Cross-Site Scripting Attacks and Possible Defenses

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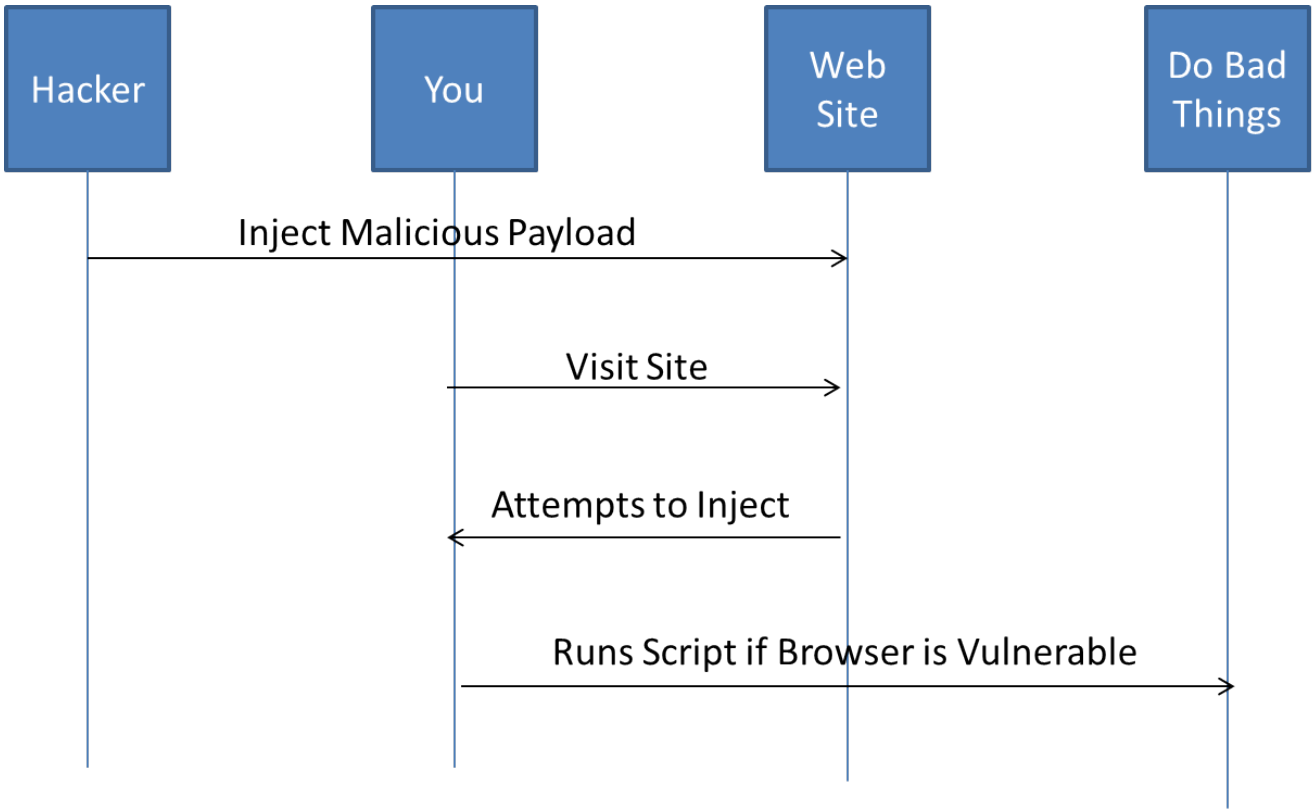

http://www.acunetix.com/websitesecurity/xss/

What is Cross-Site Scripting?

- XSS attacks have been a major issue for over a decade, and account for 84% of web security vulnerabilties in 2007 according to Symantec.
- Currently many forms of XSS attacks are not written down for study. Primarily only basic XSS attacks are listed in many cheatsheets.
- XSS attacks are continually evolving to work around existing defenses.

Outline

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NoScript & IE8

- Both utilize regular expressions to identify the presence of JavaScript in HTTP request parameters and attempts to sanitize them before submission.
- This type of search can prevent some web pages from loading.
- NoScript incurs many false positives, but IE8 incurs fewer false positives than NoScript at the cost of an increase of false negatives.
- NoScript has about 40 non-trivial regular expressions in detection and sanitation.

NoScript & IE8 Cont.

- Both have complex set of regular expressions for detection and sanitation. Even with this complex set of regular expressions parsing tricks can bypass the filter.

Example (Parsing trick)

$< a < img/src/onerror = alert(1)// <$

- Neither NoScript nor IE8 can detect XSS scriptless attacks.

noXSS & XSSAuditor

- noXSS and XSSAuditor utilize exact substring matching to match reflected content for malicious script.
- noXSS achieves a high fidelity rate but at the cost of slower performance.
- noXSS cannot handle HTML entity encoded javascript URLs. This allows a hacker to bypass the filter by inserting a full-page hyperlink.

noXSS & XSSAuditor Cont.

- XSSAuditor is implemented on the client-side and improved upon some of the faults that were found in noXSS and IE8.
- XSSAuditor cannot handle partial-script injections which have the ability to alter the structure of script on a web page.
- XSSAuditor is unable to detect attacks that are non-script based. One such attack can be carried out using CSS.

Example (Partial-Script Attack)

$< script >$
$docuement.write($
$< ahref = ''../plugin.php?passed\_id = <= \$\_GET[''id'']; ? > '' >< /a >);$
$< /script >$

Injected Attack
id :
$); do\_xss(); document.write($

Progression of Web Browsers, Hypothesis 1

H1. Browsers belonging to two different families have different attack surfaces.

- In other words, they are not sensitive to the same attack vectors.
- Crucial to understand whether there is a shared security policy between web browser vendors against XSS attacks.

Hypothesis 1 Cont.

- To support H1, 84 dissimilar attack vectors were chosen from a variety of cheetsheets and a few generated by the researchers.
- Tested against three types of browsers: modern/recent, mobile, and legacy versions.
- Types of attacks tested include <script> tags with various payloads, <body> tags, HTML5 tags and properties, etc.

Hypothesis 1 Cont.

vector/browser	Chrome 11.0.696.68	IE 8.0.6001.19048	Opera mobile 11	Opera11.11 rev2109	IE mobile	Safari Mac OSX	iPhone 3GS	Android 2.2	Firefox 5 Android	Firefox 8.0a1	IE 6.0.2900.2180	Firefox 2.0.0.2	Netscape 4.8	IE 4.0.1	Opera 4.00
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
8	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
9	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
11	1	1	0	0	1	1	1	1	1	1	1	1	0	1	0
12	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	1	1	1	1	1	0	0	0	1	1	1	1	0	0	0
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
18	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
21	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
22	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
31	1	0	1	1	0	1	1	1	0	0	0	1	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	1	1	0	0	1	1	1	1	1	1	1	1	0	1	0
34	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
35	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
36	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
37	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
38	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0
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41	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
42	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
43	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
47	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
49	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
50	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	1	0	0	0	0	1	1	1	1	1	0	0	0	0	0
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59	1	0	1	1	0	1	1	1	1	1	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
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63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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65	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
66	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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71	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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76	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0
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78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0
84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0
86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hypothesis 1 Cont.

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3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1
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7	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
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10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
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18	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
21	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
22	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
31	1	0	1	1	0	1	1	1	0	0	0	1	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	1	1	0	0	1	1	1	1	1	1	1	1	0	1	0
34	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
35	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
36	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
37	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
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39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
41	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
42	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
43	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

vector/browser	Chrome 11.0.696.68	IE 8.0.6001.19048	Opera mobile 11	Opera11.11 rev2109	IE mobile	Safari Mac OSX	iPhone 3GS	Android 2.2	Firefox 5 Android	Firefox 8.0a1	IE 6.0.2900.2180	Firefox 2.0.0.2	Netscape 4.8	IE 4.0.1	Opera 4.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
47	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
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67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
71	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
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76	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0
77	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0
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79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0
84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0
86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hypothesis 1 Cont.

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3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1
5	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
8	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
9	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
11	1	1	0	0	1	1	1	1	1	1	1	1	0	1	0
12	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
21	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
22	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
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25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	1	0	0	0	0	0	1	0	1	1	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
31	1	0	1	1	0	1	1	1	0	0	0	1	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	1	1	0	0	1	1	1	1	1	1	1	1	0	1	0
34	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
35	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
36	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
37	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
38	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
41	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
42	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0
43	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

vector/browser	Chrome 11.0.696.68	IE 8.0.6001.19048	Opera mobile 11	Opera11.11 rev2109	IE mobile	Safari Mac OSX	iPhone 3GS	Android 2.2	Firefox 5 Android	Firefox 8.0a1	IE 6.0.2900.2180	Firefox 2.0.0.2	Netscape 4.8	IE 4.0.1	Opera 4.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
47	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
49	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
50	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	1	0	0	0	0	1	1	1	1	1	0	0	0	0	0
54	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	1	0	1	1	0	1	1	1	1	1	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
65	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
66	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
71	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0
77	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0
78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
83	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0
84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0
86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

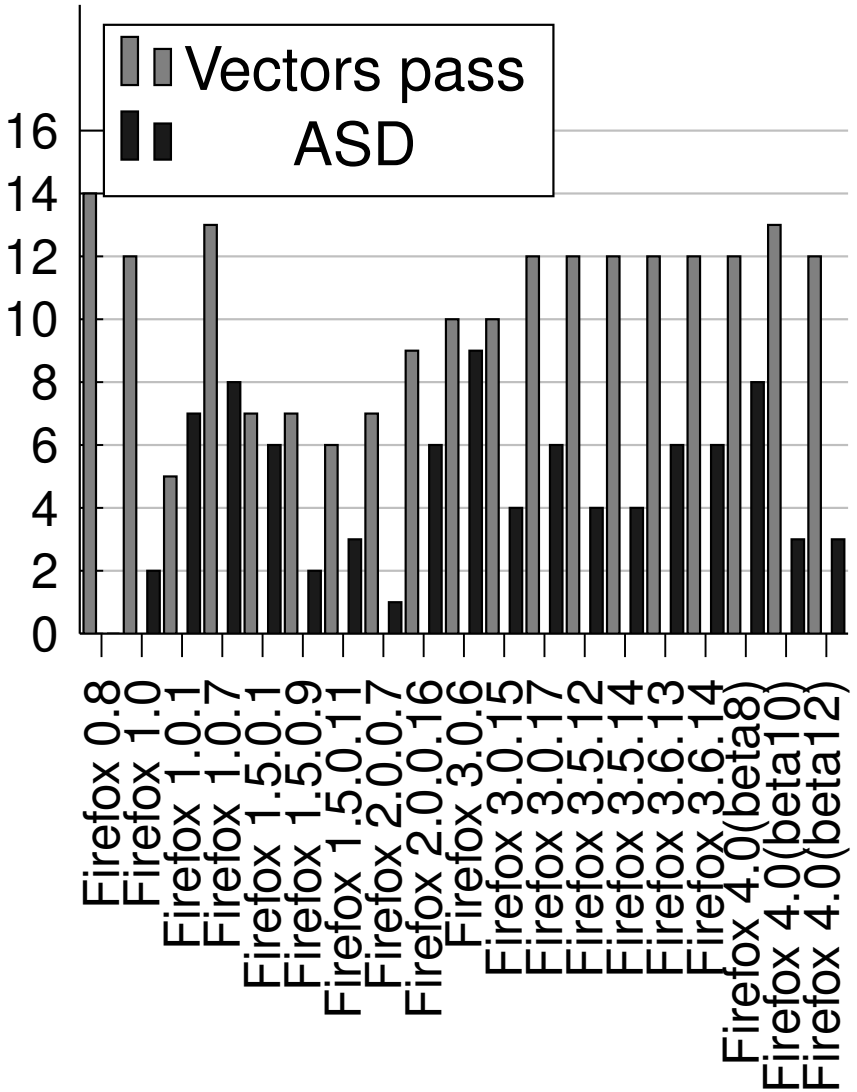
Progression of Web Browsers, Hypothesis 2

H2. Web browsers are not systematically tested with respect to their sensitivity to XSS vectors.

- Explores whether there is a clear continuity in the attack surface of a given web browser over time.
- The validation of this hypothesis would mean that web browser providers do not have a systematic regression strategy for improving the robustness of their web browser.

Hypothesis 2 Cont.

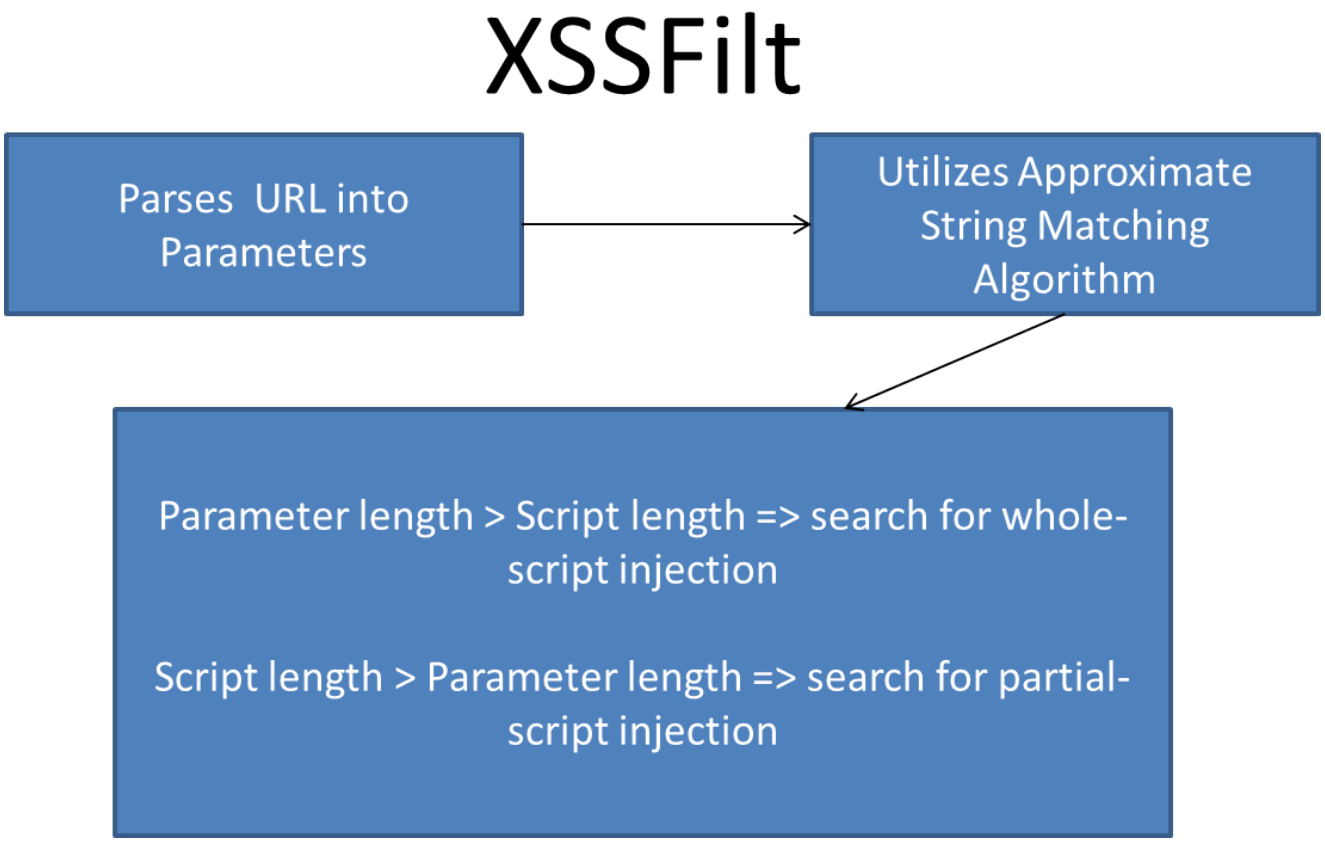
- Figure displays Firefox regression.
- Gray shows how many attacks passed their testing, while black shows the attack surface distance (ASD) with the current version and the previous.
- This data helps support H2.



Outline

XSSFilt

- Utilizes an approximate string matching algorithm that can detect both whole and partial-script injections.



XSSFilt Cont.

- XSSFilt runs significantly slower than an exact substring matching program like XSSAuditor.
- XSSFilt has a higher false positive rate than XSSAuditor.
- XSSFilt can deal with application-specific sanitations unlike XSSAuditor.

Dataset	XSSFilt	XSSAuditor	NoScript
xssed	399/400	379/400	400/400
cheatsheet	20/20	18/20	20/20

Scriptless Attack Defenses

- There is not much research done to fight against scriptless attacks.
- Content Security Policy (CSP) can be used to reduce the harm of injected malicious script. CSP can also restrict access to undesirable non-script-based files such as Cascading Style Sheet (CSS) and Scalable Vector Graphics (SVG).
- CSP is unable to cover a wide variety of scriptless attacks, but is a step in the right direction since it is able to eliminate some side channels.

Scriptless Attack Defenses Cont.

- The authors of *Scriptless Attacks: Stealing the Pie Without Touching the Sill* propose a solution to a type of scriptless attack labeled double-clickjacking.
- Their solution is a patch created for Firefox that expands on the window object by adding two properties: `isPopup` and `loadedCrossDomain`.
- `isPopup` is true when the GUI window represented by the current DOM window object is in a detached view, while `loadedCrossDomain` is true if the current DOM window object was loaded in a cross-domain.
- With this ability, websites can detect if they are being loaded in a detached view, which can allow it to mitigate different scriptless attack vectors.

Outline

Conclusion

- A good majority of previous defenses have trouble dealing with scriptless and/or partial-script attacks such as NoScript, IE8, noXSS, and XSSAuditor.
- Found that web browser providers do not follow a systematic regression strategy in the developement of new versions of their browsers.
- Looked at a more recent defense called XSSFilt which is a client-side defense that utilizes an approximate string matching algorithm.
- Looked at the start of scriptless attack defenses
- Continous research must be done in order to combat current vulnerabilities in web security and potential future vulnerabilities since XSS is a continuously evolving problem.

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References

Abgrall, E. and Le Traon, Y. and Gombault, S. and Monperrus, M.

Empirical Investigation of the Web Browser Attack Surface under Cross-Site Scripting: An Urgent Need for Systematic Security Regression Testing.

In Software Testing, Verification and Validation Workshops (ICSTW), 2014 IEEE Seventh International Conference on, *CCS '12*, pages 760–771, Raleigh, North Carolina, USA, 2014.

Bates, Daniel and Barth, Adam and Jackson, Collin

Regular Expressions Considered Harmful in Client-side XSS Filters

In Proceedings of the 19th International Conference on World Wide Web, *WWW '10*, pages 91–100, Raleigh, North Carolina, USA, 2010.

Heiderich, Mario and Niemietz, Marcus and Schuster, Felix and Holz, Thorsten and Schwenk, J

Scriptless Attacks: Stealing the Pie Without Touching the Sill

In Proceedings of the 2012 ACM Conference on Computer and Communications Security, *CCS '12*, pages 760–771, Raleigh, North Carolina, USA, 2010.

Pelizzi, Riccardo and Sekar, R.

Protection, Usability and Improvements in Reflected XSS Filters

In Proceedings of the 7th ACM Symposium on Information, Computer and Communications Security, *ASIACCS '12*, pages 5–5, Seoul, Korea, 2012.

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Questions?