WEB SECURITY

Defense Against the Dark Arts 101

FUNDAMENTAL CONCERNS

Authentication

Trusting that someone is who they say they are.

Communication

Transferring data through potentially unreliable middlemen.

Authorization

Giving resource access to the right people.

Control

Limiting or understanding the capabilities of agents.

OWASP TOP 10 (2013)

Injection	Server-side code execution
Broken Authentication	Allows for impersonation
XSS	Client-side code execution
Direct References	Access control can be circumvented
Security Misconfiguration	Vulnerable default/inherited settings
Data Exposure	Data is insecurely transmitted, stored, or simply overshared
Missing Access Control	Users can do things they shouldn't be allowed to do
XSRF	Abuse the target website's trust in the browser
Vulnerable Components	Third-party tools are vulnerable
Unvalidated Redirects	Abusable open-ended forwarding

source

OWASP Top 10 - 2013	→	OWASP Top 10 - 2017
A1 – Injection	→	A1:2017-Injection
A2 – Broken Authentication and Session Management	→	A2:2017-Broken Authentication
A3 – Cross-Site Scripting (XSS)	↘	A3:2017-Sensitive Data Exposure
A4 – Insecure Direct Object References [Merged+A7]	U	A4:2017-XML External Entities (XXE) [NEW]
A5 – Security Misconfiguration	↘	A5:2017-Broken Access Control [Merged]
A6 – Sensitive Data Exposure	↗	A6:2017-Security Misconfiguration
A7 – Missing Function Level Access Contr [Merged+A4]	U	A7:2017-Cross-Site Scripting (XSS)
A8 – Cross-Site Request Forgery (CSRF)	☒	A8:2017-Insecure Deserialization [NEW, Community]
A9 – Using Components with Known Vulnerabilities	→	A9:2017-Using Components with Known Vulnerabilities
A10 – Unvalidated Redirects and Forwards	☒	A10:2017-Insufficient Logging&Monitoring [NEW,Comm.]

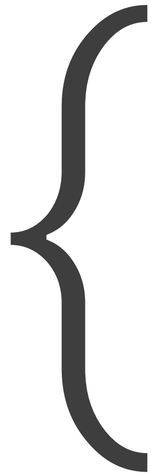
https://www.owasp.org/images/7/72/OWASP_Top_10-2017_%28en%29.pdf.pdf

AUTHER (CURRENTLY)

HTTP://HUMBLE-HOMES.COM/TINY-HOUSE-PRECARIOUSLY-PERCHED-ON-A-ROCK-WITHSTANDS-SEVERE-FLOODING/

WORKSHOP

- Game with 5 rounds
- Each round
  - attack
  - attack demo
  - defense
  - defense review



- uncovering secrets
- improper access
- injection
- cross-site scripting
- data theft

ROUND 1:
UNCOVERING SECRETS
(SECURITY MISCONFIGURATION)

40 lines (33 sloc) | 1.13 KB

Raw Blame History

```
'use strict';

var router = require('express').Router();
var passport = require('passport');
var GoogleStrategy = require('passport-google-oauth').OAuth2Strategy;

var User = require('../api/users/user.model');

router.get('/', passport.authenticate('google', {
  scope: 'email'
}));

router.get('/callback', passport.authenticate('google', {
  successRedirect: '/stories',
  failureRedirect: '/signup'
}));

passport.use(new GoogleStrategy({
  clientID: '238524570915-ivf9lnhm9bsfq13cle5ap8s28d4lmhrp.apps.googleusercontent.com',
  clientSecret: 'GST6VQnVmhx1YIB1vDXXB3PF',
  callbackURL: 'http://127.0.0.1:8080/auth/google/callback'
}, function (token, refreshToken, profile, done) {
  var info = {
    name: profile.displayName,
    // google may not provide an email, if so we'll just fake it
    email: profile.emails ? profile.emails[0].value : [profile.username , 'fake-auther-email.com'].join('@'),
    photo: profile.photos ? profile.photos[0].value : undefined
  };
  User.findOrCreate({
    where: {googleId: profile.id},
    defaults: info
  })
```

UNCOVERING SECRETS

- Assume attacker has access to codebase
- Defense vulnerable if…
  - application secrets are easy to discover
  - files are improperly shared
- Bad stuff: app impersonation, decryption

not (yet) about user secrets

ROUND 2:
IMPROPER ACCESS
(MISSING ACCESS CONTROL)

IMPROPER ACCESS

- Assume attacker is client
- Defense vulnerable if client can act outside of authorization
- Bad stuff: depends on the action and resource

still not (yet) about user secrets

IMPROPER ACCESS

- Frontend “access control” is actually just good UX
- True access control comes from backend
- Considerations (be thorough)…
  - requested resource
  - requested action
  - agent making the request

```
fetch('/api/users/1', {
  method: 'DELETE',
  credentials: 'same-origin'
});
```

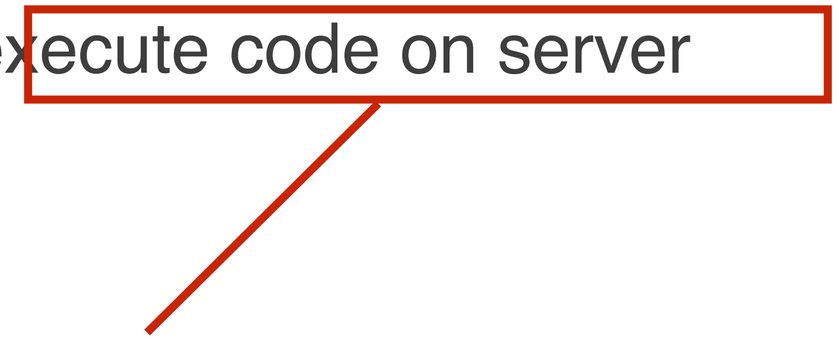
BEWARE OVERPROTECTION

```
// "safe server"
var app = require('express')();
app.use(function (req, res) {
  res.status(403);
  res.send('NONE SHALL ENTER');
});
app.get('/', function (req, res) {
  res.sendFile(__dirname + '/index.html');
});
...
```

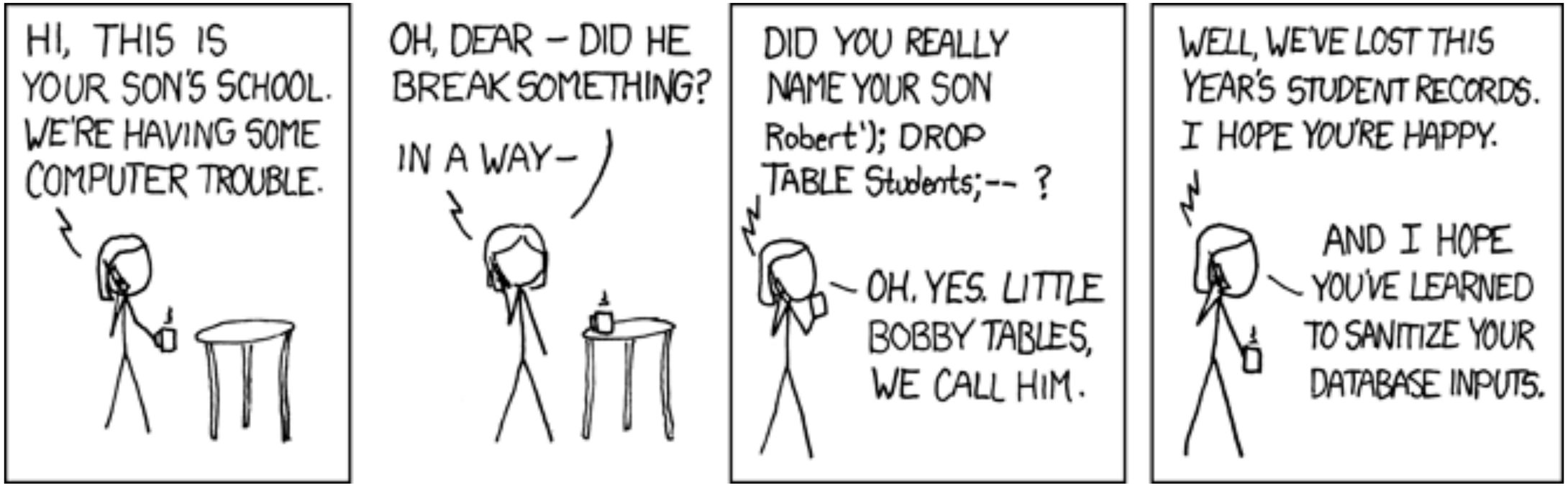
ROUND 3: INJECTION

INJECTION

- Assume attacker is non-admin client
- Defense vulnerable if client can execute code on server
- Bad stuff: umm, everything?



INJECTION



HTTPS://XKCD.COM/327/

INJECTION server-side execution of attacker-defined code

User.destroy({});

```
POST /whatever HTTP/1.1
...
{
  "modulePath": "./user.model",
  "method": "destroy",
  "args": [{}]
}
```

```
...
// at end of middleware stack
app.use(function (req, res, next) {
  // allow client to specify *any* module
  var theModule = require(req.body.modulePath);
  // allow client to specify *any* method
  var method = theModule[req.body.methodName];
  // allow client to specify *any* arguments
  var args = req.body.args;
  // blindly invoke!
  var result = method.apply(theModule, args);
  res.json(result);
});
...
```

ROUND 4:
CROSS-SITE SCRIPTING

XSS

- Assume attacker is non-admin client
- Defense vulnerable if client can execute code on another client
- Bad stuff: yeah pretty much everything
- Two flavors: “stored” and “reflected”

STORED XSS

4 Comments The Atlantic 1 Login

Recommend Share Sort by Oldest

<script>alert('i am an xss attack');</script>

LOG IN WITH

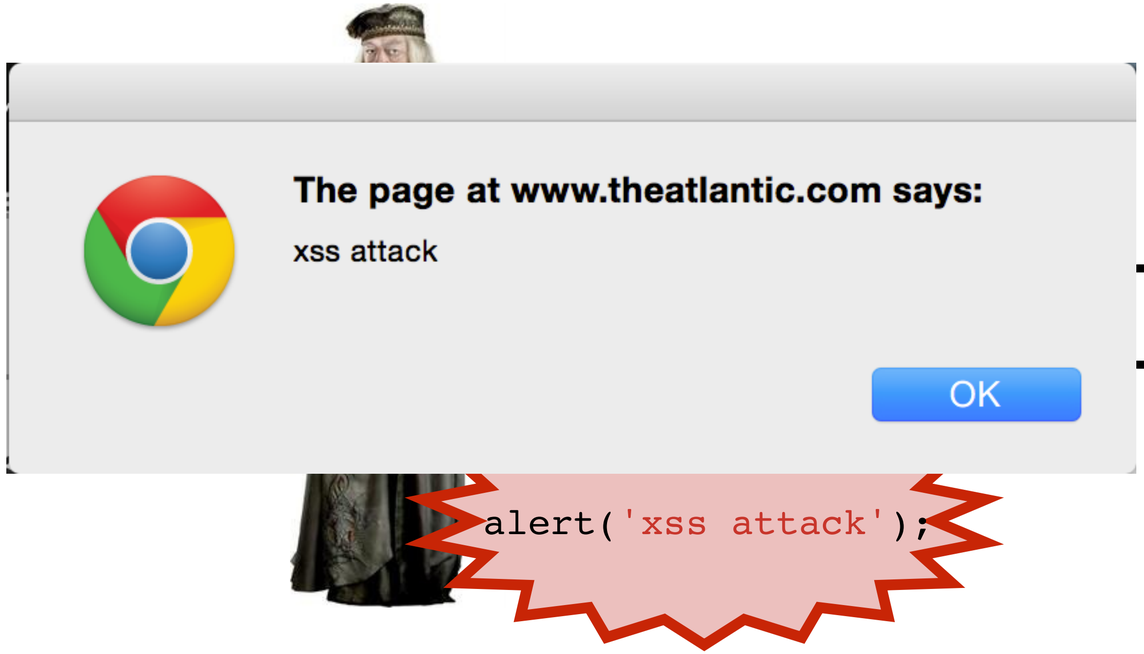
OR SIGN UP WITH DISQUS ?

Name

submit

```
<script>alert('xss attack');</script>
```

STORED XSS

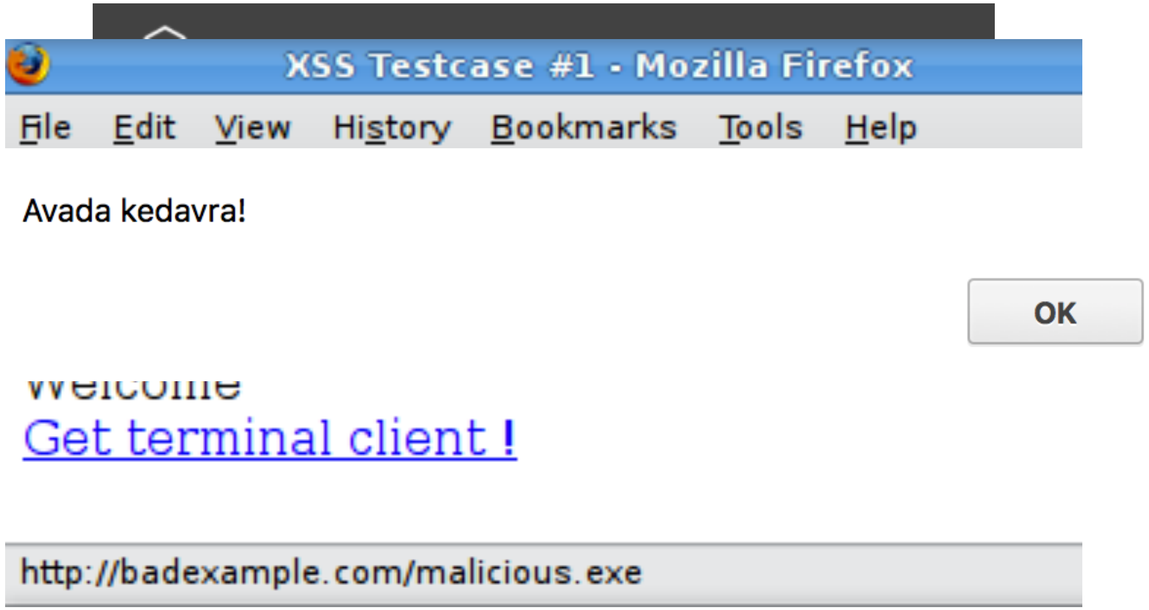

The page at www.theatlantic.com says:
xss attack
OK
alert('xss attack');


<script>alert('xss attack');</script>

REFLECTED XSS

- Server sends parts of request in response
- Attacker forms link with script in it
- Victim clicks link
- Server responds with script
- Script runs on victim’s browser

REFLECTED XSS




```
http://example.com/index.php?user=<script>window.onload = function() {var
AllLinks=document.getElementsByTagName("a");
AllLinks[0].href = "http://badexample.com/malicious.exe"; }</script>
```

https://www.owasp.org/index.php/Testing_for_Reflected_Cross_site_scripting_(OTG-INPVAL-001)

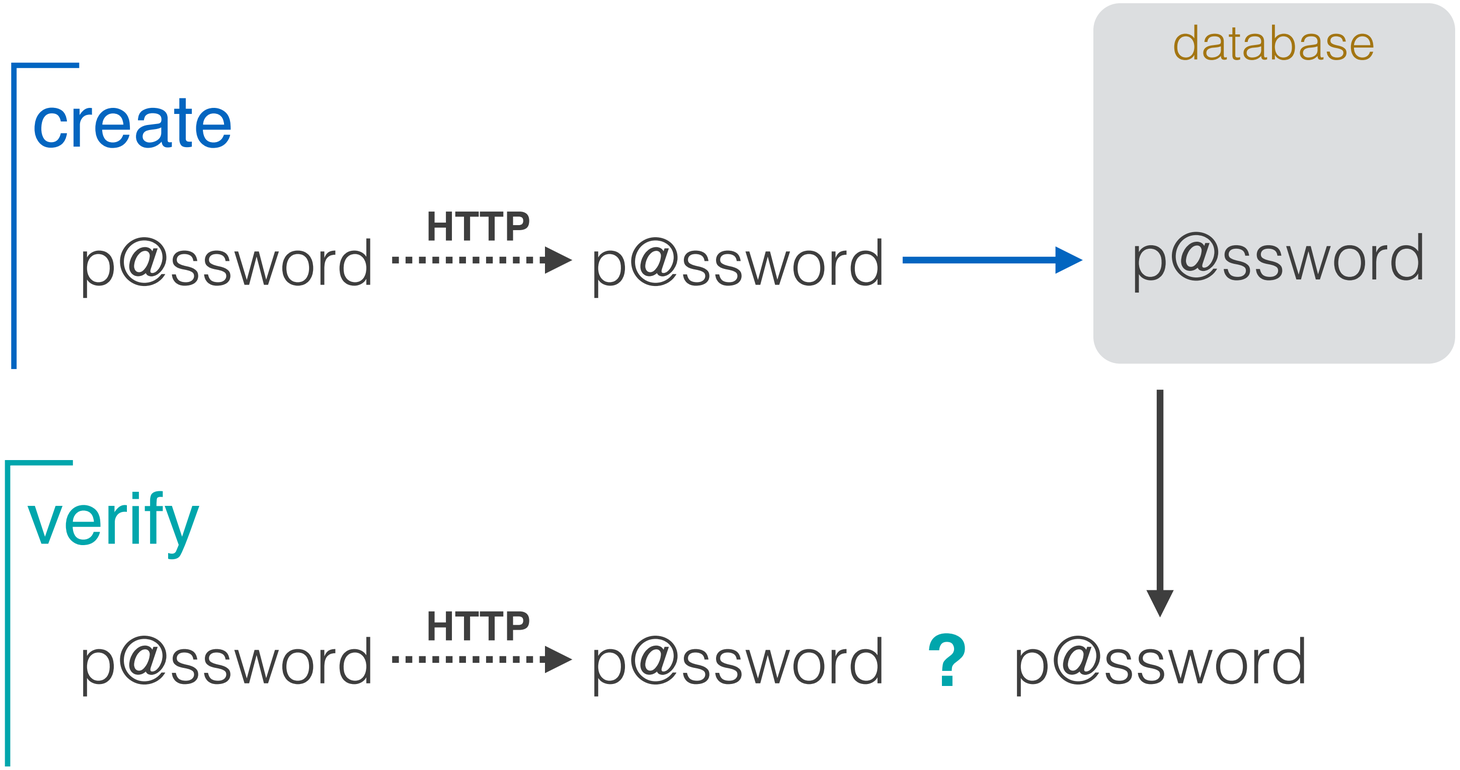
ROUND 5:
DATA THEFT
(BAD AUTH / DATA EXPOSURE)

“IDENTITY THEFT”

- Assume attacker has access to middlemen and database
- Defense vulnerable if communication or storage exposes passwords
- Bad stuff: user impersonation

PASSWORD SECURITY

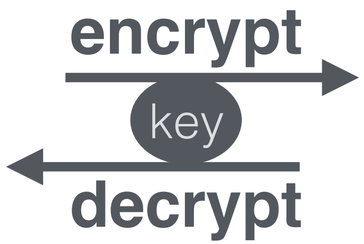
THE WORST WAY



ENCRYPTION

plaintext scheme ciphertext

word



981kje

HTTP

encryption

+ “authentic” server } SSL

HTTPS

"AUTHENTIC" SERVER

- Has an SSL certificate
- Digitally signed
- Forms a web of trust
- Self-signed in development

HTTPS IN PRACTICE

With openssl generate a private key with…

```
$ openssl genrsa -out key.pem 2048
```

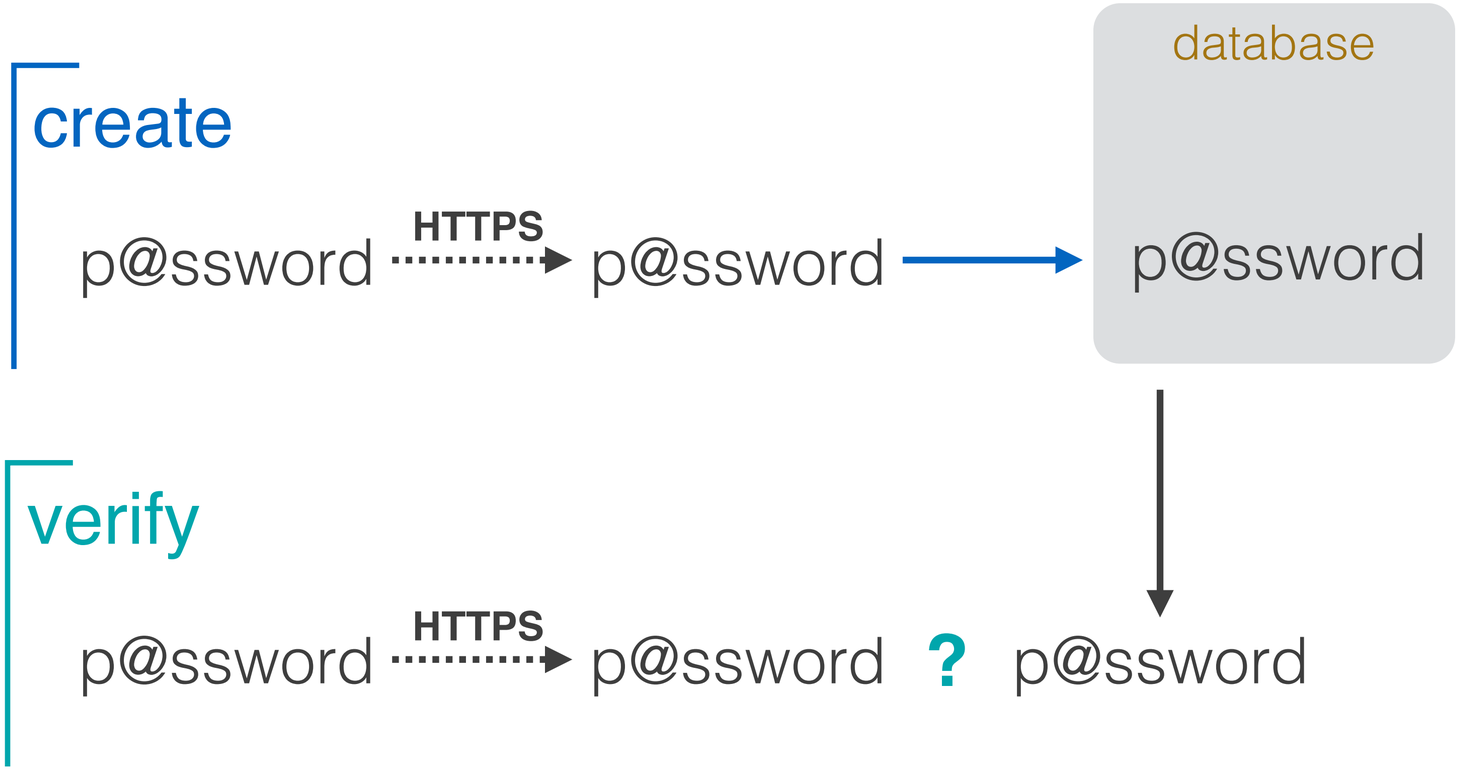
Then generate self-signed SSL certificate with…

```
$ openssl req -x509 -new -nodes -key key.pem -days 1024 -out cert.pem
```

Now use node's **`https`** library with this key and certificate

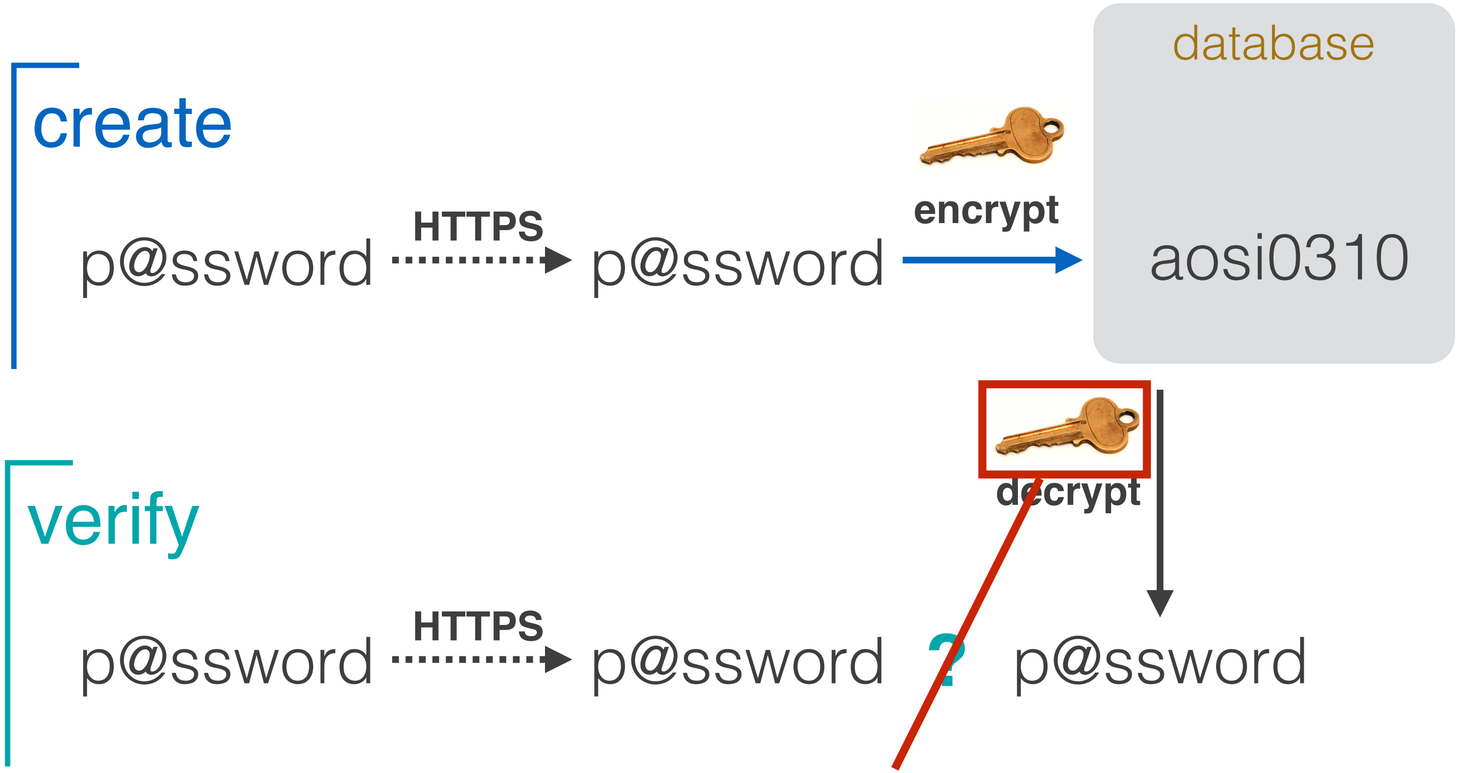
PASSWORD SECURITY

SECURE COMMUNICATION



PASSWORD SECURITY

SECURE-ISH STORAGE



HASHING

string algorithm hash

word

jads82

PASSWORD SECURITY

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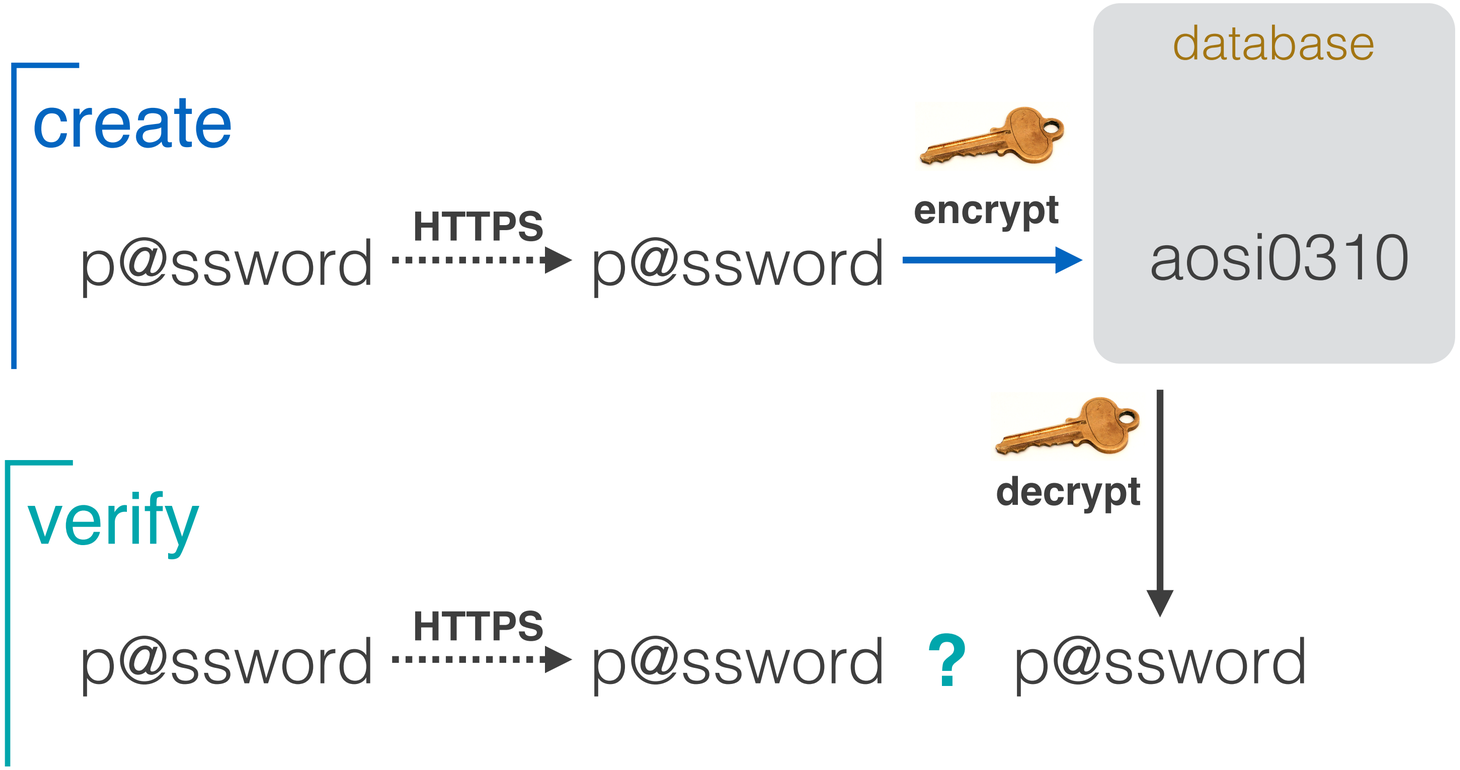
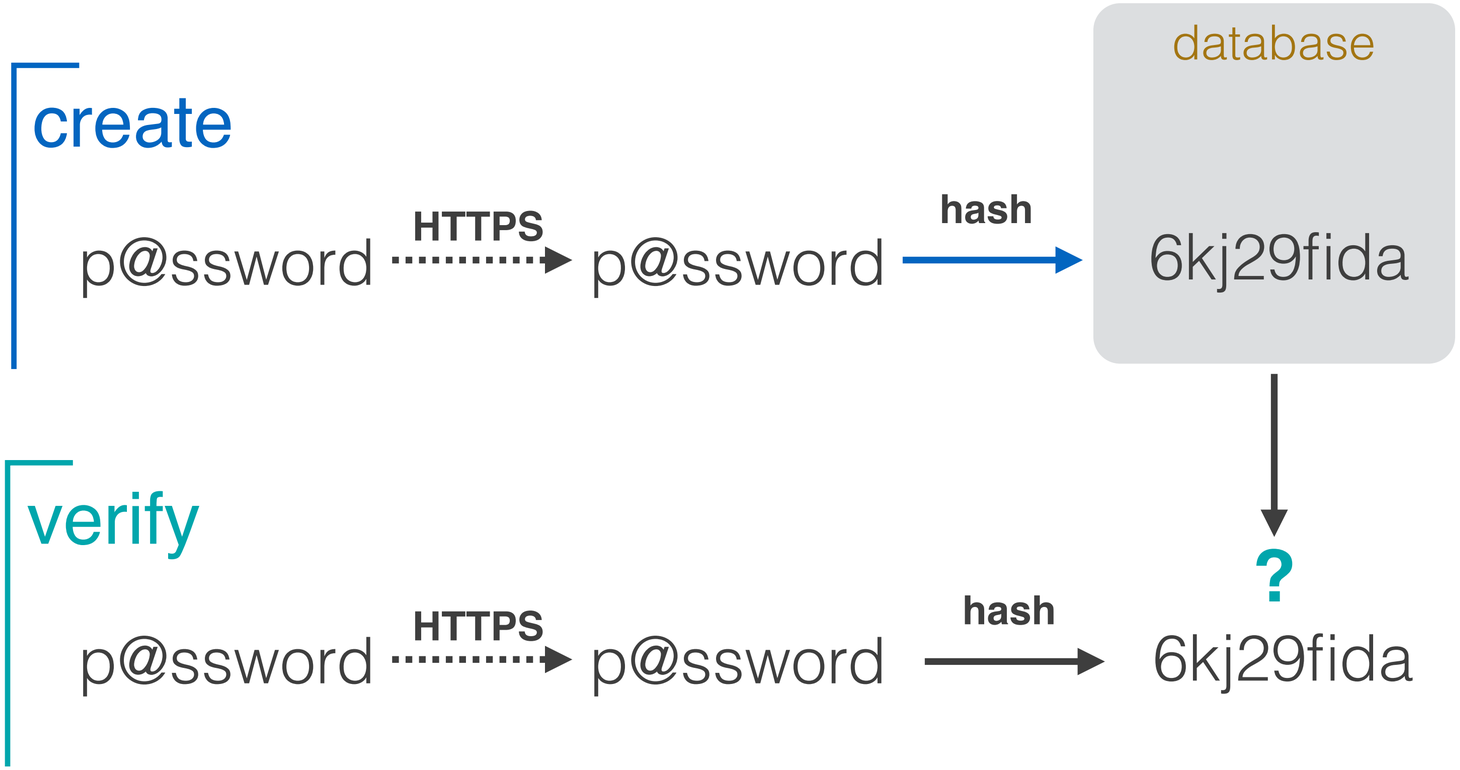


PASSWORD SECURITY

SECURE STORAGE



GOOD HASH KEY FUNCTION

Should be slow

Ultimately, this will hurt would-be attackers more than it will hurt you.

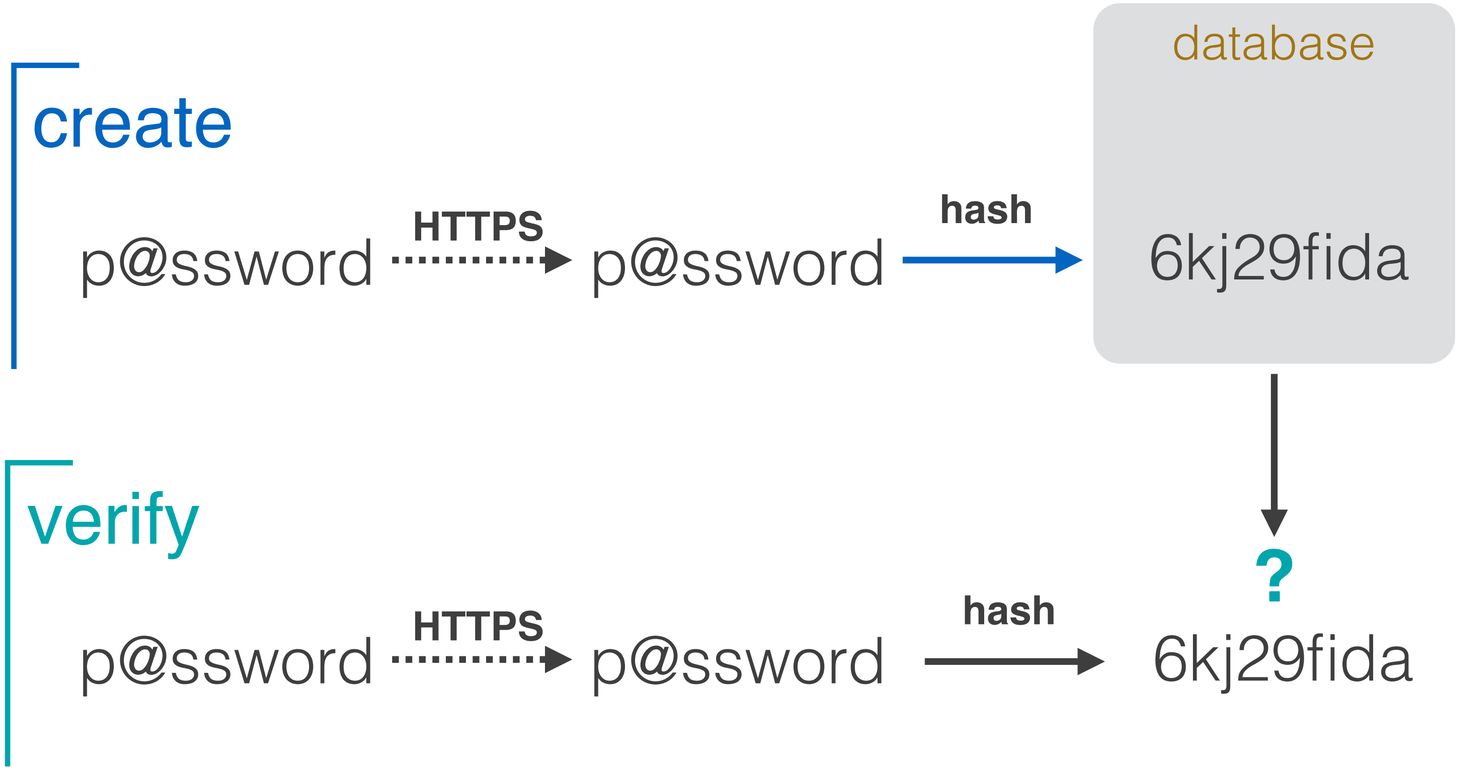
Should have a low collision frequency

Fewest possible duplicates. Or else two inputs could be indistinguishable.

PASSWORD SECURITY

Can we make it even better?

SECURE STORAGE

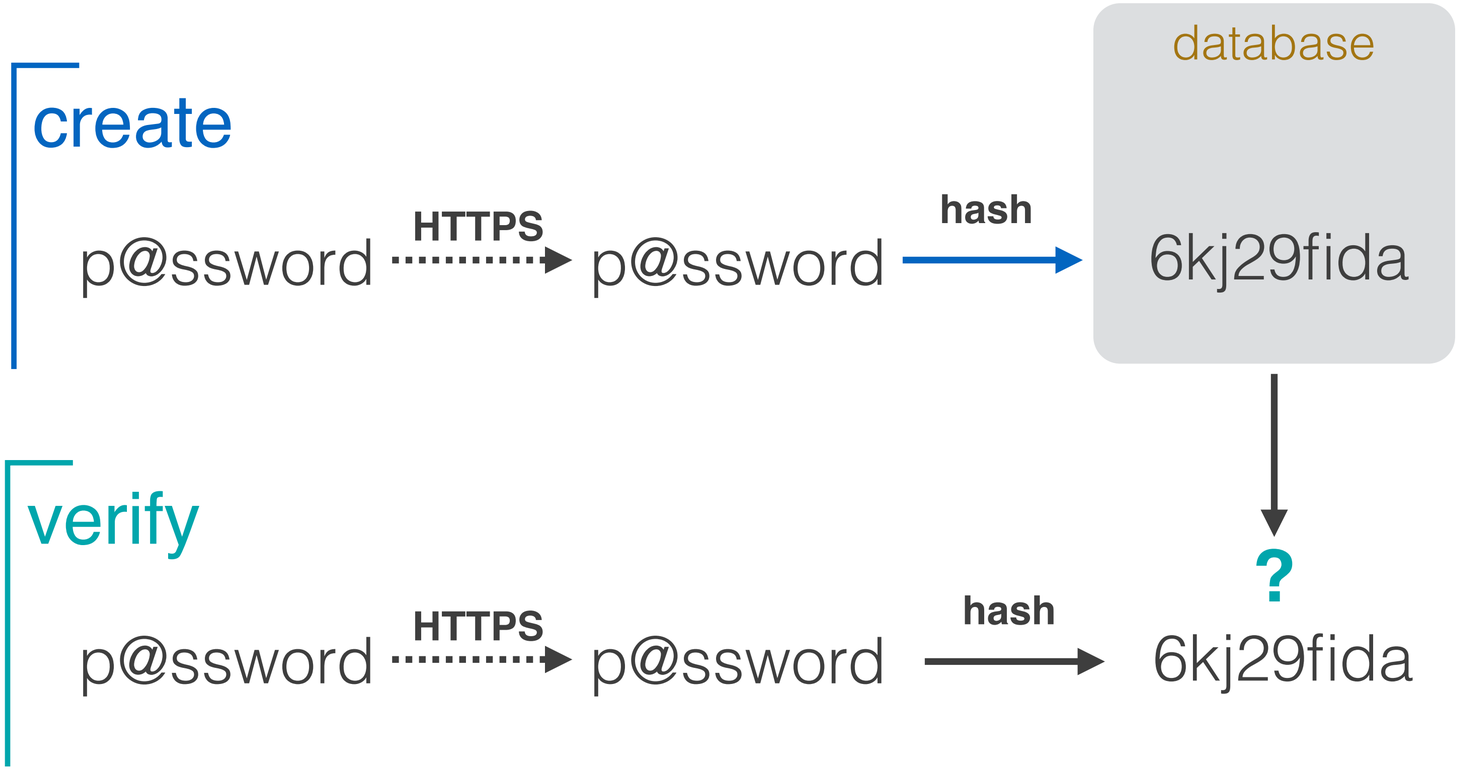


SALT

- Random string, unique to each user
- Added before hashing password
- Two users with the same password have different hashes
- Hashes are not computable ahead-of-time

PASSWORD SECURITY

SECURE STORAGE



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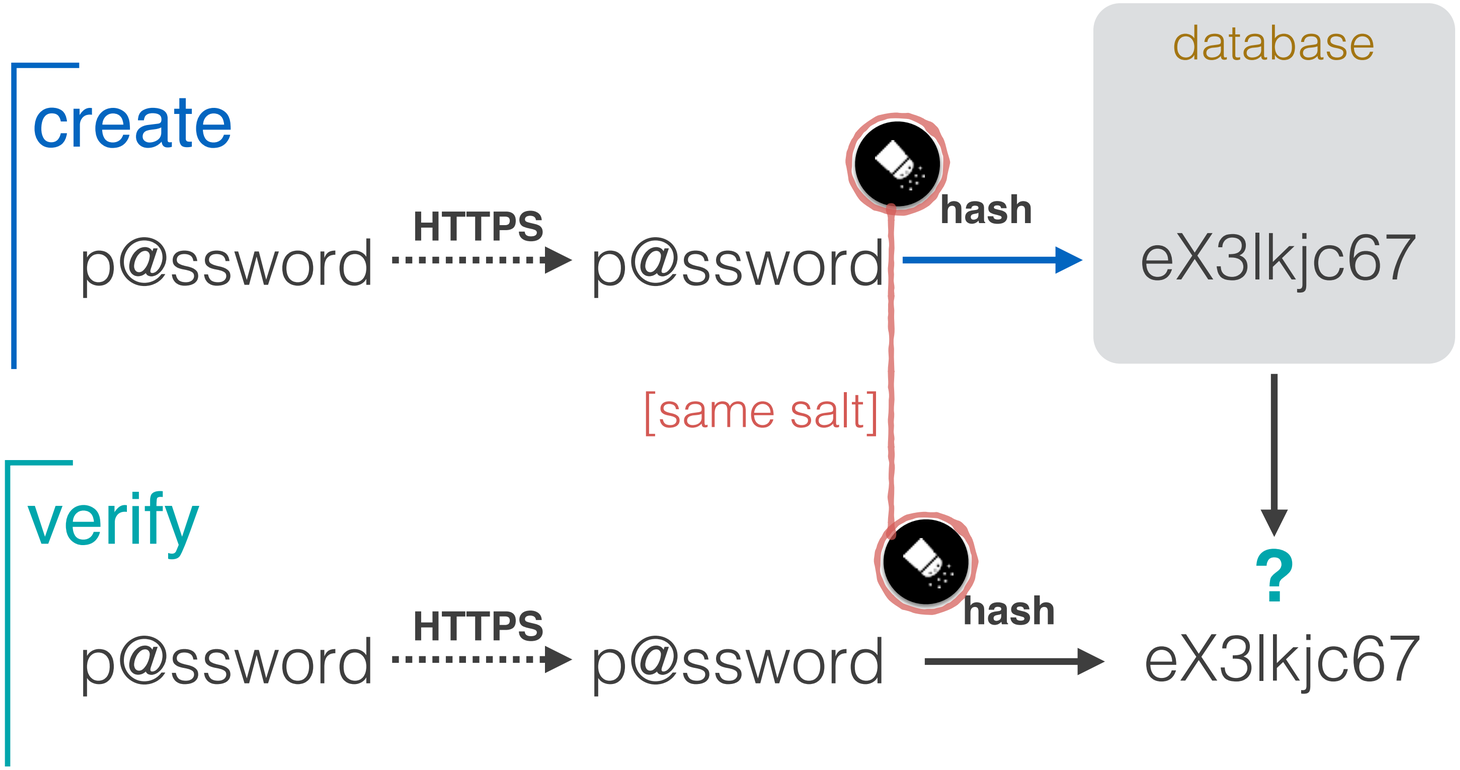

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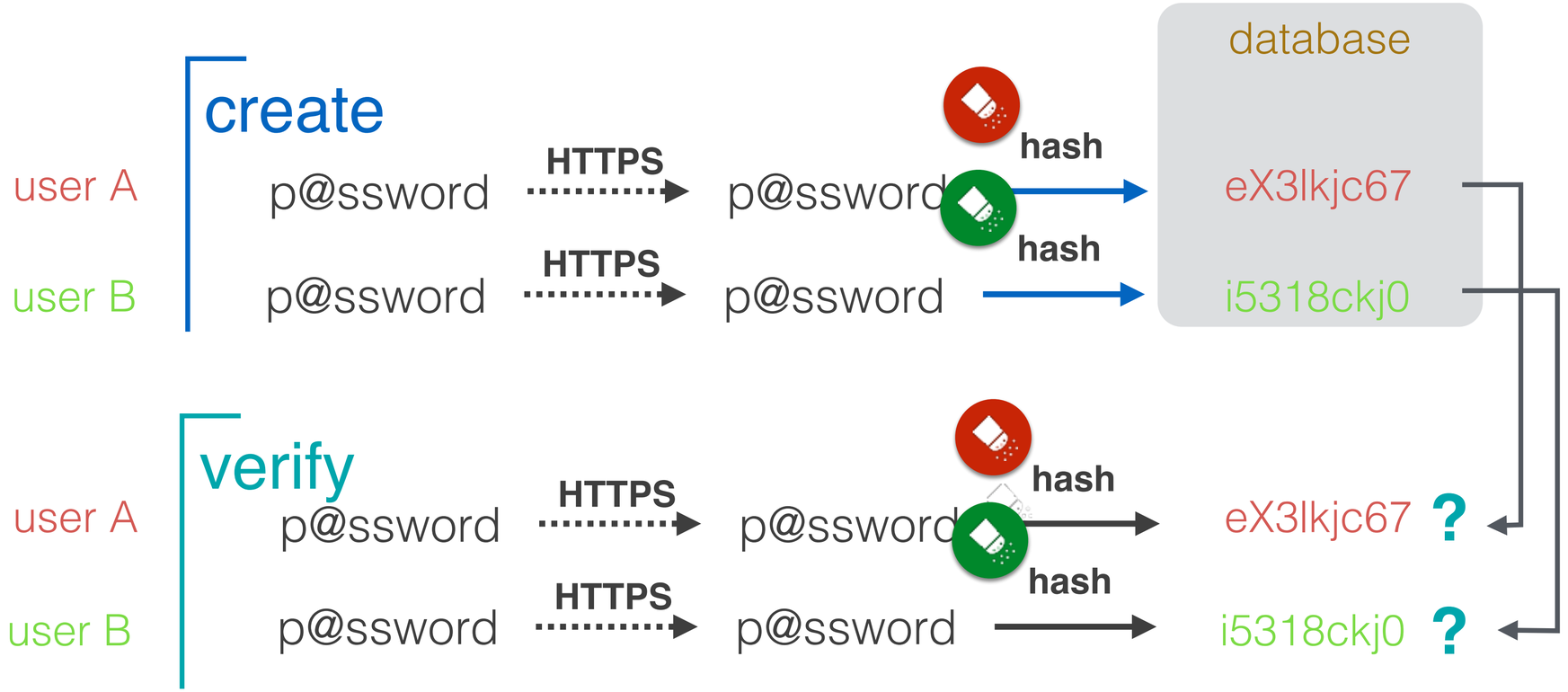

HASHING IN PRACTICE

```
// built-in node library
var crypto = require('crypto');
var salt = crypto.randomBytes(16);
var iterations = 1;
var bytes = 64;
var buffer = crypto.pbkdf2Sync('password', salt, iterations, bytes);
var hash = buffer.toString('base64');
// ...
```

```
User.generateSalt = function () {
  return crypto.randomBytes(16).toString('base64')
}

User.encryptPassword = function (plainText, salt) {
  return crypto
    .createHash('RSA-SHA256')
    .update(plainText)
    .update(salt)
    .digest('hex')
}

const setSaltAndPassword = user => {
  if (user.changed('password')) {
    user.salt = User.generateSalt()
    user.password = User.encryptPassword(user.password, user.salt)
  }
}

User.beforeCreate(setSaltAndPassword)
User.beforeUpdate(setSaltAndPassword)
```

OTHER CONSIDERATIONS

- Broken authentication flow
- Oversharing data

BROKEN AUTH

- Assume attacker is guest client
- Defense vulnerable if signup or login are improper
- Bad stuff: user impersonation, admin impersonation

OVERSHARING

- Assume attacker is non-admin client
- Defense vulnerable if attacker can see sensitive info of another
- Bad stuff: failed user privacy, NSA loves you

```
curl http://hogwarts.com/api/teachers
```

```
[
  {
    name: 'Dumbledore',
    position: 'headmaster',
    weaknesses: ['candy']
  },
  {
    name: 'Snape',
    position: 'Potions Master',
    weaknesses: ['unrequited love', 'conditioner']
  }
]
```

GOOD AUTH

- Communication is secure
- Storage is secure
- Cannot set privileges via signup
- Logging in requires username and password
- Data is not inadvertently shared

RECAP

FUNDAMENTAL CONCERNS

Authentication

Trusting that someone is who they say they are.

Communication

Transferring data through potentially unreliable middlemen.

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Control

Limiting or understanding the capabilities of agents.

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source

weak **authentication** | poor **authorization** | insecure **communication** | breakdown of **control**

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source

Lesson: [illegible] through the server.

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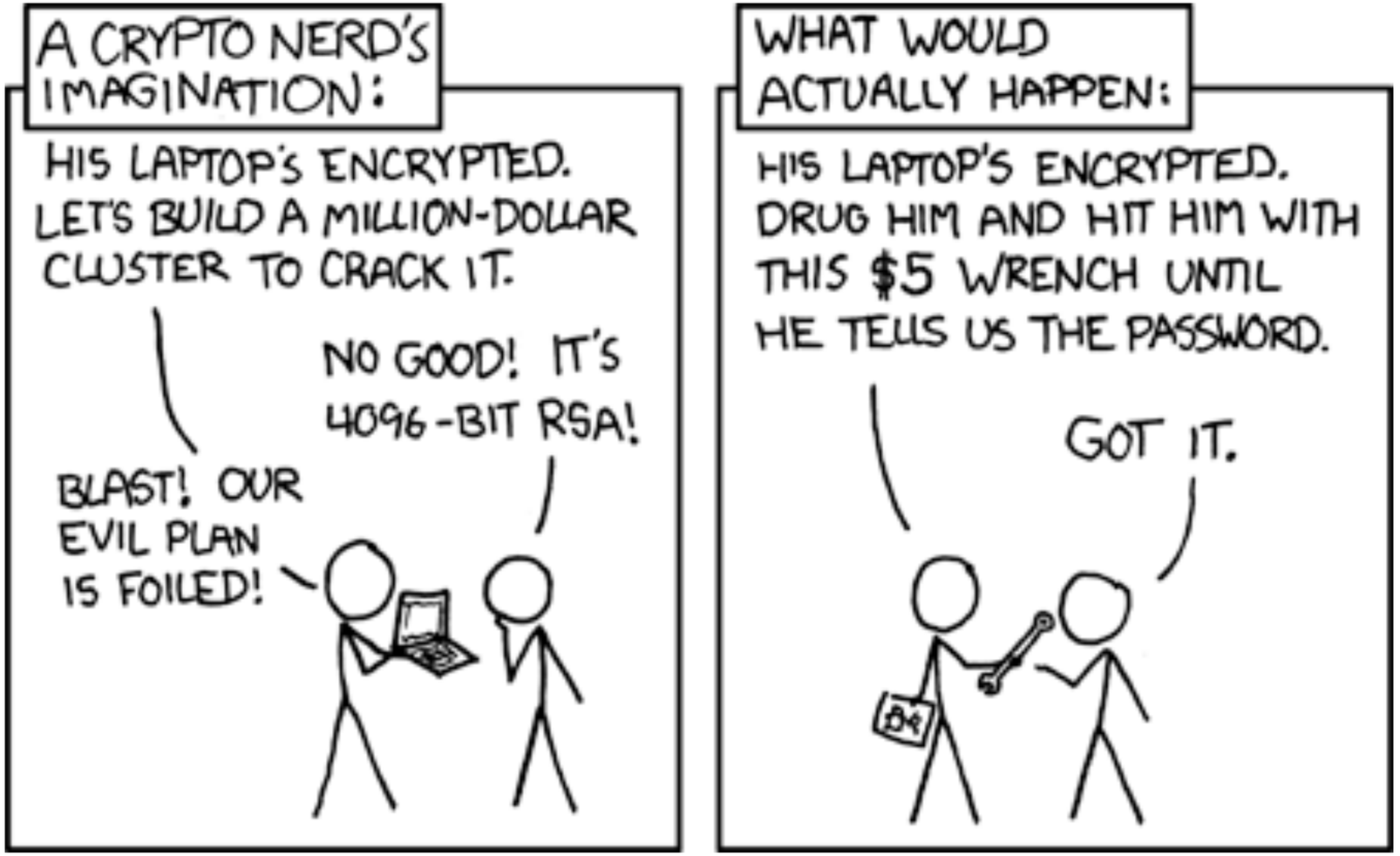

HTTPS://XKCD.COM/538/