CYBER SECURITY DIVISION

2013 PRINCIPAL INVESTIGATORS'

Code Dx: Visual analytics for triage of source code vulnerabilities

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Homeland Security

Science and Technology

Secure Decisions

SECURE DECISIONS
A DIVISION OF APPLIED VISIONS, INC.

We help you **make sense of data**

- Analyze security *decision-making* processes
- Build *visual analytics* to enhance security decisions and training

Our expertise starts where automated security sensors and scanners leave off

We **transition** our R&D into **operational use**, in government and industry

Secure SCOPE

VIASSIST

MeerCAT

Grounded in commercial software and product development

- Division of Applied Visions, developer of commercial software
- 40 people, most with clearances, and secure facilities

Hackers are paid bounties to find software flaws

The New York Times

JULY 13, 2013

"In 2010, Google started paying hackers up to $3,133.70 ... for bugs in its Web browser.

Last month, Microsoft sharply increased the amount it was willing to pay for such flaws, raising its top offer to $150,000.

Software Assurance
SwA Terminology

Weakness Source code defect that an attacker *might* exploit

Vulnerability Source code defect *known* to be exploitable

- For simplicity, we'll use "vulnerability" in this presentation

SAST Static Application Security Testing tools

- Find vulnerabilities and poor quality in static source code
- Rapidly growing market
  Commercial: Fortify, AppScan, Armorize, Coverity ...
  Open source: FindBugs, Jlint, cppcheck ...

Focus of Code Dx

Other categories of tools

DAST Dynamic Application Security Testing tools

- Penetration testing of web applications during execution

Binary code analysis

- Finding vulnerabilities through analysis of complied code

The Need
Stop shipping insecure software

> **90%** of reported security incidents result from **exploits** of application software **defects**
>
> **Build Security In Website, DHS**
> https://buildsecurityin.us-cert.gov/bsi/mission.html

On average, one SAST tool finds only **14%** of vulnerabilities; you need lots of different tools to **cover** the vulnerabilities

50,000 weaknesses in 200,000 lines of code ...
Where do I start? What's most important?

Code Dx Approach
Find the most important *vulnerabilities*

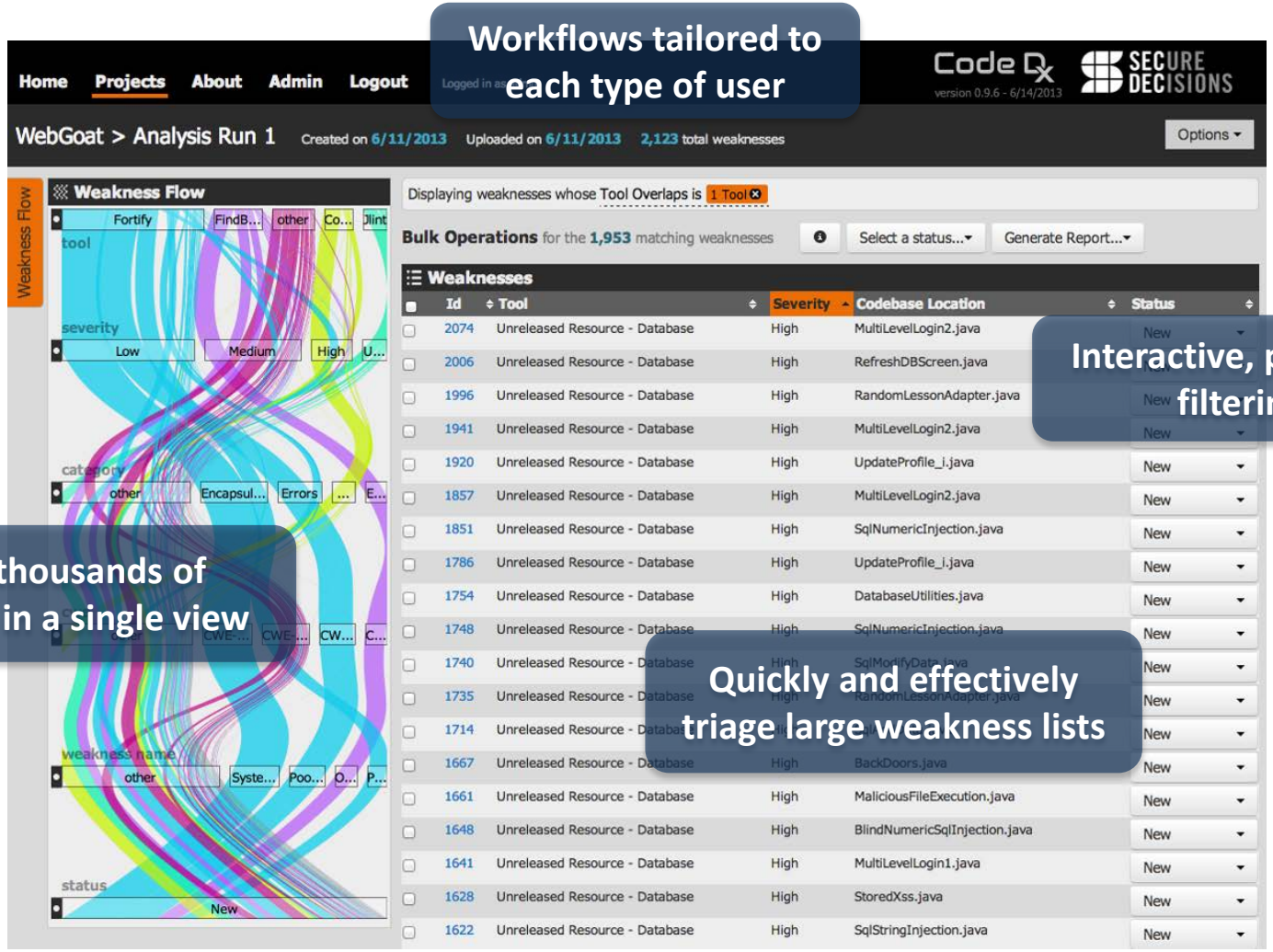
Challenge

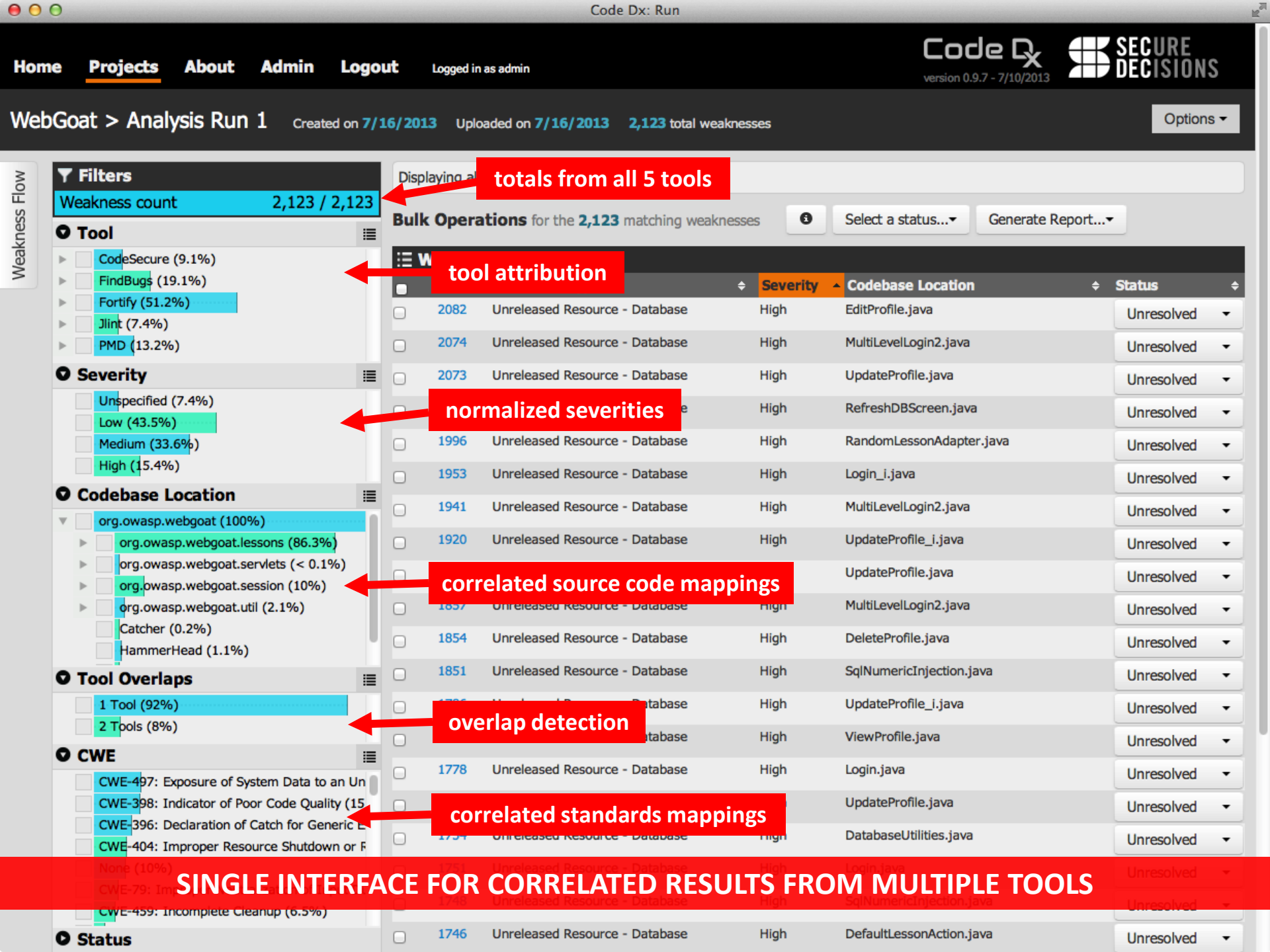
- Incomplete vulnerability coverage by single tool
- Difficult to compare tool results; different semantics
- Tens of thousands of vulnerabilities reported
- Format of results impedes communication and collaboration
- Expensive tools; hard to use for non-experts

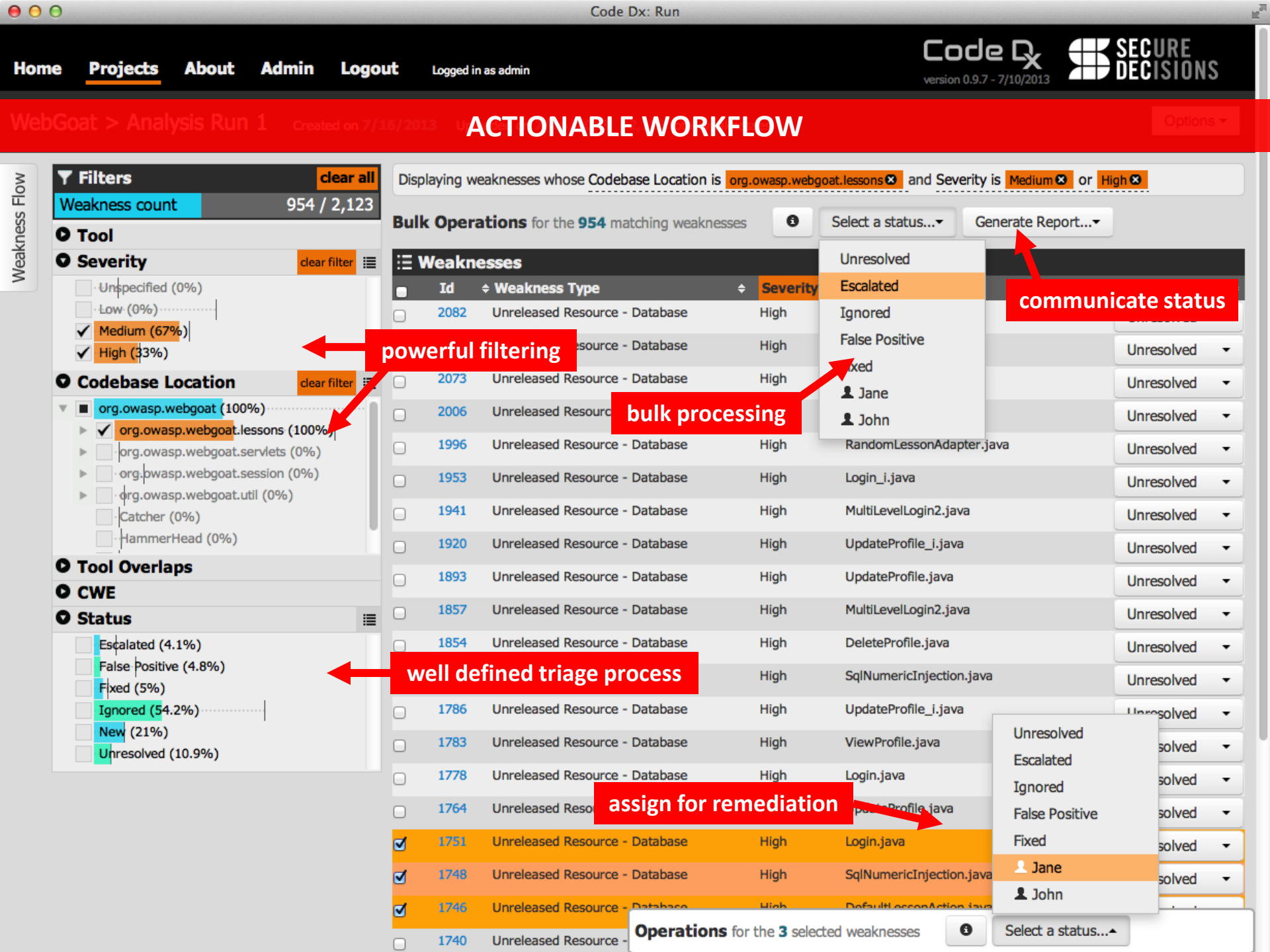
Code Dx Solution

- Imports and correlates results from multiple tools
- Normalizes results; common severity scale
- Visual analytics to rapidly triage results
- Common UI with custom detail for security analysts, developers, and CISOs
- *Code Dx* will embed open source SAST tools for use with or without commercial tools

Visual Analytics
for triage, remediation, and communication




Code Dx: Run
Home
Projects
About
Admin
Logout
Logged in as admin
Code Dx
version 0.9.7 - 7/10/2013
SECURE DECISIONS
WebGoat > Analysis Run 1
Created on 7/16/2013
Uploaded on 7/16/2013
2,123 total weaknesses
Options
Weakness Flow
Filters
Weakness count 2,123 / 2,123
totals from all 5 tools
Tool
CodeSecure (9.1%)
FindBugs (19.1%)
Fortify (51.2%)
Jlint (7.4%)
PMD (13.2%)
tool attribution
Severity
Unspecified (7.4%)
Low (43.5%)
Medium (33.6%)
High (15.4%)
normalized severities
Codebase Location
org.owasp.webgoat (100%)
org.owasp.webgoat.lessons (86.3%)
org.owasp.webgoat.servlets (< 0.1%)
org.owasp.webgoat.session (10%)
org.owasp.webgoat.util (2.1%)
Catcher (0.2%)
HammerHead (1.1%)
correlated source code mappings
Tool Overlaps
1 Tool (92%)
2 Tools (8%)
overlap detection
CWE
CWE-497: Exposure of System Data to an Un
CWE-398: Indicator of Poor Code Quality (15
CWE-396: Declaration of Catch for Generic E
CWE-404: Improper Resource Shutdown or F
correlated standards mappings
Status
Displaying all
Bulk Operations for the 2,123 matching weaknesses
Select a status...
Generate Report...
Severity
Codebase Location
Status
2082 Unreleased Resource - Database High EditProfile.java Unresolved
2074 Unreleased Resource - Database High MultiLevelLogin2.java Unresolved
2073 Unreleased Resource - Database High UpdateProfile.java Unresolved
High RefreshDBScreen.java Unresolved
1996 Unreleased Resource - Database High RandomLessonAdapter.java Unresolved
1953 Unreleased Resource - Database High Login_i.java Unresolved
1941 Unreleased Resource - Database High MultiLevelLogin2.java Unresolved
1920 Unreleased Resource - Database High UpdateProfile_i.java Unresolved
UpdateProfile.java Unresolved
MultiLevelLogin2.java Unresolved
1854 Unreleased Resource - Database High DeleteProfile.java Unresolved
1851 Unreleased Resource - Database High SqlNumericInjection.java Unresolved
High UpdateProfile_i.java Unresolved
High ViewProfile.java Unresolved
1778 Unreleased Resource - Database High Login.java Unresolved
UpdateProfile.java Unresolved
DatabaseUtilities.java Unresolved
1746 Unreleased Resource - Database High DefaultLessonAction.java Unresolved
SINGLE INTERFACE FOR CORRELATED RESULTS FROM MULTIPLE TOOLS


Code Dx: Run
Home
Projects
About
Admin
Logout
Logged in as admin
Code Dx
version 0.9.7 - 7/10/2013
SECURE DECISIONS
WebGoat > Analysis Run 1
ACTIONABLE WORKFLOW
Options
Weakness Flow
Filters
clear all
Weakness count
954 / 2,123
Tool
Severity
clear filter
Unspecified (0%)
Low (0%)
Medium (67%)
High (33%)
powerful filtering
Codebase Location
clear filter
org.owasp.webgoat (100%)
org.owasp.webgoat.lessons (100%)
org.owasp.webgoat.servlets (0%)
org.owasp.webgoat.session (0%)
org.owasp.webgoat.util (0%)
Catcher (0%)
HammerHead (0%)
Tool Overlaps
CWE
Status
Escalated (4.1%)
False Positive (4.8%)
Fixed (5%)
Ignored (54.2%)
New (21%)
Unresolved (10.9%)
well defined triage process
Displaying weaknesses whose Codebase Location is org.owasp.webgoat.lessons and Severity is Medium or High
Bulk Operations for the 954 matching weaknesses
Select a status...
Generate Report...
Unresolved
Escalated
Ignored
False Positive
Fixed
Jane
John
communicate status
bulk processing
Weaknesses
Id
Weakness Type
Severity
2082 Unreleased Resource - Database High
2073 Unreleased Resource - Database High
2006 Unreleased Resource - Database High
1996 Unreleased Resource - Database High RandomLessonAdapter.java
1953 Unreleased Resource - Database High Login_i.java
1941 Unreleased Resource - Database High MultiLevelLogin2.java
1920 Unreleased Resource - Database High UpdateProfile_i.java
1893 Unreleased Resource - Database High UpdateProfile.java
1857 Unreleased Resource - Database High MultiLevelLogin2.java
1854 Unreleased Resource - Database High DeleteProfile.java
High SqlNumericInjection.java
1786 Unreleased Resource - Database High UpdateProfile_i.java
1783 Unreleased Resource - Database High ViewProfile.java
1778 Unreleased Resource - Database High Login.java
1764 Unreleased Reso High
1751 Unreleased Resource - Database High Login.java
1748 Unreleased Resource - Database High SqlNumericInjection.java
1746 Unreleased Resource - Database High
1740 Unreleased Resource -
Unresolved
assign for remediation
Unresolved
Escalated
Ignored
False Positive
Fixed
Jane
John
Operations for the 3 selected weaknesses
Select a status...

WebGoat > Analysis Run 1 > Weakness 944

SQL_NONCONSTANT_STRING_PASSED_TO_EXECUTE detected by FindBugs with High severity

First seen on 7/16/2013 19 weaknesses in this file 13 similar weaknesses in this analysis run

CWE 89 - Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection') [CWEVis | Mitre]

jump to weakness

Status

John

Activity Stream

@Jane You're right. I'll fix this right away!

You can write your comments using markdown

Jane commented

@John Looks like we didn't sanitize the user's input!

2 minutes ago

Jane changed status to **Assigned to John**

4 minutes ago

admin changed status to **New**

3 days ago

- 944 **(Current Weakness)**
- 302 **SQL** line 101
- 538 **CheckResultSet** line 101

```
68      */
69     protected Element createContent(WebSession s)
70     {
71         return super.createStagedContent(s);
72     }
73
74     protected Element doStage1(WebSession s) throws Exception
75     {
76         return injectableQuery(s);
77     }
78
79     protected Element doStage2(WebSession s) throws Exception
80     {
81         return parameterizedQuery(s);
82     }
84     protected Element injectableQuery(WebSession s)
85     {
86         ElementContainer ec = new ElementContainer();
87
88         try
89         {
90             Connection connection = DatabaseUtilities.getConnection(s);
91
92             ec.addElement(makeAccountLine(s));
93
94             String query = "SELECT * FROM user_data WHERE last_name = '" + accountName + "'";
95             ec.addElement(new PRE(query));
97             try
98             {
99                 Statement statement = connection.createStatement(ResultSet.TYPE_SCROLL_INSENSITIVE,
100                                                                  ResultSet.CONCUR_READ_ONLY);
101                ResultSet results = statement.executeQuery(query);
102
103                if ((results != null) && (results.first() == true))
104                {
105                    ResultSetMetaData resultsMetaData = results.getMetaData();
106                    ec.addElement(DatabaseUtilities.writeTable(results, resultsMetaData));
107                    results.last();
108
109                    // If they get back more than one user they succeeded
110                    if (results.getRow() >= 6)
111                    {
112                        makeSuccess(s);
115                    StringBuffer msg = new StringBuffer();
116
```

detailed guidance

real-time collaboration

correlated weaknesses

impacted source

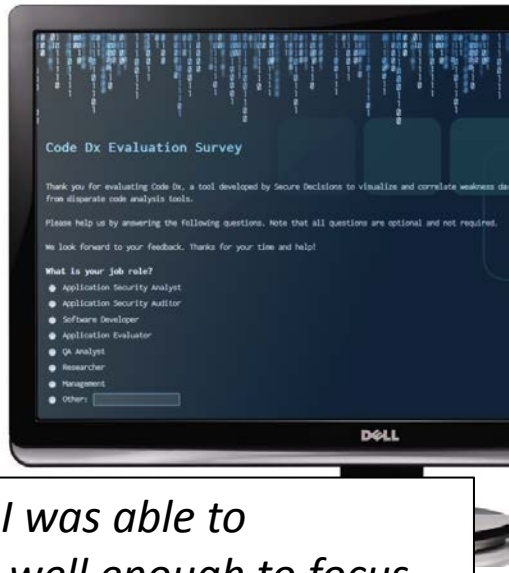
DEVELOPER FOCUSED REMEDIATION

Benefits

- ***Better Coverage*** - Find **more important vulnerabilities**
  - **Combine** multiple tool results to find **more** vulnerabilities
  - **Prioritize** combined results to highlight **most important**
  - **Filter out** overlapping results and false positives
- ***Efficiency* -** Save remediation **time** and **resources**
  - Developers can remediate **highest priority** vulnerabilities first
    - *Remediation can take 7–10 hours per vulnerability*
- ***Communicate*** more effectively up and down the chain
  - Visual analytics and reports, based on **roles** and **expertise**
- ***Easy*** to get started
  - *Code Dx 1.0* (Q4 2013) **auto-runs** open source tools
  - **Affordable** to small and mid-sized businesses

Current Status
Technology Readiness Level 7

- More than **10 beta testers**, incl. ITT, NSA, Raytheon, RTI, Univ. of Nebraska …
- Systematic collection of **feedback**



"I really like the visualization. ..tying [the tools] together and being able to work with that data is very useful."

"…at the present state, it seems to require the user to do a lot of work and formatting that the software itself could do."

"After a few minutes, I was able to manipulate the filters well enough to focus on particular discoveries."

- Currently being **evaluated** by NIST, DHS S&T CIO, TSA, McAfee, Domestic Nuclear Detection Office, Indiana Univ.
- Working with Morgridge Institute to integrate into **SWAMP**
- **Training** program being refined

Code Dx Roadmap

Version	Major Features	Target Users	13	2014				2015			
			Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Code Dx 1.0	Embeds and **auto-runs open source tools**; produces consolidated normalized results	Users seeking low-cost, easy-to-use bundle of SAST tools (e.g. small biz)	▲								
Code Dx 1.1	More open source tools with **additional languages**, e.g. .Net; **Enhanced reporting**	As above			▲						
Enterprise 1.0	Correlates **commercial and open source SAST tools**; Enhanced analytics/reporting	Users of commercial SAST who want to extend their vulnerability coverage	▲								
Enterprise 1.5	**Dynamic tracing** from Code Pulse; **enhanced visual analytics**	As above			▲						
Enterprise 2.0	Maps weaknessses to **compliance** (e.g. HIPAA) and industry standards (e.g. OWASP Top Ten)	As above, plus industry verticals, e.g. health					▲				
Enterprise 3.0	Addition of **hybrid analysis** correlating SAST and DAST	As above, with focus on web application risk assessment									▲
SWAMP 1.0	More tool adaptors; Modified for **SWAMP beta**	SWAMP users	▲								
SWAMP 1.1	Upgrades for **SWAMP IOC**	SWAMP users		▲							
SWAMP 2.0	SWAMP Yr 2 added **scalability** and functions	SWAMP users					▲				
SWAMP 3.0	Upgrades for SWAMP Yr 3 custom needs	SWAMP users									▲
SIEM Beta	**Feed pre-correlated SAST data to SIEM**; Beta to be integrated into McAfee ESM	SIEM vendors; SIEM users	▲								
ED 1.0	**Free** version of Code Dx **for education**	Academia; training organizations			▲						

Next 120 days towards transition

1. Transition Code Dx into **government programs**
   - Integrate into SWAMP Beta version
   - Determine effectiveness in NIST SATE program
   - Have other government agencies evaluate Code Dx
2. Initiate **operational pilots** to reach TRL 8
   - Recovery Accountability and Transparency Board; Commonwealth of PA
3. Conduct full **commercialization**
   - Integrate with McAfee ESM to demonstrate value proposition to Security Information Event Management (SIEM) users
   - Determine pricing model; Set up reseller program
   - Gain active use by at least one Fortune 500 company
4. Continue collaboration with academia

What do you think?

Diagnosis and triage of source code vulnerabilities

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