The Influence of Programming Language and Framework on Application Security

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Motivation

- Some languages and frameworks more prone to vulnerabilities?
- How can we find out empirically?

Overview

- The problem
- Experiment
- Not enough data
- How can we gather better data?

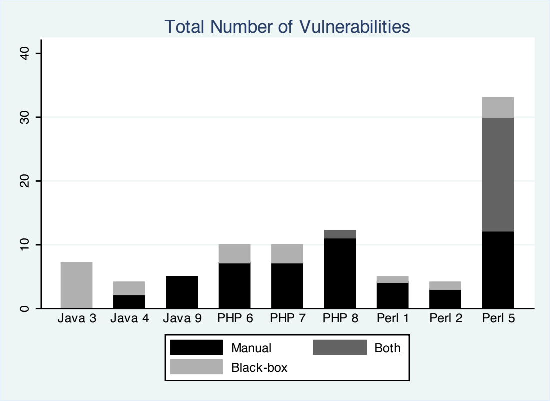
Problem

- Many language and framework choices
  - None clearly superior
- Security increasingly important
  - Languages and frameworks evolving to meet this need
- We need to measure how successful they are

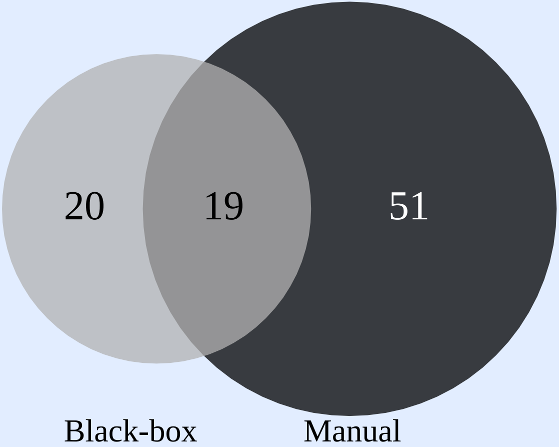
Experiment

- Data gathered from a previous study (Prechelt 2007)
- 9 implementations of same web app: 3 PHP, 3 Java, 3 Perl
- Teams chose which framework(s) to use
  - Little overlap in framework choice
- Manual and black-box security analysis of each implementation

Results


Total Number of Vulnerabilities
0
10
20
30
40
Java 3
Java 4
Java 9
PHP 6
PHP 7
PHP 8
Perl 1
Perl 2
Perl 5
Manual
Both
Black-box

Results (2)



Results (3)

		CSRF		Session Management		Password Storage	
Team Number	**Language**	Vulnerable?	Framework Support	Vulnerable?	Framework Support	Vulnerable?	Framework Support
1	Perl	X	none		opt-in	X	opt-in
2	Perl	X	none	X	none	X	none
5	Perl	X	none	X	none		opt-out
3	Java		manual		opt-out		none
4	Java		always on		opt-in	X	opt-in
9	Java	X	none		opt-in		none
6	PHP	X	none		opt-out	X	opt-in
7	PHP	X	none		opt-out	X	none
8	PHP	X	none		opt-out	X	opt-in

Results (4)

- A few interesting, significant results
- But not as many as we would like

Larger data set

- Programming contest
- Student programming projects
- Outsourced development
  - guru.com, rentacoder.com, etc.

Outsourced development

- We write web application in multiple languages using multiple frameworks
- Hire programmers for single security-relevant module
- Sample size vs. module size

Conclusion

- Have performed small-scale experiment
- Some evidence that language and framework choice influence security
- Need better data for study of larger scale

Thank you!

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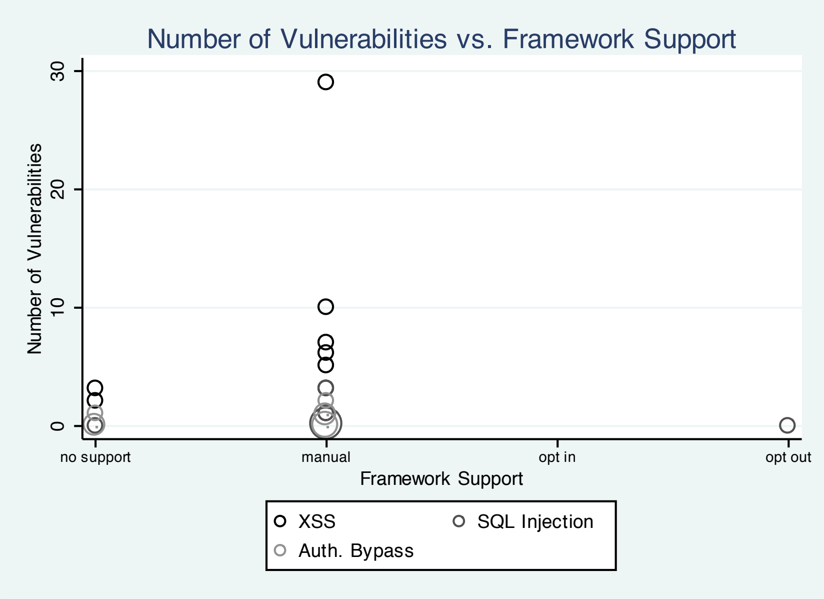
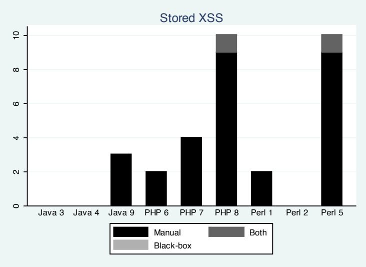
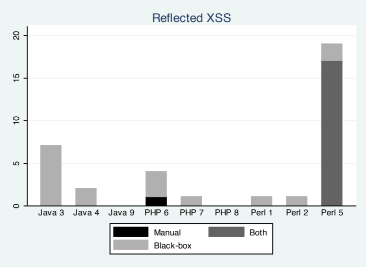
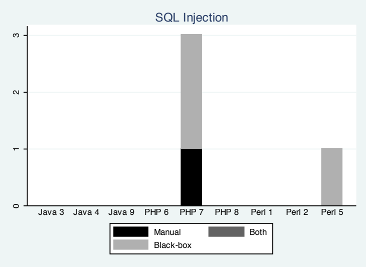
Results (5)

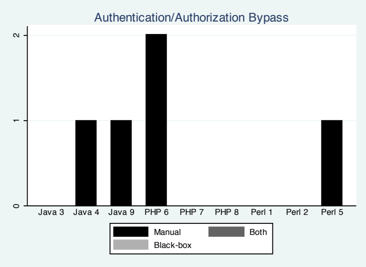

Number of Vulnerabilities vs. Framework Support
Number of Vulnerabilities
0
10
20
30
no support
manual
opt in
opt out
Framework Support
XSS
SQL Injection
Auth. Bypass

Results (6)


Stored XSS


Reflected XSS


SQL Injection


Authentication/Authorization Bypass