Regular Expressions for Incident Response

Sql_Injection=*

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Publix Super Markets

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BOTS Tie Ins: Presentations and Hands Ons

- **Hunting the Known Unknowns: Office 365 and Microsoft Azure.** Kovar and Brant. Tuesday 4:45-5:30 PM
- **Splunking the Endpoint IV: A New Hope.** Brodsky. Wednesday 3:15-5:15 PM
- **Hands On with ES, Phantom, and BOTS Data.** Kovar, Smit, Brodsky, Stoner, Valites, Lee. Tuesday 2:15-4:15 PM
- **AWS Security Hands-On.** Valites and Lee. Wednesday 12:45-2:45 PM

Regular Expressions

Introduction

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Previous .conf Presentations

- 2016 – Gabriel Vassuer
  Reg(ular expressions?|ex(p|es)?)

- 2016 – Cary Petterborg
  Beyond Regular Expressions

- 2017 – Michael Simko
  Regex in your SPL
  - GREAT INTRODUCTION!

- RegexOne.com

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Agenda

- Prerequisites
- RegEx Philosophy
- Develop RegEx* Faster
- Common Use Cases
- Work Around Parsing Errors
- SQL Injection example
- XSS example
- Sysmon example

Pre-requisites

Comfort with Regex

- `\d{1,3}\.\d{1,3}\.\d{1,3}\.\d{1,3}`
  IP Address

- `(?<email>.+@.+)\s`
  Field extraction

- `\s\S\d\D+\w\W?.*`

- **`regex|rex`** *vs* **`r(?:eg)?ex`**

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Shift some Paradigms!

- Post Alert -> Incident Response & Investigations
- Speed Over Precision
  - Easy to understand is better than plug and play
- Accuracy Over Perfection
  - False positives are okay
  - False negatives are not okay

Validating RFC822 Email Addresses

From Stack Overflow:

```
(?:(?:\r\n)?[ \t])*(?:(?:(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|"(?:[^\"\r\\]|\\.|(?:(?:\r\n)?[ \t]))*"(?:(?:\r\n)?[
\t])*)(?:\.(?:(?:\r\n)?[ \t])*(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|"(?:[^\"\r\\]|\\.|(?:(?:\r\n)?[ \t]))*"(?:(?:\r\n)?[
\t])*))*@(?:(?:\r\n)?[ \t])*(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[
\t])*)(?:\.(?:(?:\r\n)?[ \t])*(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[
\t])*))*|(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|"(?:[^\"\r\\]|\\.|(?:(?:\r\n)?[ \t]))*"(?:(?:\r\n)?[
\t])*)*\<(?:(?:\r\n)?[ \t])*(?:@(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[
\t])*)(?:\.(?:(?:\r\n)?[ \t])*(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\[\]\r\\]|\\.)*\](?:(?:\r\n)?[
\t])*))*(?:,@(?:(?:\r\n)?[ \t])*(?:[^()<>@,;:\\".\[\] \000-\031]+(?:(?:(?:\r\n)?[
\t])+|\Z|(?=[\["()<>@,;:\\".\[\]]))|\[([^\
```

- Roughly 20% of actual regex

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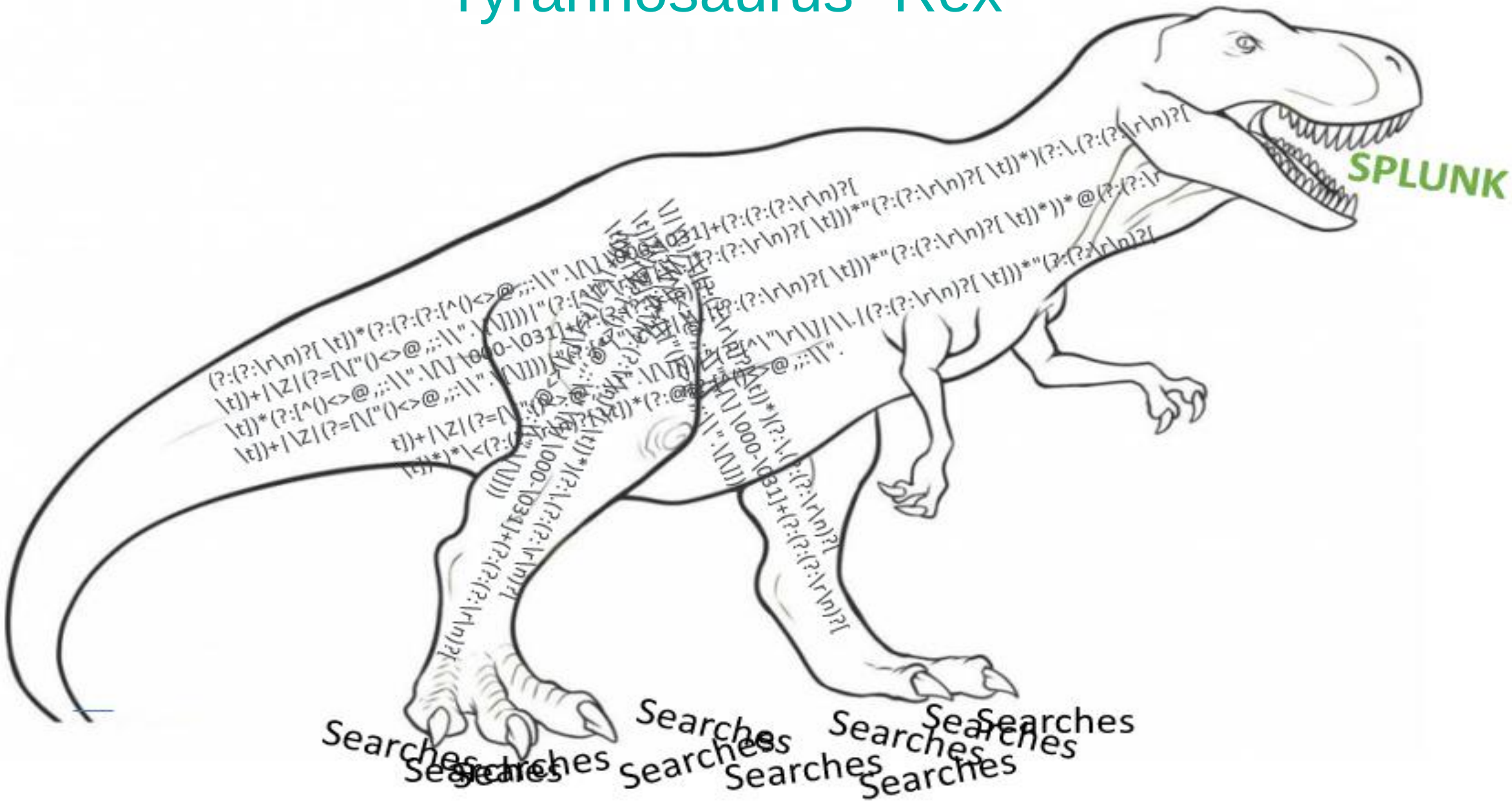
YOU WERE SO PREOCCUPIED WITH WHETHER OR NOT YOU COULD
YOU DIDN'T STOP TO THINK IF YOU SHOULD

Tyrannosaurus "Rex"



Example

Speed over Precision

- Which is easier to understand?
  - `([a-zA-Z0-9_\-\.]+)@([a-zA-Z0-9_\-\.]+)\.([a-zA-Z]{2,5})`
  - `.+@.+\..+`
- Just worry about getting the data

Example

Accuracy over Perfection

- Which is easier to understand?
  - `([a-zA-Z0-9_\-\.]+)@([a-zA-Z0-9_\-\.]+)\.([a-zA-Z]{2,5})`
  - `.+@contoso.com`
- Just worry about getting the data

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Use Case: IPv4 Addresses

Only worry about accuracy if you have to

- 192.168.1.1
- 10.10.10.3
- **1.800.555.5555**
- 8.8.8.8
- 10.10.10.5

- `[\d\.]+`
- `(\d{1,3}\.){3}\d{1,3}`

Stack Overflow's suggestion:

```
\b((?:25[0-5]|2[0-4][0-9]|[01]?[0-9][0-9]?)(?:(?<!\.)\b|\.)){4}
```

Develop RegEx* Faster

***Good Enough RegEx**

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Process

1. Identify potential anchors
   - `http://www.example.com/sample/url`
   - `Jane.Doe@example.com`
2. Set up exclusions
   - `| rex field=url “http:\/\/(?<domain>.+[^\/]”`
3. Set boundaries on quantifiers
   - `| rex field=url “http:\/\/(?<domain>.{100}[^\/]”`

Think Finite

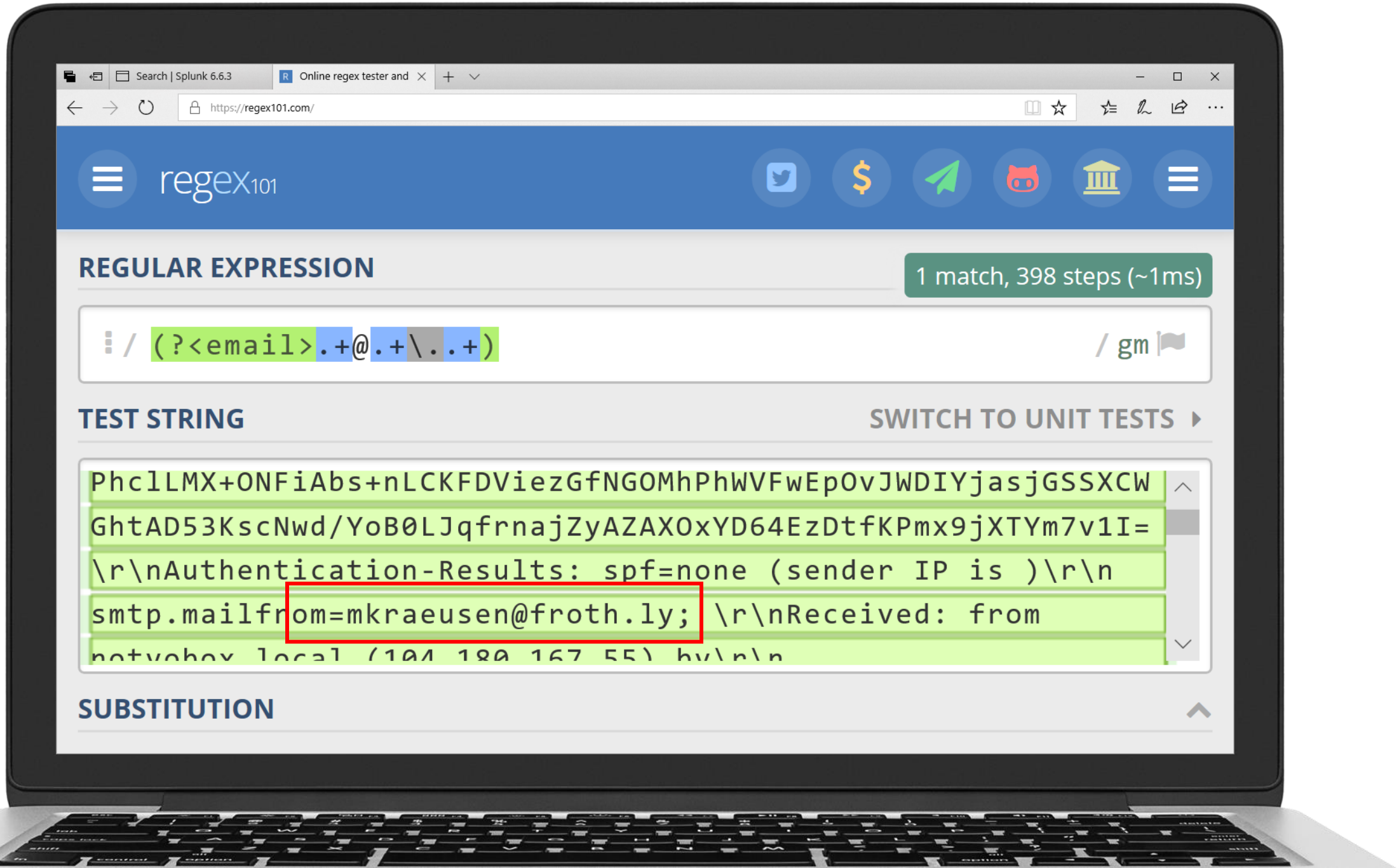
- Get all the MATCHES?

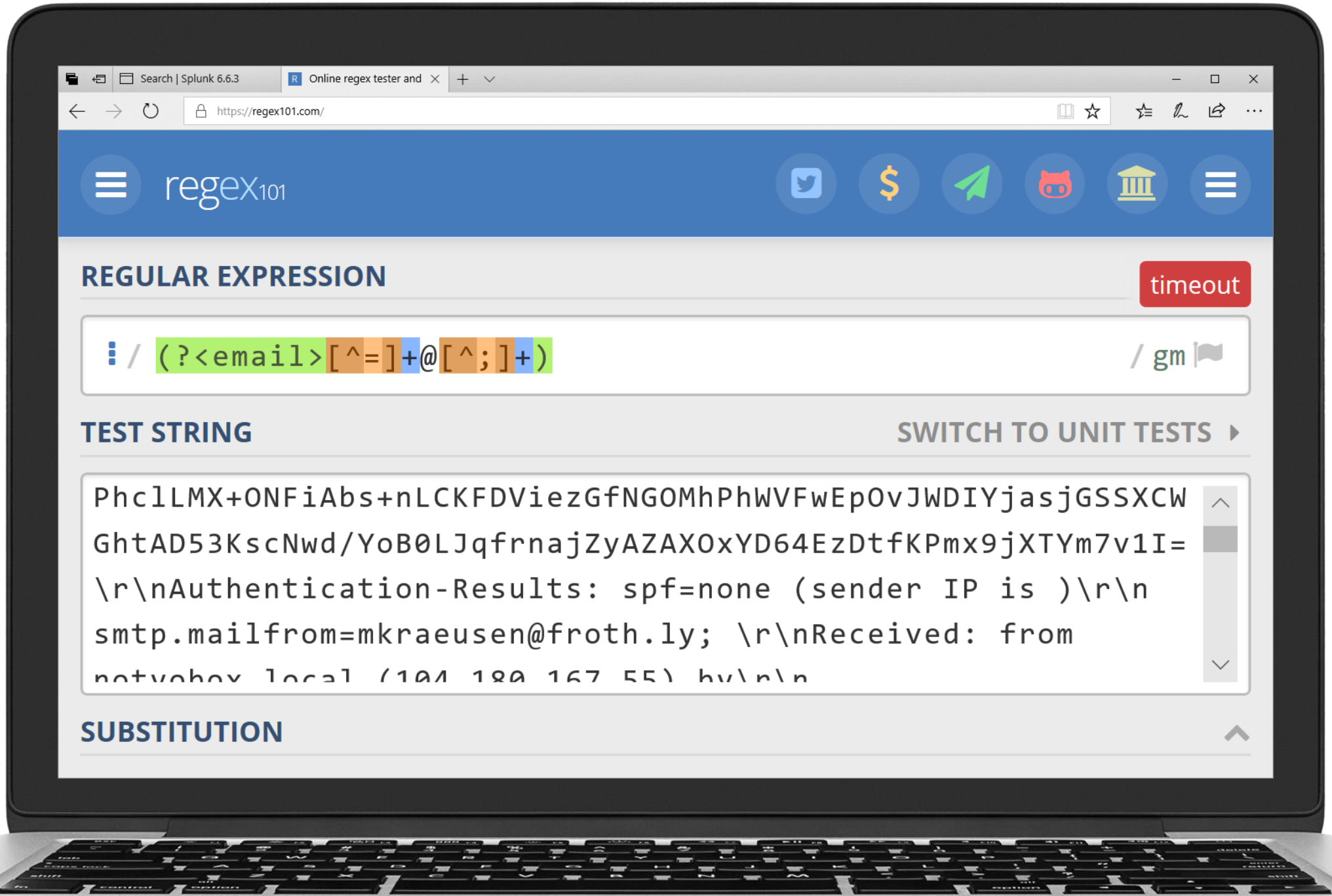
```
[a-z]+
```

- Let's be realistic:

```
[a-z]{1,64}
```

- Easier on the Regex Engine
  - Fewer Steps = Faster Search





Focus on the Negative

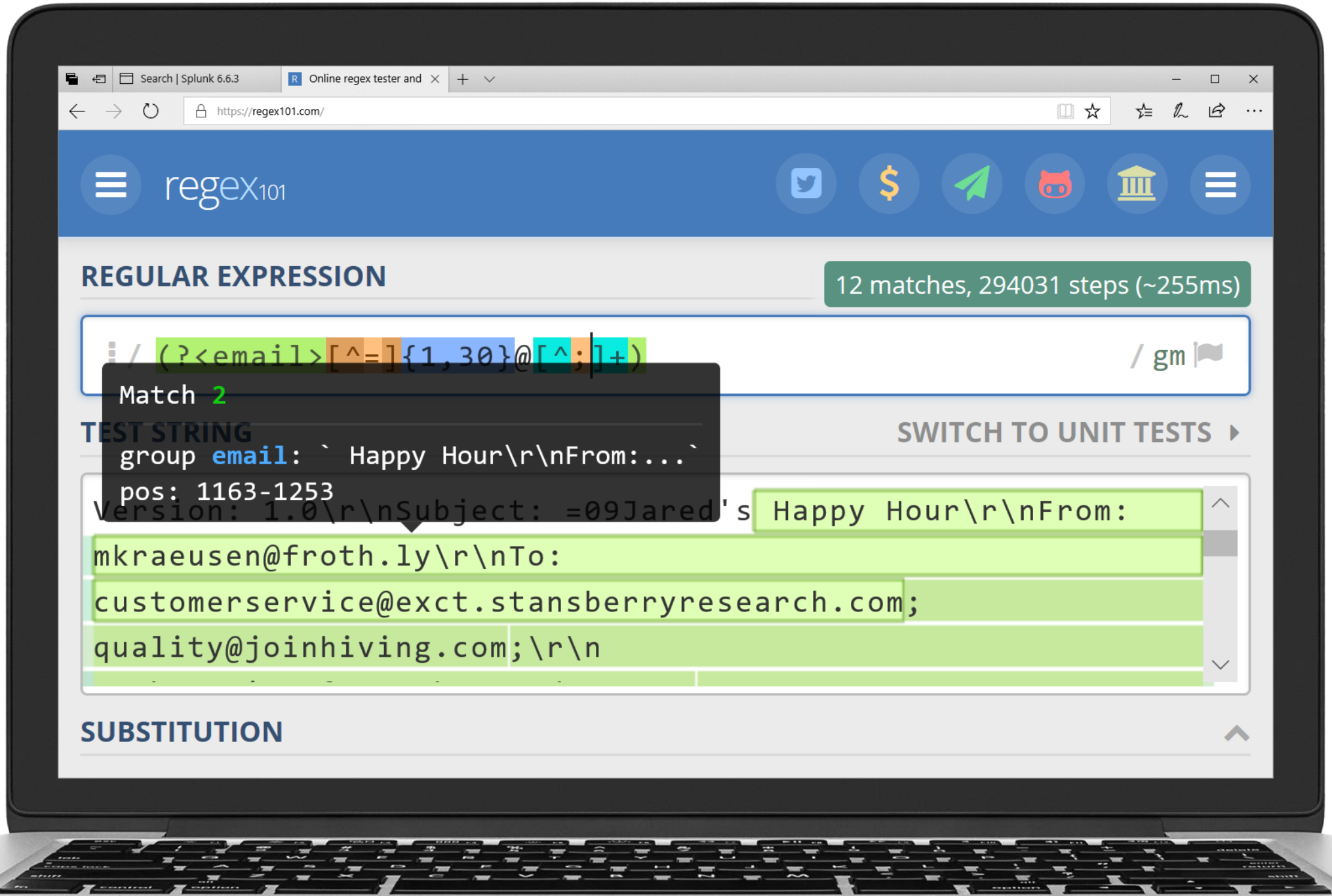
- Inclusive?

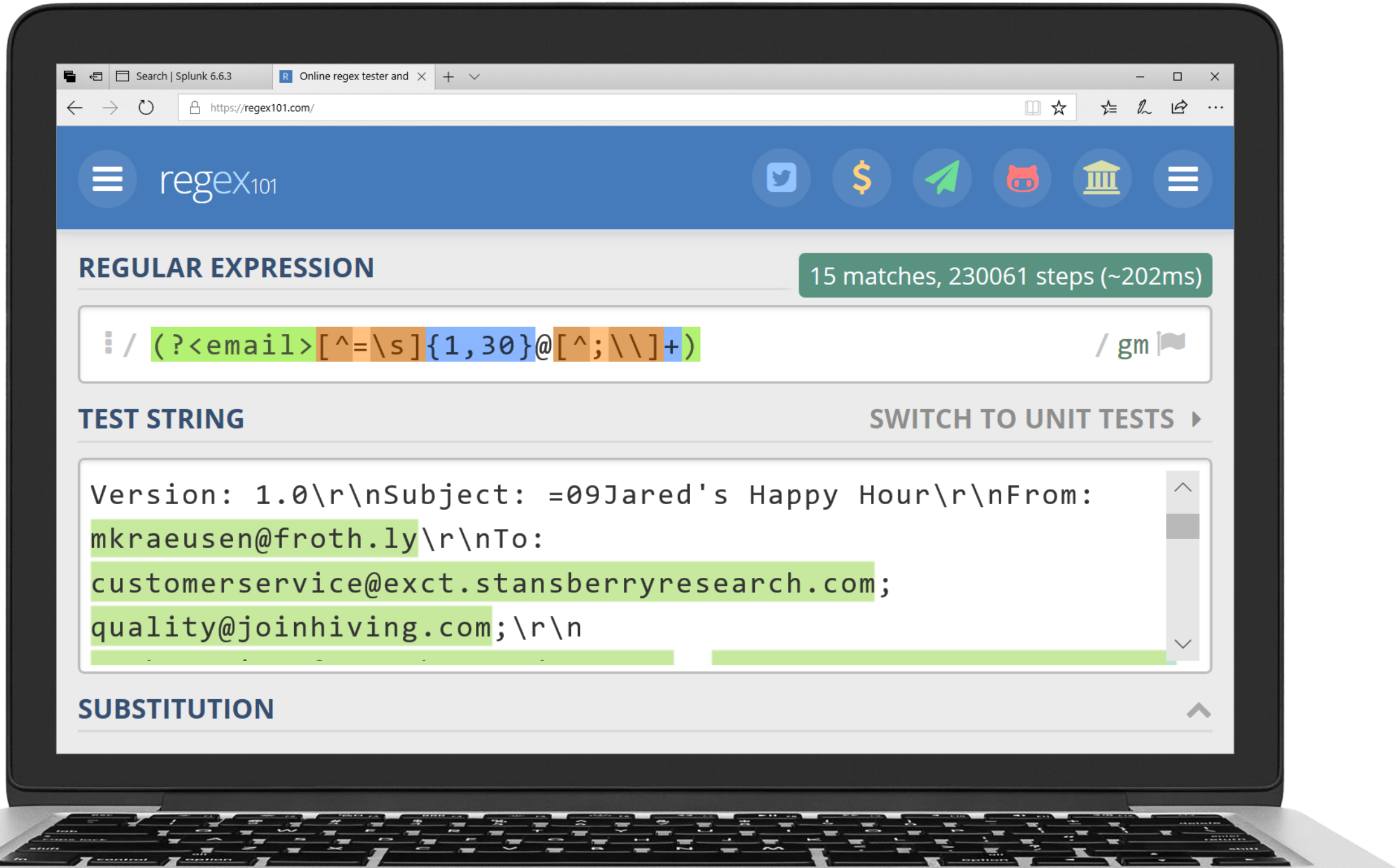
```
([a-zA-Z0-9_\-\.]+)@([a-zA-Z0-9_\-\.]+)\.([a-zA-Z]{2,5})
```

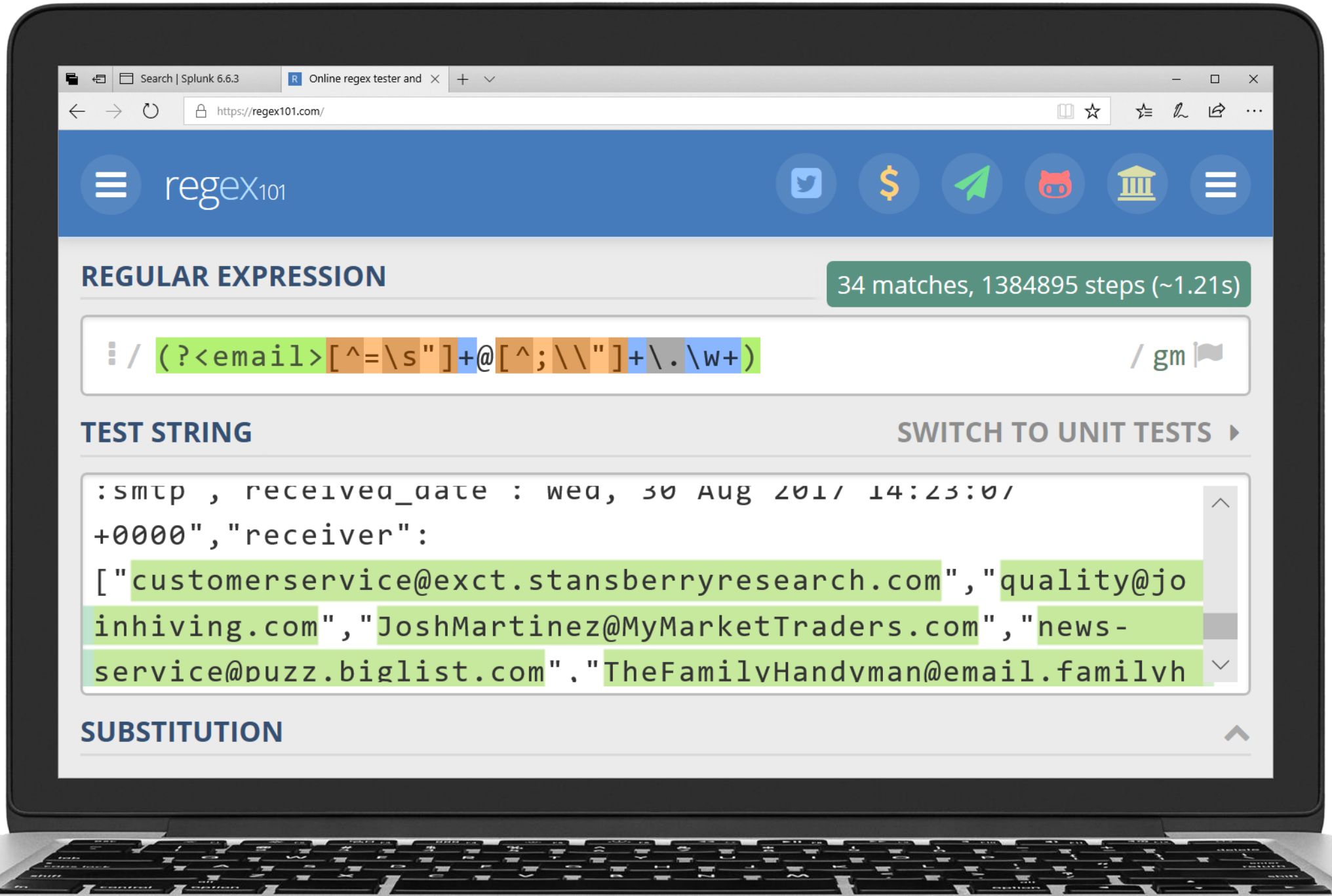
- Exclusive!

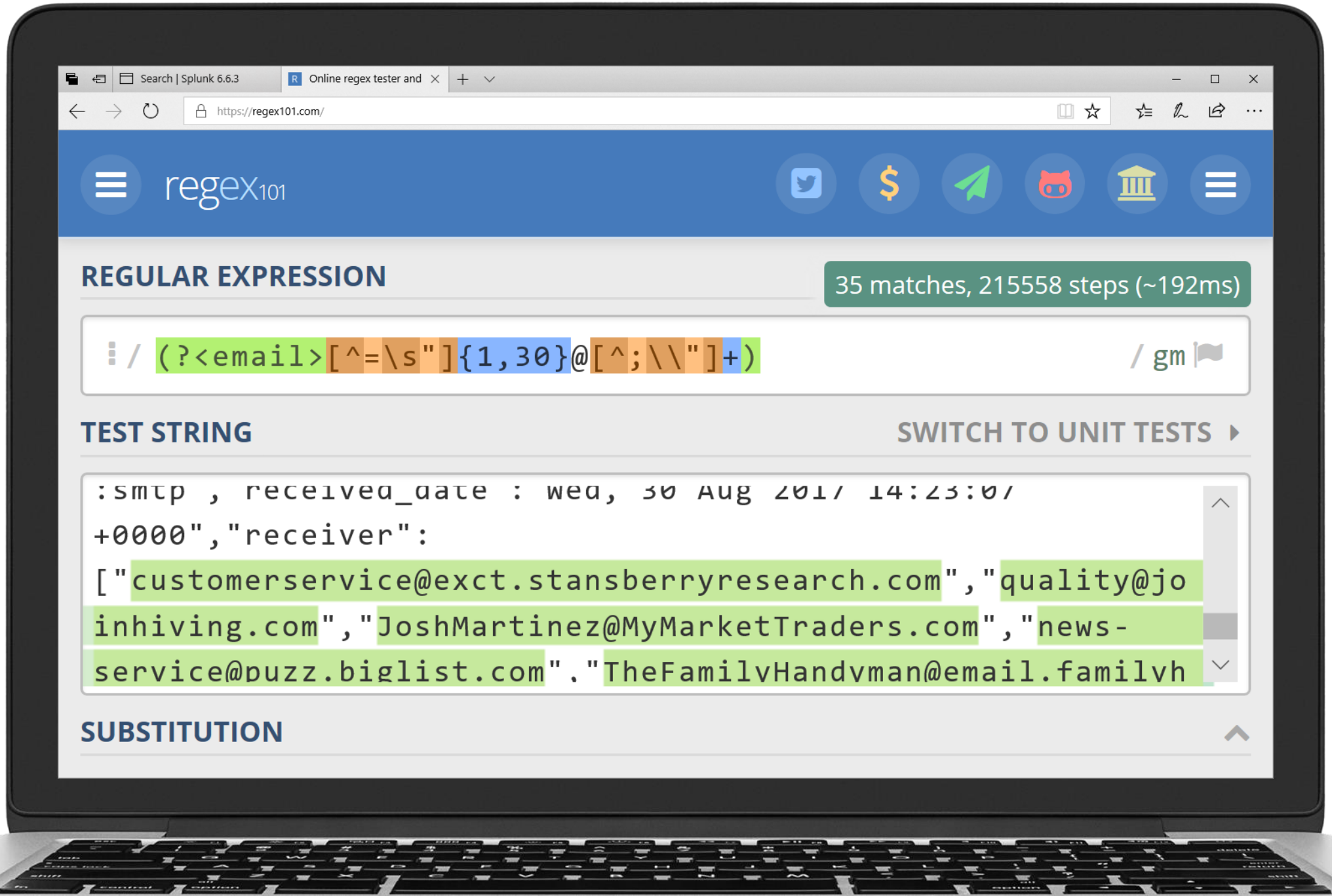
```
[^\s]+@[^\s]+\.[^\s]+
```

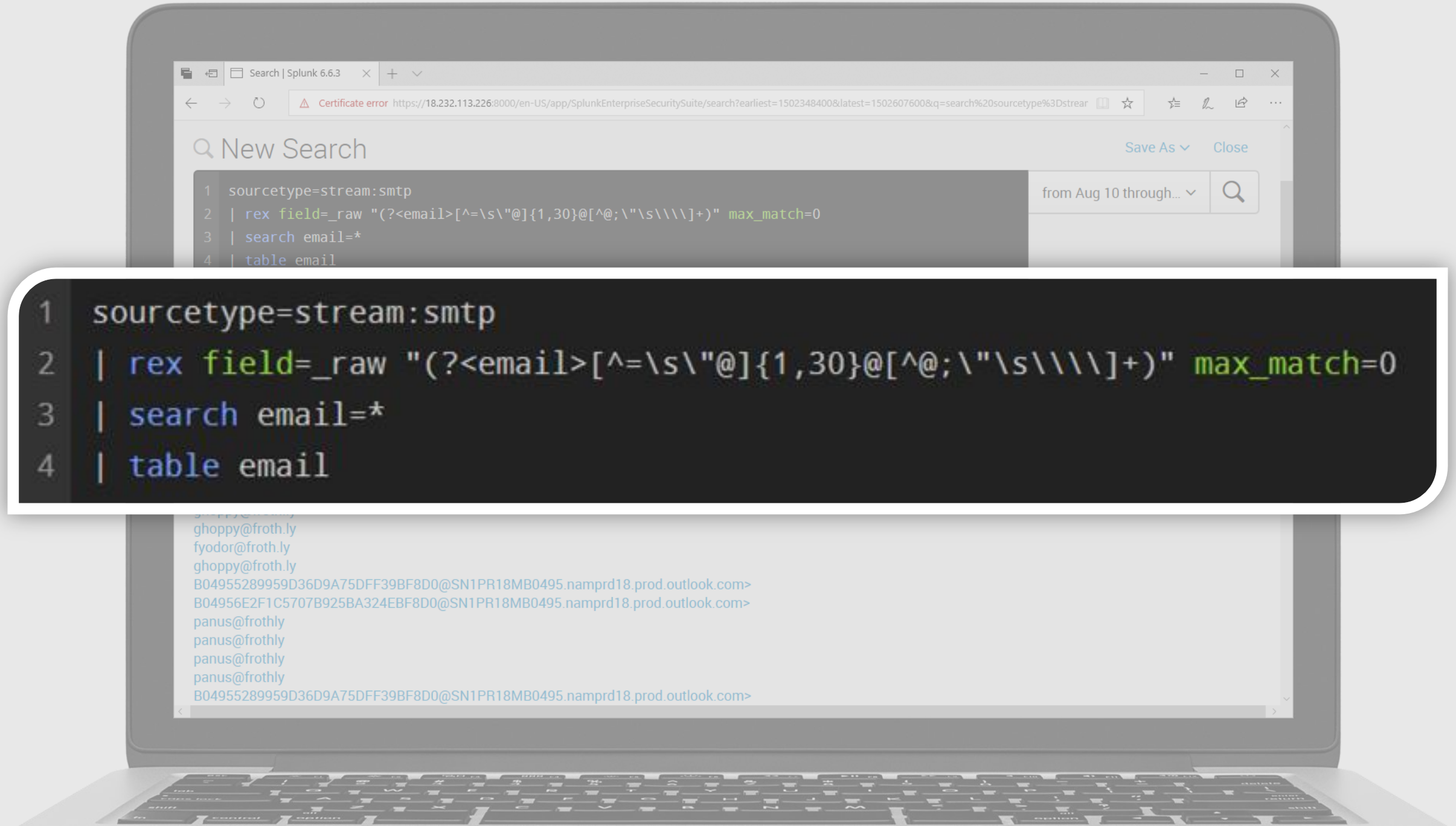
- Faster to add bad characters as you test.












```
1 sourcetype=stream:smtp
2 | rex field=_raw "(?<email>[^=\s\"@]{1,30}@[^@;\"\s\\\\]+)" max_match=0
3 | search email=*
4 | table email
```

Break It Down

```
(?<email>[^=\s\"@]{1,30}@[^@;\"\s\\\\]+)
```

- Capture Group
- Character Class for Mailbox Name
- Quantifier (Repeats 1 to 30 times)
- Literal “@” sign
- Character Class for Domain Name

Break It Down

```
(?<email>[^=\s\"@]{1,30}@[^@;\"\s\\\\]+)
```

- Weird Splunk thing:

  If you want “\\” double it

Other Pitfalls

Can Slow Down Your Search:

- Catastrophic Backtracking
- Repeating a Capturing Group

See https://regular-expressions.info

- Assuming All Results are Captured

Common Use Cases

Frequently used searches during investigations

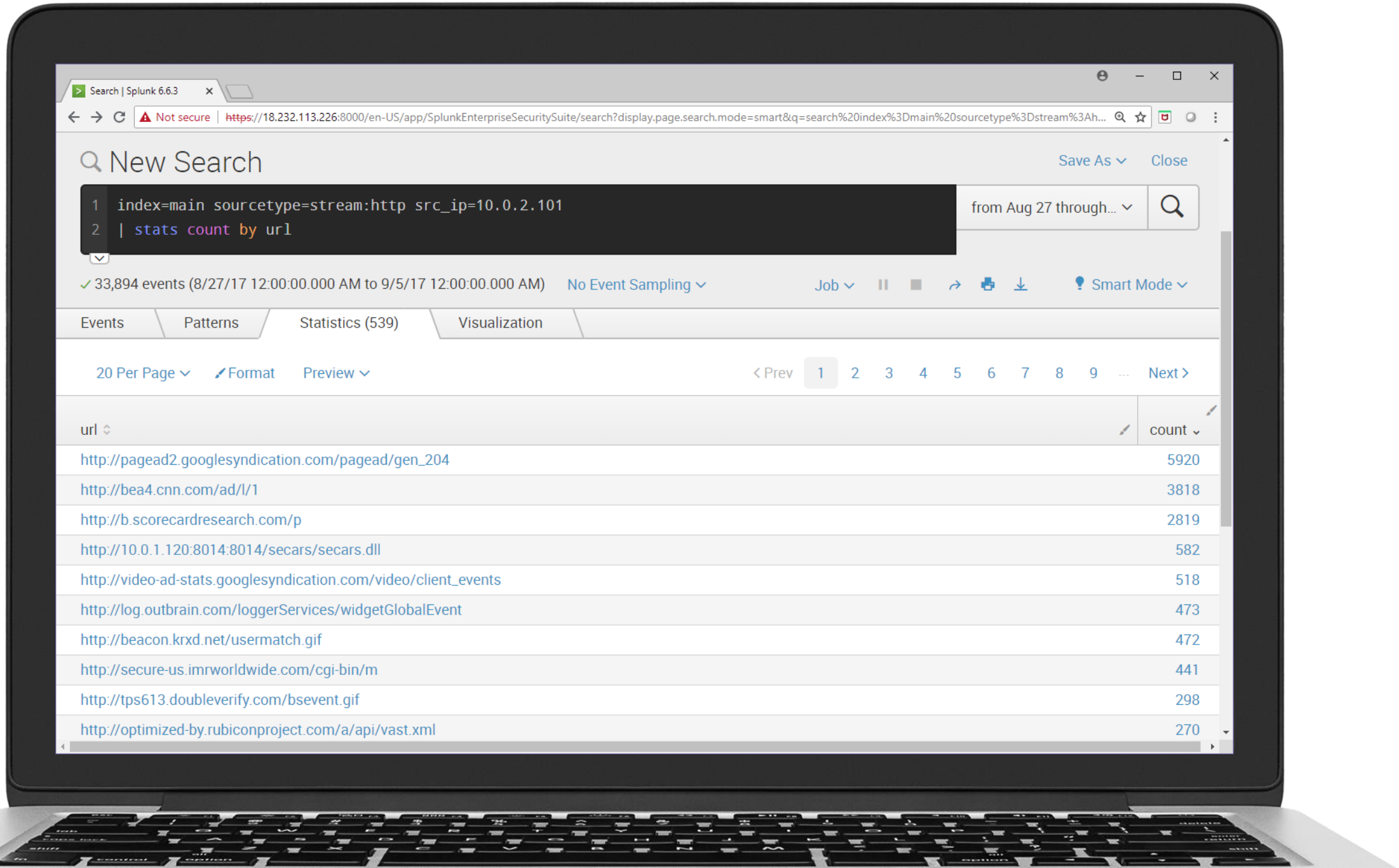
User Activity

- What sites were visited around the time of the compromise?
  - Does anything look suspicious?
- What does the search history look like?
  - Do searches appear to be unrelated to their job?
- Is there any abnormal activity?

Web Browsing

- Do any sites look suspicious?
  - Uncommon top level domains
    - .top, .download, .date
  - Abnormal amounts of traffic
    - Large spikes in activity to unfamiliar sites
  - Potentially concerning in context
    - Competitors
    - File Sharing (Google Drive, Dropbox)

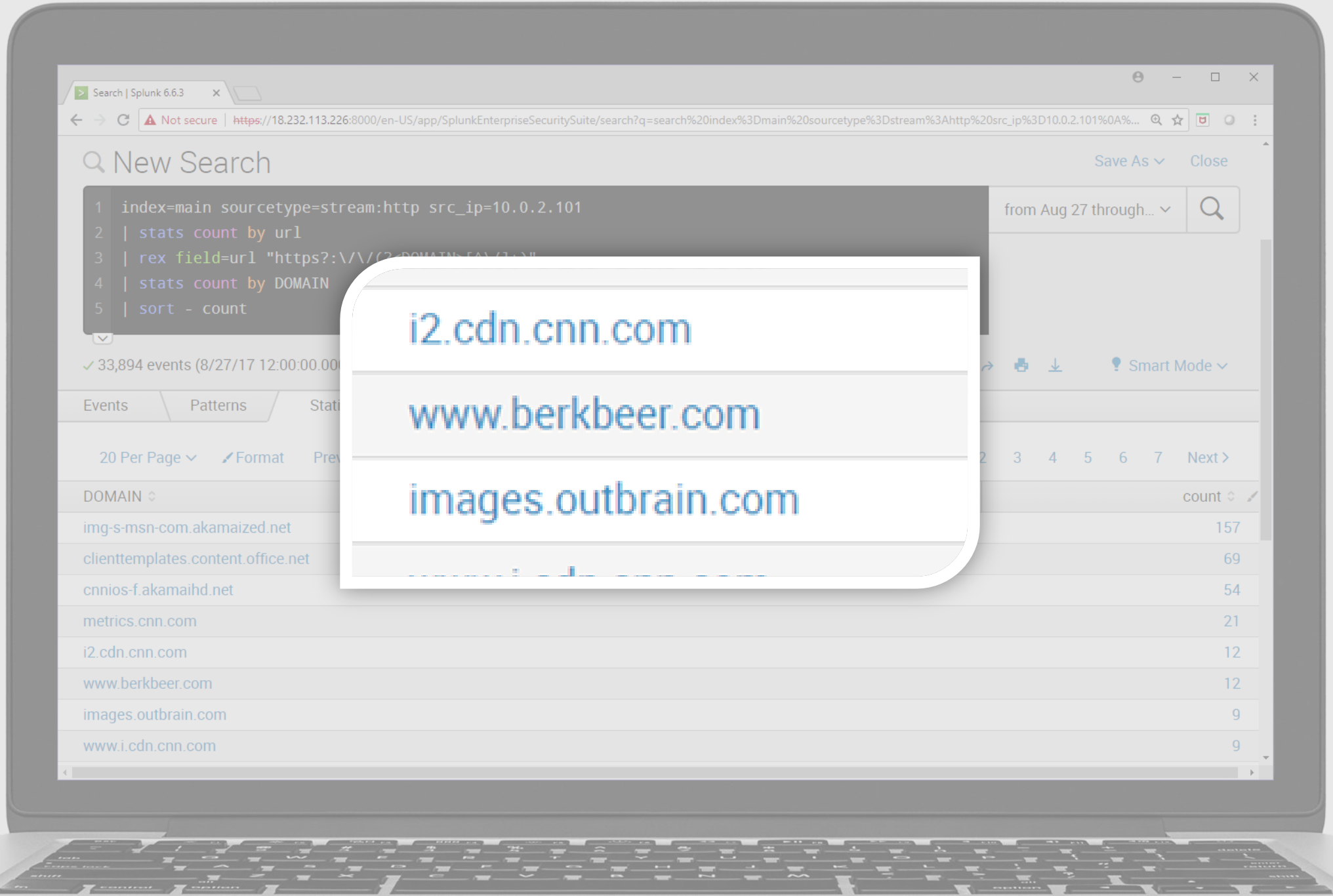
Example: Employee at Frothly Beer Company visited a competitor's website. What was that website?



Domain Search

http://metrics.cnn.com/b/ss/cnn-adbp-domestic/1/H.26.1/s95879181409321

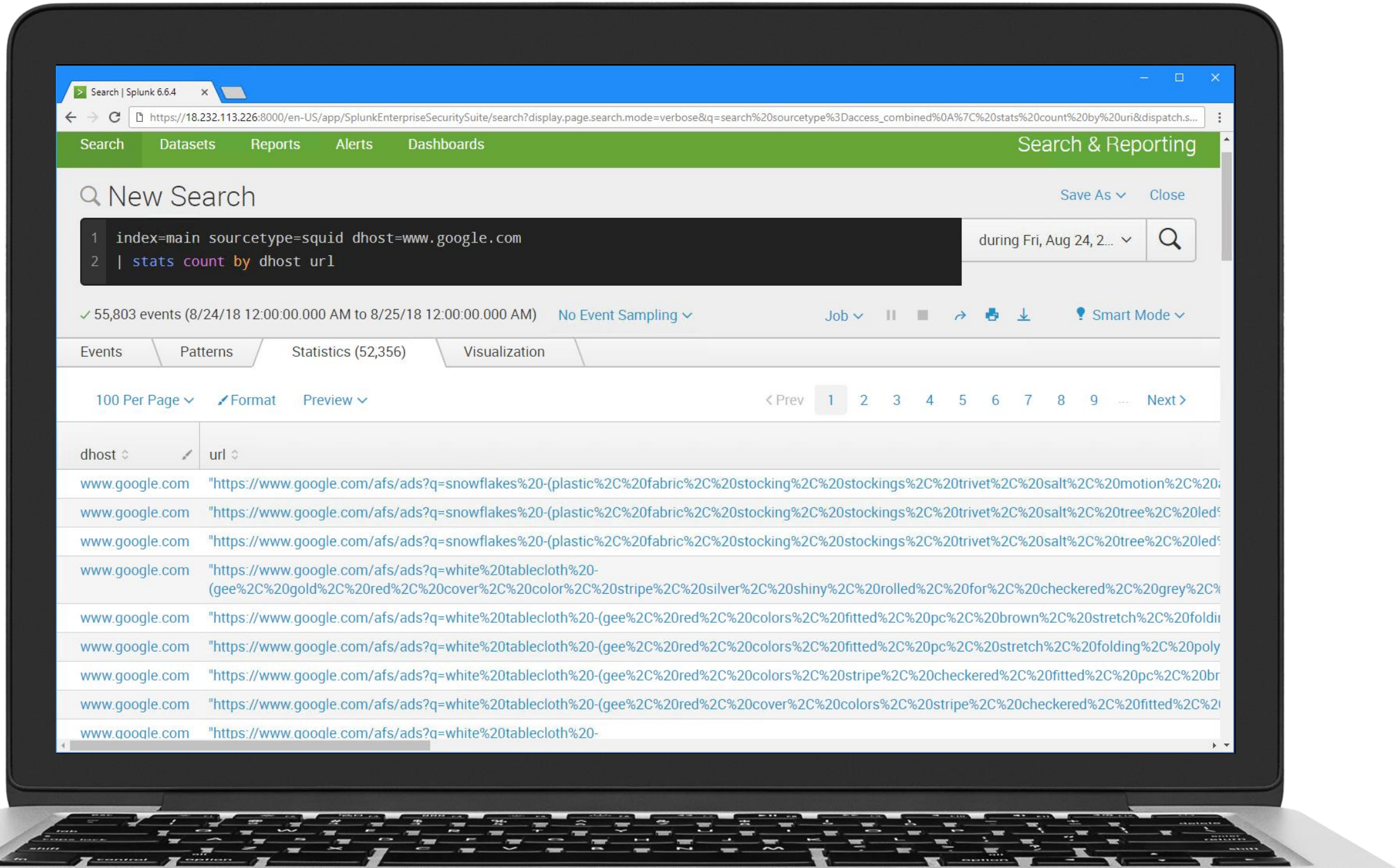
```
index=main sourcetype=stream:http src_ip=10.0.2.101
| stats count by url
| rex field=url "https?:\/\/(?<DOMAIN>[^\/]+)"
| stats count by DOMAIN
| sort - count
```



Search History

Reviewing a user's search history can assist in telling the "story".

- What was the user doing around the time of the alert/compromise?
- What was the user's intent?
  - Were they being careless or malicious?
- Do their searches appear unusual?
  - Are searches related to job activities?

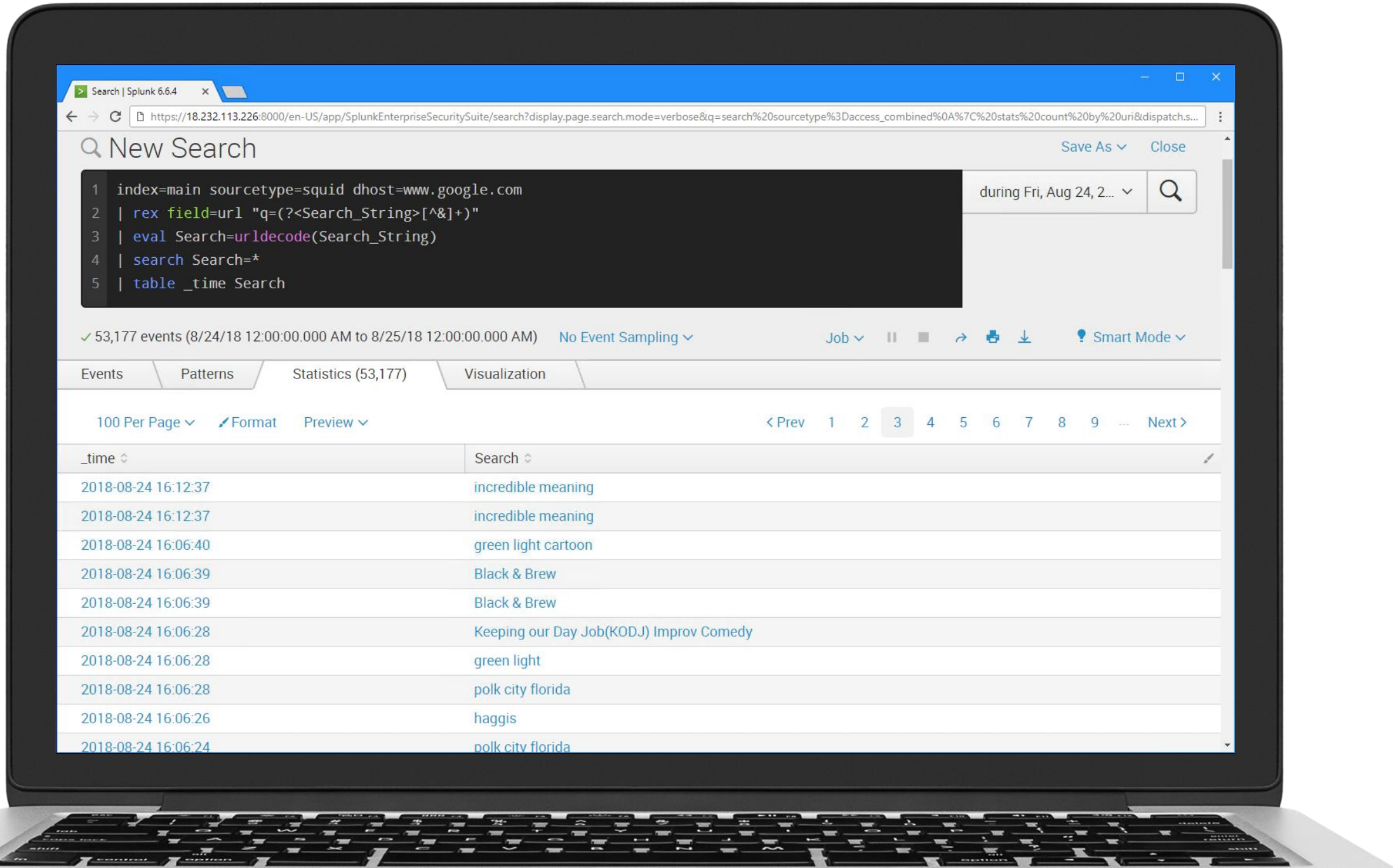


Google Search

Google search queries begin with "q=" and end with "&".

```
Bg&pq=was%20that%20t-rex%20joke%20cringeworthy&cp=
```

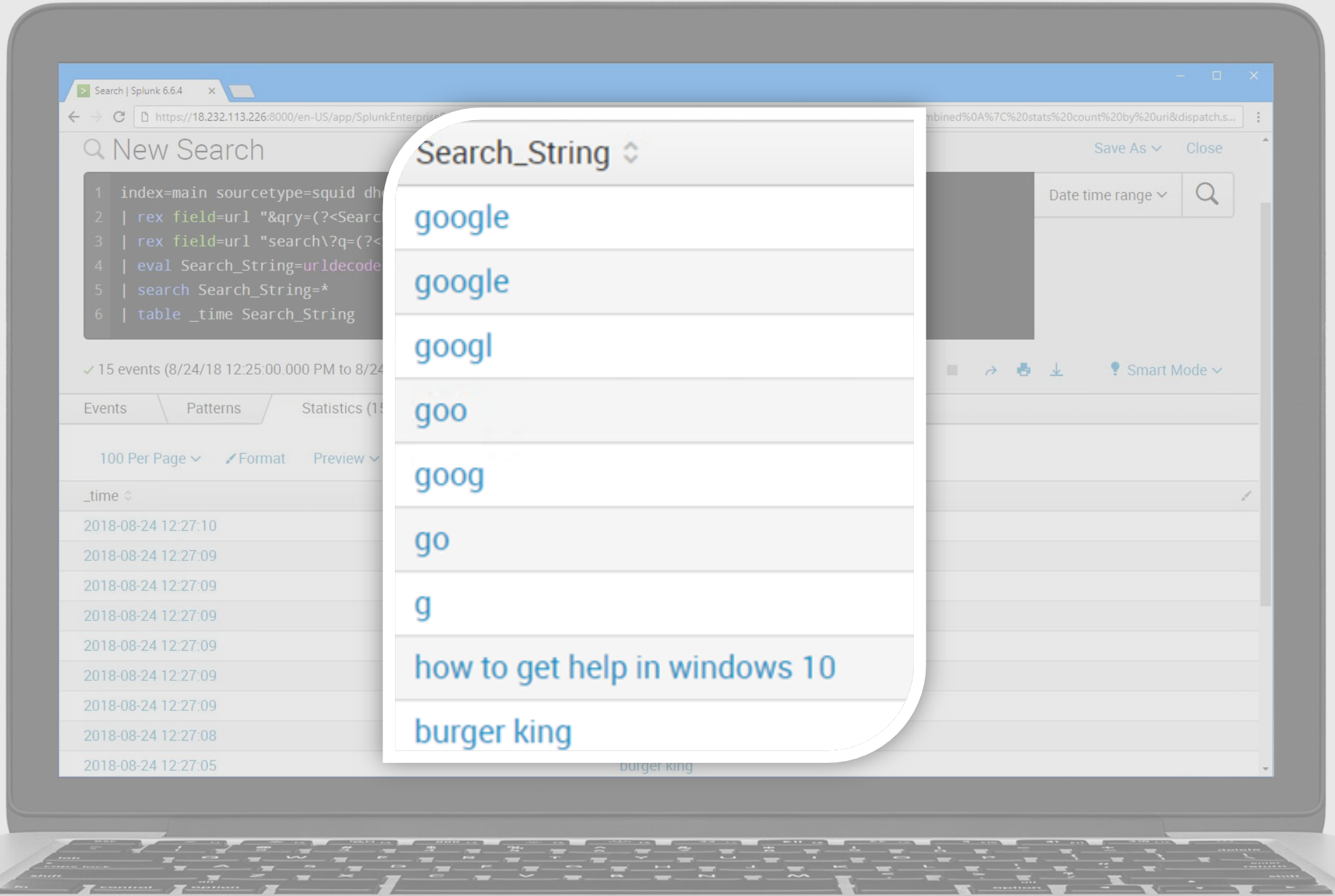
```
index=main sourcetype=squid dhost=www.google.com
| rex field=url "q=(?<Search_String>[^&]+)"
| eval Search=urldecode(Search_String)
| search Search=*
| table Search
```



Bing Search

```
index=main sourcetype=squid dhost=www.bing.com
| rex field=url "&qry=(?<Search_String>[^&]+)"
| rex field=url "search\?q=(?<Search_String>[^&]+)"
| eval Search_String=urldecode(Search_String)
| search Search_String=*
| table Search_String
```

*Note that Bing has two possible search strings.
Be careful not to assume that "results" = "all results"



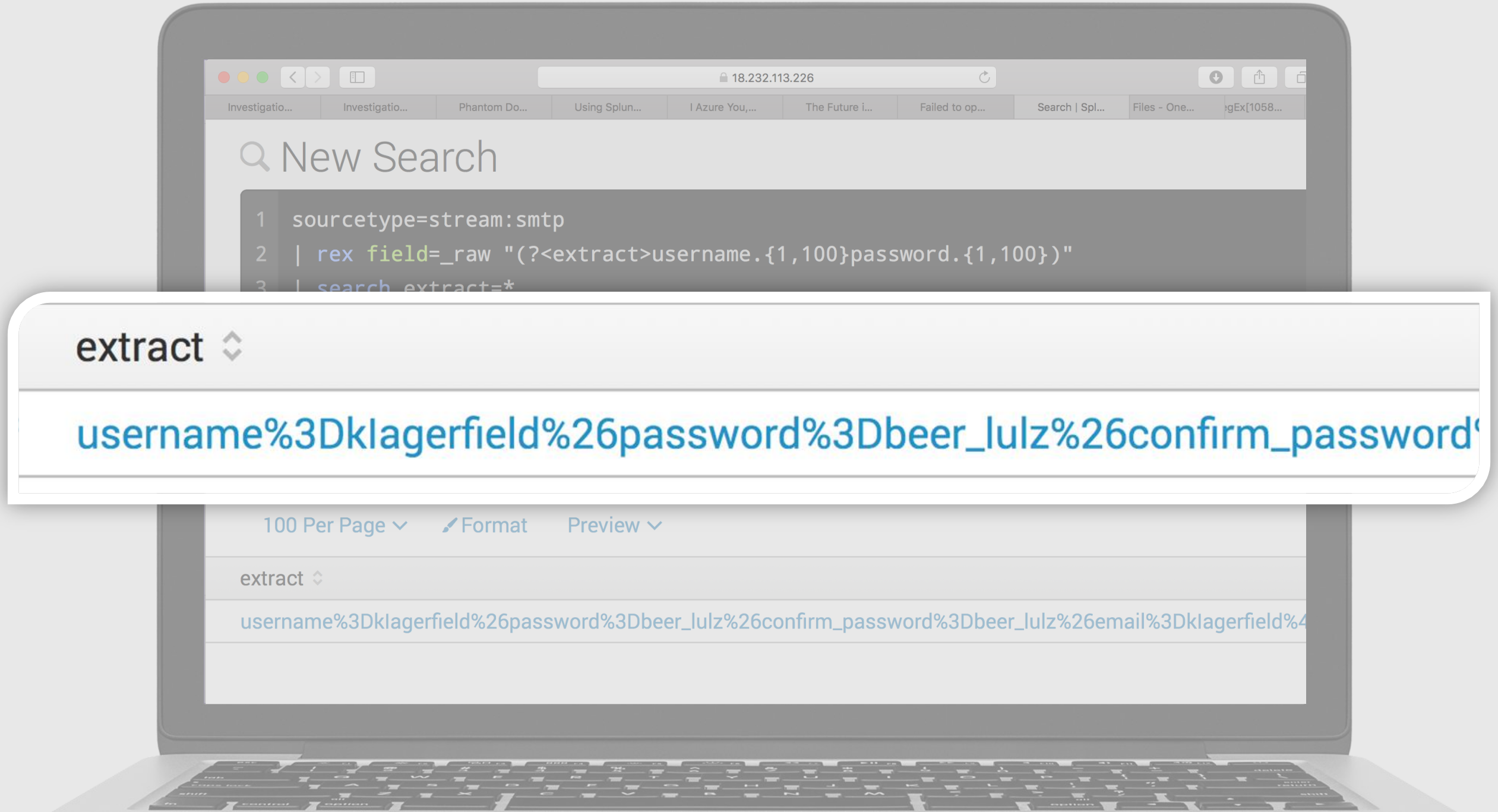
Words near other words

- Think commonly paired words
- Can assist in identifying potential security concerns.

  - Select, From, Where
  - <script>,</script>
  - Download, docm

Example: username, password

```
| rex field=_raw
"(?<extract>username.{1,100}password.{1,100})"
```



Words near other words

```
sourcetype=stream:smtp
| rex field=_raw
 "(?<extract>username.{1,100}password.{1,100})"
| search extract=*
| eval extractdecode=urldecode(extract)
| rex field=extractdecode
 "username=(?<USERNAME>.{1,64})&password=(?<PASSWOR
 D>.{1,64})&confirm"
| table USERNAME PASSWORD extractdecode
```

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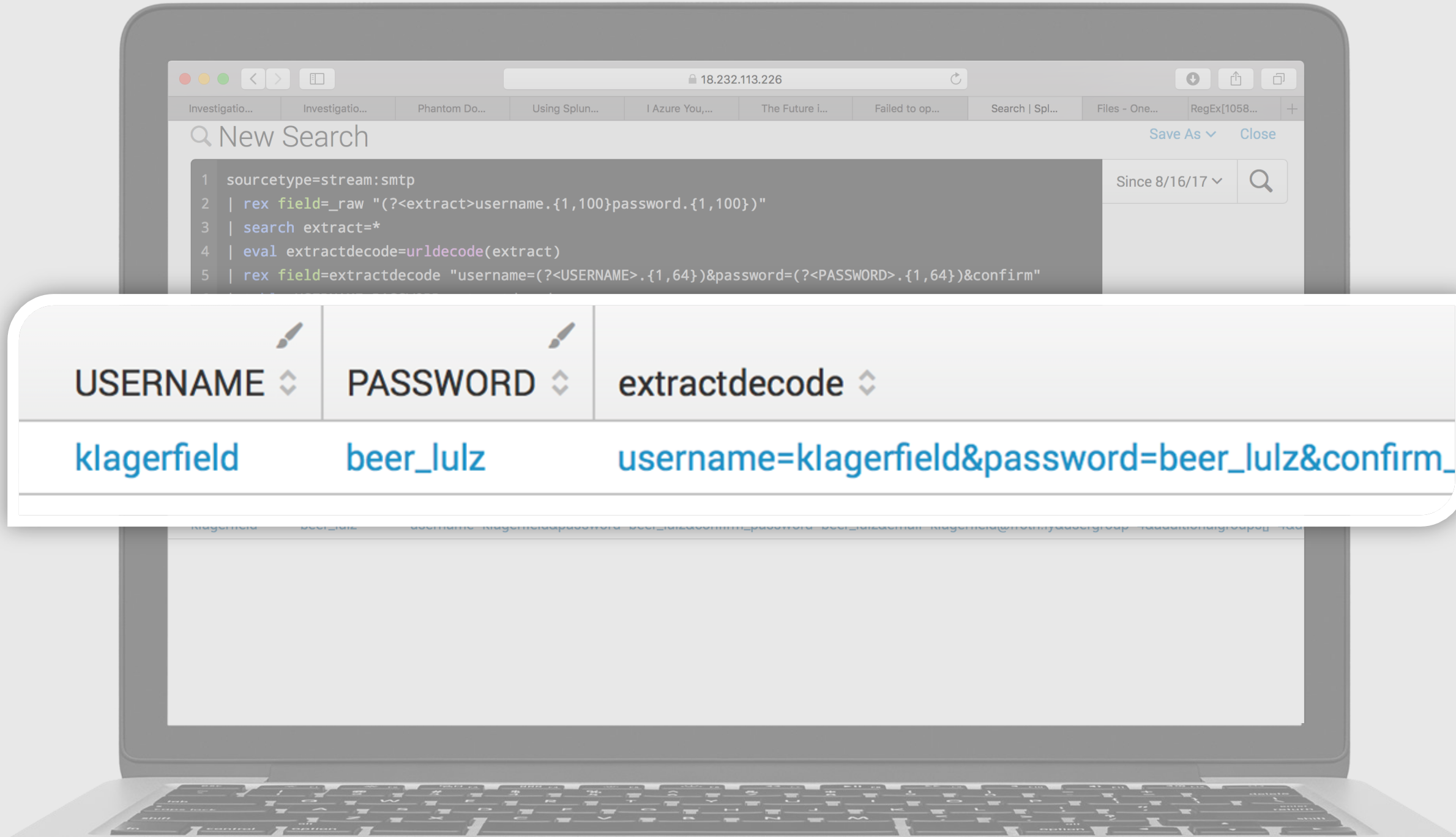

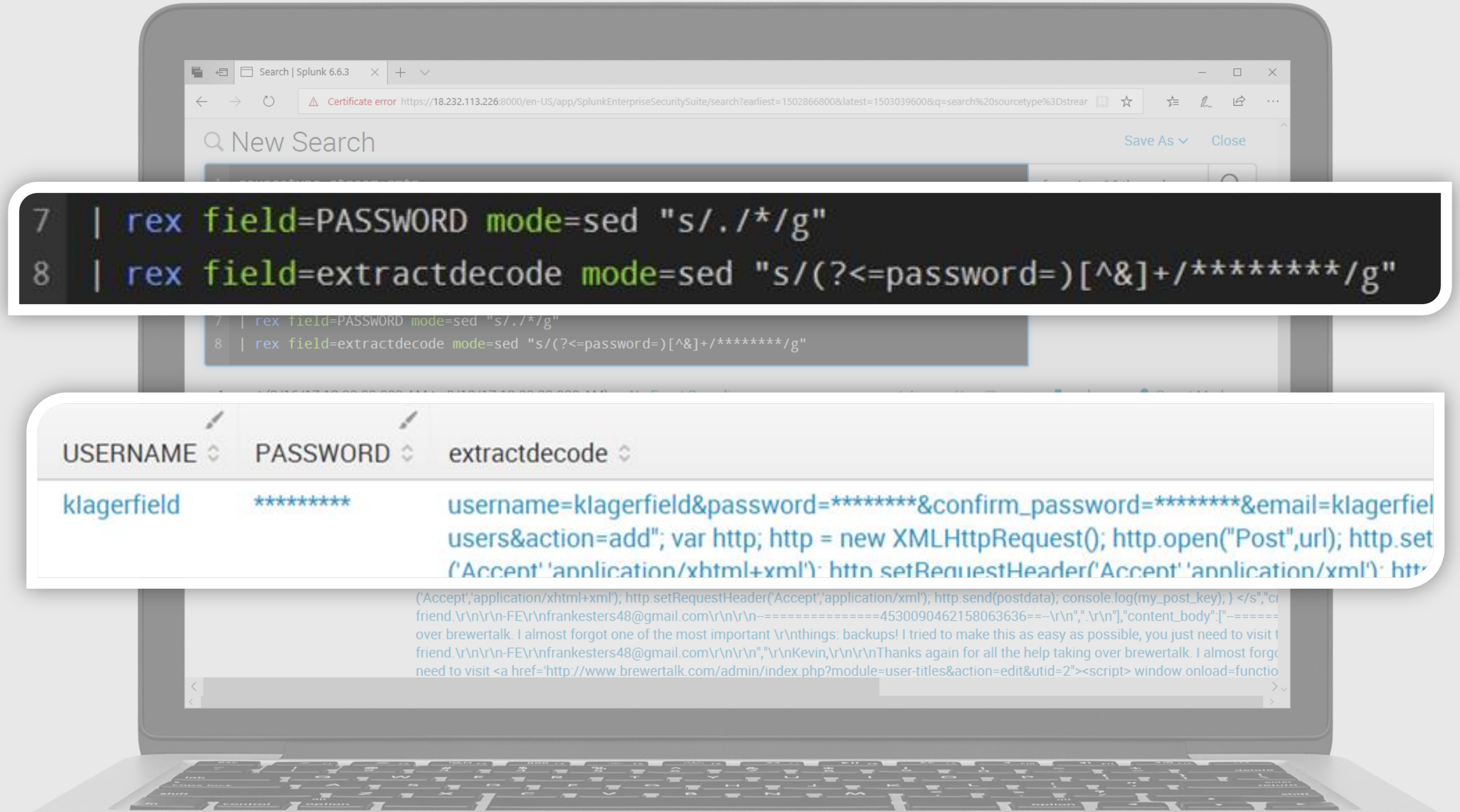

Work Around Parsing Errors

Incident Response

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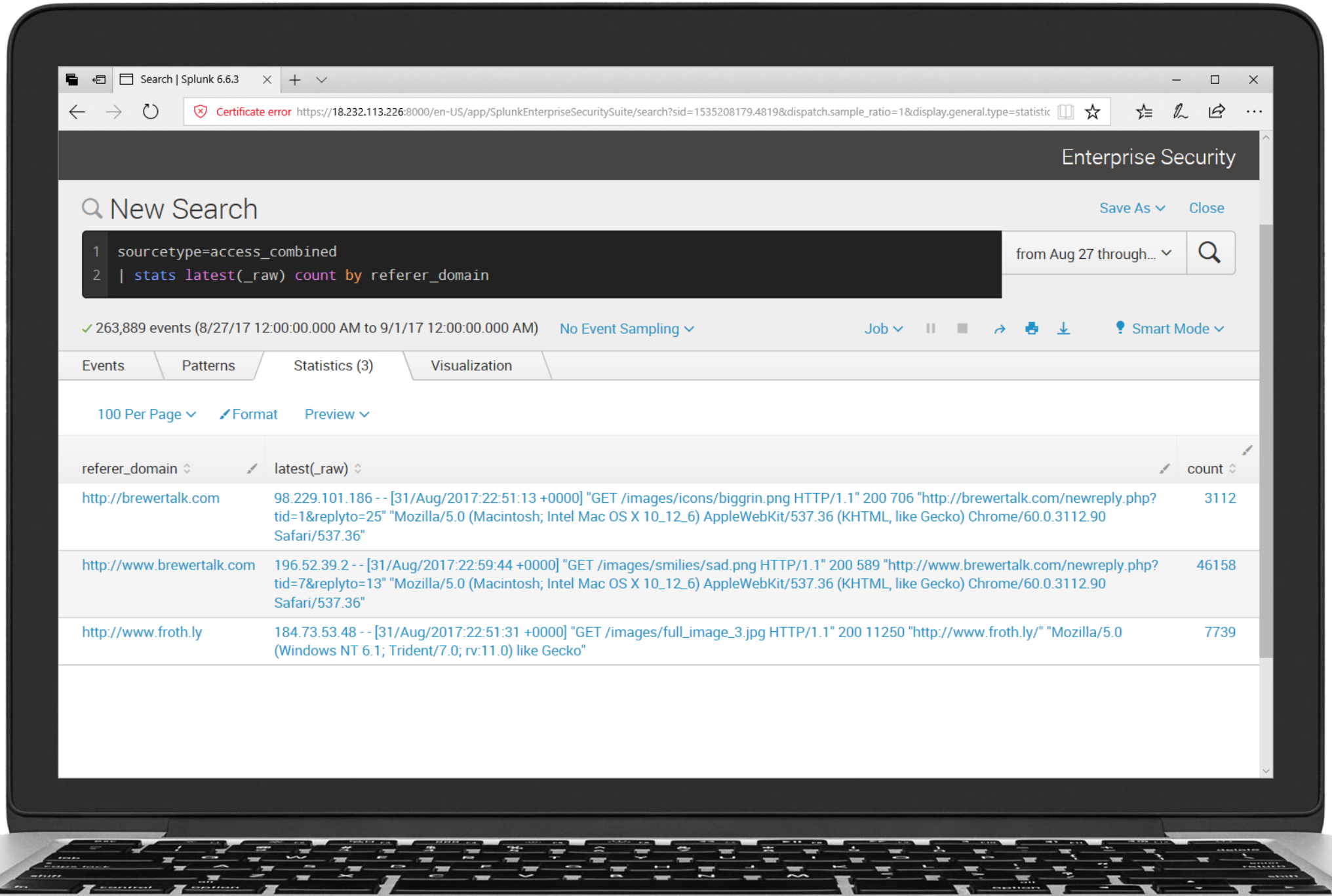

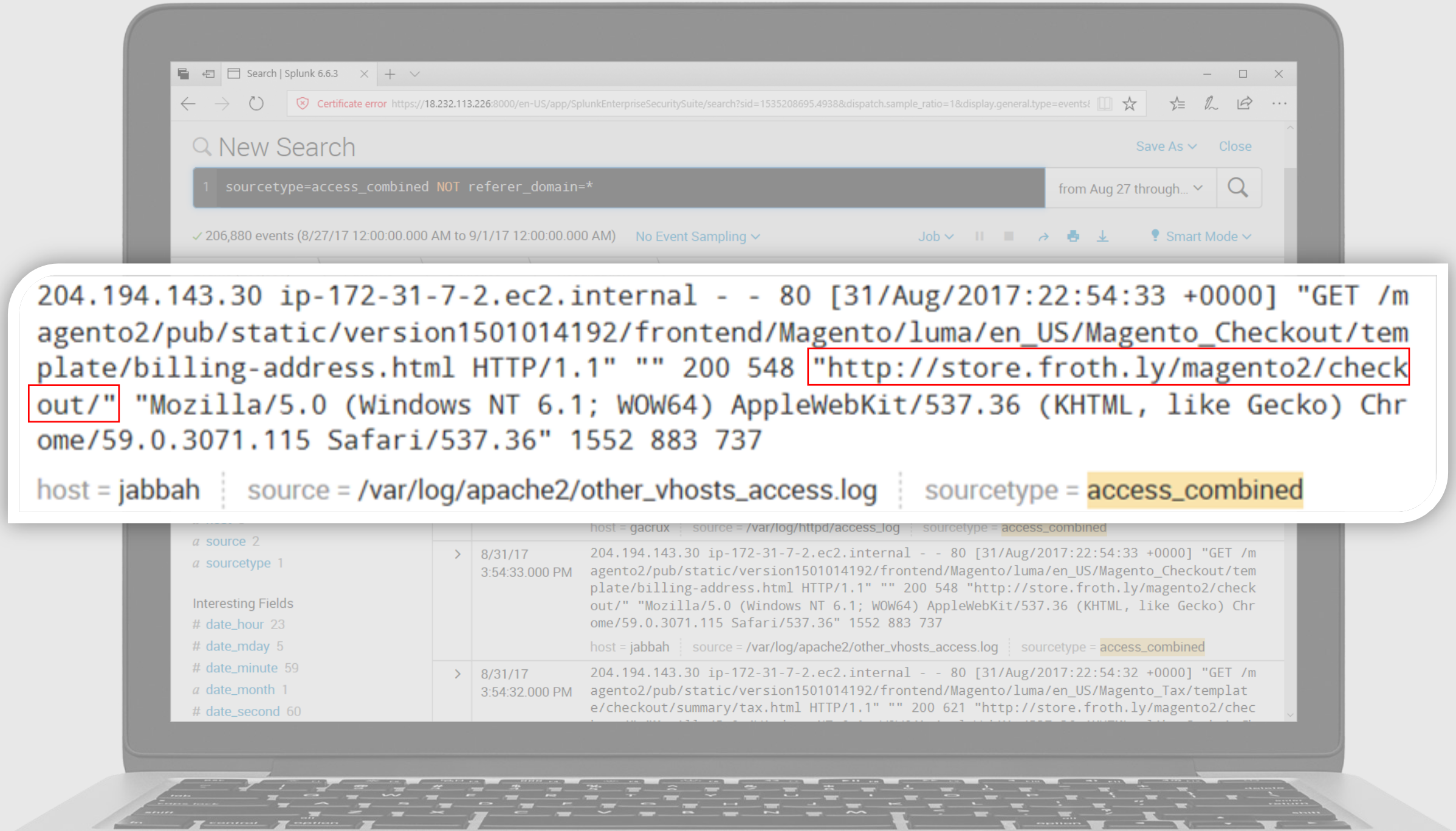

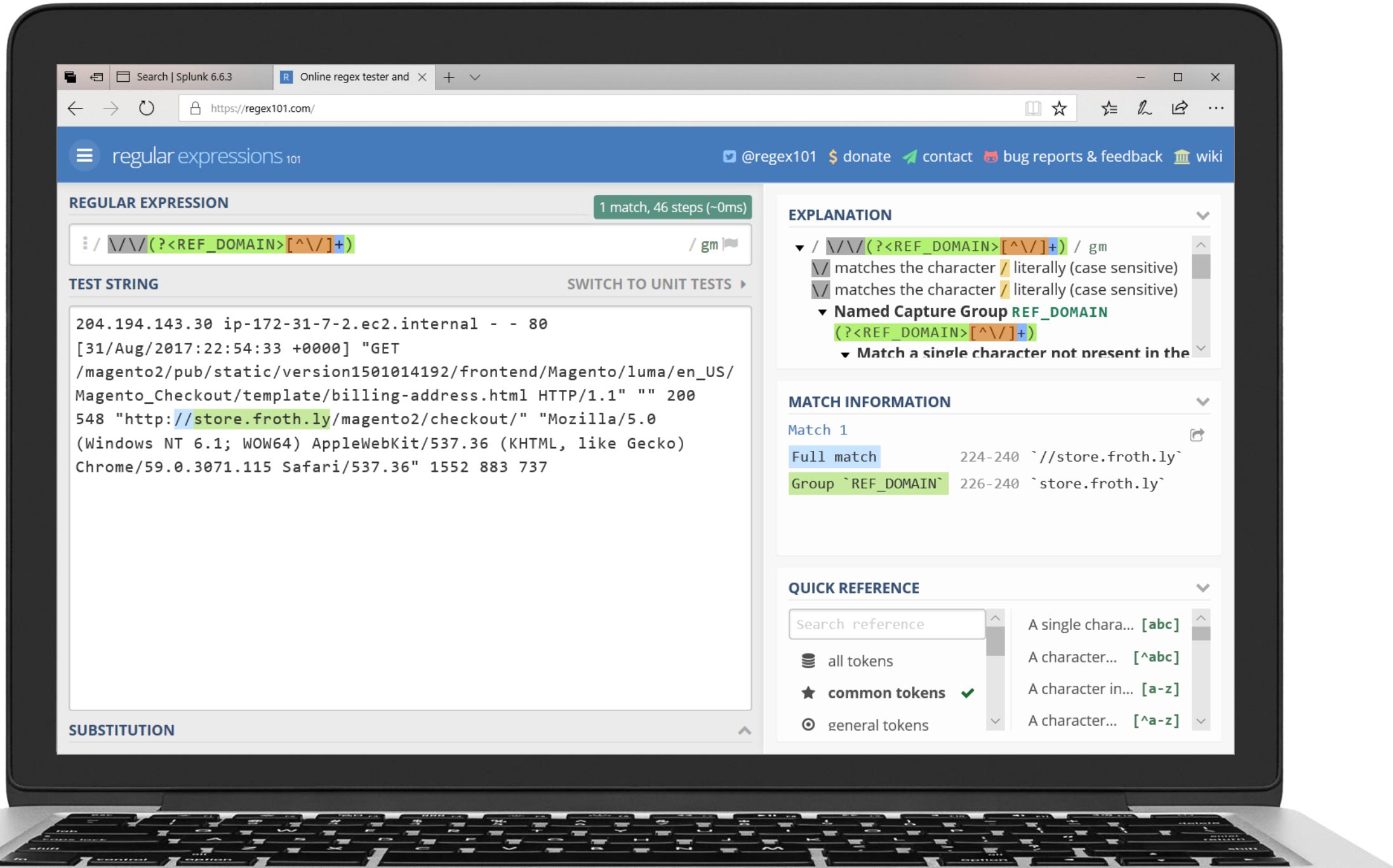

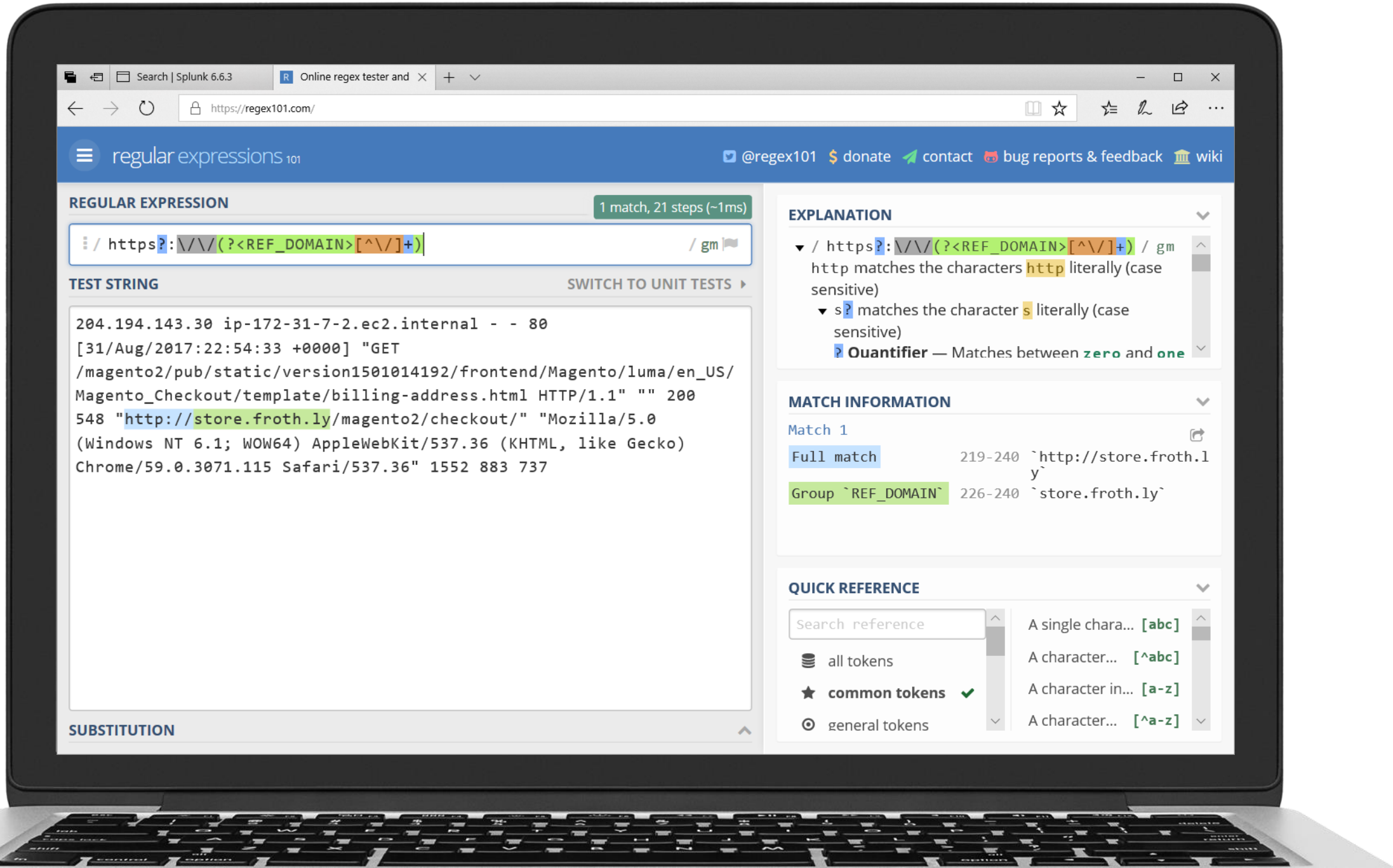

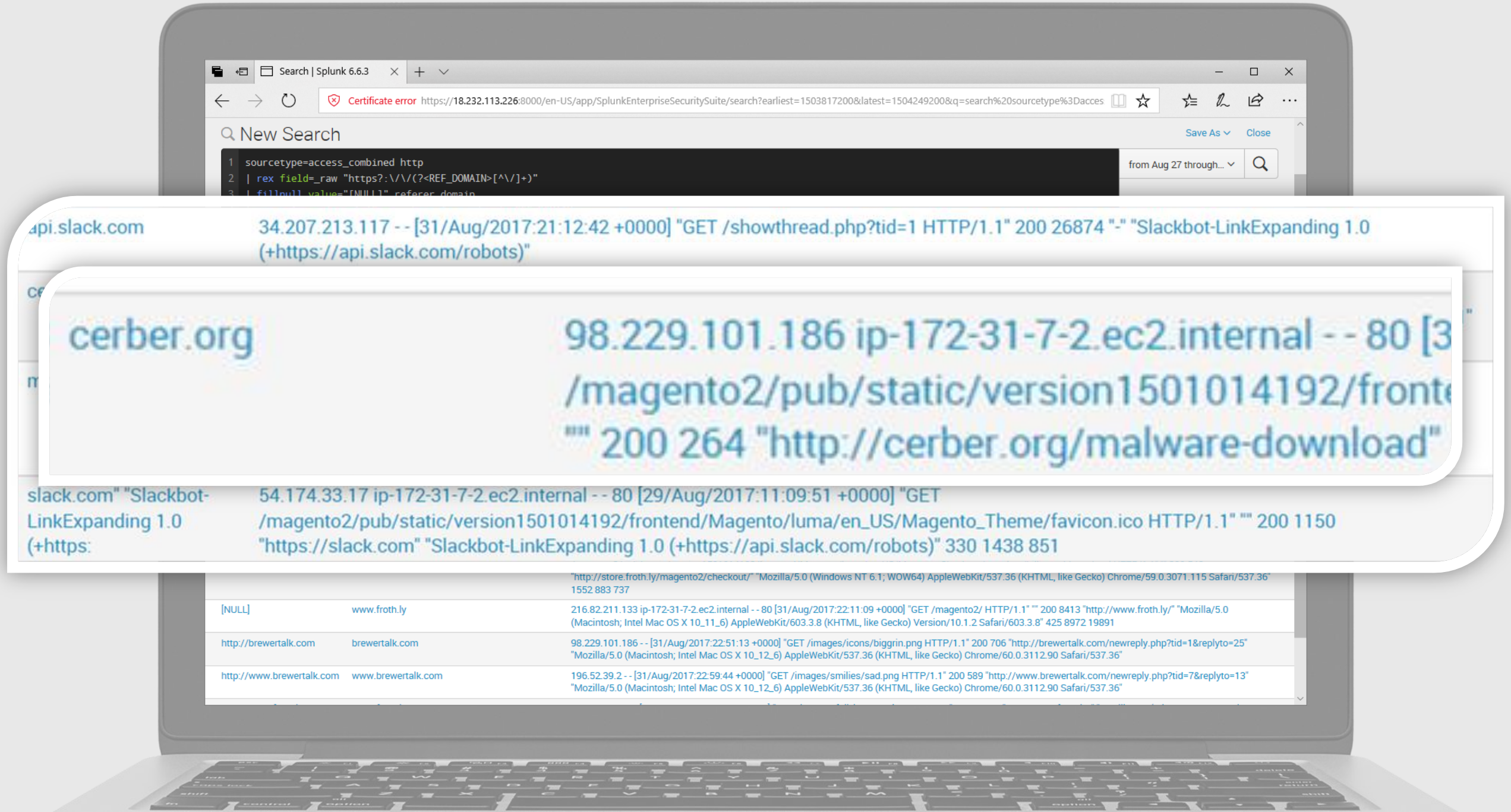

SQL Injection

Incident Response

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SQL Injection

According to OWASP, "A SQL injection attack consists of insertion or "injection" of a SQL query via the input data from the client to the application.“

https://www.owasp.org/index.php/SQL_injection

SQL Injection

- Investigations start somewhere
  - Alert
  - Pen Test Results
- Alert
  - e.g. IDS event indicating a SQL Injection
  - Direct us to a specific log

SQL Injection REGEX - Data

<dt>Query:</dt>

<dd> SELECT q.*, s.sid FROM mybb_questionsessions s

LEFT JOIN mybb_questions q ON (q.qid=s.qid)

WHERE q.active='1' AND s.sid='makman' and

updatexml(NULL,concat (0x3a,(

SELECT email FROM mybb_users ORDER BY UID LIMIT 5,1)),NULL) and '1' </dd>

<dd>1105 - XPATH syntax error: ':**klagerfield@froth.ly**'</dd>

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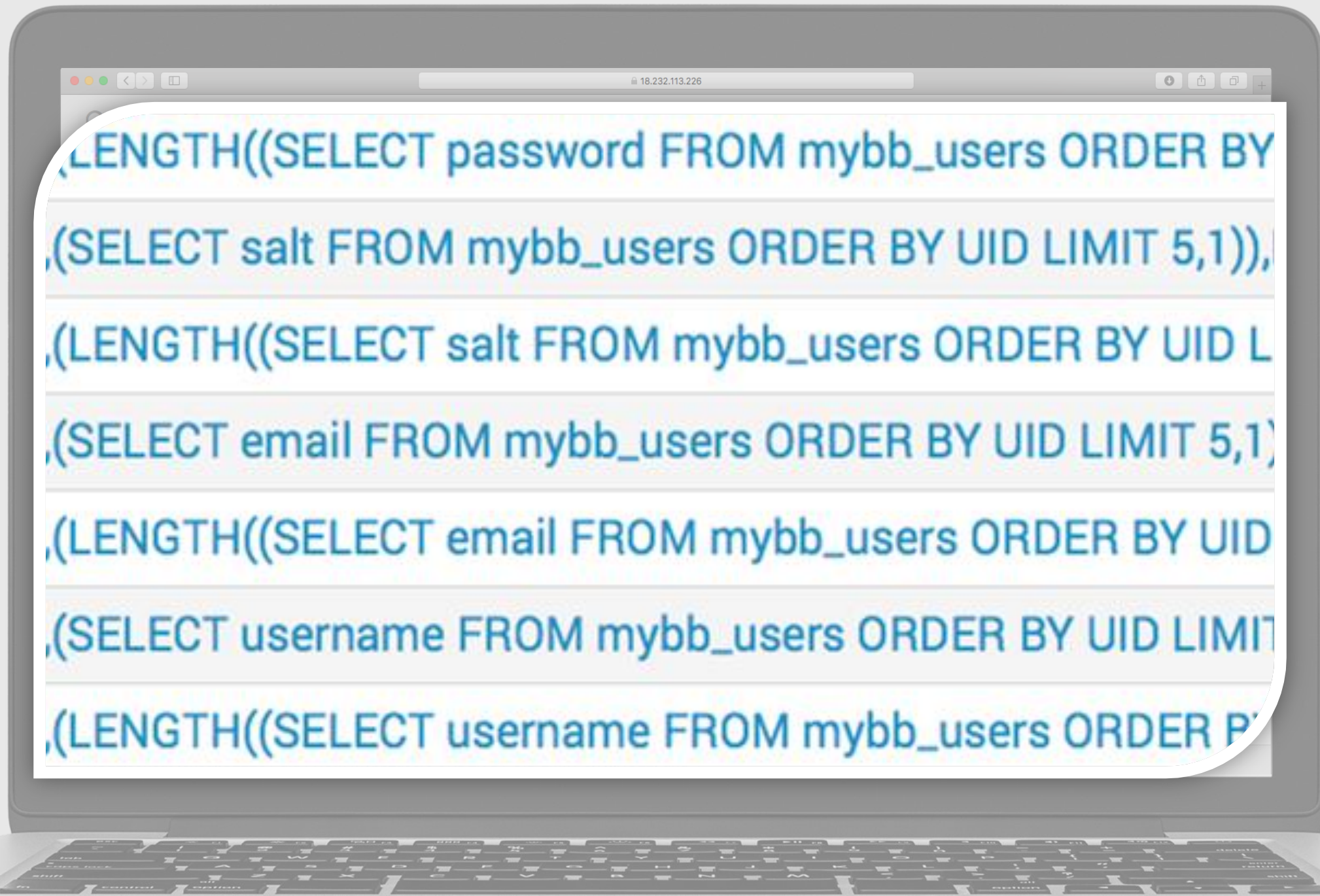
SQL Injection REGEX: Query

- What is the scope?
  - How many attacks occurred?
  - Which were successful?
  - What data was targeted?
  - What data was exposed?

SQL Injection REGEX: Query

For simplicity, pull out the query and result separately.

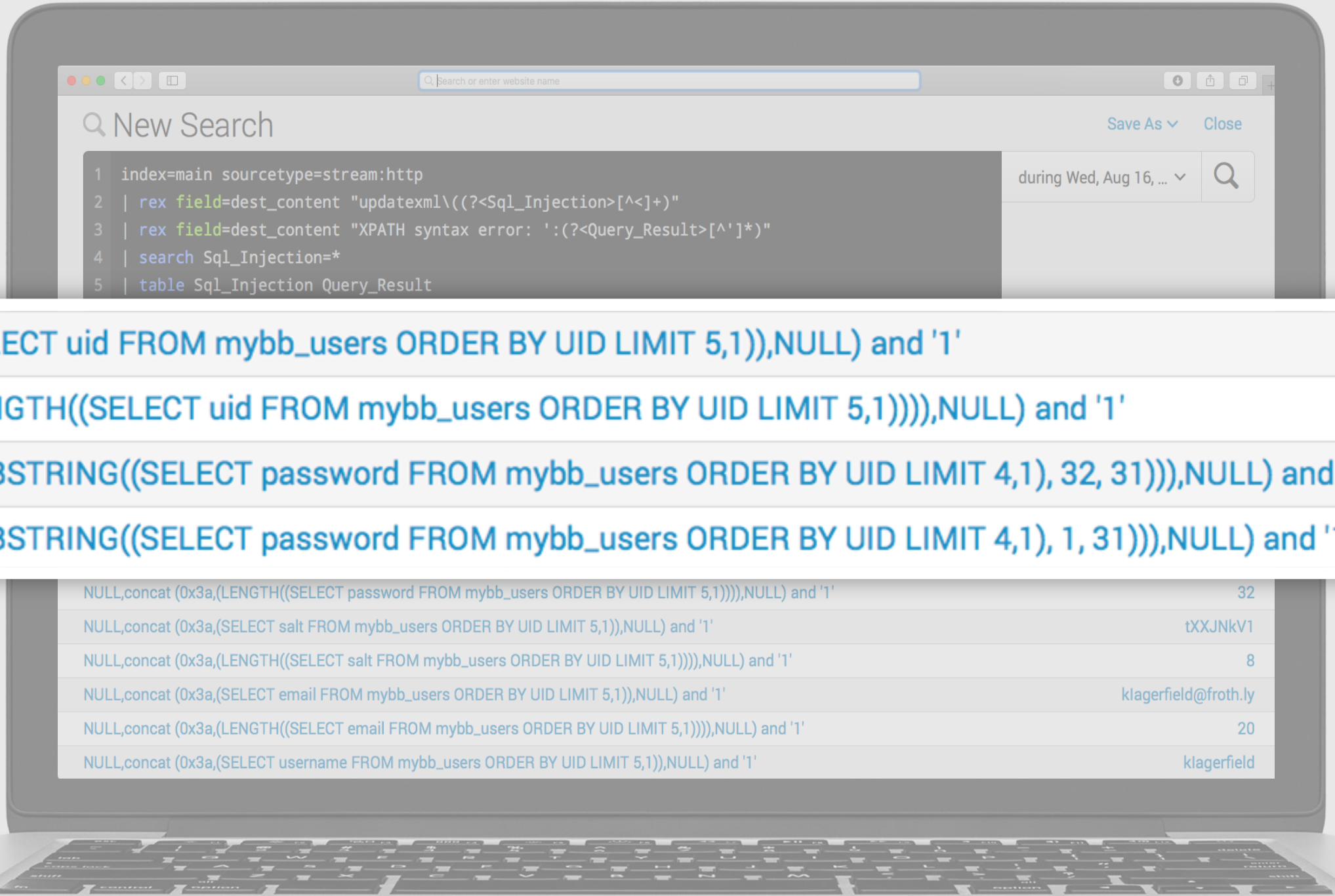
```
index=main sourcetype=stream:http
| rex field=dest_content "updatexml\((?<Sql_Injection>[^<]+)”
| search Sql_Injection=*
| table Sql_Injection
```

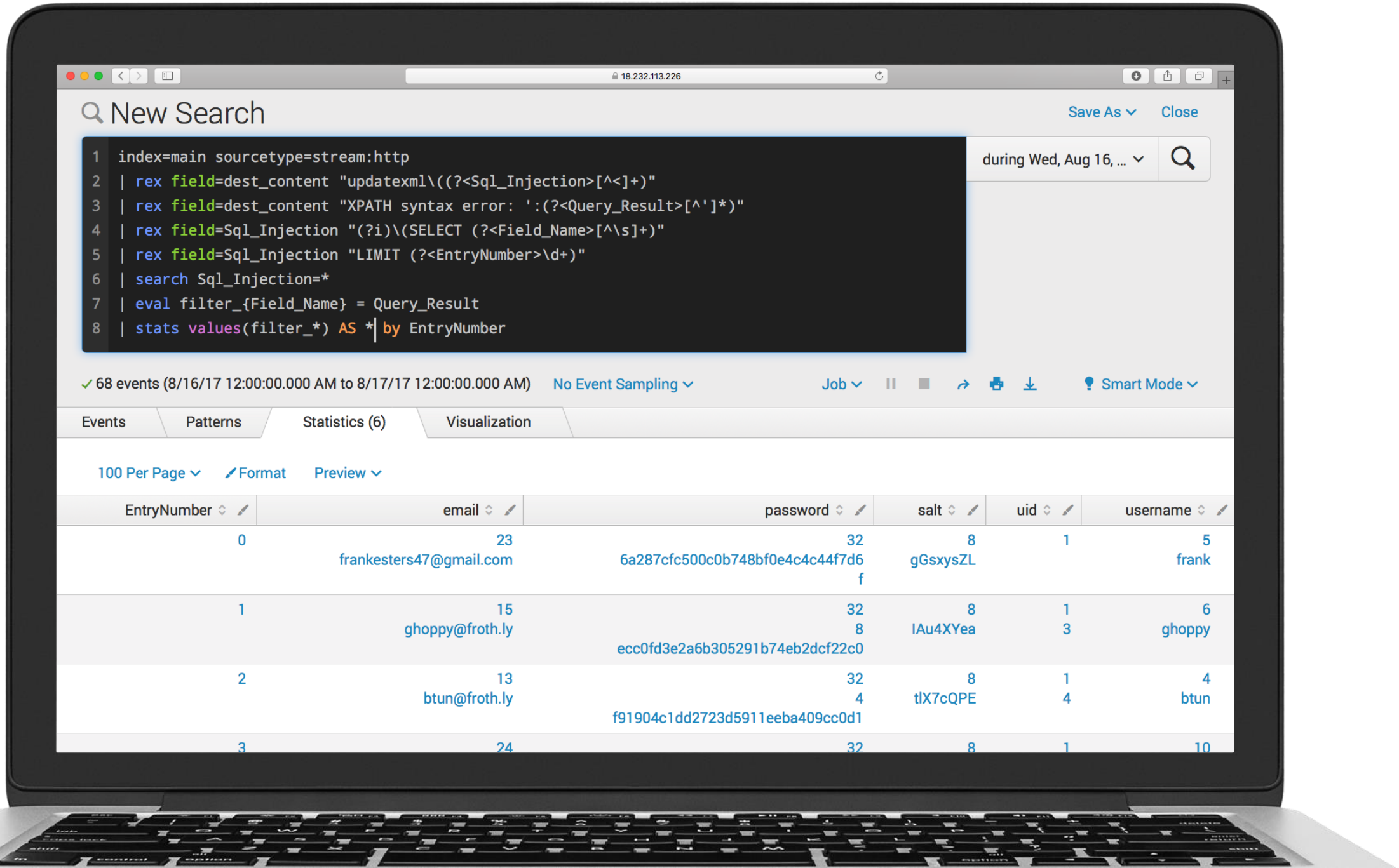


SQL Injection REGEX - Data

Now extract the results.

```
index=main sourcetype=stream:http
| rex field=dest_content
  "updatexml\((?<Sql_Injection>[^<]+)”
| rex field=dest_content "XPATH syntax error: ‘:
  (?<Query_Result>[^']*)"
| search Sql_Injection=*
| table Sql_Injection Query_Result
```





Cross Site Scripting

Incident Response

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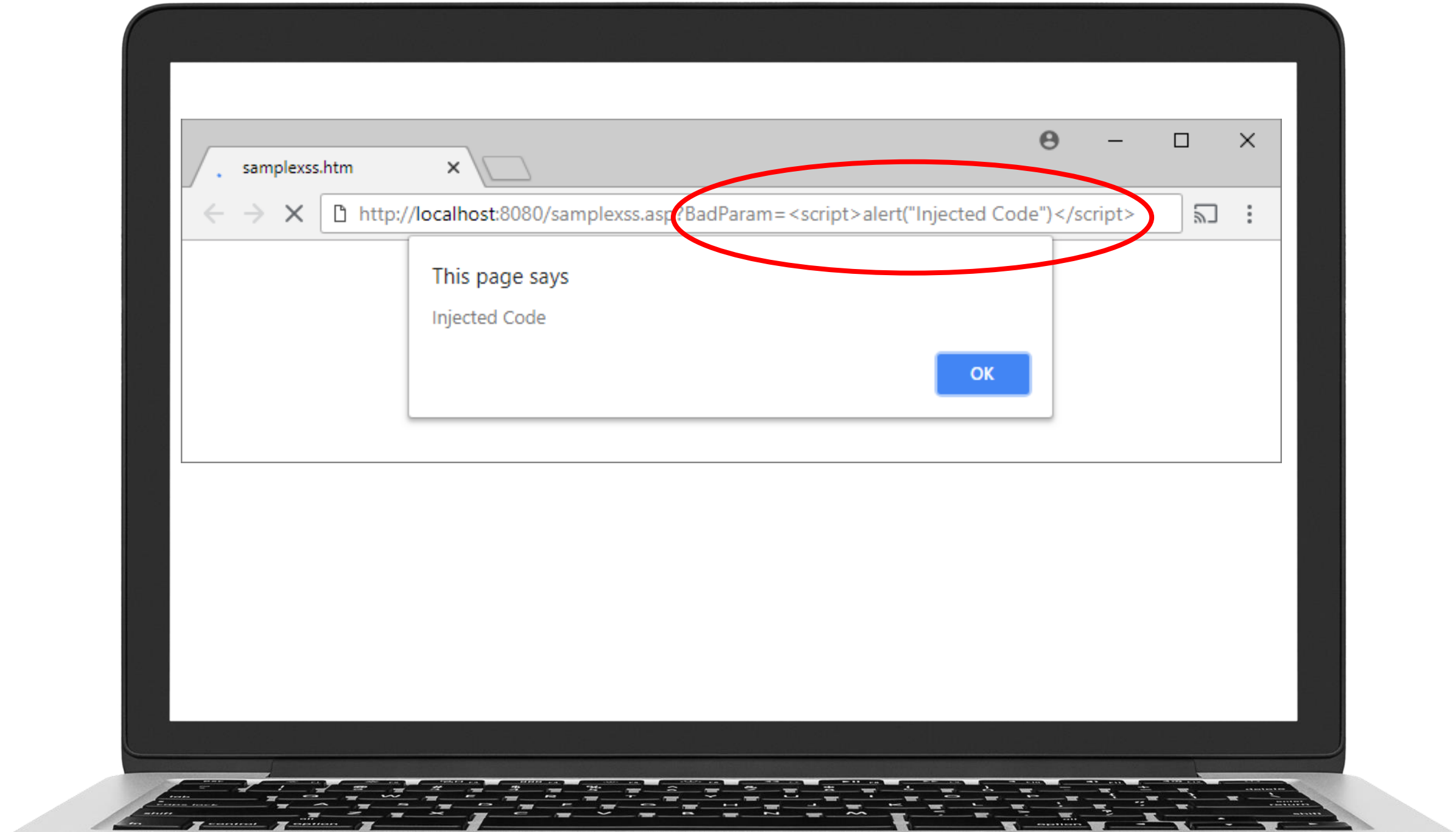

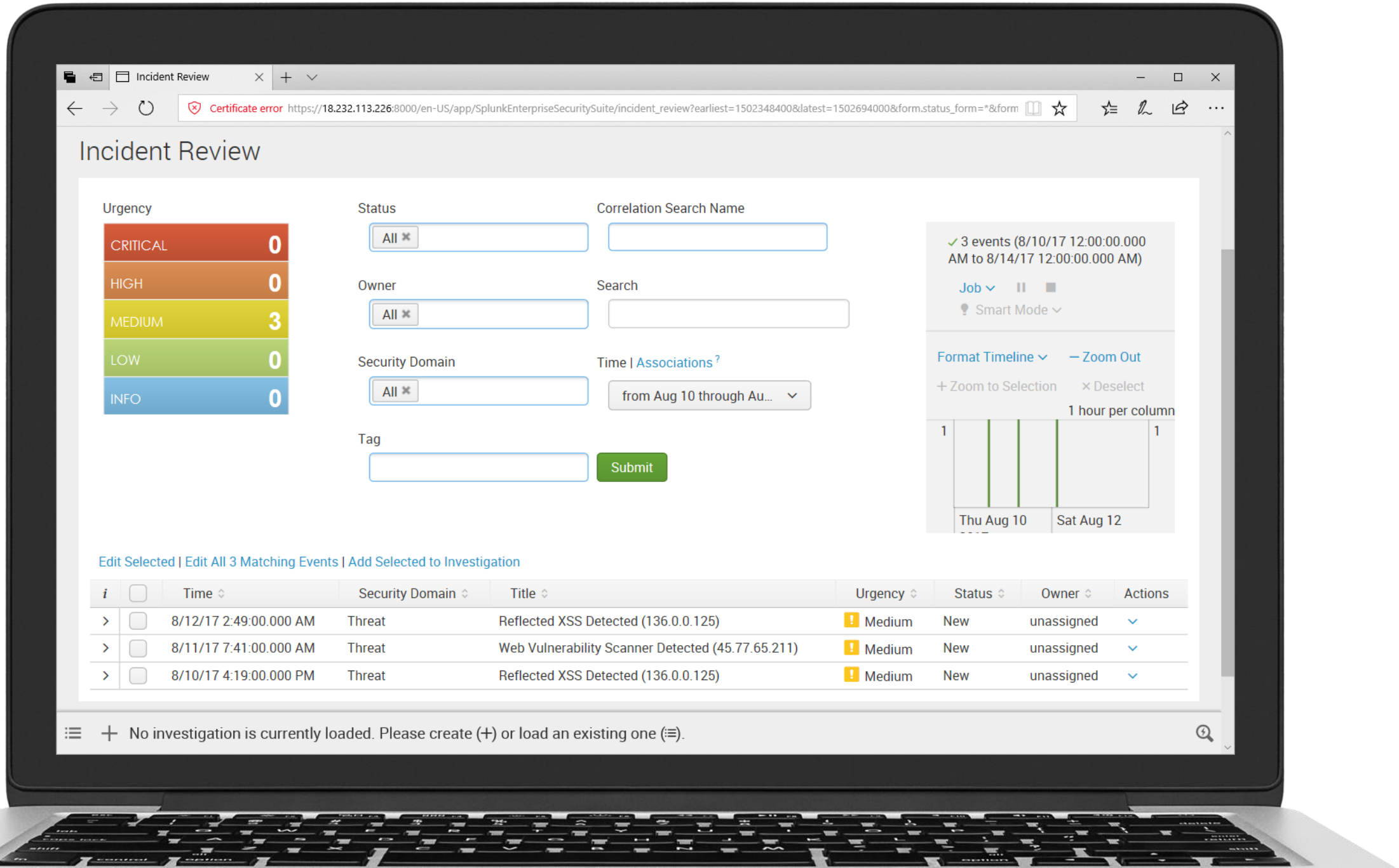

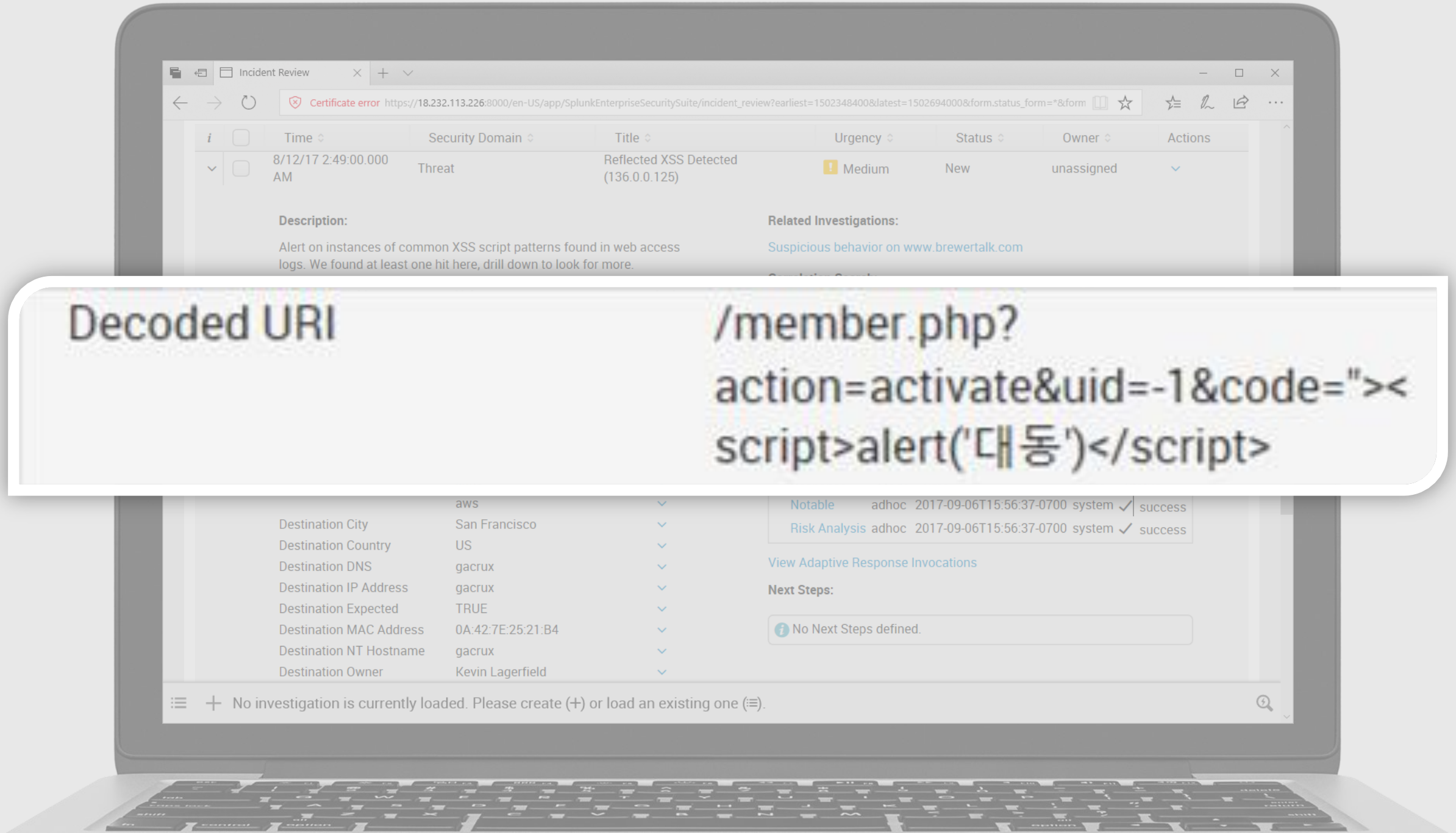

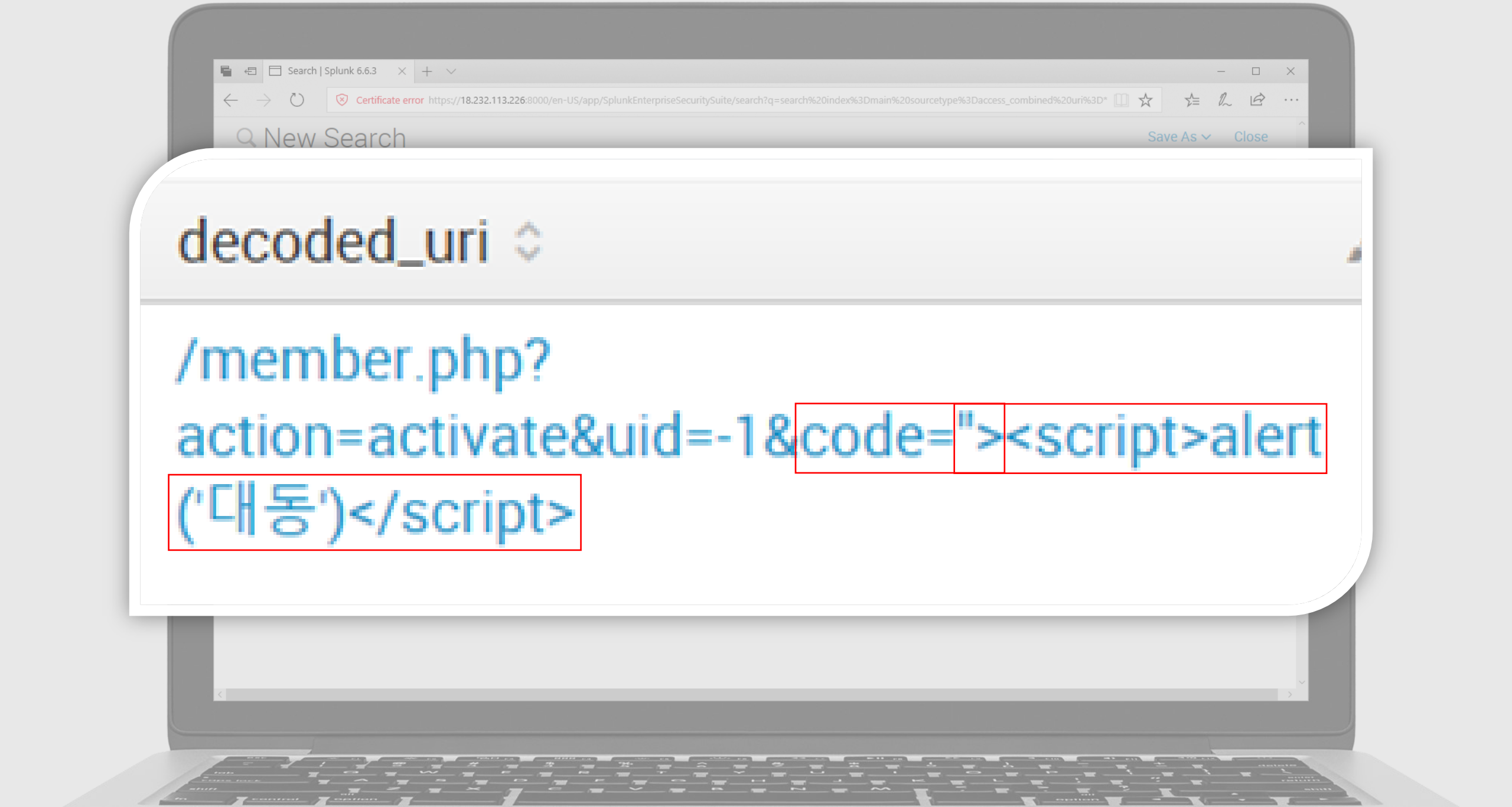

XSS REGEX

- `| rex field=decoded_uri “code=(?<XSS>.+)”`

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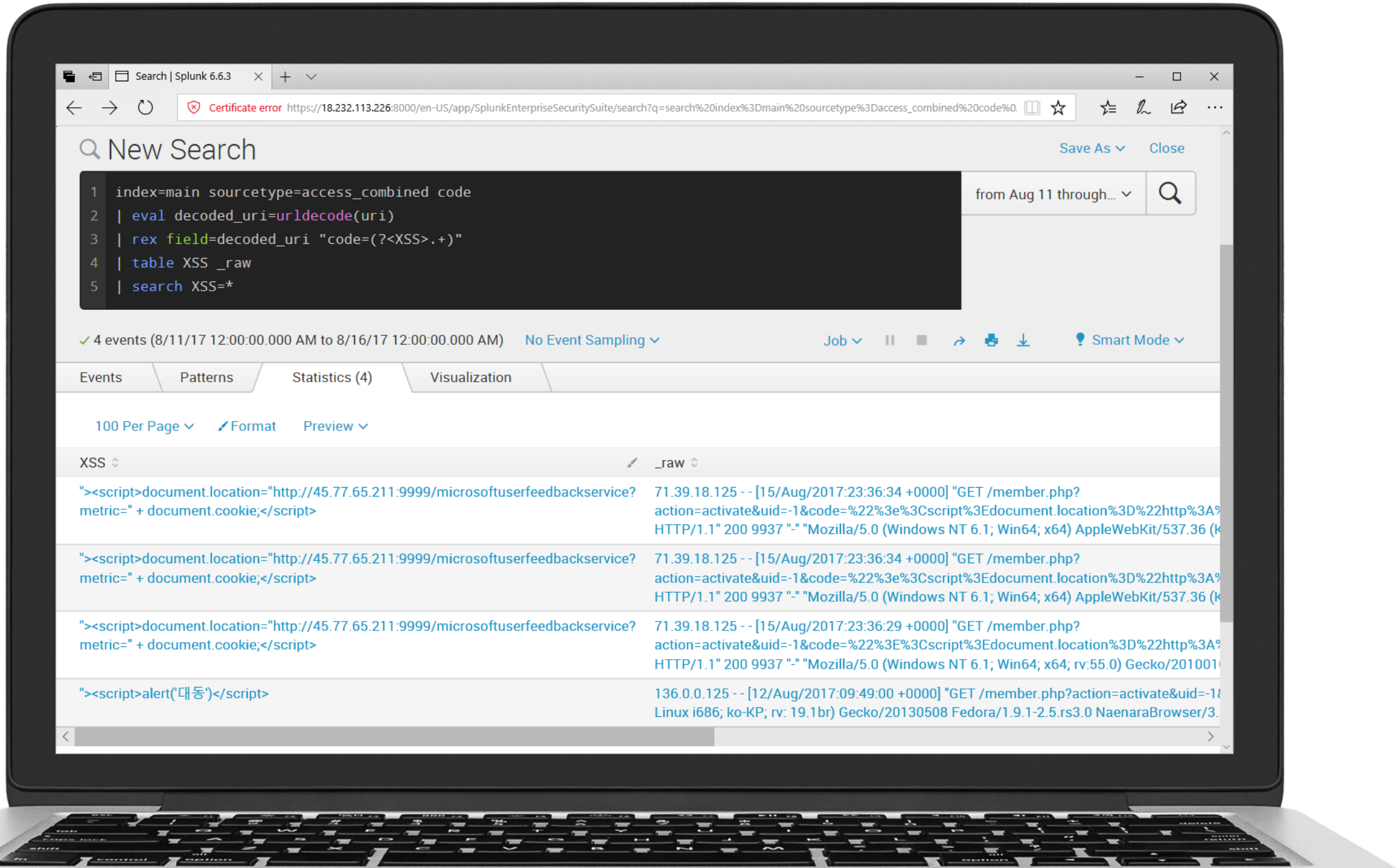

Which is easier to understand?

```
1  index=main sourcetype=access_combined uri=*code*
2  | eval decoded_uri=urldecode(uri)
3  | search decoded_uri="*code=\">*"
4  | table _time decoded_uri
```

```
1  index=main sourcetype=access_combined code
2  | eval decoded_uri=urldecode(uri)
3  | rex field=decoded_uri "code=(?<XSS>.+)"
4  | table XSS _raw
5  | search XSS=*
```

Working with Sysmon

Incident Response

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Sysmon

- According to Microsoft, sysmon "...provides detailed information about process creations, network connections, and changes to file creation time."
- Useful for identifying
  - Downloads
  - Suspicious processes
  - Unusual activity

Scenario

- Internal employee is hiding browsing history using Tor. What is the version of the Tor browser?
- What do we know?
  - Workstation: wrk-aturing
  - Keyword: "tor"

Sysmon

Sample Log:

- <Channel>Microsoft-Windows-Sysmon/Operational</Channel>

  <Computer>wrk-abungst.frothly.local**</Computer>**

  <Security UserID='S-1-5-18'/></System>

  <EventData>

  <Data Name='UtcTime'>2017-08-27 03:57:15.174</Data>

  <Data Name='Image'>C:\Program Files\Splunk\bin\splunk-admon.exe**</Data>**

  </EventData>

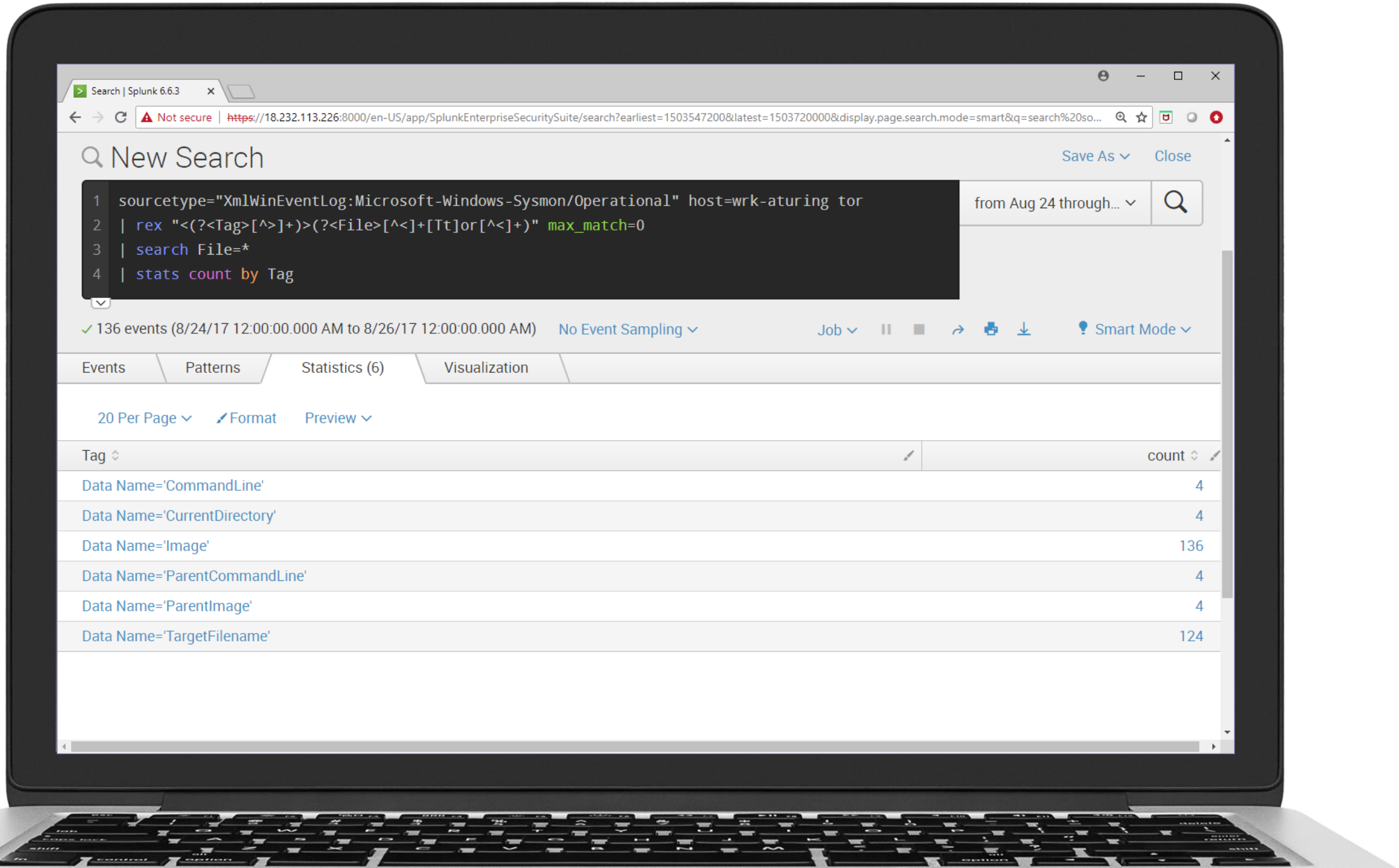
- Each data element has <tag>Data</tag>

Sysmon

Stimulus: Searching for Suspicious Download

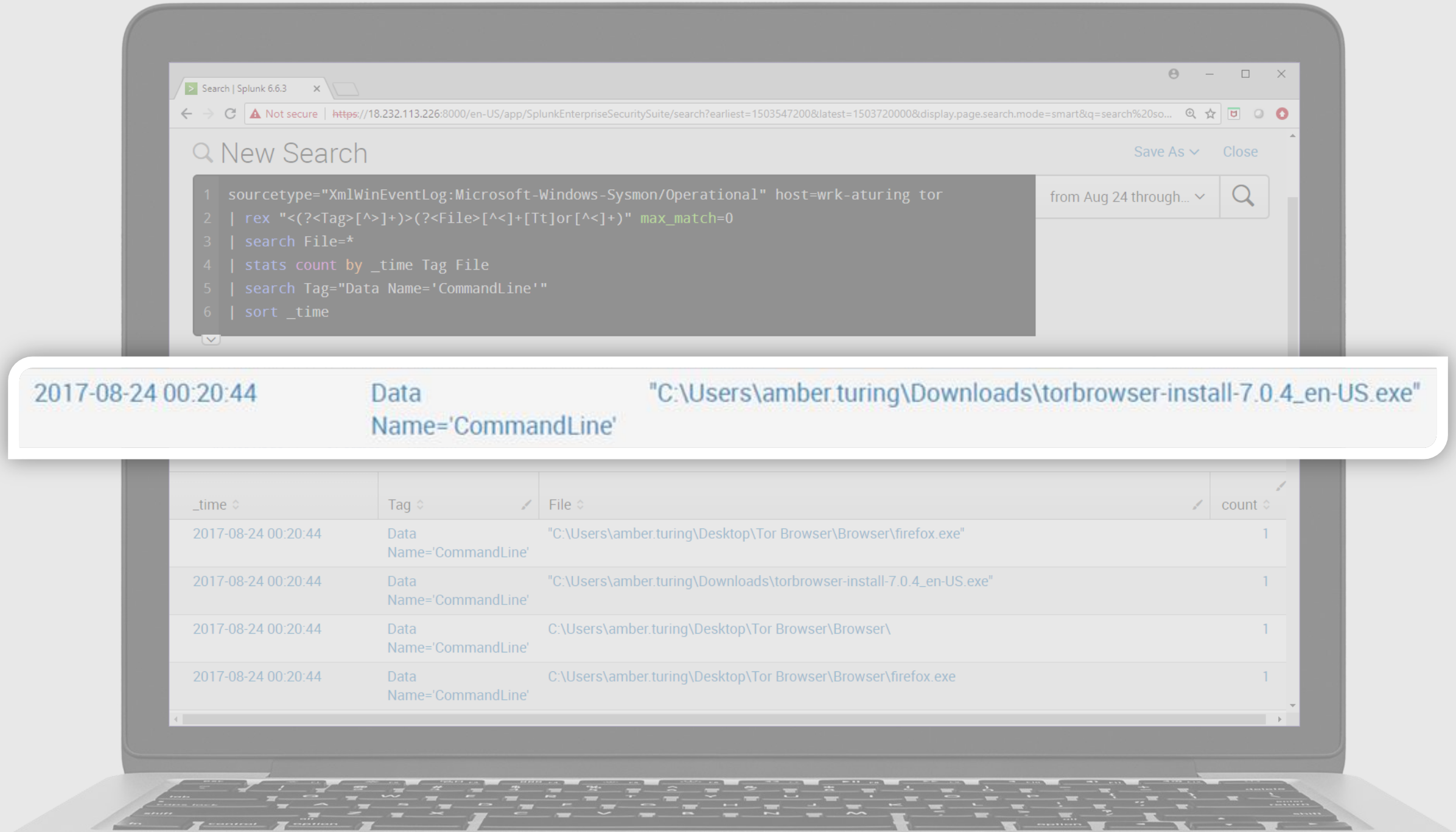
Keyword: Tor

```
sourcetype="XmlWinEventLog:Microsoft-Windows-
  Sysmon/Operational" host=wrk-aturing tor
| rex "<(?<Tag>[^>]+)>(?<File>[^<]+[Tt]or[^<]+)" max_match=0
| search File=*
| stats count by Tag
```



Sysmon

```
sourcetype="XmlWinEventLog:Microsoft-Windows-
  Sysmon/Operational" host=wrk-aturing tor
| rex "<(?<Tag>[^>]+)>(?<File>[^<]+[Tt]or[^<]+)" max_match=0
| search File=*
| stats count by _time Tag File
| search Tag="Data Name='CommandLine'"
| sort _time
```



Q&A

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Thank You

Don't forget to rate this session in the .conf18 mobile app