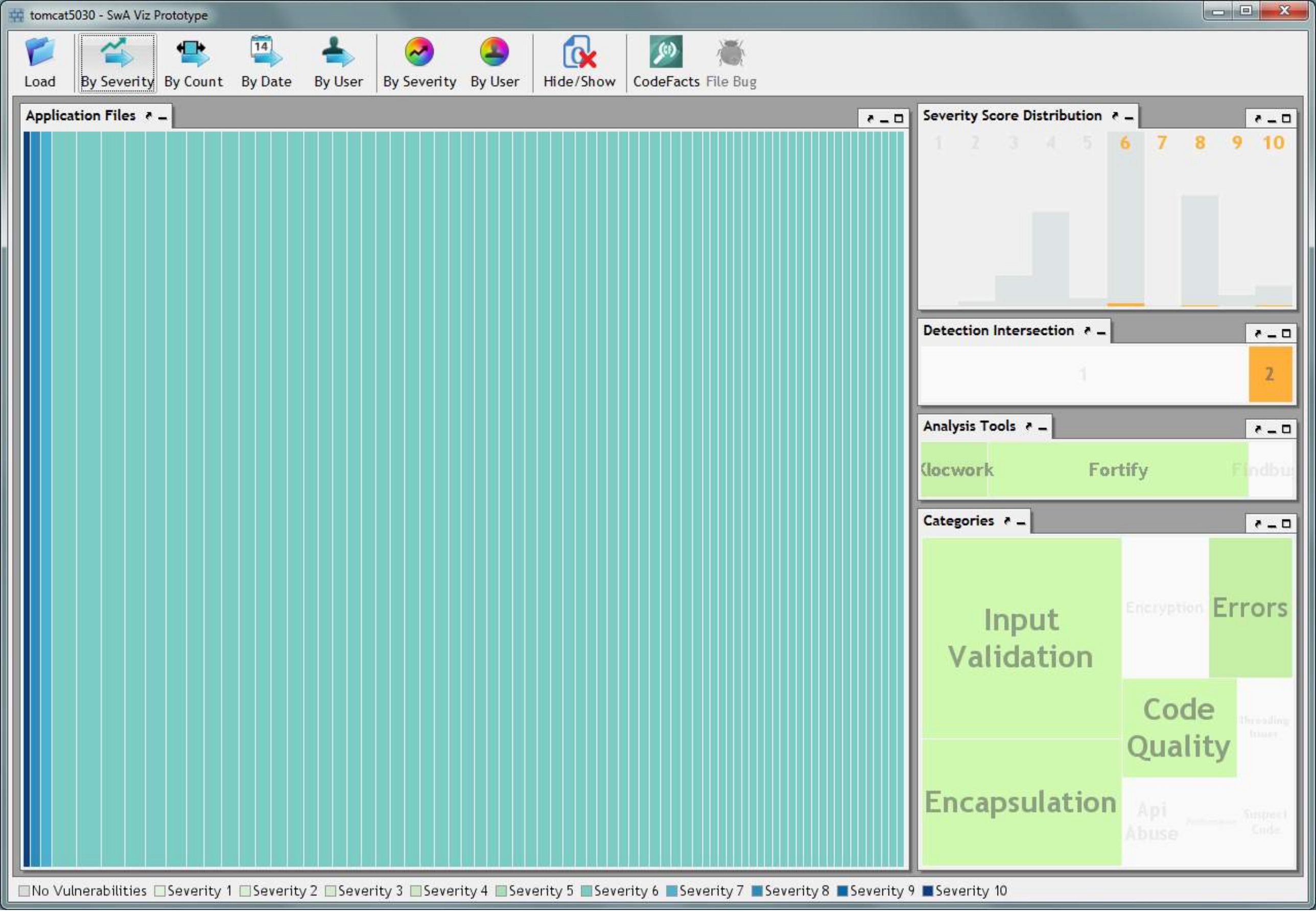
Api Abuse

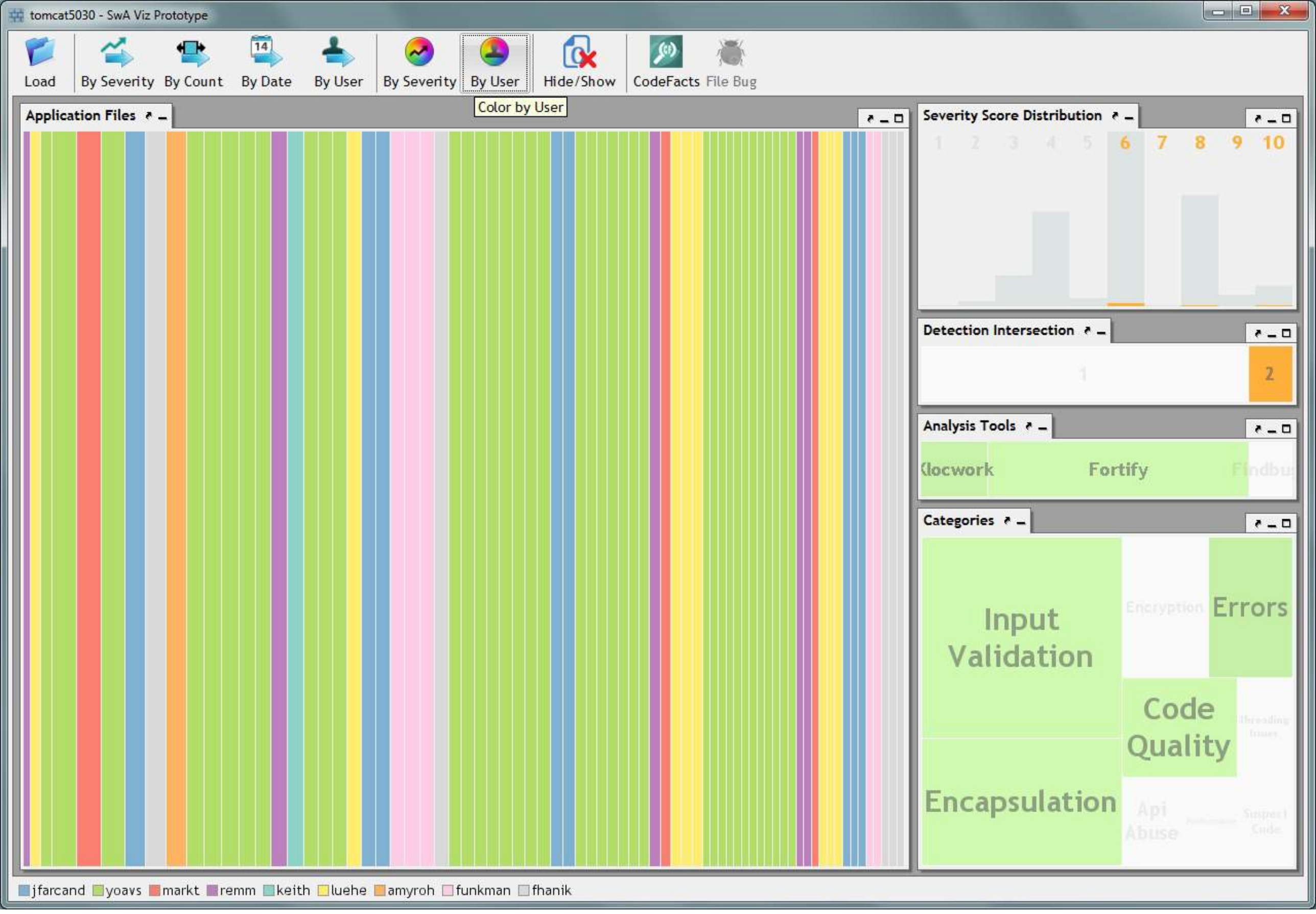
Performance

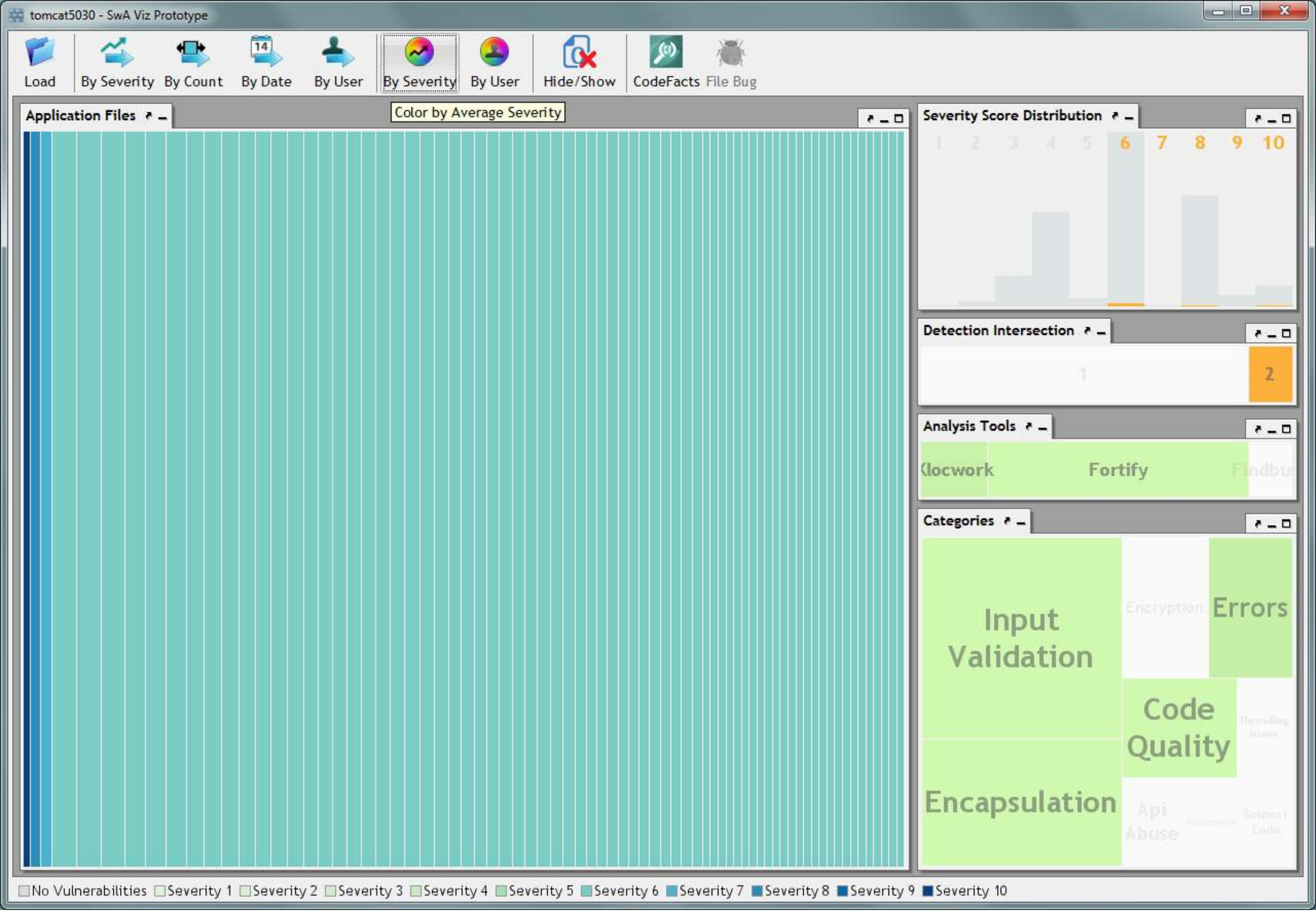
Suspect Code

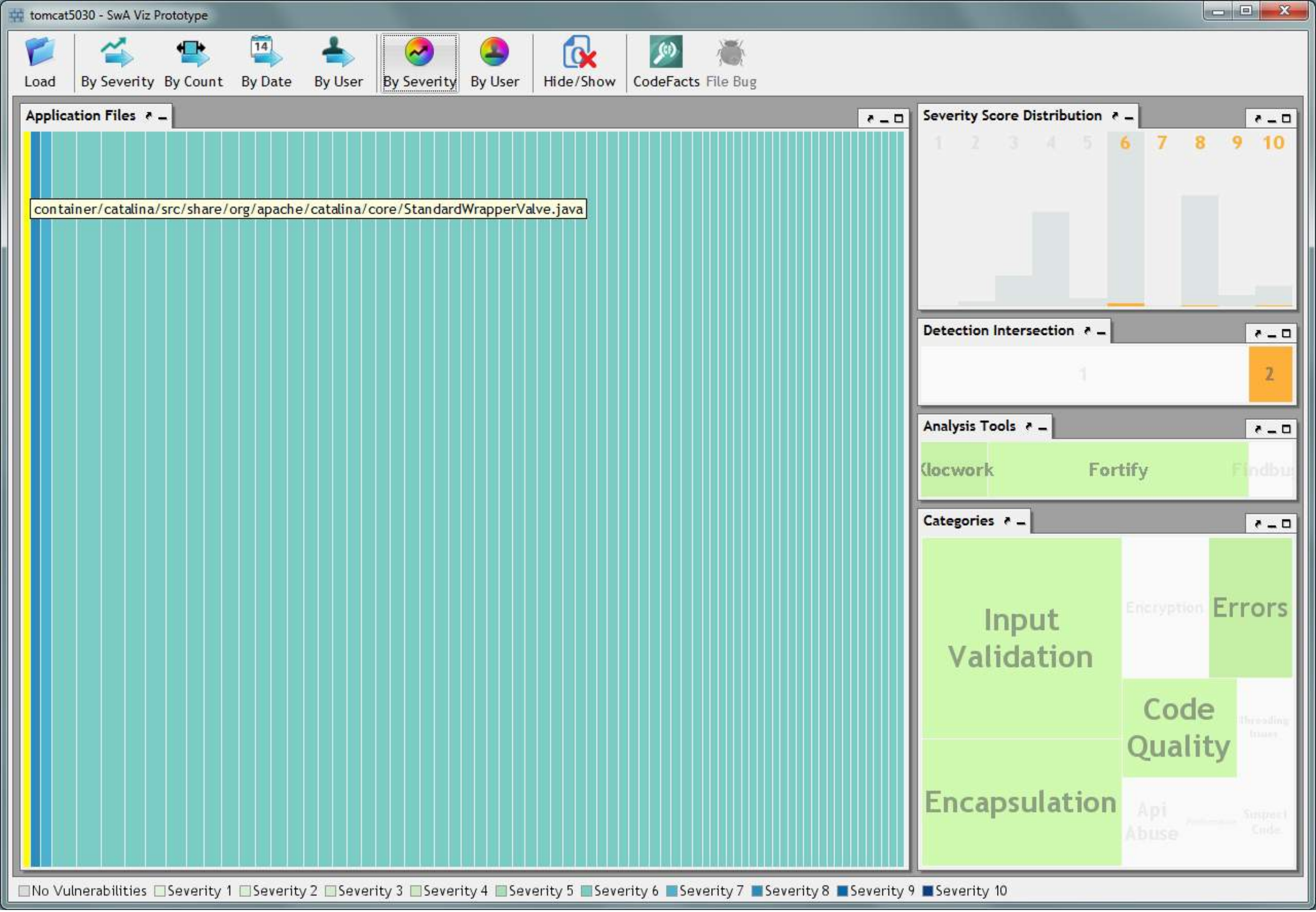
No Vulnerabilities | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Severity 5 | Severity 6 | Severity 7 | Severity 8 | Severity 9 | Severity 10











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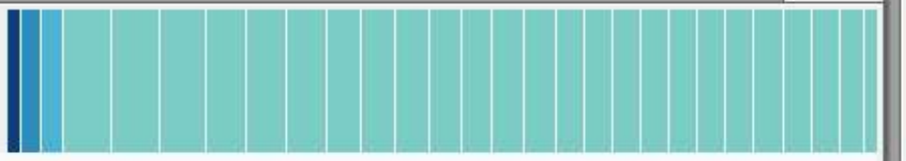


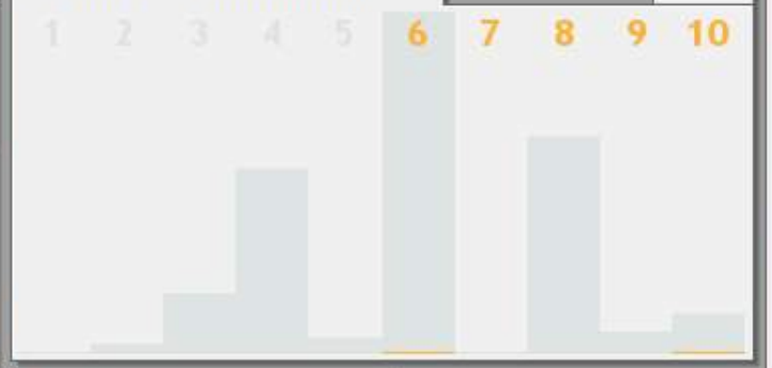
StandardWrapperValve.java

container\catalina\src\share\org\apache\catalina\core

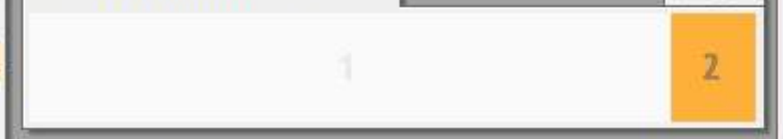
Severity Score: 8.25 Minimum Severity: 6
Vulnerabilities: 2 Maximum Severity: 10

Vulnerabilities	Severity Score	Distribution	Objects
2	**8.25**		- **StandardWrapperValve**
2	8.25		- public invoke(Request request, Response response, ValveContext val
1	10.00		Line 192 - Errors::NPE.COND (Klocwork)
1	6.00		Line 192 - Errors::Null Dereference (Fortify)

Severity Score Distribution

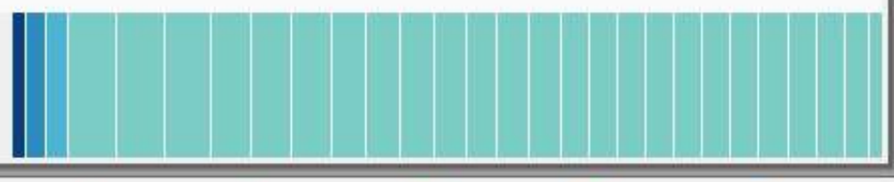


Detection Intersection



Analysis Tools

Categories



No Vulnerabilities | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Severity 5 | Severity 6 | Severity 7 | Severity 8 | Severity 9 | Severity 10

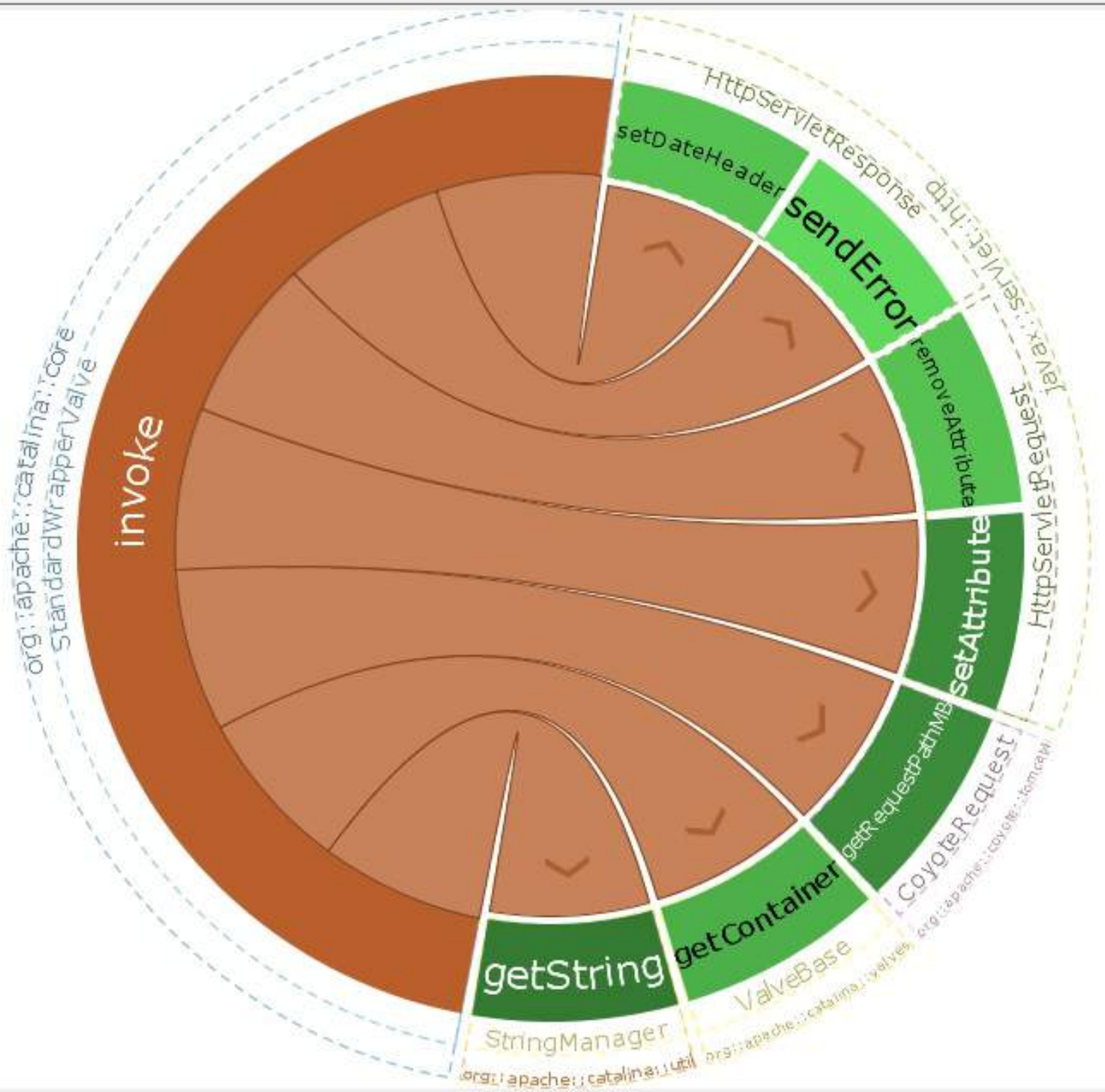
tomcat5030 - SwA Viz Prototype

Load

Tomcat5030 - iTVO 0.1.0.113

File TreeMap Options SAW Options

Treemap SAW



Colors Struct Constructor Destructor Method Static Method Virtual Method

search >>

Ready

tomcat5030 - SwA Viz Prototype

Load | By Severity | By Count | By Date | By User | By Severity | By User | Hide/Show | CodeFacts | File Bug

File currently selected vulnerability as an issue to bugzilla

Application Files

StandardWrapperValve.java

container\catalina\src\share\org\apache\catalina\core

Severity Score: 8.25 Minimum Severity: 6
Vulnerabilities: 2 Maximum Severity: 10

Vulnerabilities	Severity Score	Distribution	Objects
2	**8.25**		- **StandardWrapperValve**
2	8.25		- public invoke(Request request, Response response, ValveContext val
1	10.00		Line 192 - Errors::NPE.COND (Klocwork)
1	6.00		Line 192 - Errors::Null Dereference (Fortify)

Severity Score Distribution

1 2 3 4 5 6 7 8 9 10

Detection Intersection

1 2

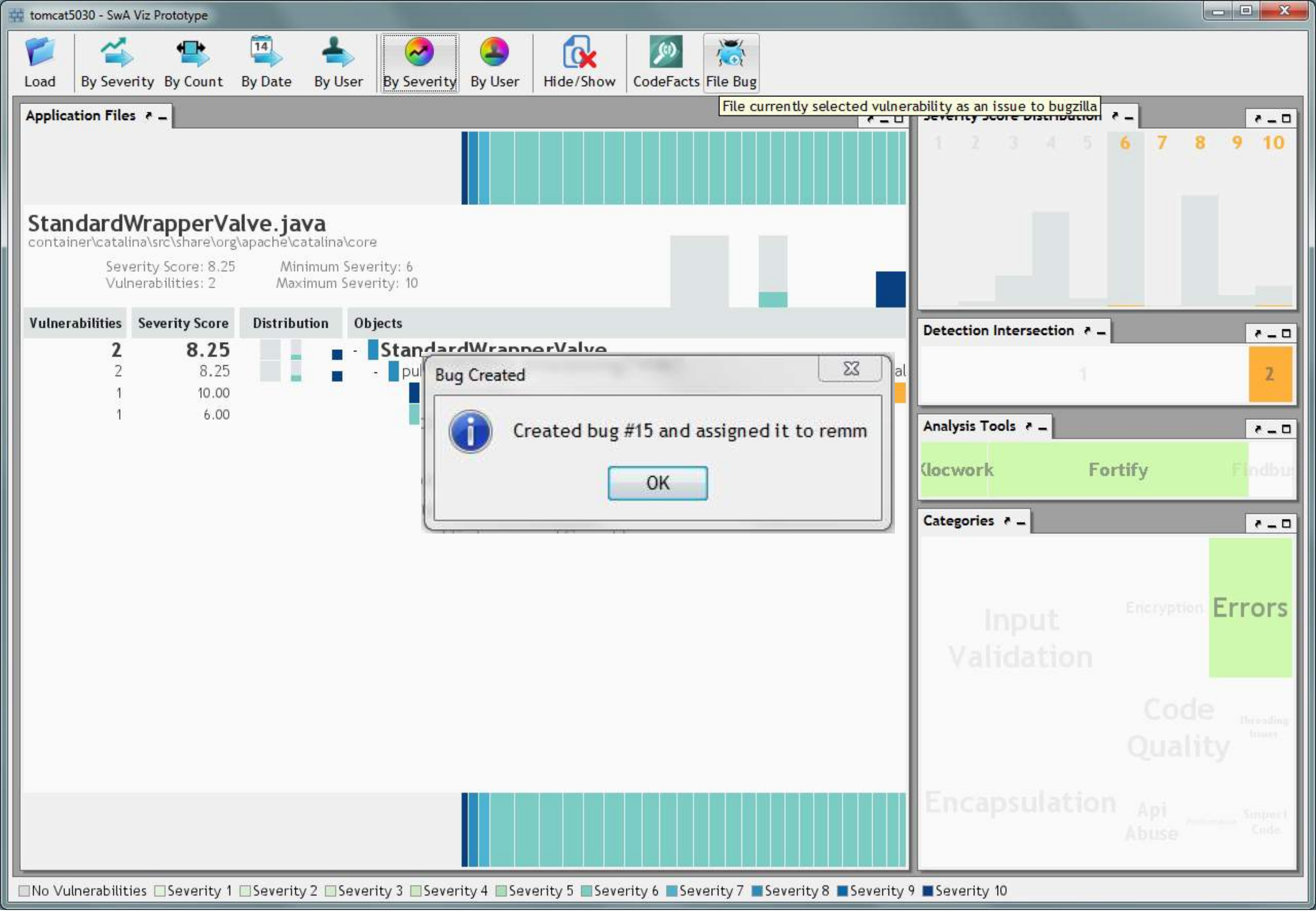
Analysis Tools

Klocwork Fortify Findbu

Categories

Input Validation | Encryption | Errors | Code Quality | Threading Issues | Encapsulation | Api Abuse | Suspect Code

No Vulnerabilities | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Severity 5 | Severity 6 | Severity 7 | Severity 8 | Severity 9 | Severity 10



Bug List

http://192.168.238.129/buglist.cgi?query_format=advanced&order=Importance&bug_status=NEW&bug_status=ASSIGNED&bug_status

Bugzilla – Bug List

Home | New | Search | Find | Reports | Help | New Account | Log In | Forgot Password

Mon May 24 2010 15:50:45 EDT

Bugzilla would like to put a random quip here, but no one has entered any.

Status: NEW, ASSIGNED, REOPENED **Version:** 5030 **Component:** Tomcat **Product:** Tomcat

Zarro Boogs found.

Edit Search Remember search as

File a new bug in the "Tomcat" product

Home | New | Search | Find |

Virtual Bugzilla Server 3.4 brought to you by ALM Work

See also: Deskzilla the desktop client for Bugzilla | VBS F

Before

Bug List

http://192.168.238.129/buglist.cgi?query_format=advanced&order=Importance&bug_status=NEW&bug_status=ASSIGNED&bug_status

Bugzilla – Bug List

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Mon May 24 2010 15:53:08 EDT

Bugzilla would like to put a random quip here, but no one has entered any.

Status: NEW, ASSIGNED, REOPENED **Version:** 5030 **Component:** Tomcat **Product:** Tomcat

ID	Sev	Pri	OS	Assignee	Status	Resolution	Summary
15	cri	P1	Wind	remm	ASSI		StandardWrapperValve.java: Errors @ line 192

One bug found.

Long Format XML CSV | Feed | iCalendar | Change Columns | Edit Search Remember search as

File a new bug in the "Tomcat" product

Home | New | Search | Find | Reports | Help | New Account | Log In | Forgot Password

Virtual Bugzilla Server 3.4 brought to you by ALM Works | 2009-12-13

See also: Deskzilla the desktop client for Bugzilla | VBS Forum | Commercial Bugzilla Support

After

Starting point

33,895 vulnerabilities

2 clicks later ...

227 vulnerabilities

Benefits

- Increased vulnerability coverage through the integration of multiple tools
- Overview of large number of vulnerabilities
- Visual prioritization of vulnerabilities
- Traceability of developer responsibility
- Remediation via integration with SDLC

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- Overview of large number of vulnerabilities
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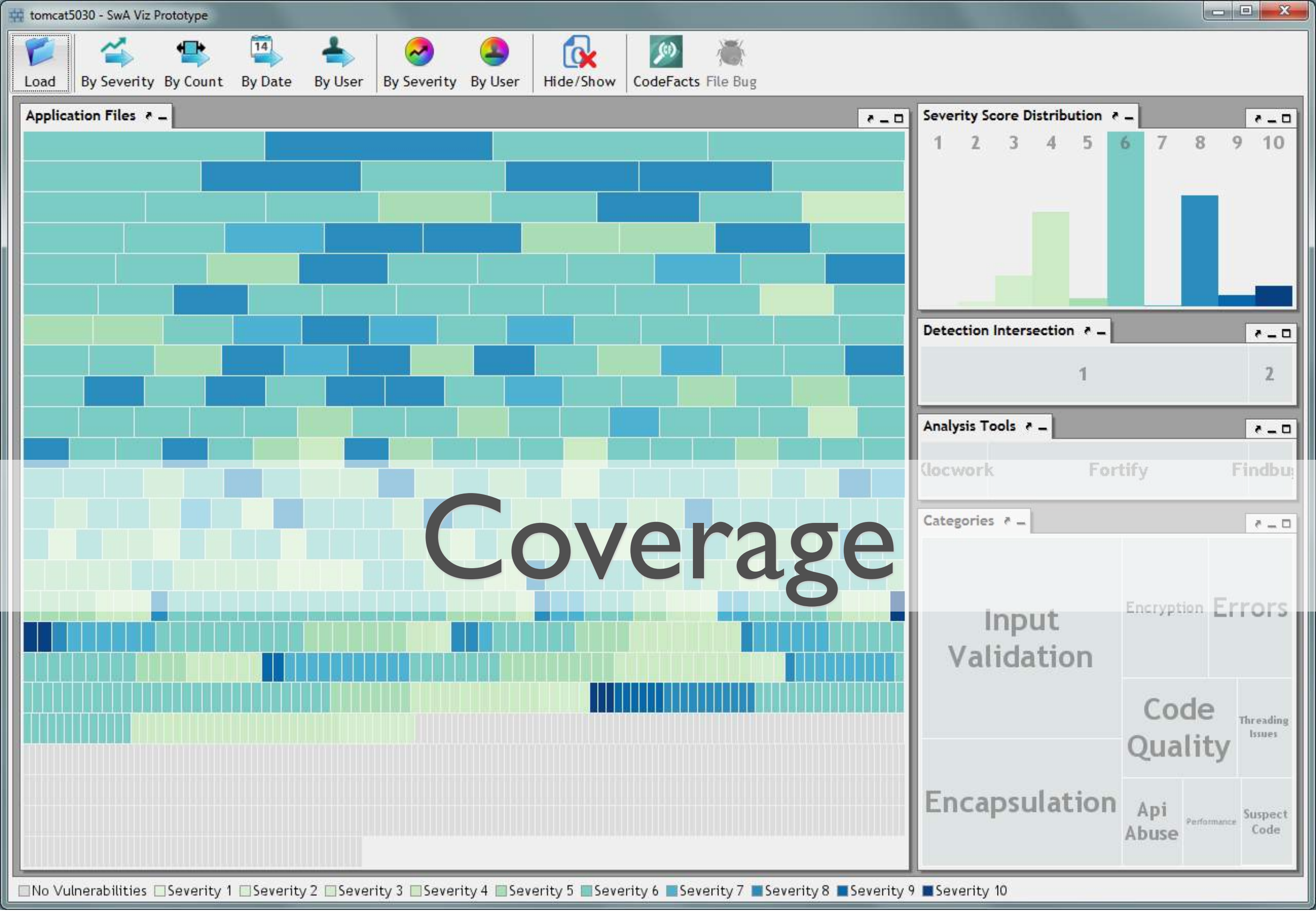
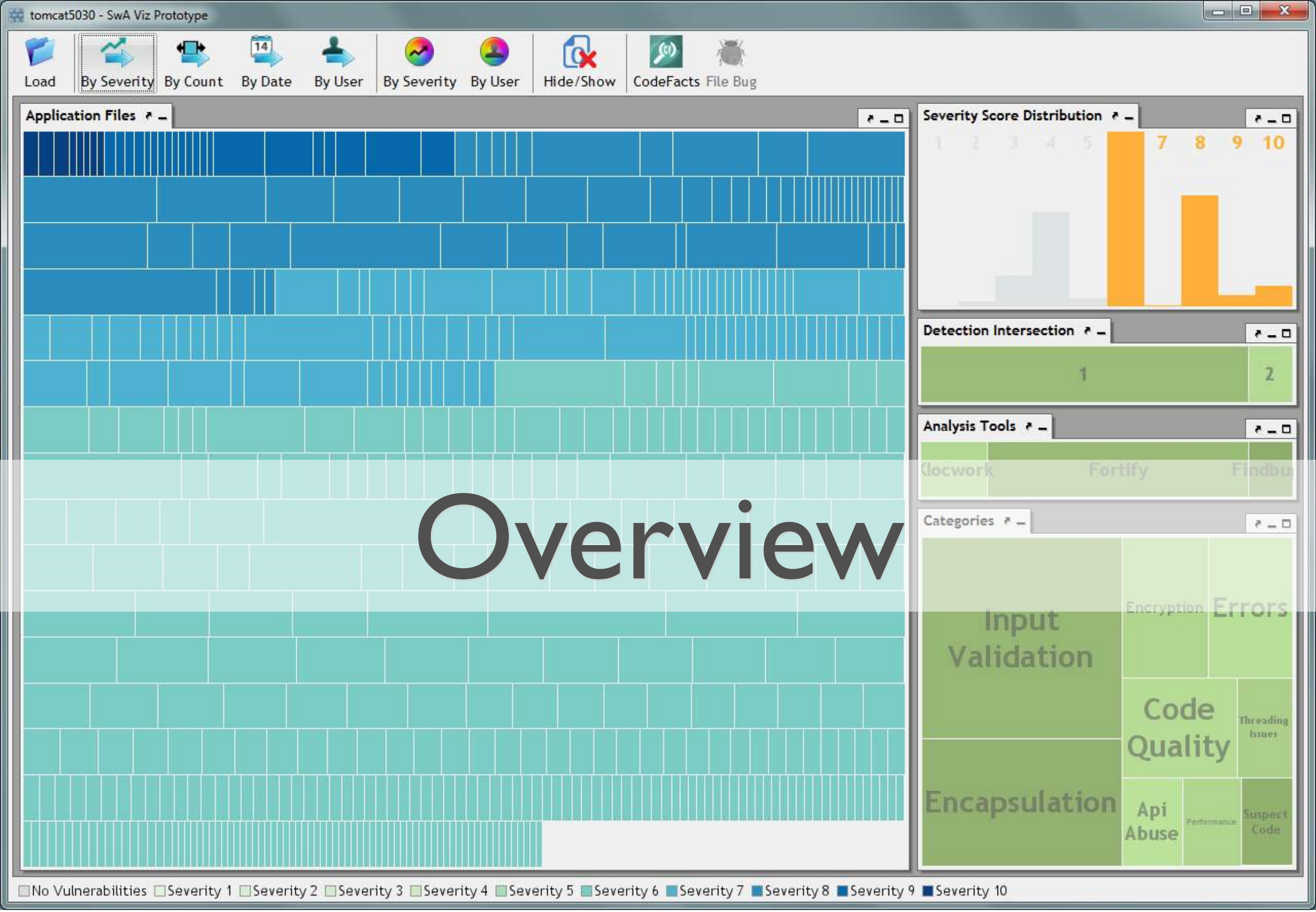
Enhances the coverage & speed for detection & remediation of vulnerabilities

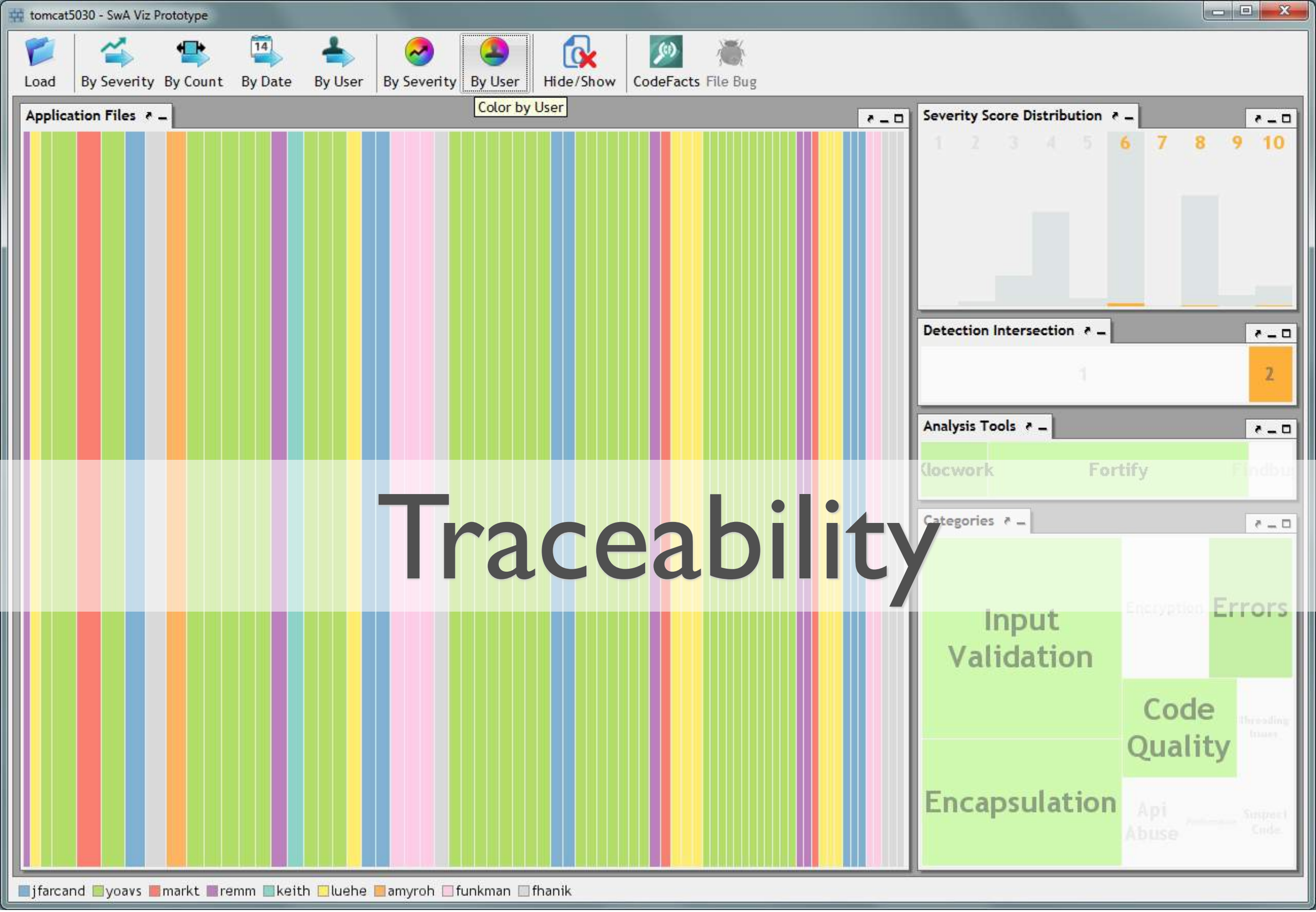


Coverage

Overview

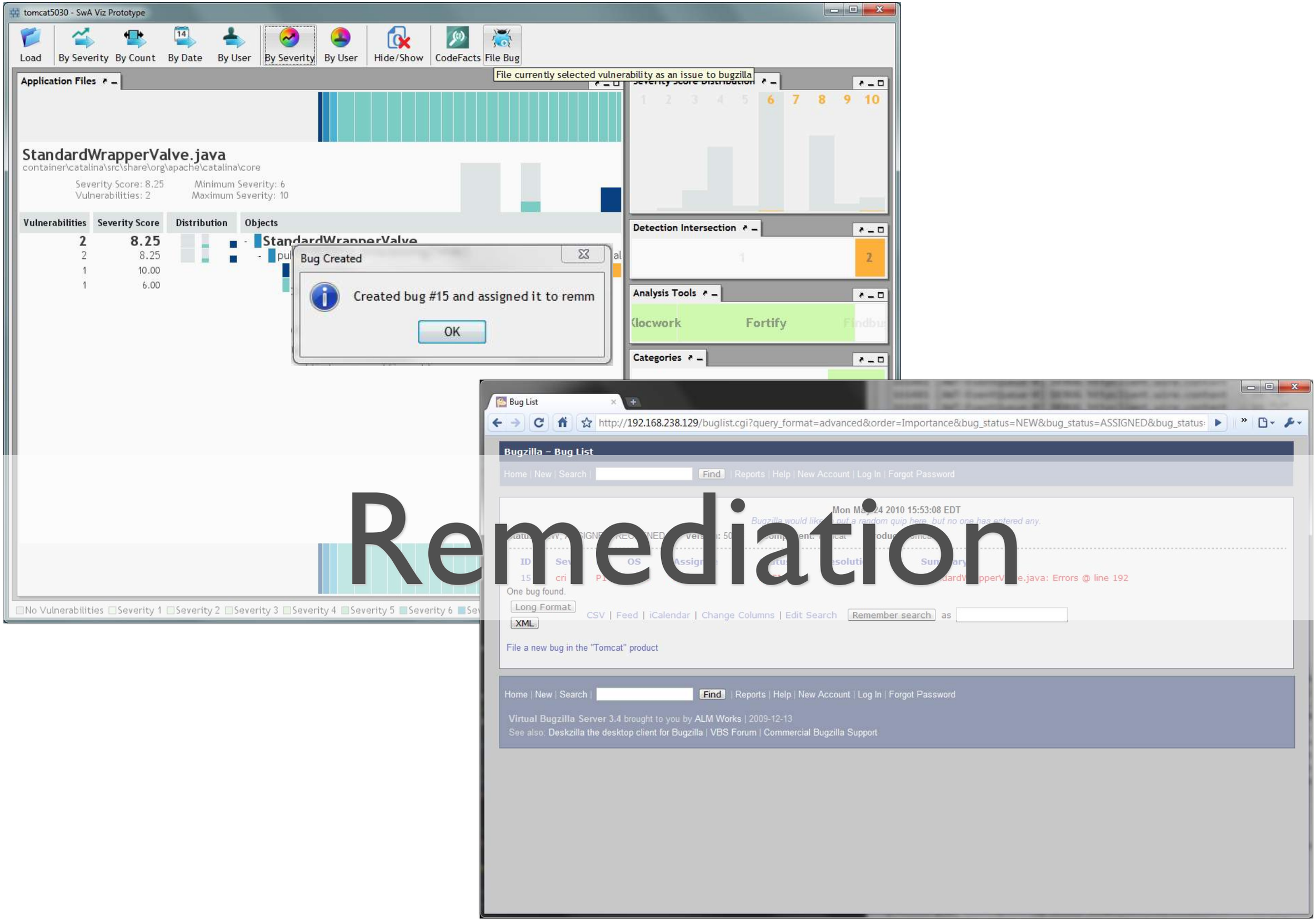


Prioritization

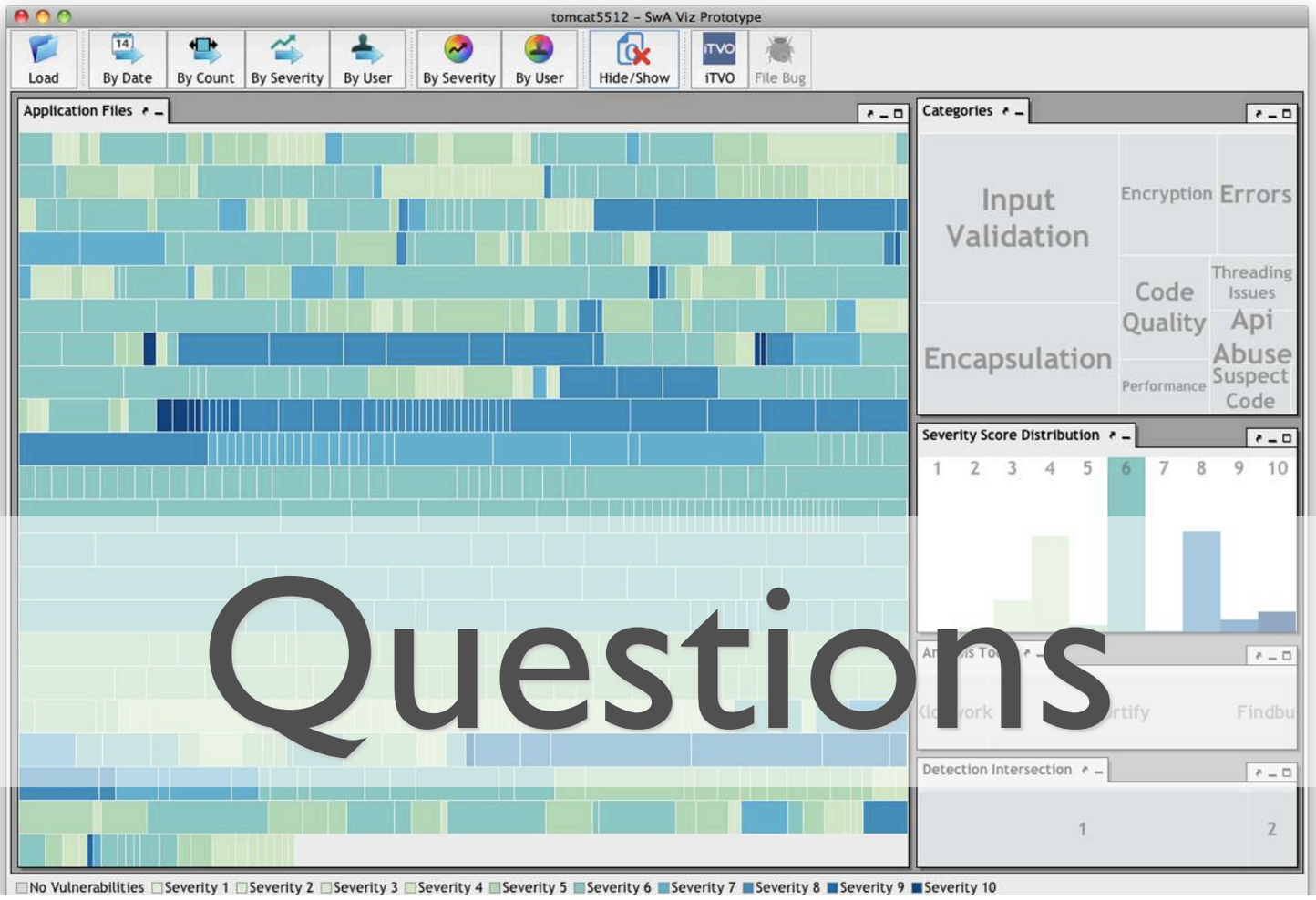


Traceability

Remediation



Visual analysis of code security



Questions

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