



No More Whack-a-Mole: How to Find and Prevent Entire Classes of Security Vulnerabilities

Sam Lanning



@samlanning



@samlanning

A story of many bugs (CVE-2017-8046)

7 September 2017

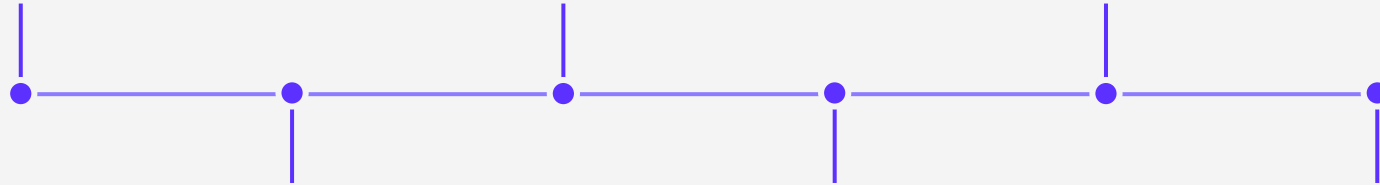
Mo privately discloses vulnerability and exploit in Spring Framework

22 September 2017

Mo checks patch, sees it's incomplete sends updated exploit to Pivotal

27 September 2017

Mo checks patch, sees it's *still* incomplete sends updated exploit to Pivotal



21 September 2017

Pivotal publish a patch, and make an announcement.

26 September 2017

Pivotal sends Mo details of second attempt at fix

25 October 2017

Pivotal publishes a complete refactor of relevant code to hopefully prevent further occurrences.

https://lgtm.com/blog/spring_data_rest_CVE-2017-8046_q1

A story of many bugs 2

27 April 2016

S2-032 / CVE-2016-3081

RCE in Apache Struts 2 via OGNL

Nike Zheng

20 June 2016

S2-037 / CVE-2016-4438

RCE in Apache Struts 2 via OGNL

Chao Jack, Shinsaku Nomura

22 September 2017

S2-046 / CVE-2017-5638

RCE in Apache Struts 2 via OGNL

Chris Frohoff, Nike Zheng, Alvaro Munoz

12 May 2016

S2-033 / CVE-2016-3087

RCE in Apache Struts 2 via OGNL

Alvaro Munoz

19 March 2017

S2-045 / CVE-2017-5638

RCE in Apache Struts 2 via OGNL

Nike Zheng

24 September 2018

S2-057 / CVE-2018-11776

RCE in Apache Struts 2 via OGNL

Man Yue Mo

See Also: CVE-2012-0394, CVE-2013-1966, CVE-2012-0391, CVE-2013-2115, CVE-2012-0393



Solution:

**When a new mistake is discovered,
try and find similar mistakes across
your code base**

Variant Analysis?

“After doing this [root cause analysis], our next step is **variant analysis**: finding and investigating any variants of the vulnerability. It’s important that we find all such variants and patch them simultaneously, otherwise we bear the risk of these being exploited in the wild.”

- Steven Hunter, MSRC Vulnerabilities & Mitigations team

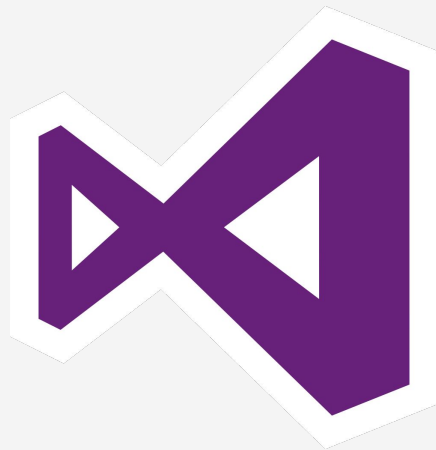
<https://blogs.technet.microsoft.com/srd/2018/08/16/vulnerability-hunting-with-semmler-ql-part-1/>

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vendor
env.example
.gitattributes
.gitignore
.htaccess
local.env
.phpstorm.meta.php
.prod.env
123.php
_ide_helper.php
artisan
composer.json
composer.lock
gulpfile.js
part

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3 SPR = Product::select('id', 'image', 'mirror')->whereIn('cat_id', [156,162])->where('color_id', 13);  
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5  
6 $bar = new ProgressBar($this->output, SPR->count());  
7 $bar->setFormat('%d%% [<bar>] %s')->setBarWidth(50)->start();  
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```

Code Navigation / IDE





Automating Variant Analysis

Could we describe a mistake in a way that lets us automatically find other instances?

An Example: Chakra

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2 {
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4     // from Chakra, acquire pointer to array
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<https://blogs.technet.microsoft.com/srd/2018/08/16/vulnerability-hunting-with-semmler-ql-part-1/>

An Example: Chakra

```
var buf = new ArrayBuffer(length);
var arr = new Uint8Array(buf);

var param = {}
param.valueOf = function() {
    /* free `buf`
       (code to actually do this would be defined elsewhere) */
    neuter(buf); // neuter `buf` by e.g. posting it to a web worker
    gc();        // trigger garbage collection
    return 0;
};

vulnerableFunction(arr, param);
```

<https://blogs.technet.microsoft.com/srd/2018/08/16/vulnerability-hunting-with-semmle-ql-part-1/>

An Example: Chakra

```
1 from Variable v, TypedArrayBufferPointer def, FunctionCall call, VariableAccess use
2 where
3   // variable is defined at "def", and used at "use"
4   v.getAnAccess() = def and v.getAnAccess() = use
5   // "call" may eventually call a function that calls back into JS code
6   and exists(Function g | call.getTarget().calls+(g) and g.hasName("MethodCallToPrimitive"))
7   // "call" happens after "def"
8   and def.getASuccessor+() = call
9   // "use" happens after "call"
10  and call.getASuccessor+() = use
11 select def, call, use
```

*slightly modified query from:

<https://blogs.technet.microsoft.com/srd/2018/08/16/vulnerability-hunting-with-semmler-ql-part-1/>

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5     BYTE* pBuffer; v
6     UINT bufferSize;
7     hr = Jscript::GetTypedArrayBuffer(args[1], &pBuffer, &bufferSize);
8                                     def
9     // get second argument -
10    // from Chakra, obtain an integer value
11    int someValue;
12    hr = Jscript::VarToInt(args[2], &someValue);
13
14    // perform some operation on the array acquired previously
15    doSomething(pBuffer, bufferSize);
16    }
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call

<https://blogs.technet.microsoft.com/srd/2018/08/16/vulnerability-hunting-with-semmler-ql-part-1/>

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16 }
```

1st
def

2nd
call

<https://blogs.technet.microsoft.com/srd/2018/08/16/vulnerability-hunting-with-semmler-ql-part-1/>

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```

call

2nd use

<https://blogs.technet.microsoft.com/srd/2018/08/16/vulnerability-hunting-with-semmler-ql-part-1/>

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Beyond your own code

- Make your (general-purpose) mistake descriptions open source!
- Use external mistake descriptions!

ZipSlip



<https://snyk.io/research/zip-slip-vulnerability>

ZipSlip

../../../../.bashrc

../../../../../../../../etc/crontab

<https://snyk.io/research/zip-slip-vulnerability>

ZipSlip



```
1 Enumeration<ZipEntry> entries = zip.getEntries();
2 while (entries.hasMoreElements()) {
3     ZipEntry e = entries.nextElement();
4     File f = new File(destinationDir, e.getName());
5     InputStream input = zip.getInputStream(e);
6     IOUtils.copy(input, write(f));
7 }
```

<https://snyk.io/research/zip-slip-vulnerability>

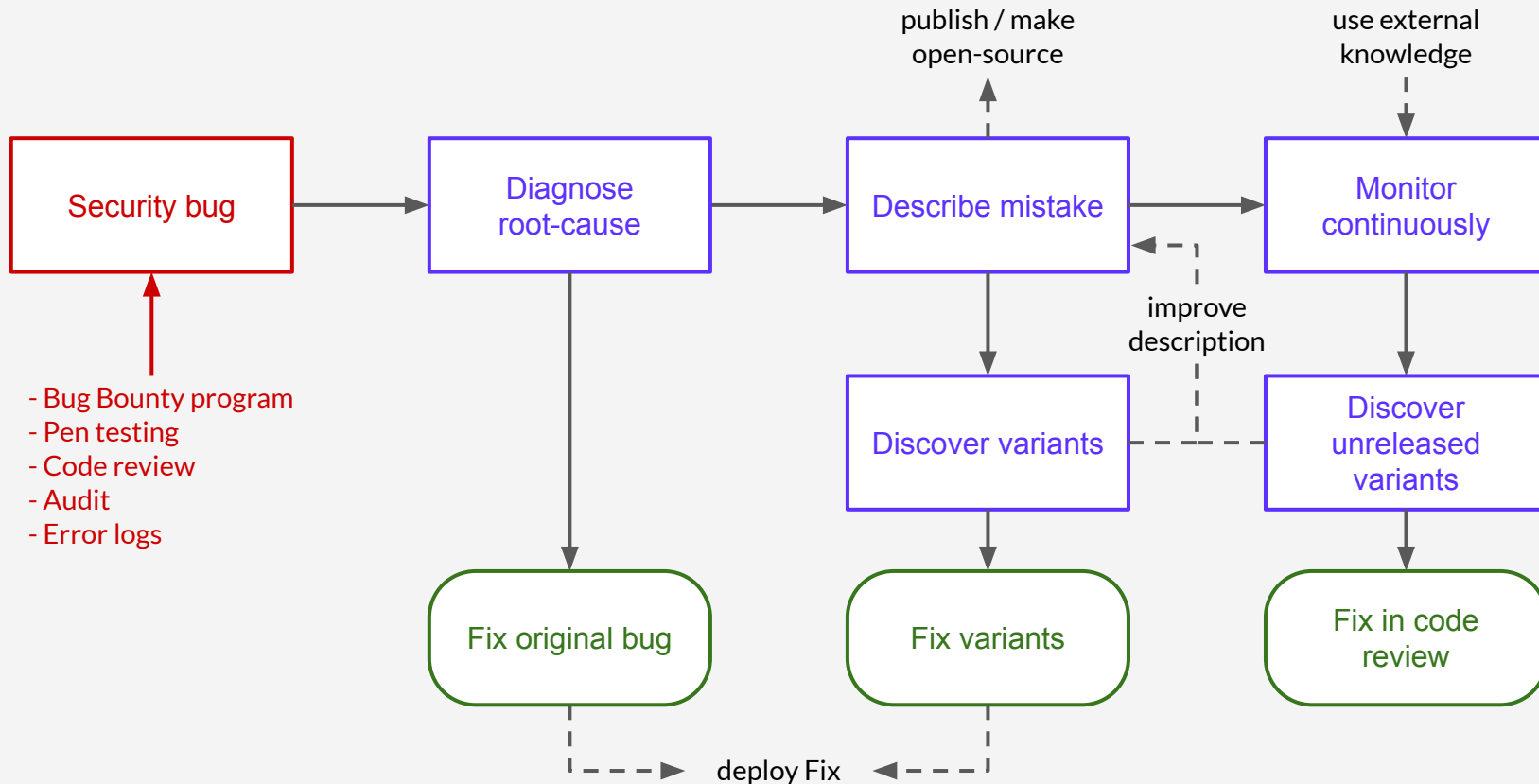
ZipSlip



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<https://snyk.io/research/zip-slip-vulnerability>

Fitting in to your workflow



No vulnerability response process?

What variant analysis is NOT

- A replacement for good security architecture, a way to avoid large refactors
- A replacement for exploit mitigation
- A replacement for other security processes
- Something that automatically fixes bugs / vulnerabilities.

Recap

- You should do variant analysis
- Better yet, you should do *automated* variant analysis
- Use and contribute to the shared knowledge / checks
- Checks should be run continuously, not once-off!
- VA compliments (not replaces) other security practices

Thank You

SemmlerTM

<http://semmler.com>

 @Semmler

Sam Lanning

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