SYNACKTIV

THCon Pre-Challenge

0xf4b

04/04/2024

whoami

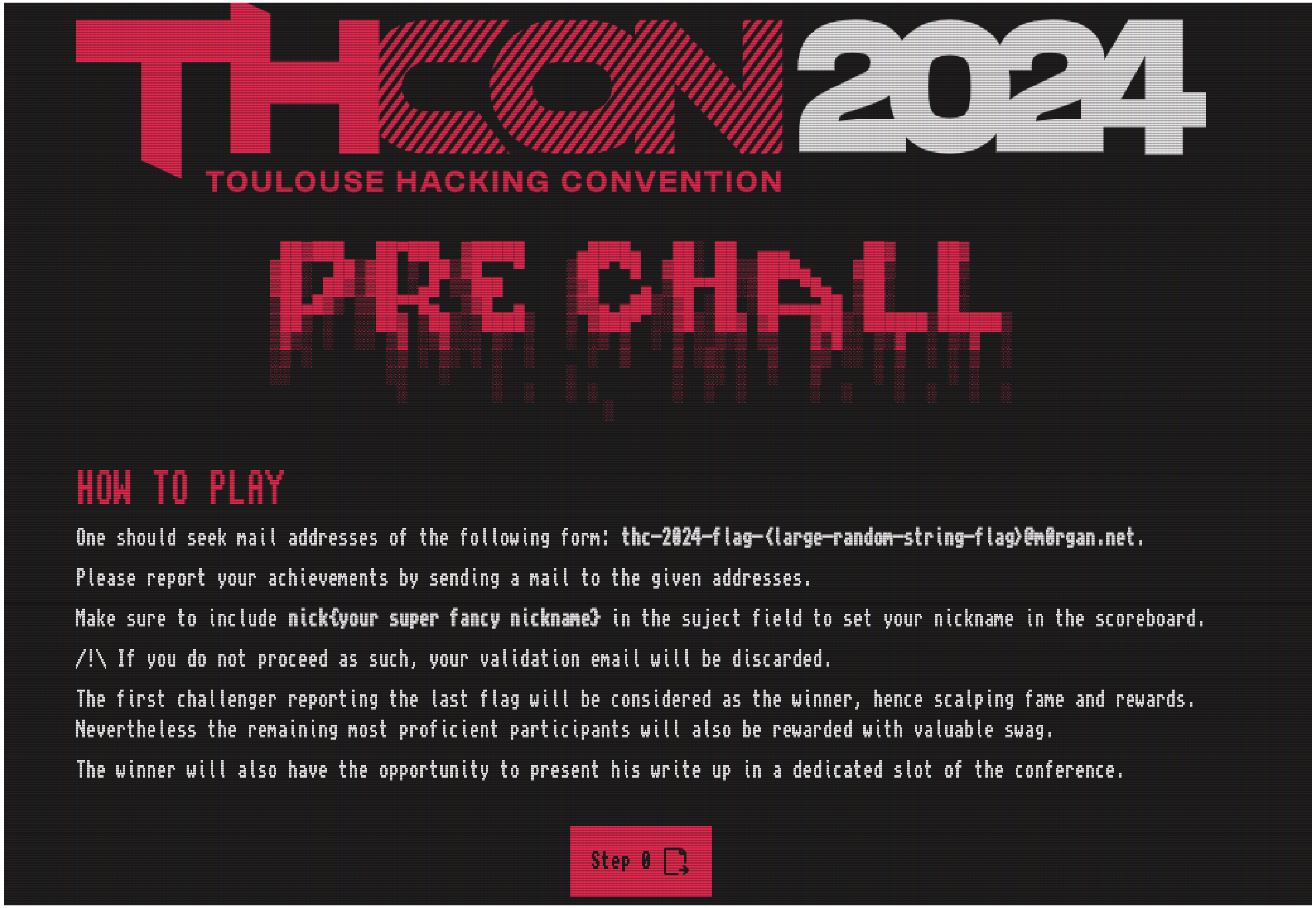
- Fabien PERIGAUD - 0xf4b
- Reverse team tech lead
- Challenges enthousiast

The challenge

SYNACKTIV

- **Four steps**
  - Step 0: Steganography
  - Step 1: Web
  - Step 2: Reverse
  - Step 3: Harder Reverse
- **Increasing difficulty**
  - Well… unless you don’t know web!

Step 0



HOW TO PLAY

One should seek mail addresses of the following form: **thc-2024-flag-<large-random-string-flag>@m0rgan.net**.

Please report your achievements by sending a mail to the given addresses.

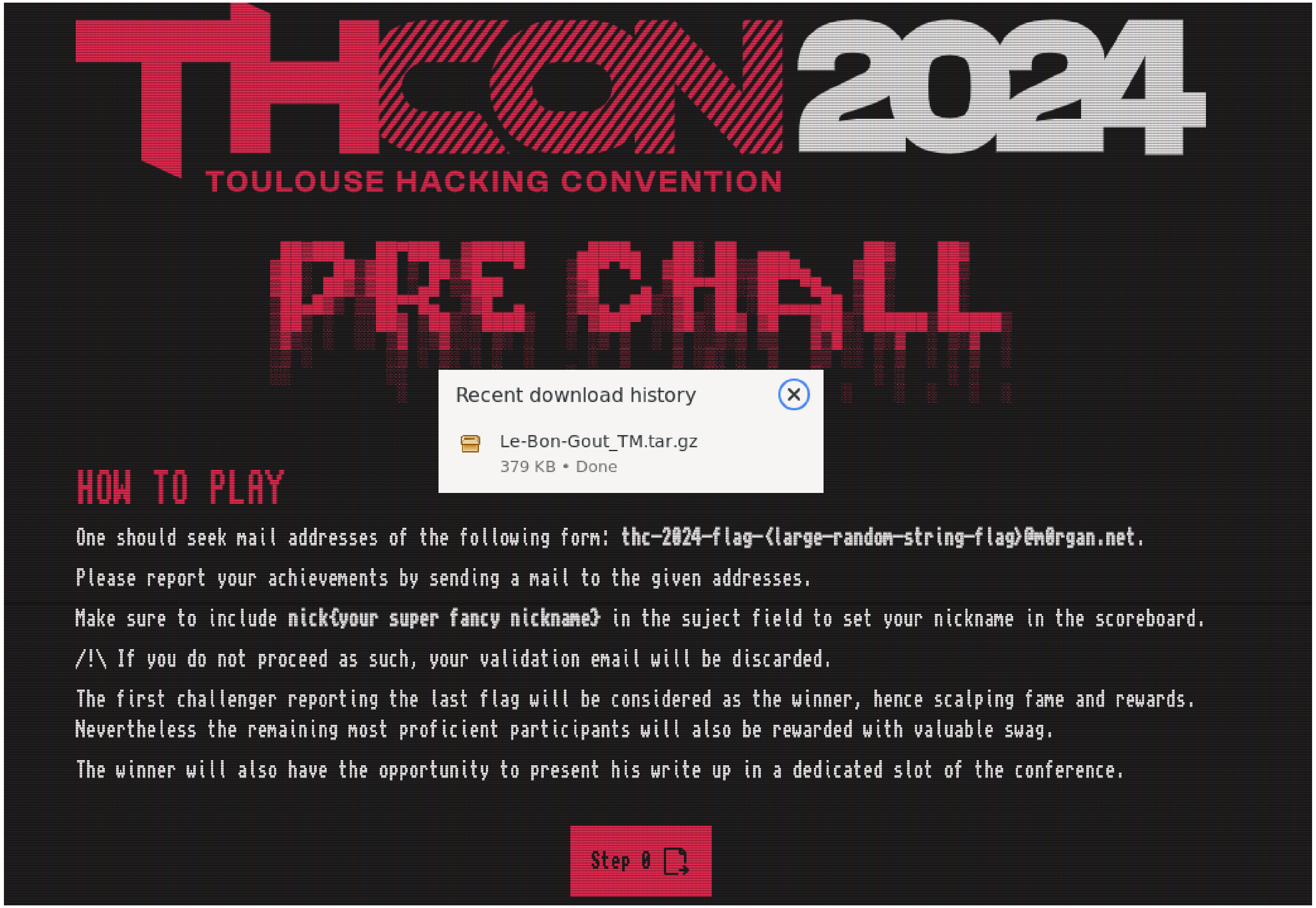
Make sure to include **nick{your super fancy nickname}** in the suject field to set your nickname in the scoreboard.

/!\ If you do not proceed as such, your validation email will be discarded.

The first challenger reporting the last flag will be considered as the winner, hence scalping fame and rewards.
Nevertheless the remaining most proficient participants will also be rewarded with valuable swag.

The winner will also have the opportunity to present his write up in a dedicated slot of the conference.

Step 0



HOW TO PLAY

One should seek mail addresses of the following form: **thc-2024-flag-<large-random-string-flag>@m0rgan.net**.

Please report your achievements by sending a mail to the given addresses.

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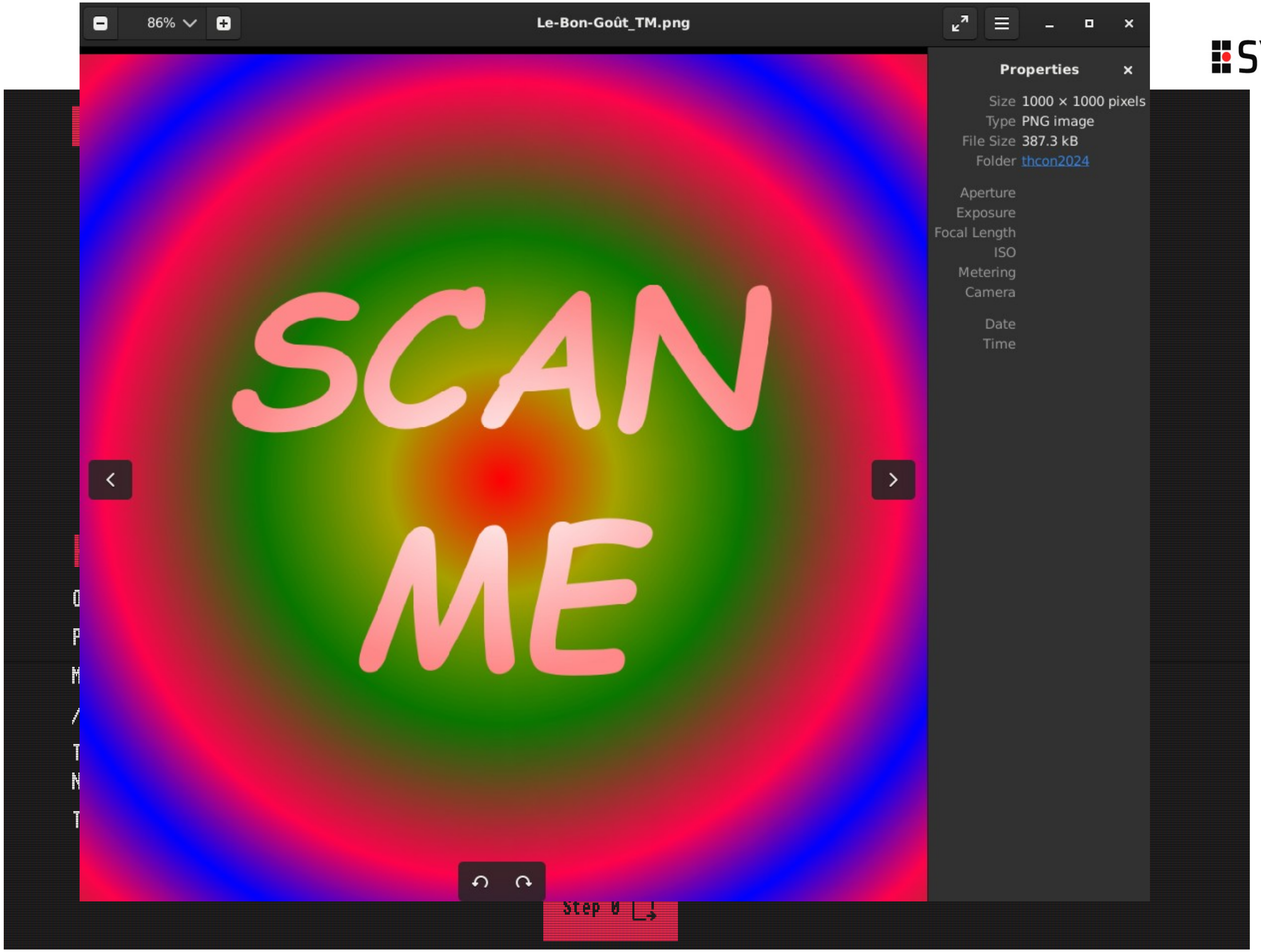
Step 0



Le-Bon-Goût_TM.png

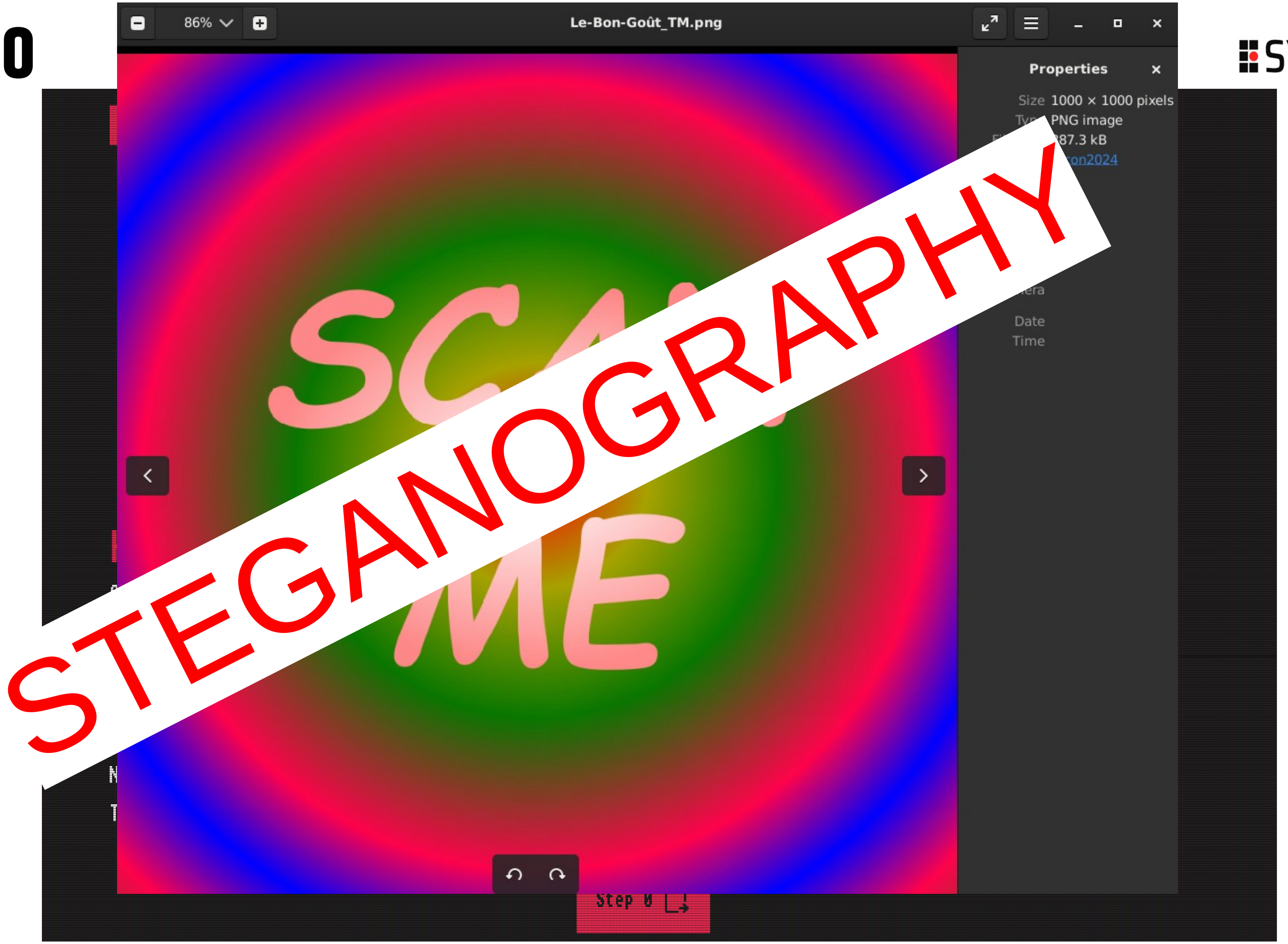
86%

Properties

Size	1000 × 1000 pixels
Type	PNG image
File Size	387.3 kB
Folder	thcon2024
Aperture	
Exposure	
Focal Length	
ISO	
Metering	
Camera	
Date	
Time	

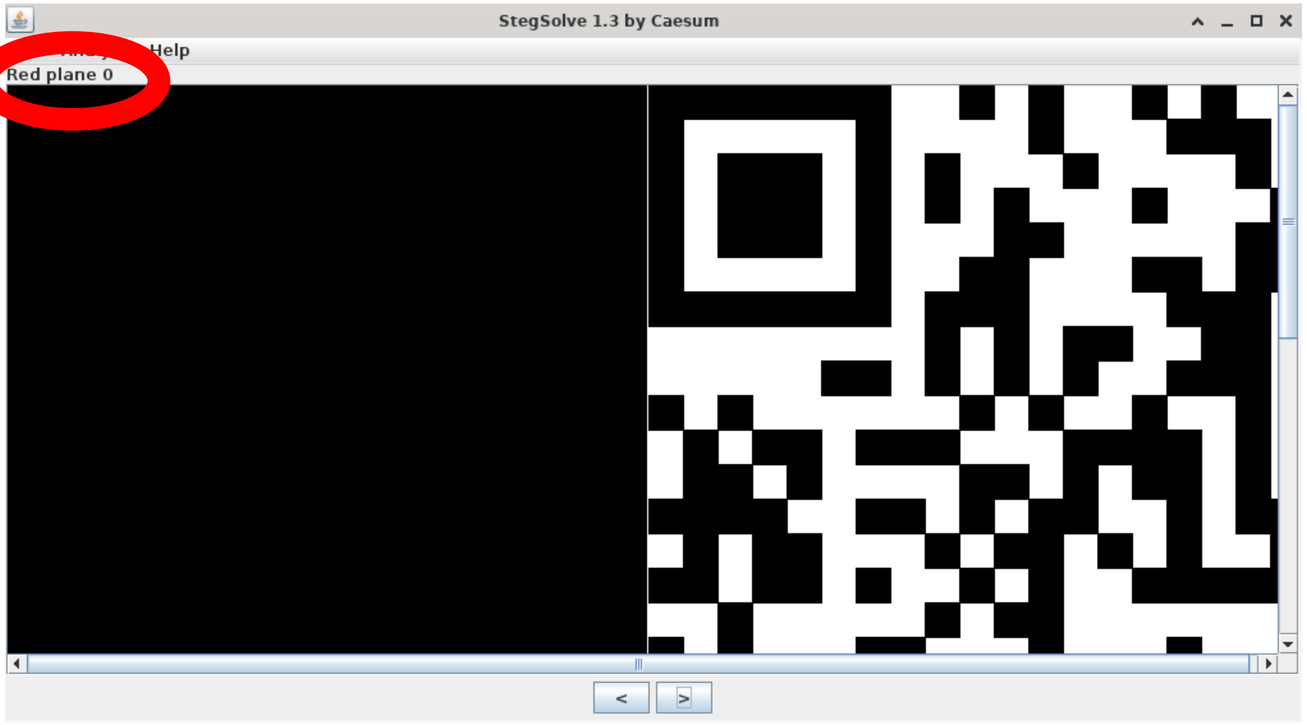
Step 0

SYNACKTIV

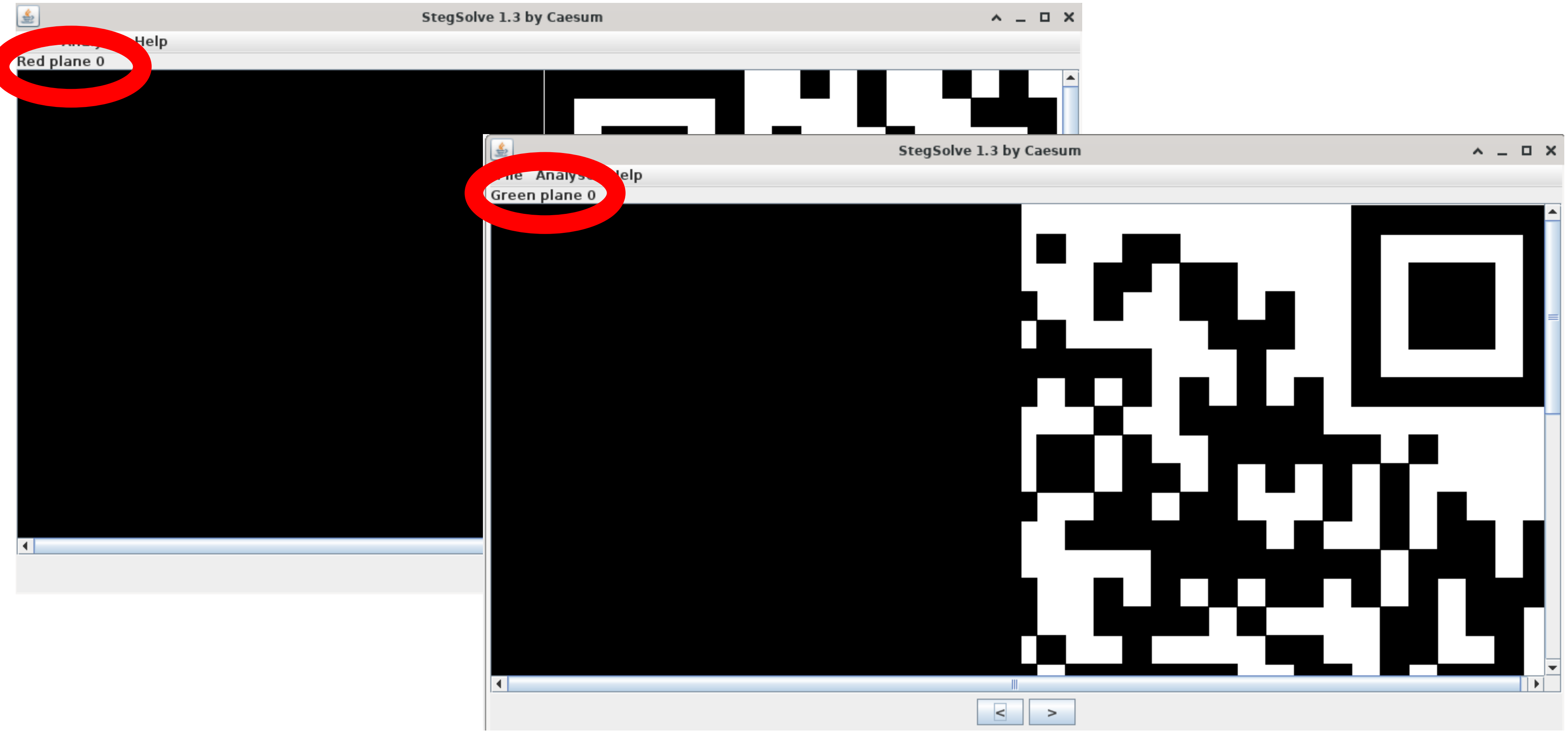


Step 0 → StegSolve

SYNACKTIV

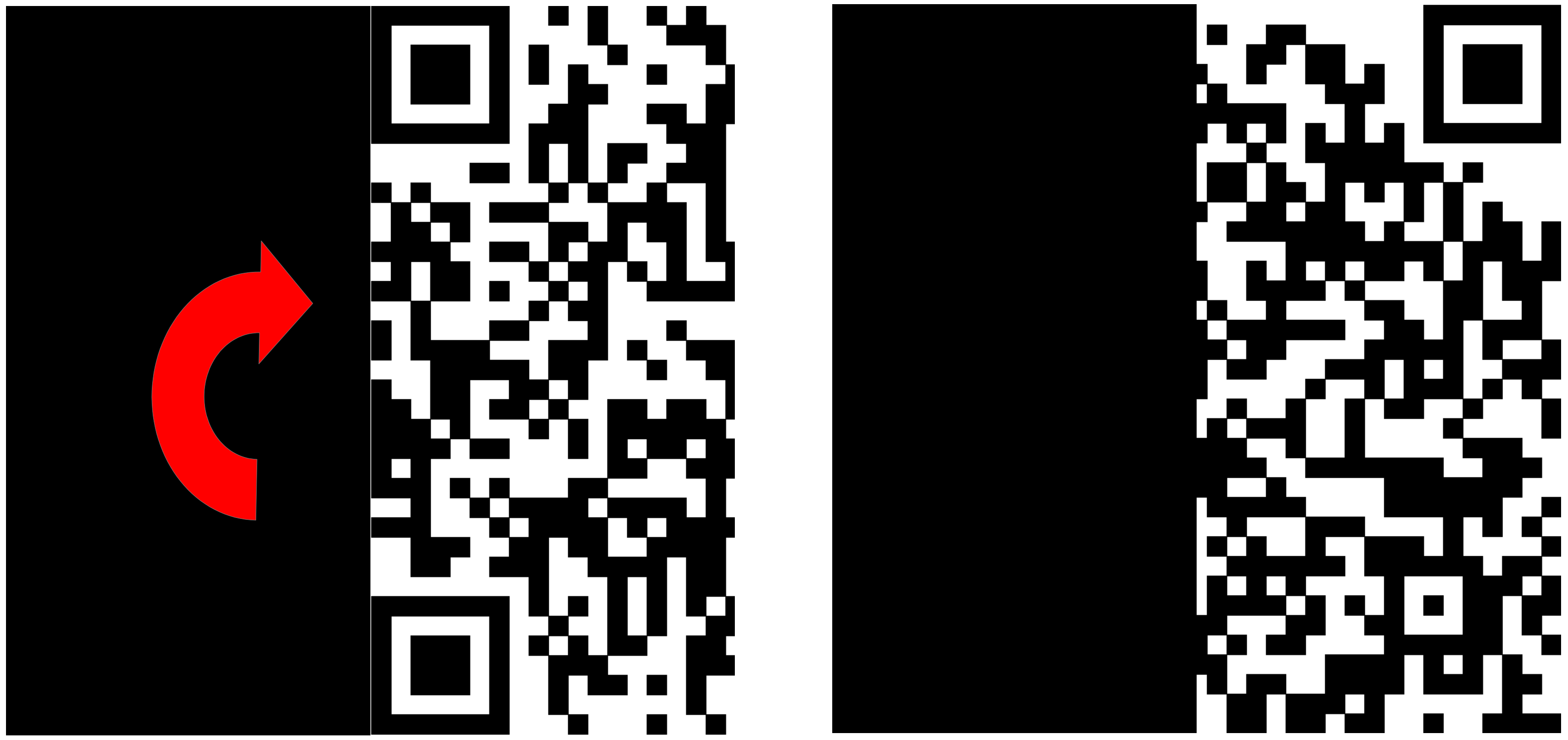


Step 0 → StegSolve

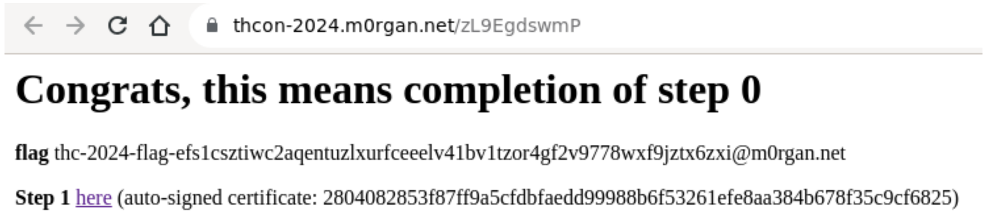


Step 0

SYNACKTIV



Step 0 - Done

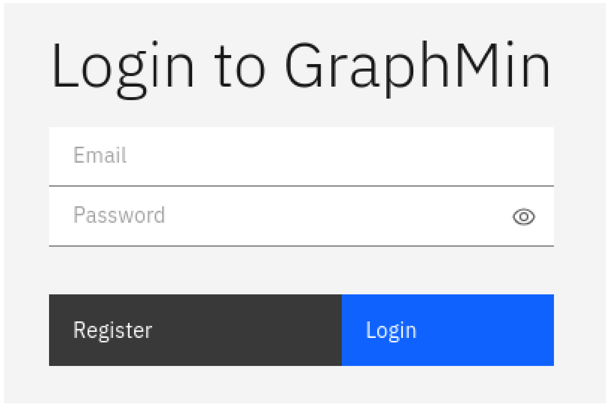

thcon-2024.m0rgan.net/zL9EgdswmP

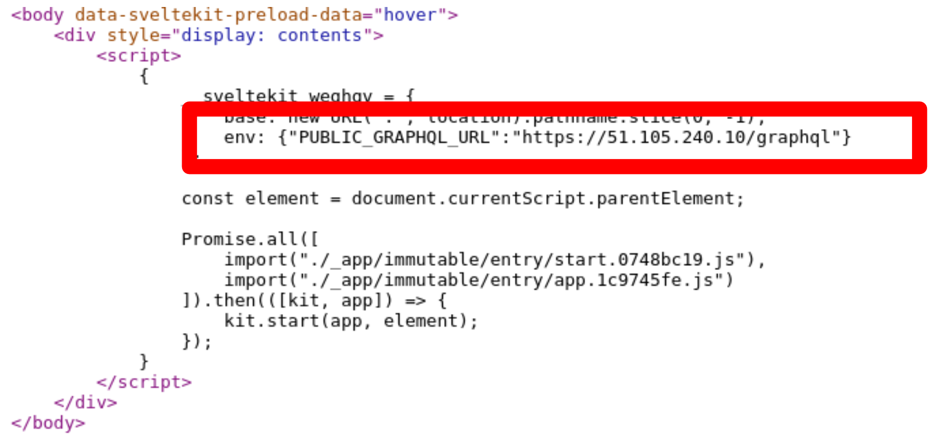
Congrats, this means completion of step 0

flag thc-2024-flag-efs1csztiwc2aqentuzlxurfceeelv41bv1tzor4gf2v9778wxf9jztx6zxi@m0rgan.net

Step 1 here (auto-signed certificate: 2804082853f87ff9a5cfdbfaedd99988b6f53261efe8aa384b678f35c9cf6825)

Step 1

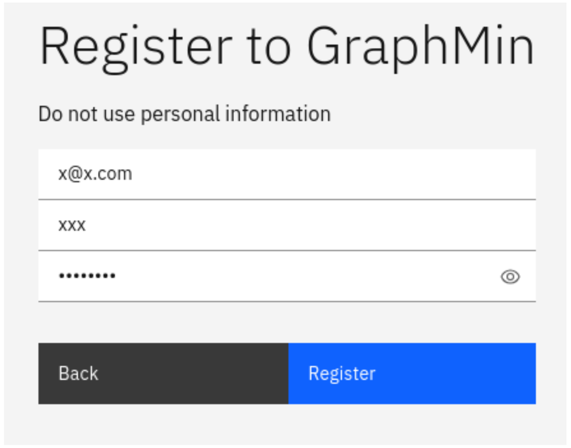




```
<body data-sveltekit-preload-data="hover">
    <div style="display: contents">
        <script>
            {
                  sveltekit_weqhqv = {
                    base: new URL(".", location).pathname.slice(0, -1),
                    env: {"PUBLIC_GRAPHQL_URL":"https://51.105.240.10/graphql"}

                const element = document.currentScript.parentElement;

                Promise.all([
                    import("./_app/immutable/entry/start.0748bc19.js"),
                    import("./_app/immutable/entry/app.1c9745fe.js")
                ]).then(([kit, app]) => {
                    kit.start(app, element);
                });
            }
        </script>
    </div>
</body>
```

Step 1 - Register

SYNACKTIV

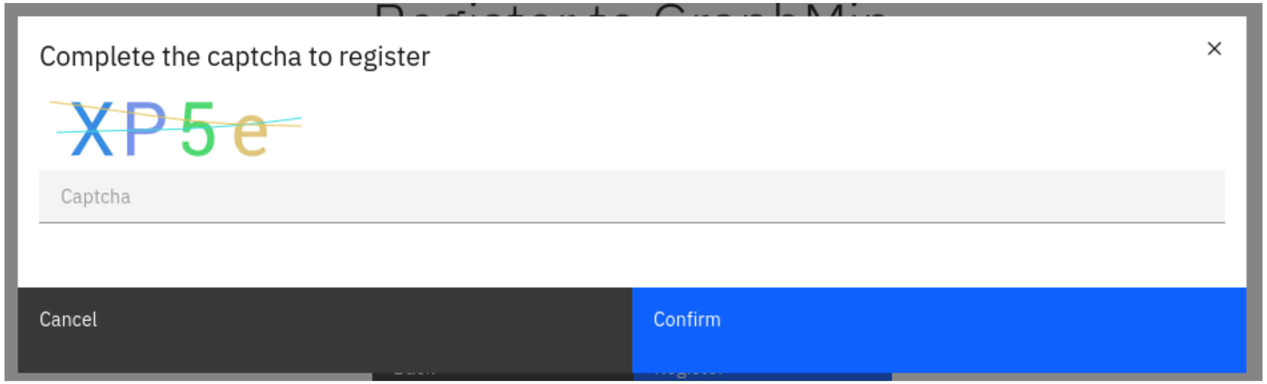

Register to GraphMin

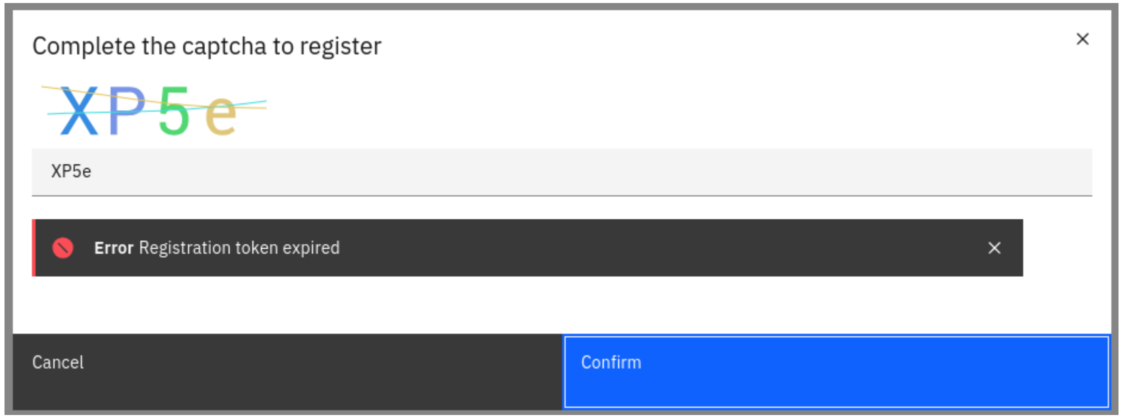
Do not use personal information

x@x.com

xxx

•••••••••

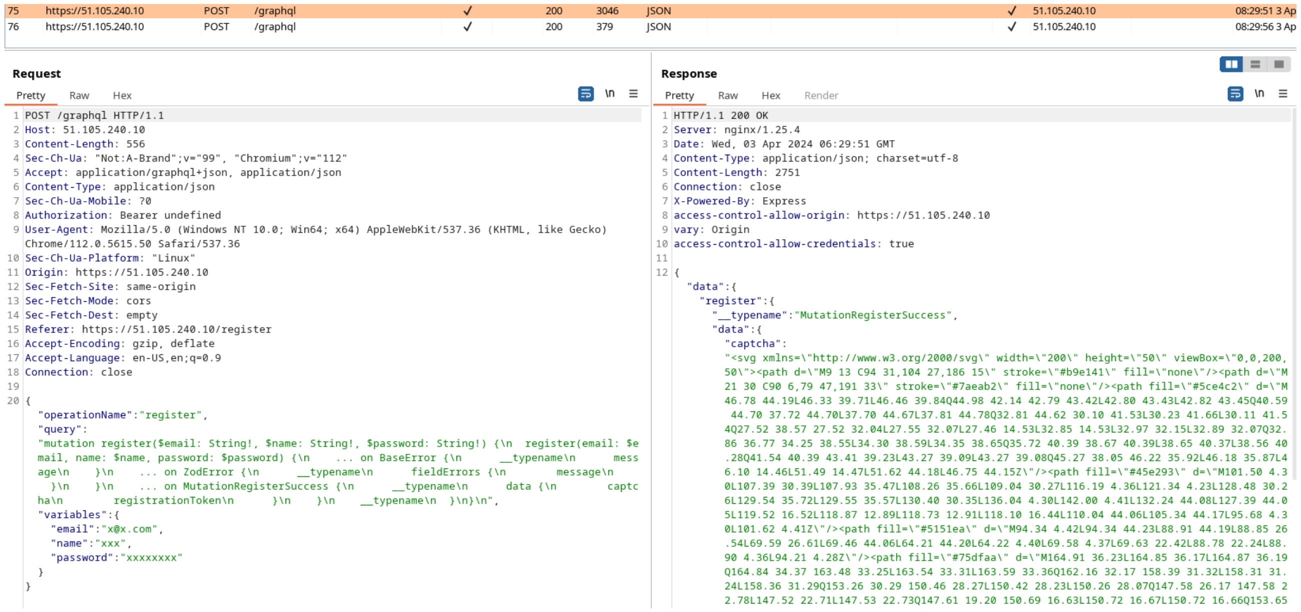

Complete the captcha to register


Complete the captcha to register

XP5e

Error Registration token expired

Step 1 - Register



75	https://51.105.240.10	POST	/graphql	✓	200	3046	JSON	✓ 51.105.240.10	08:29:51 3 Ap
76	https://51.105.240.10	POST	/graphql	✓	200	379	JSON	✓ 51.105.240.10	08:29:56 3 Ap

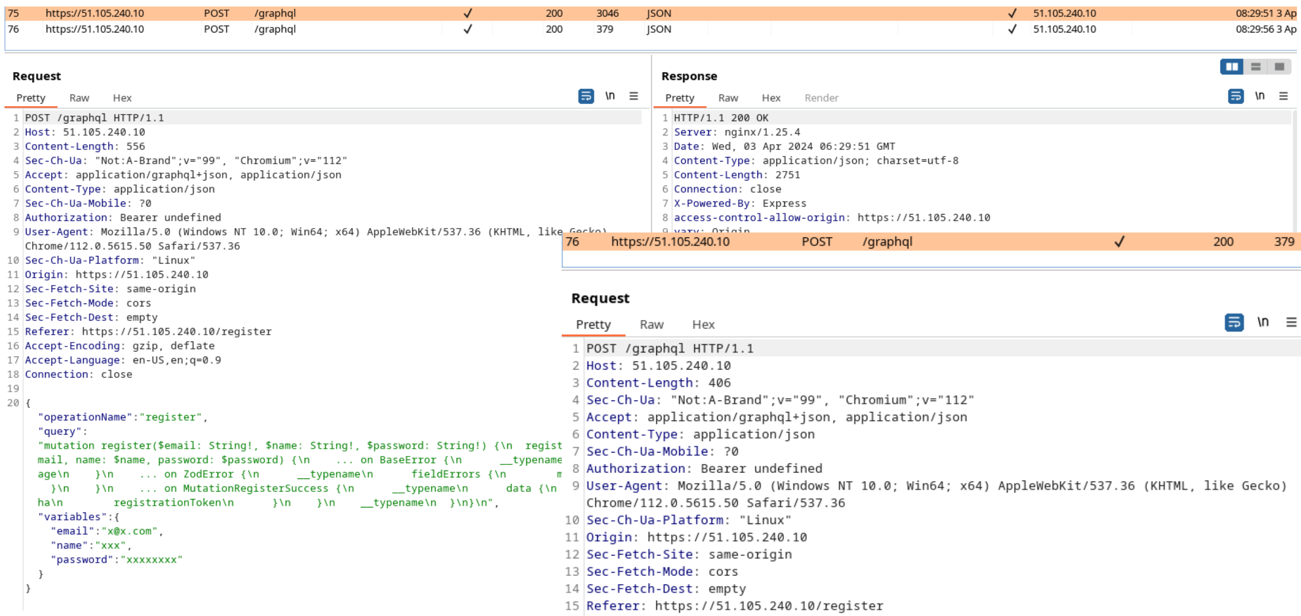
Request

```
POST /graphql HTTP/1.1
Host: 51.105.240.10
Content-Length: 556
Sec-Ch-Ua: "Not:A-Brand";v="99", "Chromium";v="112"
Accept: application/graphql+json, application/json
Content-Type: application/json
Sec-Ch-Ua-Mobile: ?0
Authorization: Bearer undefined
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/112.0.5615.50 Safari/537.36
Sec-Ch-Ua-Platform: "Linux"
Origin: https://51.105.240.10
Sec-Fetch-Site: same-origin
Sec-Fetch-Mode: cors
Sec-Fetch-Dest: empty
Referer: https://51.105.240.10/register
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en;q=0.9
Connection: close

{
  "operationName":"register",
  "query":
  "mutation register($email: String!, $name: String!, $password: String!) {\n  register(email: $e
  mail, name: $name, password: $password) {\n    ... on BaseError {\n      __typename\n      mess
  age\n    }\n    ... on ZodError {\n      __typename\n      fieldErrors {\n        message\n
    }\n    }\n    ... on MutationRegisterSuccess {\n      __typename\n      data {\n        captc
  ha\n        registrationToken\n      }\n    }\n    __typename\n  }\n}\n",
  "variables":{
    "email":"x@x.com",
    "name":"xxx",
    "password":"xxxxxxxx"
  }
}
```

Response

```
HTTP/1.1 200 OK
Server: nginx/1.25.4
Date: Wed, 03 Apr 2024 06:29:51 GMT
Content-Type: application/json; charset=utf-8
Content-Length: 2751
Connection: close
X-Powered-By: Express
access-control-allow-origin: https://51.105.240.10
vary: Origin
access-control-allow-credentials: true

{
  "data":{
    "register":{
      "__typename":"MutationRegisterSuccess",
      "data":{
        "captcha":
        "<svg xmlns=\"http://www.w3.org/2000/svg\" width=\"200\" height=\"50\" viewBox=\"0,0,200,
        50\"><path d=\"M9 13 C94 31,104 27,186 15\" stroke=\"#b9e141\" fill=\"none\"/><path d=\"M
        21 30 C90 6,79 47,191 33\" stroke=\"#7aeab2\" fill=\"none\"/><path fill=\"#5ce4c2\" d=\"M
        46.78 44.19L46.33 39.71L46.46 39.84Q44.98 42.14 42.79 43.42L42.80 43.43L42.82 43.45Q40.59
         44.70 37.72 44.70L37.70 44.67L37.81 44.78Q32.81 44.62 30.10 41.53L30.23 41.66L30.11 41.5
        4Q27.52 38.57 27.52 32.04L27.55 32.07L27.46 14.53L32.85 14.53L32.97 32.15L32.89 32.07Q32.
        86 36.77 34.25 38.55L34.30 38.59L34.35 38.65Q35.72 40.39 38.67 40.39L38.65 40.37L38.56 40
        .28Q41.54 40.39 43.41 39.23L43.27 39.09L43.27 39.08Q45.27 38.05 46.22 35.92L46.18 35.87L4
        6.10 14.46L51.49 14.47L51.62 44.18L46.75 44.15Z\"/><path fill=\"#45e293\" d=\"M101.50 4.3
        0L107.39 30.39L107.93 35.47L108.26 35.66L109.04 30.27L116.19 4.36L121.34 4.23L128.48 30.2
        6L129.54 35.72L129.55 35.57L130.40 30.35L136.04 4.30L142.00 4.41L132.24 44.08L127.39 44.0
        5L119.52 16.52L118.87 12.89L118.73 12.91L118.10 16.44L110.04 44.06L105.34 44.17L95.68 4.3
        0L101.62 4.41Z\"/><path fill=\"#5151ea\" d=\"M94.34 4.42L94.34 44.23L88.91 44.19L88.85 26
        .54L69.59 26.61L69.46 44.06L64.21 44.20L64.22 4.40L69.58 4.37L69.63 22.42L88.78 22.24L88.
        90 4.36L94.21 4.28Z\"/><path fill=\"#75dfaa\" d=\"M164.91 36.23L164.85 36.17L164.87 36.19
        Q164.84 34.37 163.48 33.25L163.54 33.31L163.59 33.36Q162.16 32.17 158.39 31.32L158.31 31.
        24L158.36 31.29Q153.26 30.29 150.46 28.27L150.42 28.23L150.26 28.07Q147.58 26.17 147.58 2
        2.78L147.52 22.71L147.53 22.73Q147.61 19.20 150.69 16.63L150.72 16.67L150.72 16.66Q153.65
```

Step 1 - Register



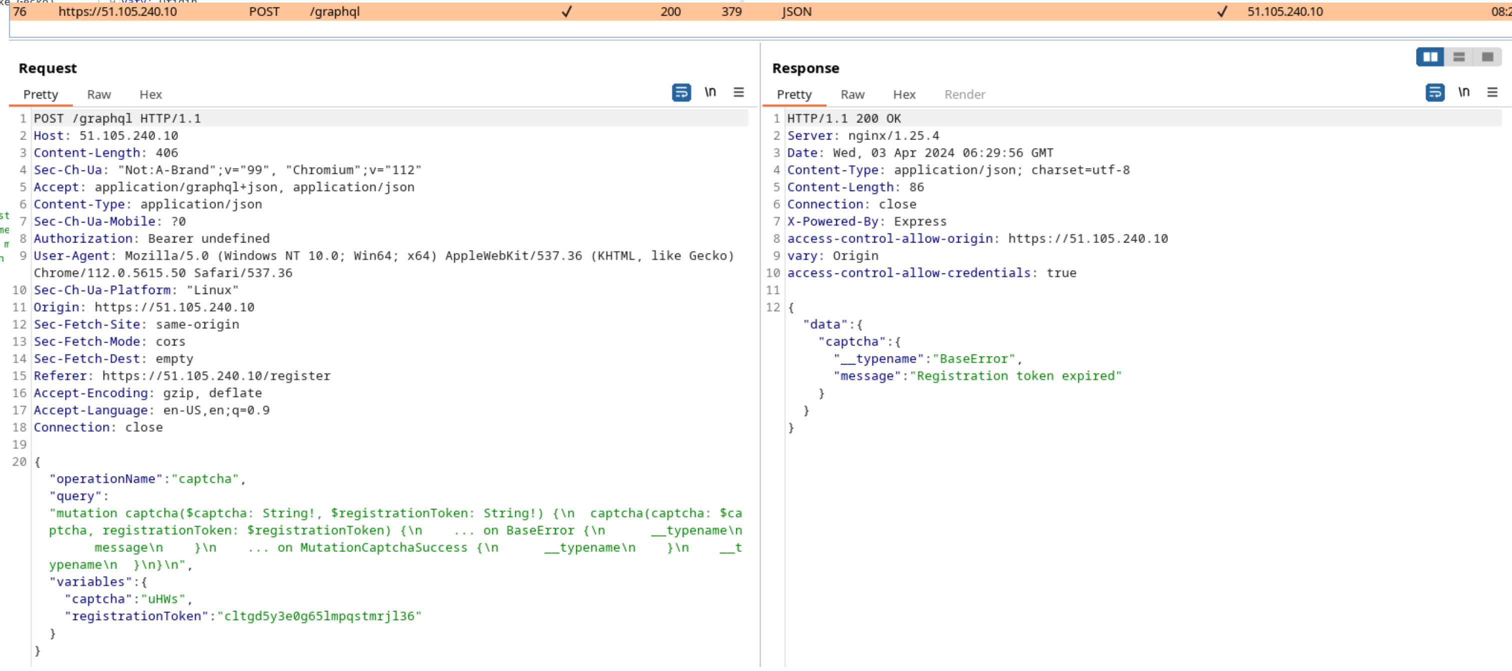
```
75   https://51.105.240.10   POST   /graphql   ✓   200   3046   JSON   ✓   51.105.240.10   08:29:51 3 Ap
76   https://51.105.240.10   POST   /graphql   ✓   200   379    JSON   ✓   51.105.240.10   08:29:56 3 Ap
```

Request

```
POST /graphql HTTP/1.1
Host: 51.105.240.10
Content-Length: 556
Sec-Ch-Ua: "Not:A-Brand";v="99", "Chromium";v="112"
Accept: application/graphql+json, application/json
Content-Type: application/json
Sec-Ch-Ua-Mobile: ?0
Authorization: Bearer undefined
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/112.0.5615.50 Safari/537.36
Sec-Ch-Ua-Platform: "Linux"
Origin: https://51.105.240.10
Sec-Fetch-Site: same-origin
Sec-Fetch-Mode: cors
Sec-Fetch-Dest: empty
Referer: https://51.105.240.10/register
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en;q=0.9
Connection: close

{
  "operationName":"register",
  "query":
  "mutation register($email: String!, $name: String!, $password: String!) {\n  regist
  mail, name: $name, password: $password) {\n    ... on BaseError {\n      __typename
  age\n    }\n    ... on ZodError {\n      __typename\n      fieldErrors {\n        m
    }\n    }\n    ... on MutationRegisterSuccess {\n      __typename\n      data {\n
  ha\n        registrationToken\n      }\n    }\n    __typename\n  }\n}\n",
  "variables":{
    "email":"x@x.com",
    "name":"xxx",
    "password":"xxxxxxxx"
  }
}
```

Response

```
HTTP/1.1 200 OK
Server: nginx/1.25.4
Date: Wed, 03 Apr 2024 06:29:51 GMT
Content-Type: application/json; charset=utf-8
Content-Length: 2751
Connection: close
X-Powered-By: Express
access-control-allow-origin: https://51.105.240.10
vary: Origin
```



```
76   https://51.105.240.10   POST   /graphql   ✓   200   379   JSON   ✓   51.105.240.10   08:2
```

Request

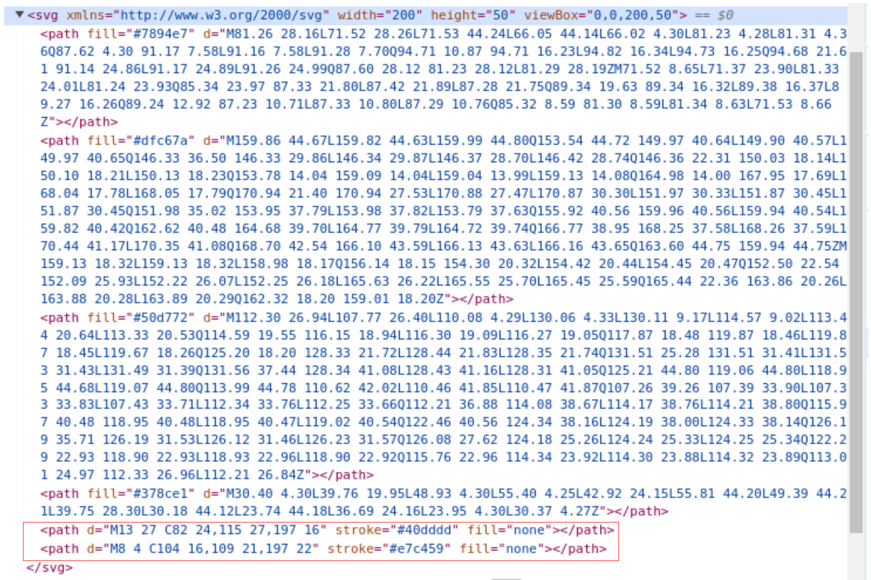
```
POST /graphql HTTP/1.1
Host: 51.105.240.10
Content-Length: 406
Sec-Ch-Ua: "Not:A-Brand";v="99", "Chromium";v="112"
Accept: application/graphql+json, application/json
Content-Type: application/json
Sec-Ch-Ua-Mobile: ?0
Authorization: Bearer undefined
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/112.0.5615.50 Safari/537.36
Sec-Ch-Ua-Platform: "Linux"
Origin: https://51.105.240.10
Sec-Fetch-Site: same-origin
Sec-Fetch-Mode: cors
Sec-Fetch-Dest: empty
Referer: https://51.105.240.10/register
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en;q=0.9
Connection: close

{
  "operationName":"captcha",
  "query":
  "mutation captcha($captcha: String!, $registrationToken: String!) {\n  captcha(captcha: $ca
  ptcha, registrationToken: $registrationToken) {\n    ... on BaseError {\n      __typename\n
        message\n    }\n    ... on MutationCaptchaSuccess {\n      __typename\n    }\n    __t
  ypename\n  }\n}\n",
  "variables":{
    "captcha":"uHWs",
    "registrationToken":"cltgd5y3e0g65lmpqstmrjl36"
  }
}
```

Response

```
HTTP/1.1 200 OK
Server: nginx/1.25.4
Date: Wed, 03 Apr 2024 06:29:56 GMT
Content-Type: application/json; charset=utf-8
Content-Length: 86
Connection: close
X-Powered-By: Express
access-control-allow-origin: https://51.105.240.10
vary: Origin
access-control-allow-credentials: true

{
  "data":{
    "captcha":{
      "__typename":"BaseError",
      "message":"Registration token expired"
    }
  }
}
```

Step 1 – break captcha!

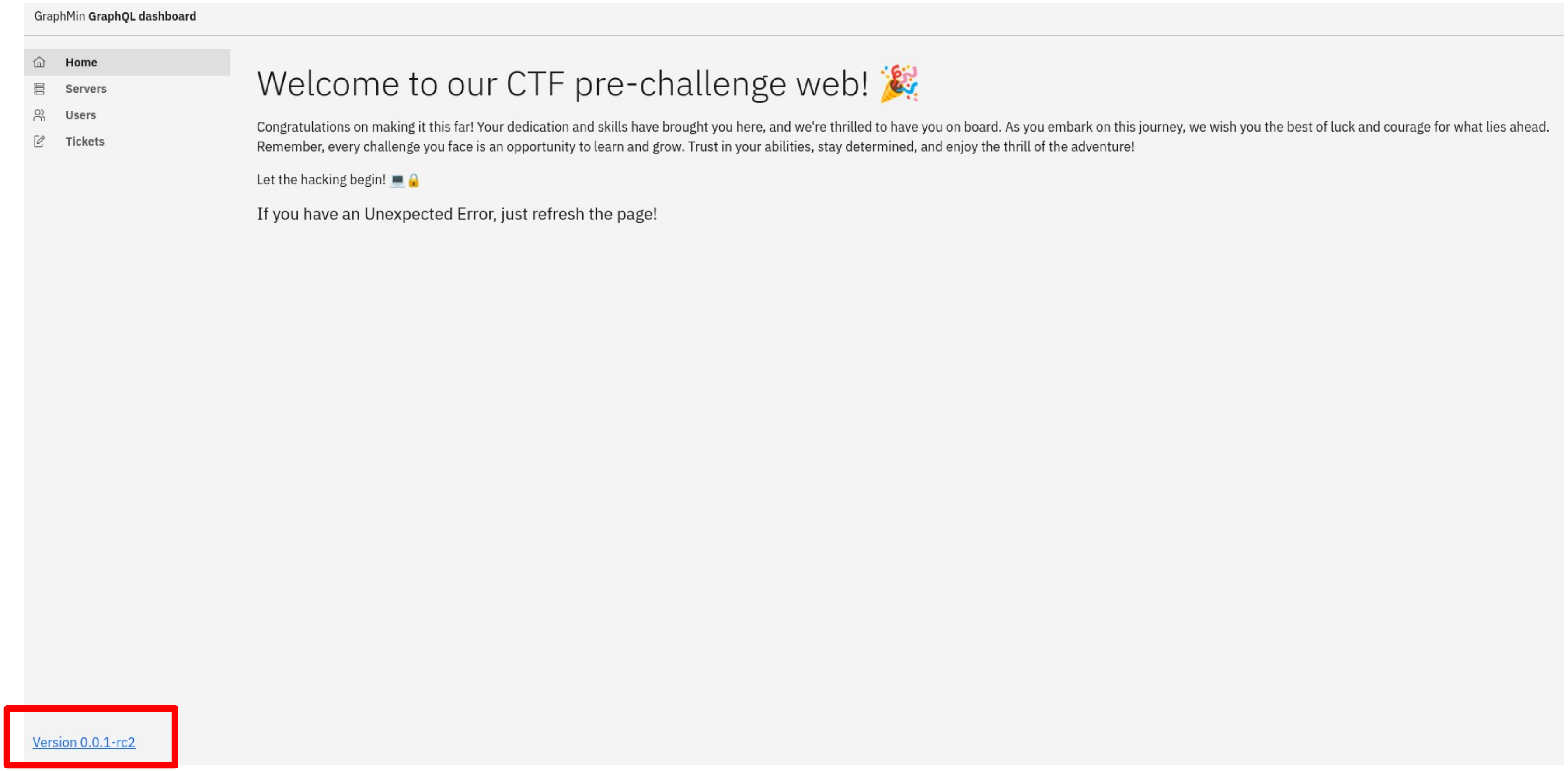
- **First try with Tesseract → fail**
- **SVG format!**
  - Just remove the lines…
- **Now Tesseract works :)**



```
▼<svg xmlns="http://www.w3.org/2000/svg" width="200" height="50" viewBox="0,0,200,50"> == $0
   <path fill="#7894e7" d="M81.26 28.16L71.52 28.26L71.53 44.24L66.05 44.14L66.02 4.30L81.23 4.28L81.31 4.3
   6Q87.62 4.30 91.17 7.58L91.16 7.58L91.28 7.70Q94.71 10.87 94.71 16.23L94.82 16.34L94.73 16.25Q94.68 21.6
   1 91.14 24.86L91.17 24.89L91.26 24.99Q87.60 28.12 81.23 28.12L81.29 28.19ZM71.52 8.65L71.37 23.90L81.33
   24.01L81.24 23.93Q85.34 23.97 87.33 21.80L87.42 21.89L87.28 21.75Q89.34 19.63 89.34 16.32L89.38 16.37L8
   9.27 16.26Q89.24 12.92 87.23 10.71L87.33 10.80L87.29 10.76Q85.32 8.59 81.30 8.59L81.34 8.63L71.53 8.66
   Z"></path>
   <path fill="#dfc67a" d="M159.86 44.67L159.82 44.63L159.99 44.80Q153.54 44.72 149.97 40.64L149.90 40.57L1
   49.97 40.65Q146.33 36.50 146.33 29.86L146.34 29.87L146.37 28.70L146.42 28.74Q146.36 22.31 150.03 18.14L1
   50.10 18.21L150.13 18.23Q153.78 14.04 159.09 14.04L159.04 13.99L159.13 14.08Q164.98 14.00 167.95 17.69L1
   68.04 17.78L168.05 17.79Q170.94 21.40 170.94 27.53L170.88 27.47L170.87 30.30L151.97 30.33L151.87 30.45L1
   51.87 30.45Q151.98 35.02 153.95 37.79L153.98 37.82L153.79 37.63Q155.92 40.56 159.96 40.56L159.94 40.54L1
   59.82 40.42Q162.62 40.48 164.68 39.70L164.77 39.79L164.72 39.74Q166.77 38.95 168.25 37.58L168.26 37.59L1
   70.44 41.17L170.35 41.08Q168.70 42.54 166.10 43.59L166.13 43.63L166.16 43.65Q163.60 44.75 159.94 44.75ZM
   159.13 18.32L159.13 18.32L158.98 18.17Q156.14 18.15 154.30 20.32L154.42 20.44L154.45 20.47Q152.50 22.54
   152.09 25.93L152.22 26.07L152.25 26.18L165.63 26.22L165.55 25.70L165.45 25.59Q165.44 22.36 163.86 20.26L
   163.88 20.28L163.89 20.29Q162.32 18.20 159.01 18.20Z"></path>
   <path fill="#50d772" d="M112.30 26.94L107.77 26.40L110.08 4.29L130.06 4.33L130.11 9.17L114.57 9.02L113.4
   4 20.64L113.33 20.53Q114.59 19.55 116.15 18.94L116.30 19.09L116.27 19.05Q117.87 18.48 119.87 18.46L119.8
   7 18.45L119.67 18.26Q125.20 18.20 128.33 21.72L128.44 21.83L128.35 21.74Q131.51 25.28 131.51 31.41L131.5
   3 31.43L131.49 31.39Q131.56 37.44 128.34 41.08L128.43 41.16L128.31 41.05Q125.21 44.80 119.06 44.80L118.9
   5 44.68L119.07 44.80Q113.99 44.78 110.62 42.02L110.46 41.85L110.47 41.87Q107.26 39.26 107.39 33.90L107.3
   3 33.83L107.43 33.71L112.34 33.76L112.25 33.66Q112.21 36.88 114.08 38.67L114.17 38.76L114.21 38.80Q115.9
   7 40.48 118.95 40.48L118.95 40.47L119.02 40.54Q122.46 40.56 124.34 38.16L124.19 38.00L124.33 38.14Q126.1
   9 35.71 126.19 31.53L126.12 31.46L126.23 31.57Q126.08 27.62 124.18 25.26L124.24 25.33L124.25 25.34Q122.2
   9 22.93 118.90 22.93L118.93 22.96L118.90 22.92Q115.76 22.96 114.34 23.92L114.30 23.88L114.32 23.89Q113.0
   1 24.97 112.33 26.96L112.21 26.84Z"></path>
   <path fill="#378ce1" d="M30.40 4.30L39.76 19.95L48.93 4.30L55.40 4.25L42.92 24.15L55.81 44.20L49.39 44.2
   1L39.75 28.30L30.18 44.12L23.74 44.18L36.69 24.16L23.95 4.30L30.37 4.27Z"></path>
   <path d="M13 27 C82 24,115 27,197 16" stroke="#40dddd" fill="none"></path>
   <path d="M8 4 C104 16,109 21,197 22" stroke="#e7c459" fill="none"></path>
 </svg>
```

- **Send register request, break captcha, send confirmation**
  - Account created!

Step 1 – Logged in



GraphMin **GraphQL dashboard**

Home
Servers
Users
Tickets

Welcome to our CTF pre-challenge web! 🎉

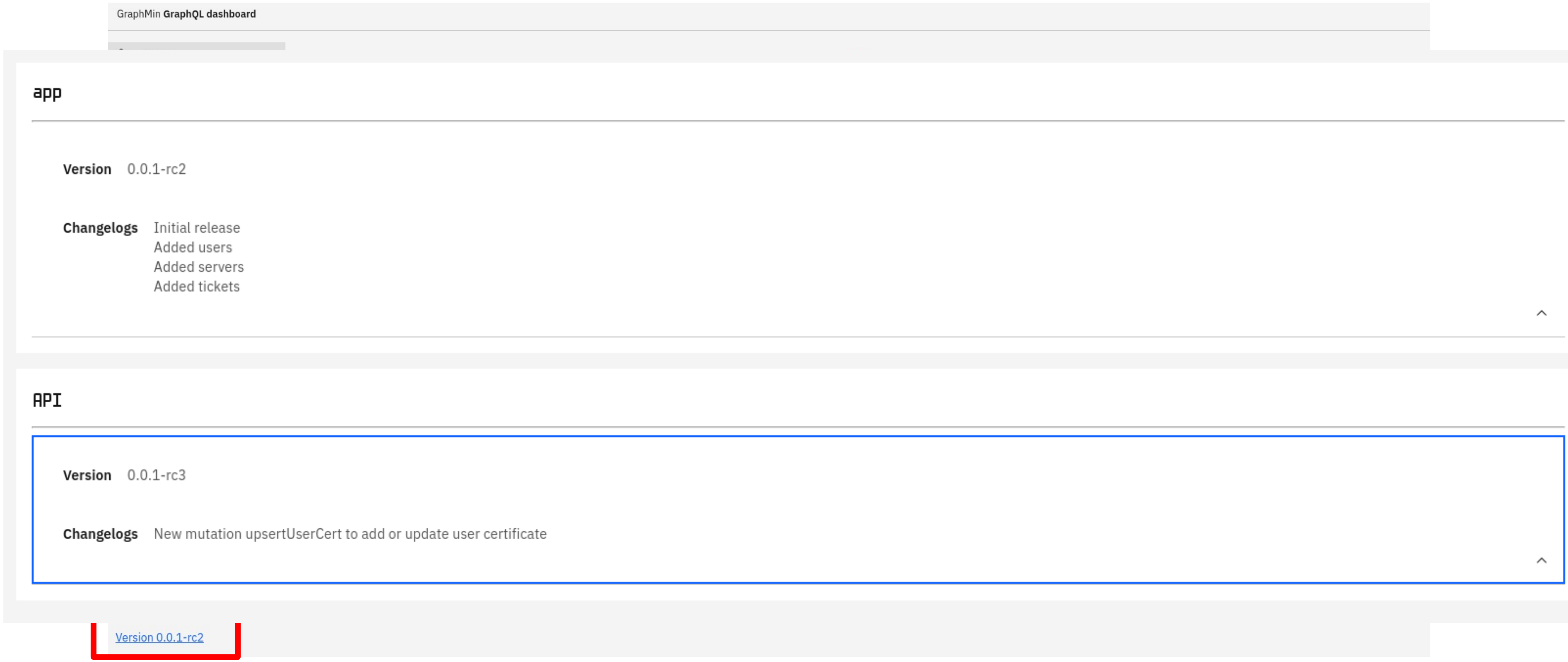
Congratulations on making it this far! Your dedication and skills have brought you here, and we're thrilled to have you on board. As you embark on this journey, we wish you the best of luck and courage for what lies ahead. Remember, every challenge you face is an opportunity to learn and grow. Trust in your abilities, stay determined, and enjoy the thrill of the adventure!

Let the hacking begin! 💻🔒

If you have an Unexpected Error, just refresh the page!

Version 0.0.1-rc2

Step 1 – Logged in



GraphMin **GraphQL dashboard**

app

Version 0.0.1-rc2

Changelogs Initial release
Added users
Added servers
Added tickets

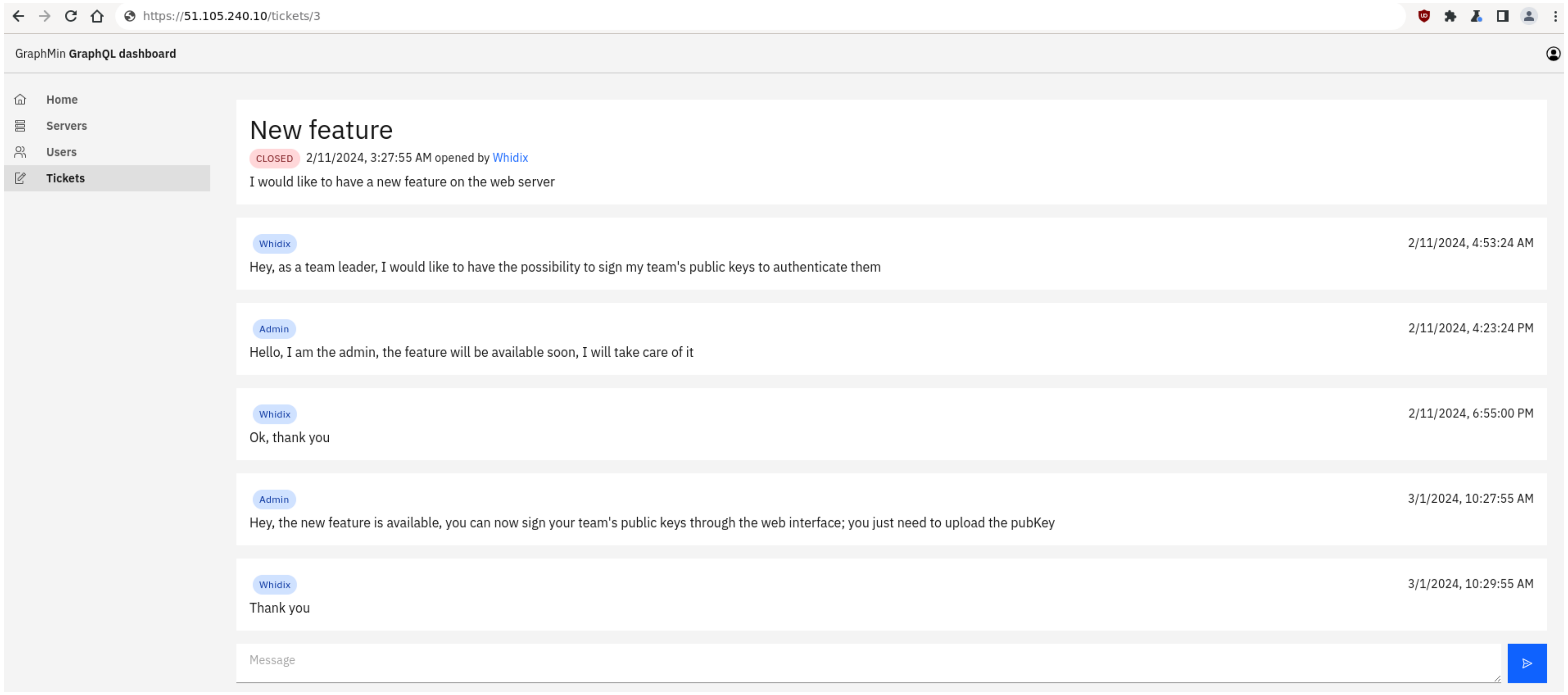
API

Version 0.0.1-rc3

Changelogs New mutation upsertUserCert to add or update user certificate

Version 0.0.1-rc2

Step 1 : Tickets



https://51.105.240.10/tickets/3

GraphMin **GraphQL dashboard**

New feature

CLOSED 2/11/2024, 3:27:55 AM opened by Whidix

I would like to have a new feature on the web server

Whidix 2/11/2024, 4:53:24 AM

Hey, as a team leader, I would like to have the possibility to sign my team's public keys to authenticate them

Admin 2/11/2024, 4:23:24 PM

Hello, I am the admin, the feature will be available soon, I will take care of it

Whidix 2/11/2024, 6:55:00 PM

Ok, thank you

Admin 3/1/2024, 10:27:55 AM

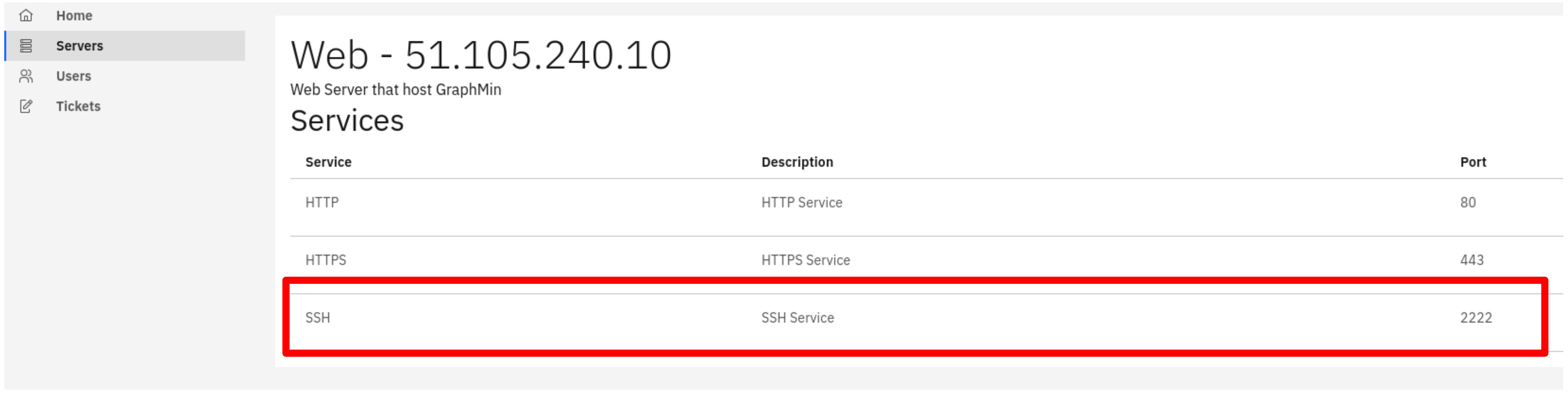
Hey, the new feature is available, you can now sign your team's public keys through the web interface; you just need to upload the pubKey

Whidix 3/1/2024, 10:29:55 AM

Thank you

Step 1

- **Clear goal:**
  - Understand how the upsertUserCert mutation works
  - Upload a public key
  - Login to SSH



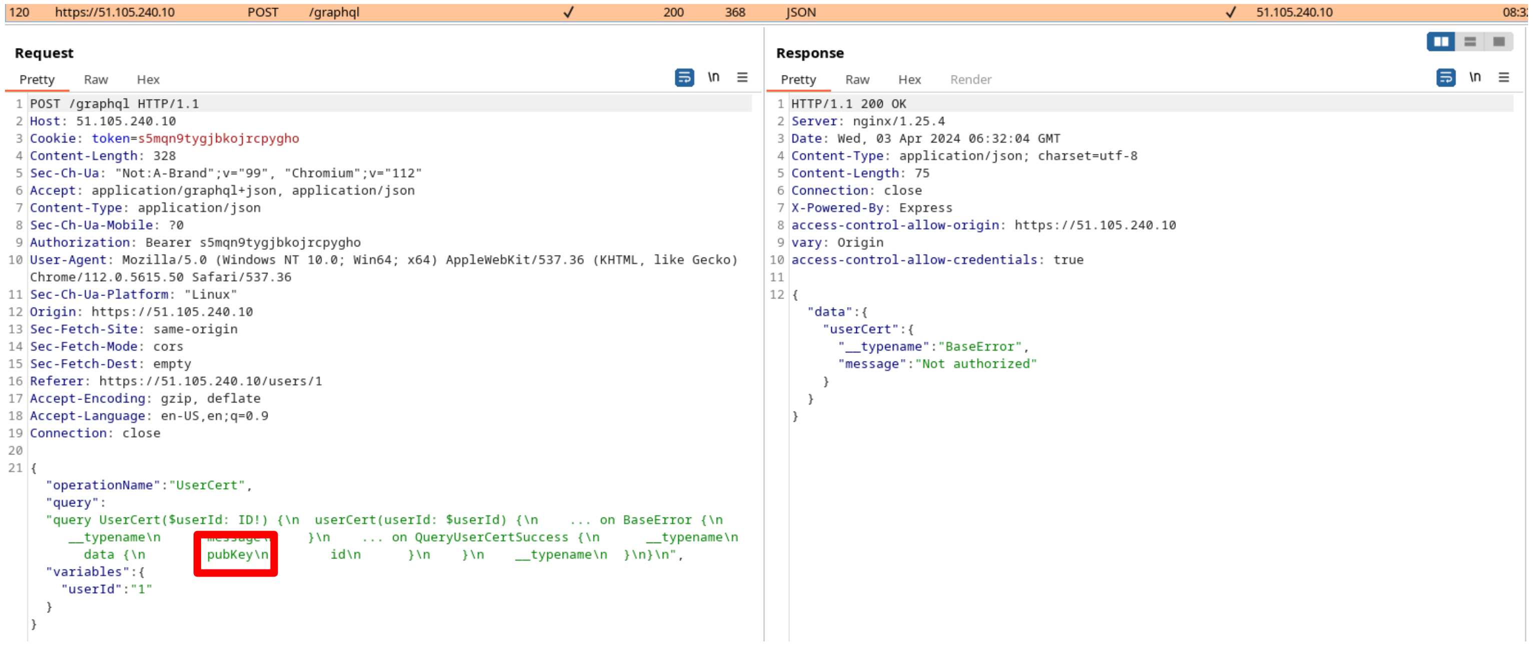
Web - 51.105.240.10

Web Server that host GraphMin

Services

Service	Description	Port
HTTP	HTTP Service	80
HTTPS	HTTPS Service	443
SSH	SSH Service	2222

Step 1



120 https://51.105.240.10 POST /graphql ✓ 200 368 JSON ✓ 51.105.240.10 08:3

Request

Pretty Raw Hex

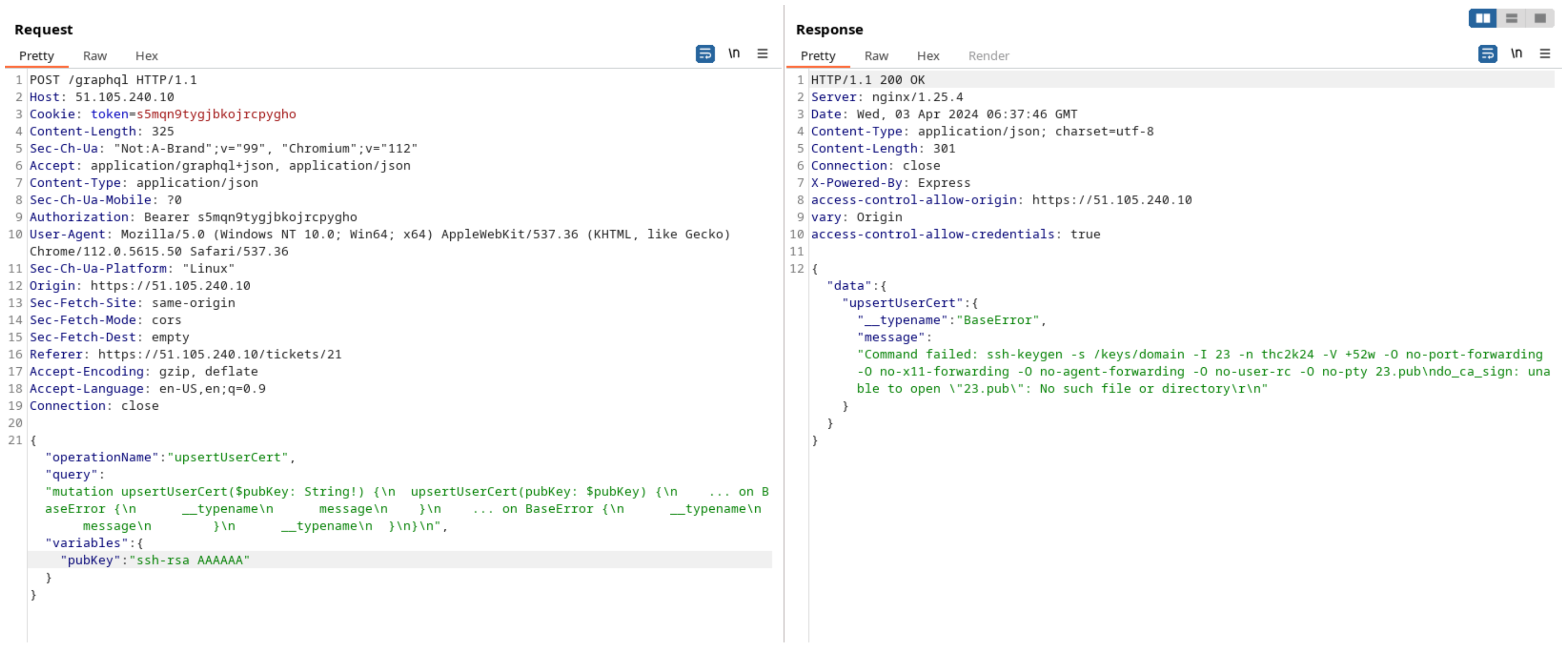
```
POST /graphql HTTP/1.1
Host: 51.105.240.10
Cookie: token=s5mqn9tygjbkojrcpygho
Content-Length: 328
Sec-Ch-Ua: "Not:A-Brand";v="99", "Chromium";v="112"
Accept: application/graphql+json, application/json
Content-Type: application/json
Sec-Ch-Ua-Mobile: ?0
Authorization: Bearer s5mqn9tygjbkojrcpygho
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/112.0.5615.50 Safari/537.36
Sec-Ch-Ua-Platform: "Linux"
Origin: https://51.105.240.10
Sec-Fetch-Site: same-origin
Sec-Fetch-Mode: cors
Sec-Fetch-Dest: empty
Referer: https://51.105.240.10/users/1
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en;q=0.9
Connection: close

{
  "operationName":"UserCert",
  "query":
  "query UserCert($userId: ID!) {\n  userCert(userId: $userId) {\n    ... on BaseError {\n
     __typename\n      message\n    }\n    ... on QueryUserCertSuccess {\n      __typename\n
       data {\n        pubKey\n        id\n      }\n    }\n    __typename\n  }\n}\n",
  "variables":{
    "userId":"1"
  }
}
```

Response

Pretty Raw Hex Render

```
HTTP/1.1 200 OK
Server: nginx/1.25.4
Date: Wed, 03 Apr 2024 06:32:04 GMT
Content-Type: application/json; charset=utf-8
Content-Length: 75
Connection: close
X-Powered-By: Express
access-control-allow-origin: https://51.105.240.10
vary: Origin
access-control-allow-credentials: true

{
  "data":{
    "userCert":{
      "__typename":"BaseError",
      "message":"Not authorized"
    }
  }
}
```

Step 1



Request

Pretty Raw Hex

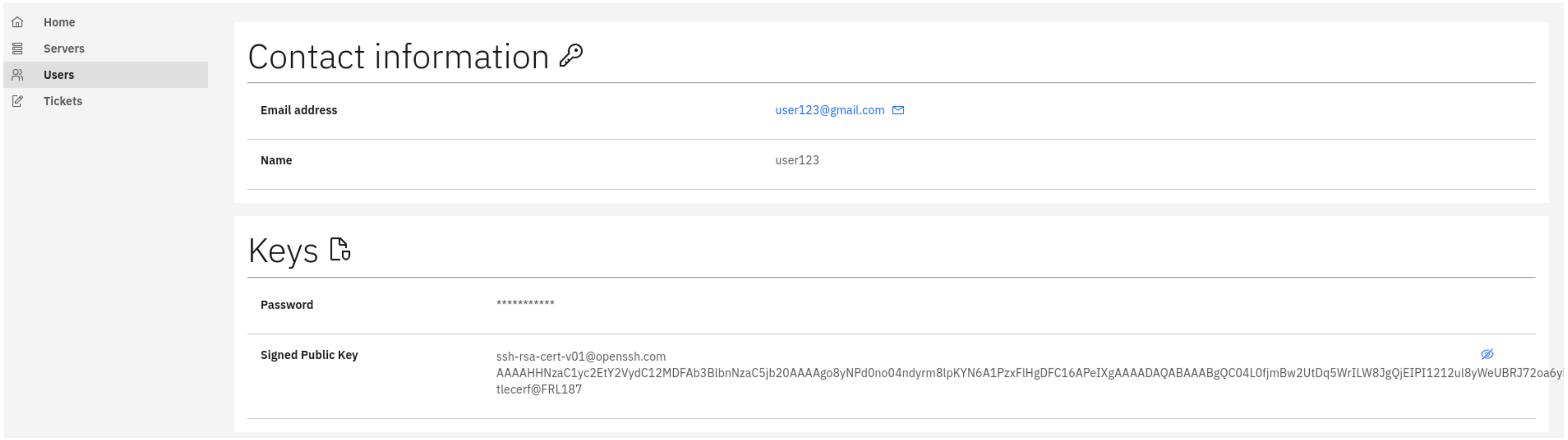
```
POST /graphql HTTP/1.1
Host: 51.105.240.10
Cookie: token=s5mqn9tygjbkojrcpygho
Content-Length: 325
Sec-Ch-Ua: "Not:A-Brand";v="99", "Chromium";v="112"
Accept: application/graphql+json, application/json
Content-Type: application/json
Sec-Ch-Ua-Mobile: ?0
Authorization: Bearer s5mqn9tygjbkojrcpygho
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/112.0.5615.50 Safari/537.36
Sec-Ch-Ua-Platform: "Linux"
Origin: https://51.105.240.10
Sec-Fetch-Site: same-origin
Sec-Fetch-Mode: cors
Sec-Fetch-Dest: empty
Referer: https://51.105.240.10/tickets/21
Accept-Encoding: gzip, deflate
Accept-Language: en-US,en;q=0.9
Connection: close

{
  "operationName":"upsertUserCert",
  "query":
  "mutation upsertUserCert($pubKey: String!) {\n  upsertUserCert(pubKey: $pubKey) {\n    ... on B
  aseError {\n      __typename\n      message\n    }\n    ... on BaseError {\n      __typename\n
       message\n        }\n      __typename\n  }\n}\n",
  "variables":{
    "pubKey":"ssh-rsa AAAAAA"
  }
}
```

Response

Pretty Raw Hex Render

```
HTTP/1.1 200 OK
Server: nginx/1.25.4
Date: Wed, 03 Apr 2024 06:37:46 GMT
Content-Type: application/json; charset=utf-8
Content-Length: 301
Connection: close
X-Powered-By: Express
access-control-allow-origin: https://51.105.240.10
vary: Origin
access-control-allow-credentials: true

{
  "data":{
    "upsertUserCert":{
      "__typename":"BaseError",
      "message":
      "Command failed: ssh-keygen -s /keys/domain -I 23 -n thc2k24 -V +52w -O no-port-forwarding
      -O no-x11-forwarding -O no-agent-forwarding -O no-user-rc -O no-pty 23.pub\ndo_ca_sign: una
      ble to open \"23.pub\": No such file or directory\r\n"
    }
  }
}
```

Step 1 - Finally



Home
Servers
Users
Tickets

Contact information

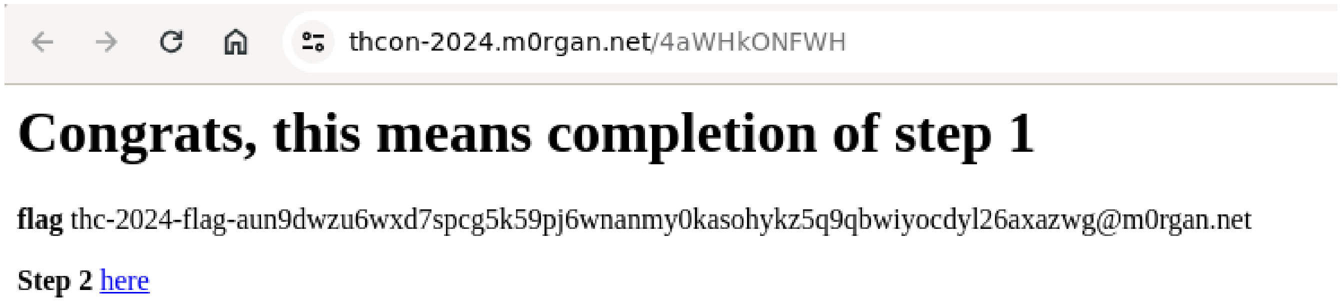
Email address	user123@gmail.com
Name	user123

Keys

Password	***********
Signed Public Key	ssh-rsa-cert-v01@openssh.com AAAAHHNzaC1yc2EtY2VydC12MDFAb3BlbnNzaC5jb20AAAAgo8yNPd0no04ndyrm8lpKYN6A1PzxFlHgDFC16APeIXgAAAADAQABAAABgQC04L0fjmBw2UtDq5WrILW8JgQjEIPI1212ul8yWeUBRJ72oa6y tlecerf@FRL187

Step 1 - Done

- Login with ssh
- Got next URL



thcon-2024.m0rgan.net/4aWHkONFWH

Congrats, this means completion of step 1

flag thc-2024-flag-aun9dwzu6wxd7spcg5k59pj6wnanmy0kasohykz5q9qbwiyocdyl26axazwg@m0rgan.net

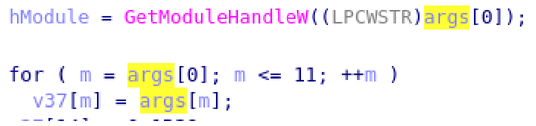
Step 2 here

Step 2

- **Windows binary**
- **“Usage: %s hex0 hex1 … hex11”**
  - Takes 12 hex arguments
- **Arguments are used for**
  - Handle and loop start (hex0)
  - Resource import (hex1 / hex2)
  - Imports resolution (hex10 / hex11)
- **Arguments 3 to 9 are not used**
- **In the end, decrypt and load a payload**

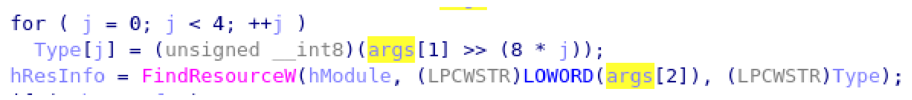
Step 2 – hex0 / hex1 / hex2

- **hex0 == 0**

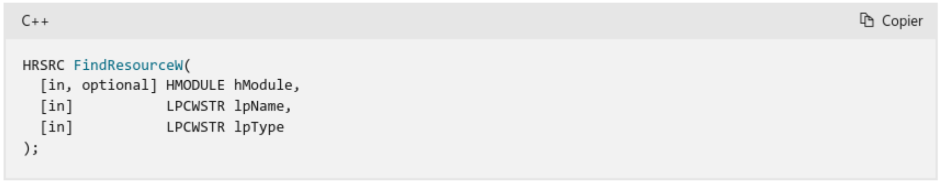


```
hModule = GetModuleHandleW((LPCWSTR)args[0]);

for ( m = args[0]; m <= 11; ++m )
  v37[m] = args[m];
```

- **Resources handling**



```
for ( j = 0; j < 4; ++j )
  Type[j] = (unsigned __int8)(args[1] >> (8 * j));
hResInfo = FindResourceW(hModule, (LPCWSTR)LOWORD(args[2]), (LPCWSTR)Type);
```

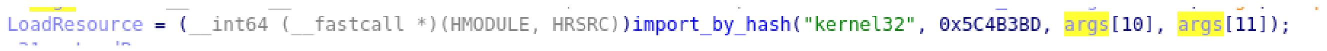


```
HRSRC FindResourceW(
  [in, optional] HMODULE hModule,
  [in]           LPCWSTR lpName,
  [in]           LPCWSTR lpType
);
```

  - lpName == “RAW” → hex1 == 574152
  - lpType == 101 → hex2 == 65

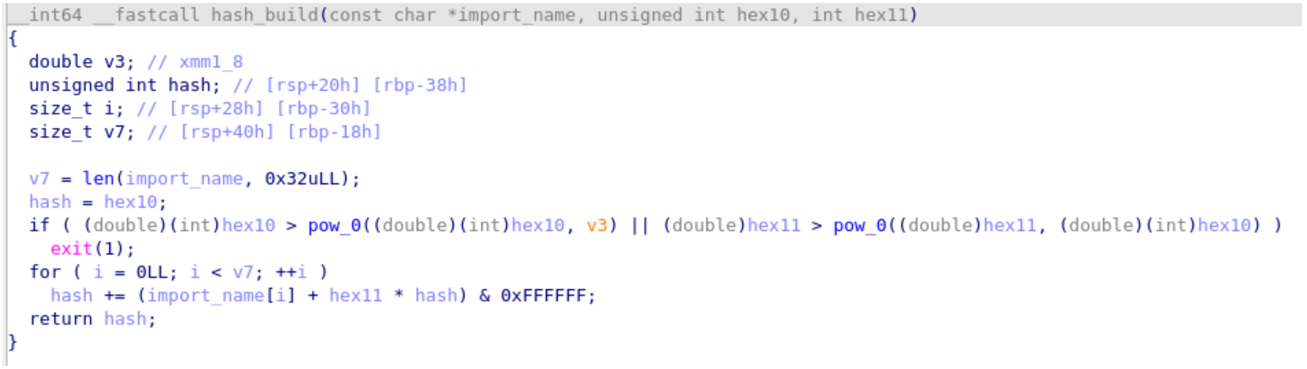
Step 2 – Imports handling

- **Custom imports by hash**



```
LoadResource = (__int64 (__fastcall *)(HMODULE, HRSRC))import_by_hash("kernel32", 0x5C4B3BD, args[10], args[11]);
```

- **Constraints**
  - Hex10 < 2^10
  - Hex11 < 2^15
- **Simple algorithm**



```
__int64 __fastcall hash_build(const char *import_name, unsigned int hex10, int hex11)
{
  double v3; // xmm1_8
  unsigned int hash; // [rsp+20h] [rbp-38h]
  size_t i; // [rsp+28h] [rbp-30h]
  size_t v7; // [rsp+40h] [rbp-18h]

  v7 = len(import_name, 0x32uLL);
  hash = hex10;
  if ( (double)(int)hex10 > pow_0((double)(int)hex10, v3) || (double)hex11 > pow_0((double)hex11, (double)(int)hex10) )
    exit(1);
  for ( i = 0LL; i < v7; ++i )
    hash += (import_name[i] + hex11 * hash) & 0xFFFFFF;
  return hash;
}
```

Step 2 – Imports handling (2)

- **We know the expected import name…**
- **We know the output hash…**
- **Let's bruteforce!**

```
$ time pypy bf1.py
(53, 30864)

real 0m1.261s
```

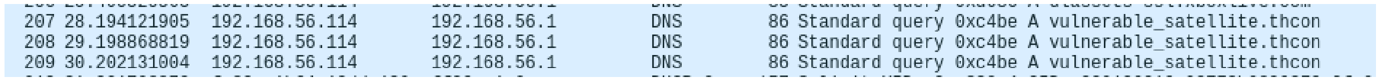
- **hex10 == 35**
- **hex11 == 7890**

Step 2 – Arguments found!

- **"C:\Users\user\Desktop\Dread-Loader.exe" 0 574152 65 3 4 5 6 7 8 9 35 7890**
  - Executes a payload
  - You can reverse it (Rust…)!
  - … or just run it?

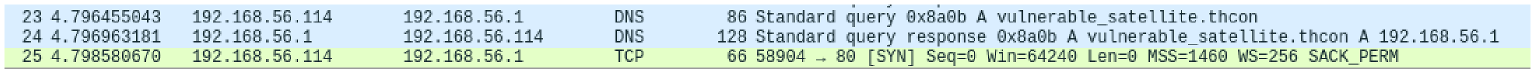
Step 2 - Network

- Listen to traffic



```
207 28.194121905  192.168.56.114       192.168.56.1         DNS        86 Standard query 0xc4be A vulnerable_satellite.thcon
208 29.198868819  192.168.56.114       192.168.56.1         DNS        86 Standard query 0xc4be A vulnerable_satellite.thcon
209 30.202131004  192.168.56.114       192.168.56.1         DNS        86 Standard query 0xc4be A vulnerable_satellite.thcon
```

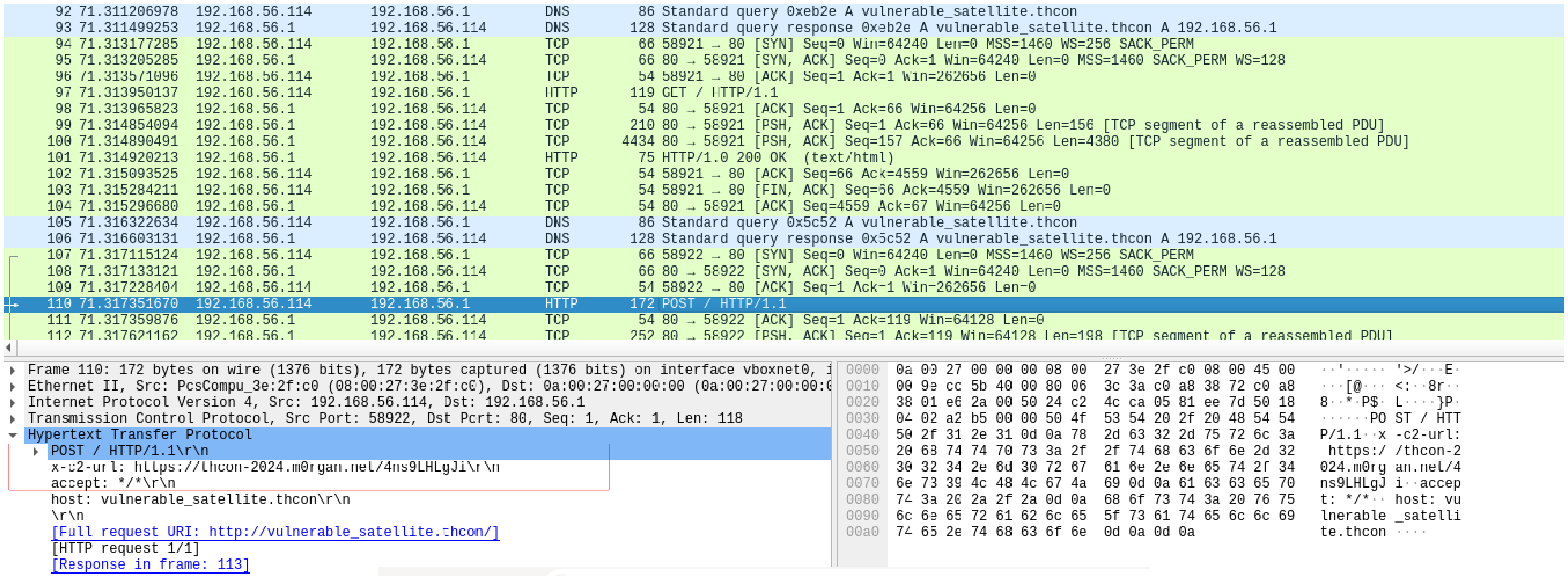
- Fake DNS!



```
23 4.796455043   192.168.56.114       192.168.56.1         DNS        86 Standard query 0x8a0b A vulnerable_satellite.thcon
24 4.796963181   192.168.56.1         192.168.56.114       DNS       128 Standard query response 0x8a0b A vulnerable_satellite.thcon A 192.168.56.1
25 4.798580670   192.168.56.114       192.168.56.1         TCP        66 58904 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
```

- Listen on 80?

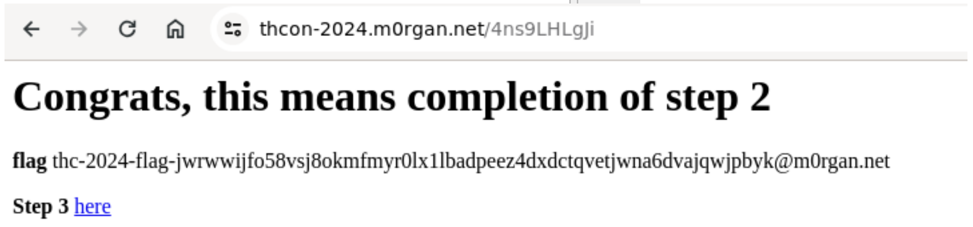
Step 2 - Done



```
 92 71.311206978  192.168.56.114  192.168.56.1    DNS    86 Standard query 0xeb2e A vulnerable_satellite.thcon
 93 71.311499253  192.168.56.1    192.168.56.114  DNS   128 Standard query response 0xeb2e A vulnerable_satellite.thcon A 192.168.56.1
 94 71.313177285  192.168.56.114  192.168.56.1    TCP    66 58921 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
 95 71.313205285  192.168.56.1    192.168.56.114  TCP    66 80 → 58921 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM WS=128
 96 71.313571096  192.168.56.114  192.168.56.1    TCP    54 58921 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0
 97 71.313950137  192.168.56.114  192.168.56.1    HTTP  119 GET / HTTP/1.1
 98 71.313965823  192.168.56.1    192.168.56.114  TCP    54 80 → 58921 [ACK] Seq=1 Ack=66 Win=64256 Len=0
 99 71.314854094  192.168.56.1    192.168.56.114  TCP   210 80 → 58921 [PSH, ACK] Seq=1 Ack=66 Win=64256 Len=156 [TCP segment of a reassembled PDU]
100 71.314890491  192.168.56.1    192.168.56.114  TCP  4434 80 → 58921 [PSH, ACK] Seq=157 Ack=66 Win=64256 Len=4380 [TCP segment of a reassembled PDU]
101 71.314920213  192.168.56.1    192.168.56.114  HTTP   75 HTTP/1.0 200 OK  (text/html)
102 71.315093525  192.168.56.114  192.168.56.1    TCP    54 58921 → 80 [ACK] Seq=66 Ack=4559 Win=262656 Len=0
103 71.315284211  192.168.56.114  192.168.56.1    TCP    54 58921 → 80 [FIN, ACK] Seq=66 Ack=4559 Win=262656 Len=0
104 71.315296680  192.168.56.1    192.168.56.114  TCP    54 80 → 58921 [ACK] Seq=4559 Ack=67 Win=64256 Len=0
105 71.316322634  192.168.56.114  192.168.56.1    DNS    86 Standard query 0x5c52 A vulnerable_satellite.thcon
106 71.316603131  192.168.56.1    192.168.56.114  DNS   128 Standard query response 0x5c52 A vulnerable_satellite.thcon A 192.168.56.1
107 71.317115124  192.168.56.114  192.168.56.1    TCP    66 58922 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
108 71.317133121  192.168.56.1    192.168.56.114  TCP    66 80 → 58922 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM WS=128
109 71.317228404  192.168.56.114  192.168.56.1    TCP    54 58922 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0
110 71.317351670  192.168.56.114  192.168.56.1    HTTP  172 POST / HTTP/1.1
111 71.317359876  192.168.56.1    192.168.56.114  TCP    54 80 → 58922 [ACK] Seq=1 Ack=119 Win=64128 Len=0
112 71.317621162  192.168.56.1    192.168.56.114  TCP   252 80 → 58922 [PSH, ACK] Seq=1 Ack=119 Win=64128 Len=198 [TCP segment of a reassembled PDU]
```

```
▸ Frame 110: 172 bytes on wire (1376 bits), 172 bytes captured (1376 bits) on interface vboxnet0, i
▸ Ethernet II, Src: PcsCompu_3e:2f:c0 (08:00:27:3e:2f:c0), Dst: 0a:00:27:00:00:00 (0a:00:27:00:00:0
▸ Internet Protocol Version 4, Src: 192.168.56.114, Dst: 192.168.56.1
▸ Transmission Control Protocol, Src Port: 58922, Dst Port: 80, Seq: 1, Ack: 1, Len: 118
▾ Hypertext Transfer Protocol
   ▸ POST / HTTP/1.1\r\n
     x-c2-url: https://thcon-2024.m0rgan.net/4ns9LHLgJi\r\n
     accept: */*\r\n
     host: vulnerable_satellite.thcon\r\n
     \r\n
     [Full request URI: http://vulnerable_satellite.thcon/]
     [HTTP request 1/1]
     [Response in frame: 113]
```

```
0000  0a 00 27 00 00 00 08 00  27 3e 2f c0 08 00 45 00   ··'····· '>/···E·
0010  00 9e cc 5b 40 00 80 06  3c 3a c0 a8 38 72 c0 a8   ···[@··· <:··8r··
0020  38 01 e6 2a 00 50 24 c2  4c ca 05 81 ee 7d 50 18   8··*·P$· L····}P·
0030  04 02 a2 b5 00 00 50 4f  53 54 20 2f 20 48 54 54   ······PO ST / HTT
0040  50 2f 31 2e 31 0d 0a 78  2d 63 32 2d 75 72 6c 3a   P/1.1··x -c2-url:
0050  20 68 74 74 70 73 3a 2f  2f 74 68 63 6f 6e 2d 32    https:/ /thcon-2
0060  30 32 34 2e 6d 30 72 67  61 6e 2e 6e 65 74 2f 34   024.m0rg an.net/4
0070  6e 73 39 4c 48 4c 67 4a  69 0d 0a 61 63 63 65 70   ns9LHLgJ i··accep
0080  74 3a 20 2a 2f 2a 0d 0a  68 6f 73 74 3a 20 76 75   t: */*·· host: vu
0090  6c 6e 65 72 61 62 6c 65  5f 73 61 74 65 6c 6c 69   lnerable _satelli
00a0  74 65 2e 74 68 63 6f 6e  0d 0a 0d 0a               te.thcon ····
```



thcon-2024.m0rgan.net/4ns9LHLgJi

Congrats, this means completion of step 2

flag thc-2024-flag-jwrwwijfo58vsj8okmfmyr0lx1lbadpeez4dxdctqvetjwna6dvajqwjpbyk@m0rgan.net

Step 3 here

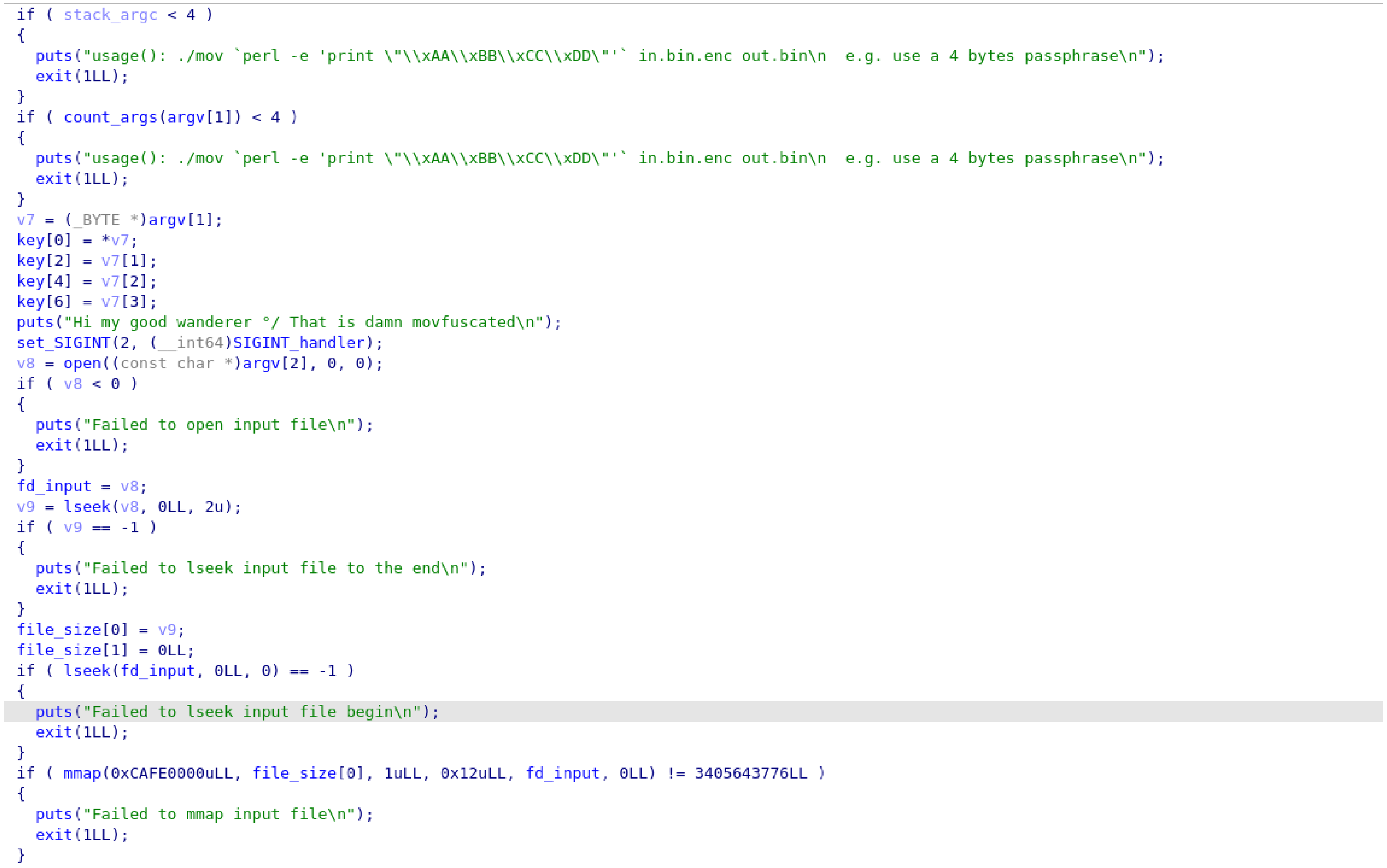
Step 3 – All cries

SYNACKTIV

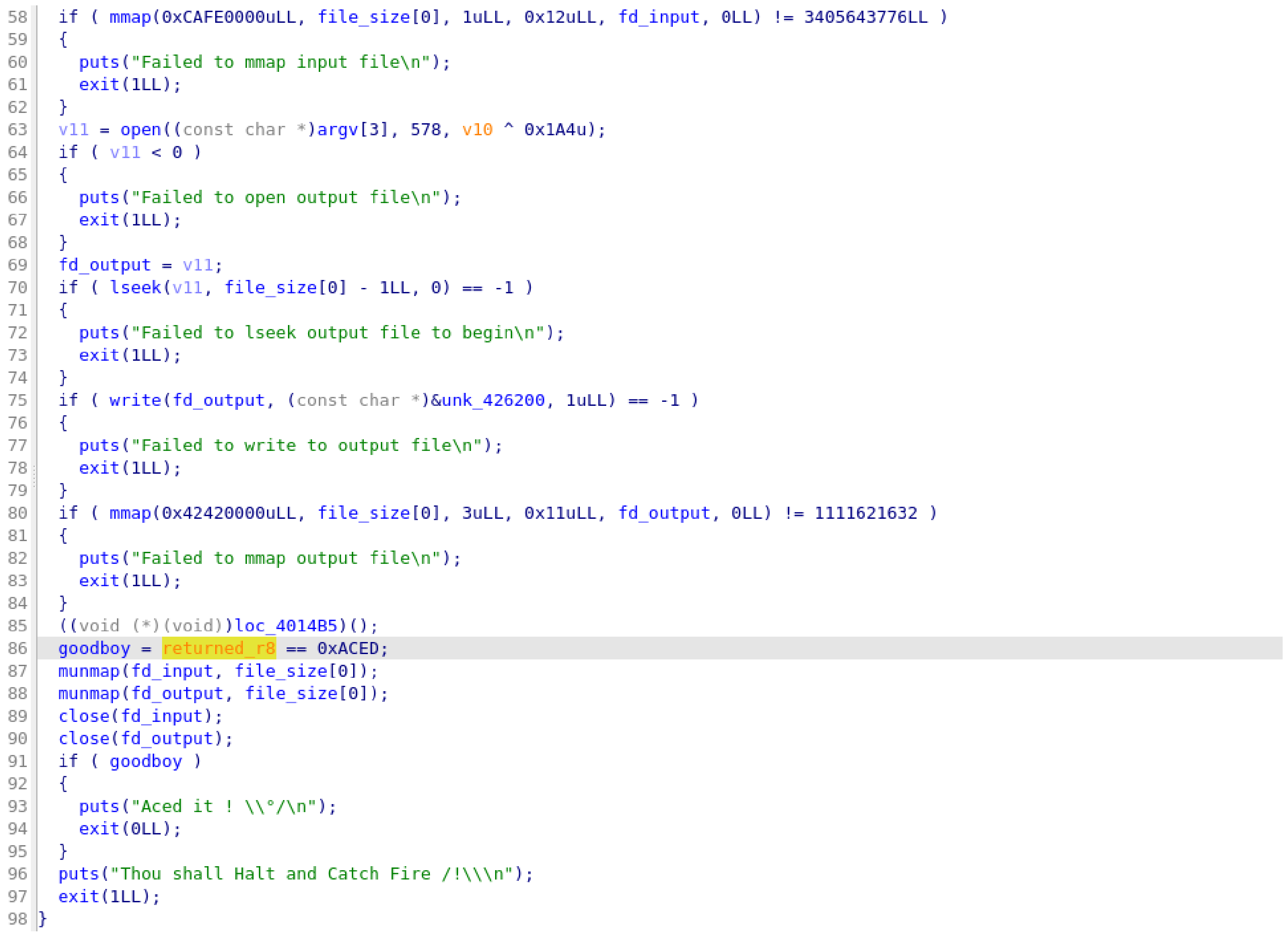
```
fab@x:/tmp$ tar xvJf all-cries.tar.xz
all-cries/
all-cries/flag.enc
all-cries/README.PLZ
all-cries/this-is-no-xoreaxeaxeax.elf

fab@x:/tmp$ cd all-cries/
fab@x:/tmp/all-cries$ cat README.PLZ
The 4 bytes key alphabet is the printable 95 ASCII characters
[127 downto 33].

Have fun

fab@x:/tmp/all-cries$ ./this-is-no-xoreaxeaxeax.elf
usage(): ./mov `perl -e 'print "\xAA\xBB\xCC\xDD"'` in.bin.enc out.bin
  e.g. use a 4 bytes passphrase
```

Step 3

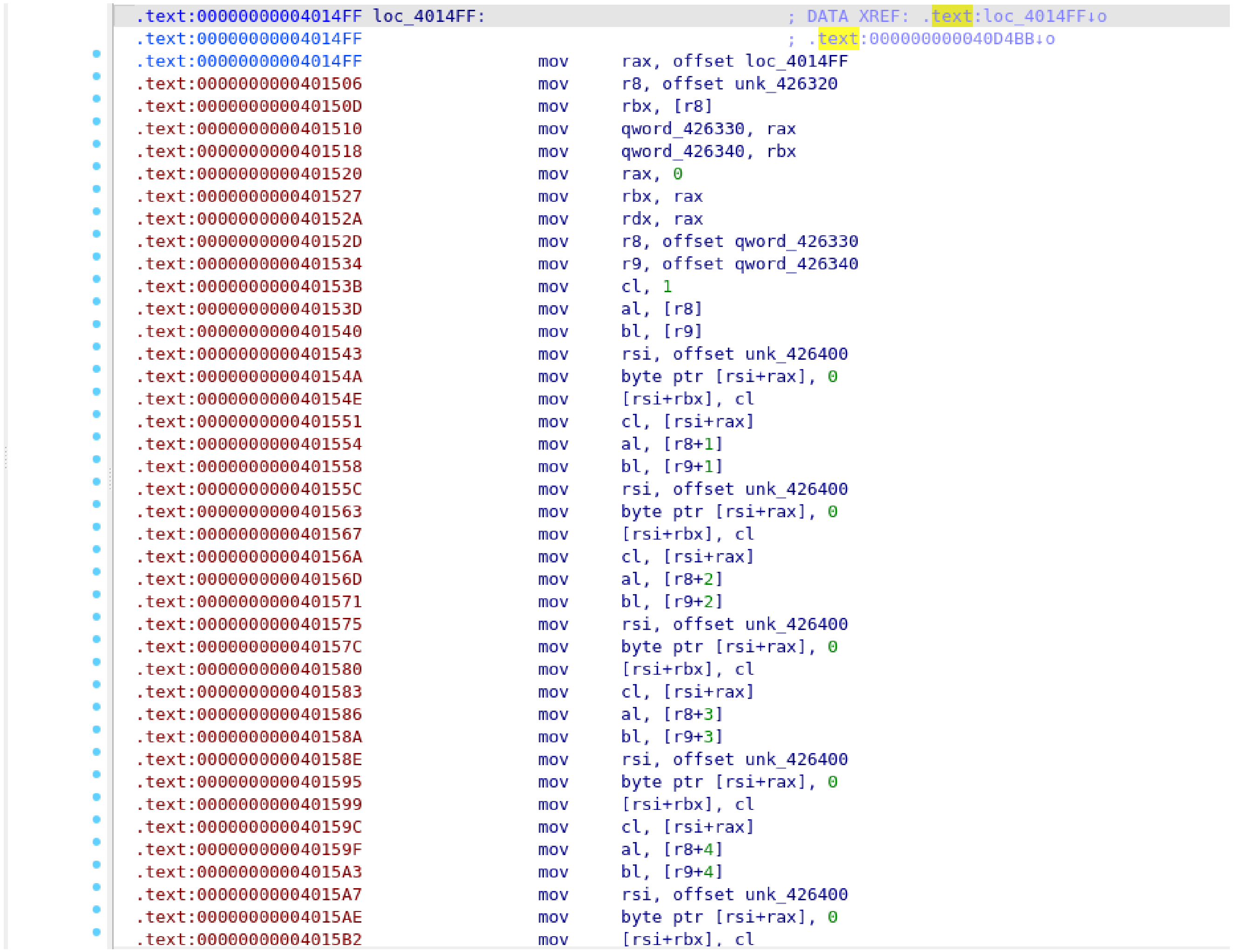
- References to “xoreaxeaxeax” and “mov”
- Points to “movfuscator”
- Highly obfuscated binary to decrypt flag.enc
- 4 ascii characters passphrase



```
if ( stack_argc < 4 )
{
  puts("usage(): ./mov `perl -e 'print \"\\xAA\\xBB\\xCC\\xDD\"'` in.bin.enc out.bin\n  e.g. use a 4 bytes passphrase\n");
  exit(1LL);
}
if ( count_args(argv[1]) < 4 )
{
  puts("usage(): ./mov `perl -e 'print \"\\xAA\\xBB\\xCC\\xDD\"'` in.bin.enc out.bin\n  e.g. use a 4 bytes passphrase\n");
  exit(1LL);
}
v7 = (_BYTE *)argv[1];
key[0] = *v7;
key[2] = v7[1];
key[4] = v7[2];
key[6] = v7[3];
puts("Hi my good wanderer °/ That is damn movfuscated\n");
set_SIGINT(2, (__int64)SIGINT_handler);
v8 = open((const char *)argv[2], 0, 0);
if ( v8 < 0 )
{
  puts("Failed to open input file\n");
  exit(1LL);
}
fd_input = v8;
v9 = lseek(v8, 0LL, 2u);
if ( v9 == -1 )
{
  puts("Failed to lseek input file to the end\n");
  exit(1LL);
}
file_size[0] = v9;
file_size[1] = 0LL;
if ( lseek(fd_input, 0LL, 0) == -1 )
{
  puts("Failed to lseek input file begin\n");
  exit(1LL);
}
if ( mmap(0xCAFE0000uLL, file_size[0], 1uLL, 0x12uLL, fd_input, 0LL) != 3405643776LL )
{
  puts("Failed to mmap input file\n");
  exit(1LL);
}
```



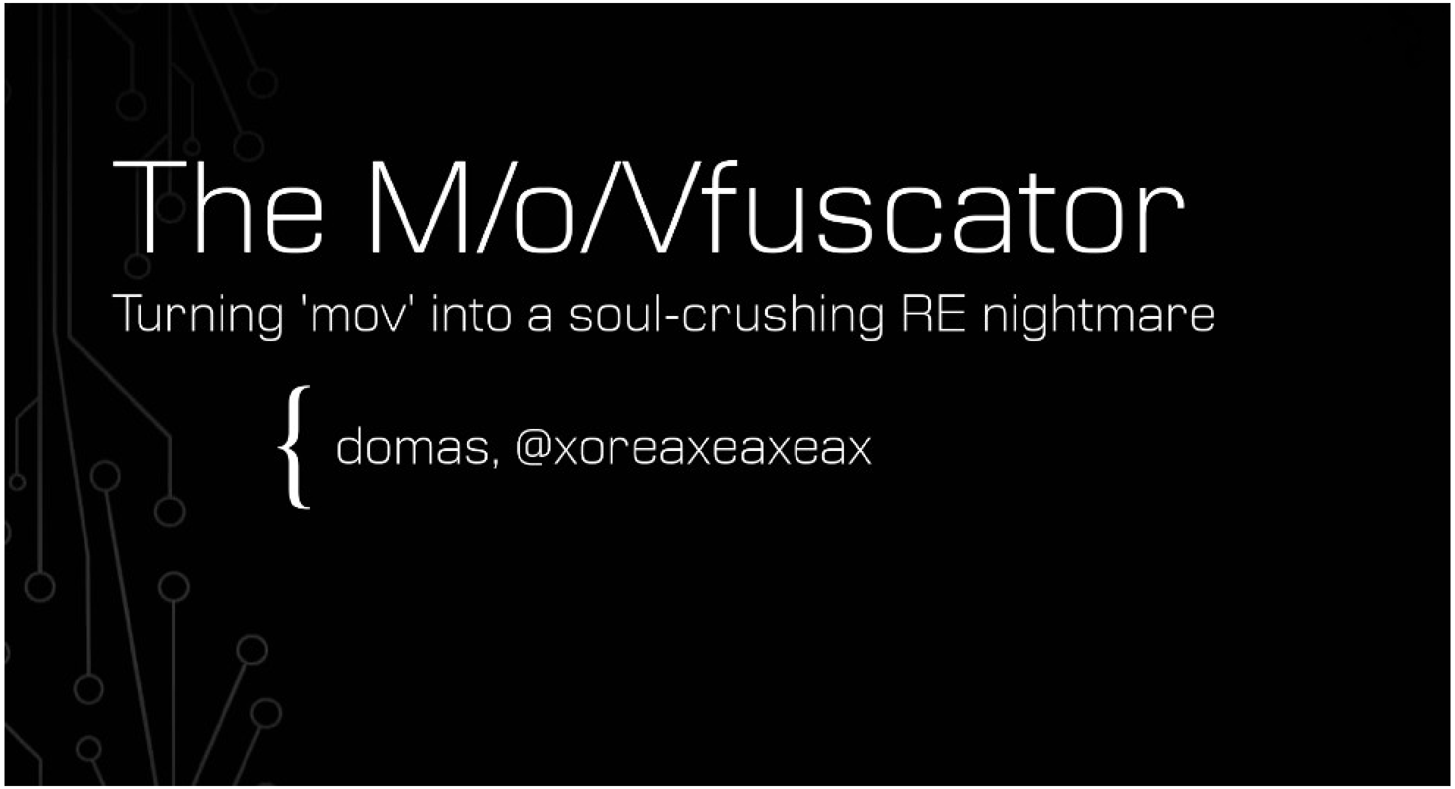
```
if ( mmap(0xCAFE0000uLL, file_size[0], 1uLL, 0x12uLL, fd_input, 0LL) != 3405643776LL )
{
  puts("Failed to mmap input file\n");
  exit(1LL);
}
v11 = open((const char *)argv[3], 578, v10 ^ 0x1A4u);
if ( v11 < 0 )
{
  puts("Failed to open output file\n");
  exit(1LL);
}
fd_output = v11;
if ( lseek(v11, file_size[0] - 1LL, 0) == -1 )
{
  puts("Failed to lseek output file to begin\n");
  exit(1LL);
}
if ( write(fd_output, (const char *)&unk_426200, 1uLL) == -1 )
{
  puts("Failed to write to output file\n");
  exit(1LL);
}
if ( mmap(0x42420000uLL, file_size[0], 3uLL, 0x11uLL, fd_output, 0LL) != 1111621632 )
{
  puts("Failed to mmap output file\n");
  exit(1LL);
}
((void (*)(void))loc_4014B5)();
goodboy = returned_r8 == 0xACED;
munmap(fd_input, file_size[0]);
munmap(fd_output, file_size[0]);
close(fd_input);
close(fd_output);
if ( goodboy )
{
  puts("Aced it ! \\°/\n");
  exit(0LL);
}
puts("Thou shall Halt and Catch Fire /!\\\n");
exit(1LL);
}
```



```
.text:00000000004014FF loc_4014FF:                             ; DATA XREF: .text:loc_4014FF↓o
.text:00000000004014FF                                         ; .text:000000000040D4BB↓o
.text:00000000004014FF                 mov     rax, offset loc_4014FF
.text:0000000000401506                 mov     r8, offset unk_426320
.text:000000000040150D                 mov     rbx, [r8]
.text:0000000000401510                 mov     qword_426330, rax
.text:0000000000401518                 mov     qword_426340, rbx
.text:0000000000401520                 mov     rax, 0
.text:0000000000401527                 mov     rbx, rax
.text:000000000040152A                 mov     rdx, rax
.text:000000000040152D                 mov     r8, offset qword_426330
.text:0000000000401534                 mov     r9, offset qword_426340
.text:000000000040153B                 mov     cl, 1
.text:000000000040153D                 mov     al, [r8]
.text:0000000000401540                 mov     bl, [r9]
.text:0000000000401543                 mov     rsi, offset unk_426400
.text:000000000040154A                 mov     byte ptr [rsi+rax], 0
.text:000000000040154E                 mov     [rsi+rbx], cl
.text:0000000000401551                 mov     cl, [rsi+rax]
.text:0000000000401554                 mov     al, [r8+1]
.text:0000000000401558                 mov     bl, [r9+1]
.text:000000000040155C                 mov     rsi, offset unk_426400
.text:0000000000401563                 mov     byte ptr [rsi+rax], 0
.text:0000000000401567                 mov     [rsi+rbx], cl
.text:000000000040156A                 mov     cl, [rsi+rax]
.text:000000000040156D                 mov     al, [r8+2]
.text:0000000000401571                 mov     bl, [r9+2]
.text:0000000000401575                 mov     rsi, offset unk_426400
.text:000000000040157C                 mov     byte ptr [rsi+rax], 0
.text:0000000000401580                 mov     [rsi+rbx], cl
.text:0000000000401583                 mov     cl, [rsi+rax]
.text:0000000000401586                 mov     al, [r8+3]
.text:000000000040158A                 mov     bl, [r9+3]
.text:000000000040158E                 mov     rsi, offset unk_426400
.text:0000000000401595                 mov     byte ptr [rsi+rax], 0
.text:0000000000401599                 mov     [rsi+rbx], cl
.text:000000000040159C                 mov     cl, [rsi+rax]
.text:000000000040159F                 mov     al, [r8+4]
.text:00000000004015A3                 mov     bl, [r9+4]
.text:00000000004015A7                 mov     rsi, offset unk_426400
.text:00000000004015AE                 mov     byte ptr [rsi+rax], 0
.text:00000000004015B2                 mov     [rsi+rbx], cl
```

About 31000 mov instructions...

Step 3 - Litterature



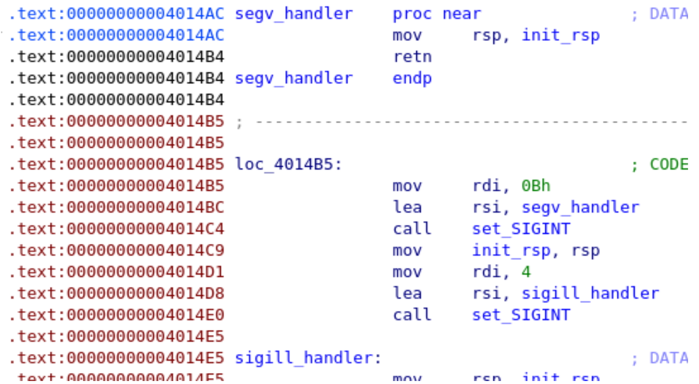
The M/o/Vfuscator

Turning 'mov' into a soul-crushing RE nightmare

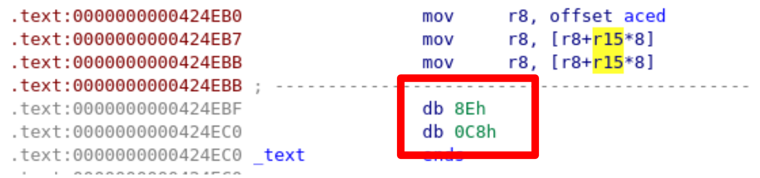
{ domas, @xoreaxeaxeax

Step 3 - Blocks

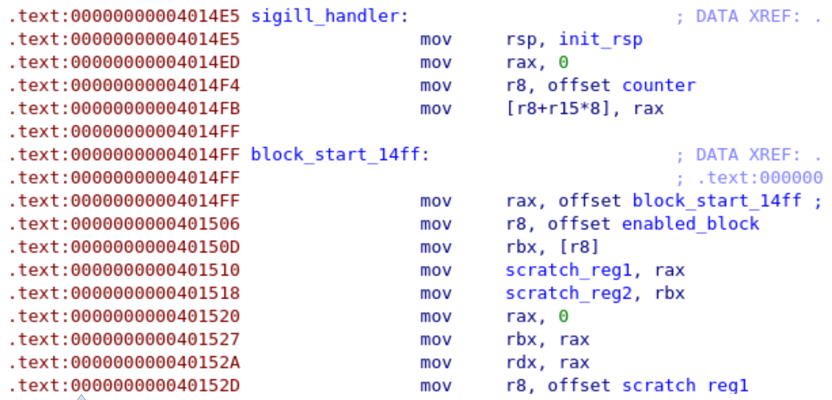
- **All blocks are sequentially executed**
- **Big loop**
  - Forced exception in the end, signal handler restarts the loop



```
.text:00000000004014AC segv_handler    proc near               ; DATA
.text:00000000004014AC                 mov     rsp, init_rsp
.text:00000000004014B4                 retn
.text:00000000004014B4 segv_handler    endp
.text:00000000004014B4
.text:00000000004014B5 ; -------------------------------------------
.text:00000000004014B5
.text:00000000004014B5 loc_4014B5:                             ; CODE
.text:00000000004014B5                 mov     rdi, 0Bh
.text:00000000004014BC                 lea     rsi, segv_handler
.text:00000000004014C4                 call    set_SIGINT
.text:00000000004014C9                 mov     init_rsp, rsp
.text:00000000004014D1                 mov     rdi, 4
.text:00000000004014D8                 lea     rsi, sigill_handler
.text:00000000004014E0                 call    set_SIGINT
.text:00000000004014E5
.text:00000000004014E5 sigill_handler:                         ; DATA
.text:00000000004014E5                 mov     rsp, init_rsp
```



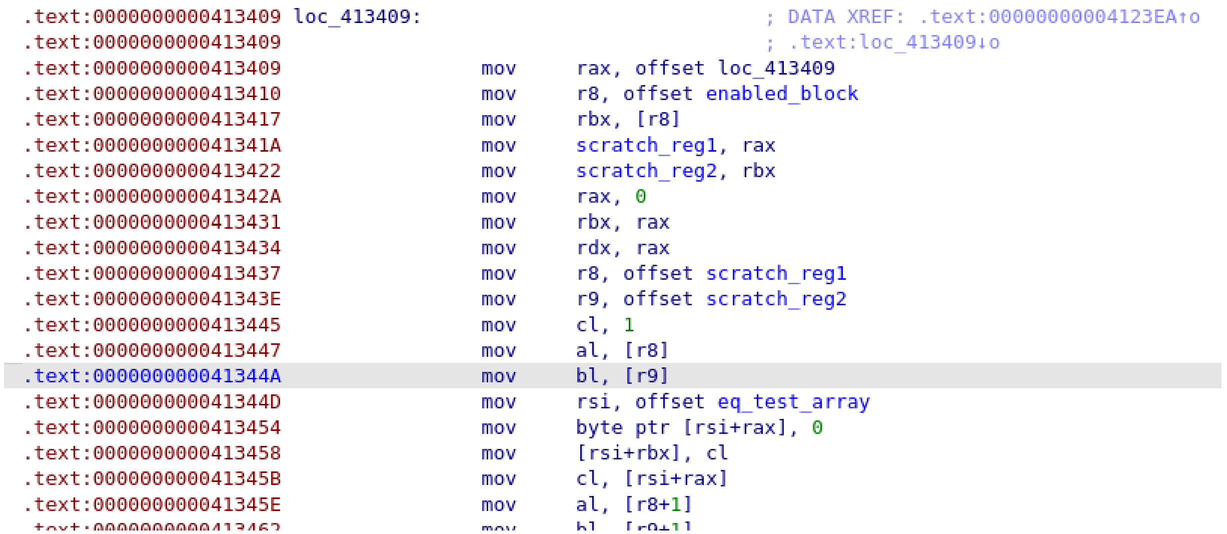
```
.text:0000000000424EB0                 mov     r8, offset aced
.text:0000000000424EB7                 mov     r8, [r8+r15*8]
.text:0000000000424EBB                 mov     r8, [r8+r15*8]
.text:0000000000424EBB ; -------------------------------------------
.text:0000000000424EBF                 db 8Eh
.text:0000000000424EC0                 db 0C8h
.text:0000000000424EC0 _text           ends
```



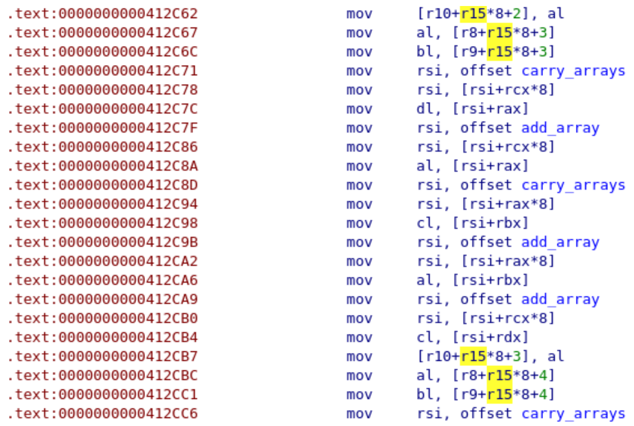
```
.text:00000000004014E5 sigill_handler:                         ; DATA XREF: .
.text:00000000004014E5                 mov     rsp, init_rsp
.text:00000000004014ED                 mov     rax, 0
.text:00000000004014F4                 mov     r8, offset counter
.text:00000000004014FB                 mov     [r8+r15*8], rax
.text:00000000004014FF
.text:00000000004014FF block_start_14ff:                       ; DATA XREF: .
.text:00000000004014FF                                         ; .text:000000
.text:00000000004014FF                 mov     rax, offset block_start_14ff ;
.text:0000000000401506                 mov     r8, offset enabled_block
.text:000000000040150D                 mov     rbx, [r8]
.text:0000000000401510                 mov     scratch_reg1, rax
.text:0000000000401518                 mov     scratch_reg2, rbx
.text:0000000000401520                 mov     rax, 0
.text:0000000000401527                 mov     rbx, rax
.text:000000000040152A                 mov     rdx, rax
.text:000000000040152D                 mov     r8, offset scratch_reg1
```

- **Mechanism to “enable” some blocks**

Step 3 - Blocks



```
.text:0000000000413409 loc_413409:                       ; DATA XREF: .text:00000000004123EA↑o
.text:0000000000413409                                   ; .text:loc_413409↓o
.text:0000000000413409           mov     rax, offset loc_413409
.text:0000000000413410           mov     r8, offset enabled_block
.text:0000000000413417           mov     rbx, [r8]
.text:000000000041341A           mov     scratch_reg1, rax
.text:0000000000413422           mov     scratch_reg2, rbx
.text:000000000041342A           mov     rax, 0
.text:0000000000413431           mov     rbx, rax
.text:0000000000413434           mov     rdx, rax
.text:0000000000413437           mov     r8, offset scratch_reg1
.text:000000000041343E           mov     r9, offset scratch_reg2
.text:0000000000413445           mov     cl, 1
.text:0000000000413447           mov     al, [r8]
.text:000000000041344A           mov     bl, [r9]
.text:000000000041344D           mov     rsi, offset eq_test_array
.text:0000000000413454           mov     byte ptr [rsi+rax], 0
.text:0000000000413458           mov     [rsi+rbx], cl
.text:000000000041345B           mov     cl, [rsi+rax]
.text:000000000041345E           mov     al, [r8+1]
.text:0000000000413462           mov     bl, [r9+1]
```



```
.text:0000000000412C62           mov     [r10+r15*8+2], al
.text:0000000000412C67           mov     al, [r8+r15*8+3]
.text:0000000000412C6C           mov     bl, [r9+r15*8+3]
.text:0000000000412C71           mov     rsi, offset carry_arrays
.text:0000000000412C78           mov     rsi, [rsi+rcx*8]
.text:0000000000412C7C           mov     dl, [rsi+rax]
.text:0000000000412C7F           mov     rsi, offset add_array
.text:0000000000412C86           mov     rsi, [rsi+rcx*8]
.text:0000000000412C8A           mov     al, [rsi+rax]
.text:0000000000412C8D           mov     rsi, offset carry_arrays
.text:0000000000412C94           mov     rsi, [rsi+rax*8]
.text:0000000000412C98           mov     cl, [rsi+rbx]
.text:0000000000412C9B           mov     rsi, offset add_array
.text:0000000000412CA2           mov     rsi, [rsi+rax*8]
.text:0000000000412CA6           mov     al, [rsi+rbx]
.text:0000000000412CA9           mov     rsi, offset add_array
.text:0000000000412CB0           mov     rsi, [rsi+rcx*8]
.text:0000000000412CB4           mov     cl, [rsi+rdx]
.text:0000000000412CB7           mov     [r10+r15*8+3], al
.text:0000000000412CBC           mov     al, [r8+r15*8+4]
.text:0000000000412CC1           mov     bl, [r9+r15*8+4]
.text:0000000000412CC6           mov     rsi, offset carry_arrays
```

Start of a basic block

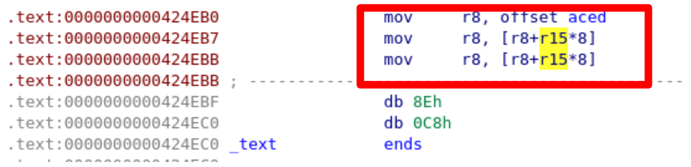
→ checks if block address matches the “enabled_block”

If match → R15 = 0
Else → R15 = 1

Every “register” access is indexed by R15

Step 3 – Segv handler

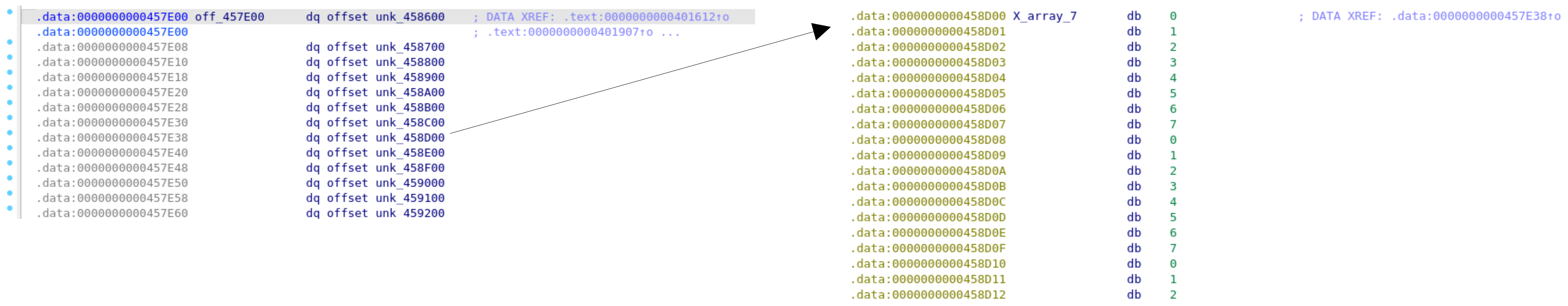
- Segv handler to end execution
- Last block checks a value and dereference a “magic” (in r8) depending on the result



```
.text:0000000000424EB0                 mov     r8, offset aced
.text:0000000000424EB7                 mov     r8, [r8+r15*8]
.text:0000000000424EBB                 mov     r8, [r8+r15*8]
.text:0000000000424EBB ; ---------------------------------------------
.text:0000000000424EBF                 db 8Eh
.text:0000000000424EC0                 db 0C8h
.text:0000000000424EC0 _text           ends
```

Step 3 - Arrays

- **Arrays of 256 arrays of 256 bytes**



```
.data:0000000000457E00 off_457E00      dq offset unk_458600    ; DATA XREF: .text:0000000000401612↑o
.data:0000000000457E00                                         ; .text:0000000000401907↑o ...
.data:0000000000457E08                 dq offset unk_458700
.data:0000000000457E10                 dq offset unk_458800
.data:0000000000457E18                 dq offset unk_458900
.data:0000000000457E20                 dq offset unk_458A00
.data:0000000000457E28                 dq offset unk_458B00
.data:0000000000457E30                 dq offset unk_458C00
.data:0000000000457E38                 dq offset unk_458D00
.data:0000000000457E40                 dq offset unk_458E00
.data:0000000000457E48                 dq offset unk_458F00
.data:0000000000457E50                 dq offset unk_459000
.data:0000000000457E58                 dq offset unk_459100
.data:0000000000457E60                 dq offset unk_459200
```

```
.data:0000000000458D00 X_array_7       db    0                 ; DATA XREF: .data:0000000000457E38↑o
.data:0000000000458D01                 db    1
.data:0000000000458D02                 db    2
.data:0000000000458D03                 db    3
.data:0000000000458D04                 db    4
.data:0000000000458D05                 db    5
.data:0000000000458D06                 db    6
.data:0000000000458D07                 db    7
.data:0000000000458D08                 db    0
.data:0000000000458D09                 db    1
.data:0000000000458D0A                 db    2
.data:0000000000458D0B                 db    3
.data:0000000000458D0C                 db    4
.data:0000000000458D0D                 db    5
.data:0000000000458D0E                 db    6
.data:0000000000458D0F                 db    7
.data:0000000000458D10                 db    0
.data:0000000000458D11                 db    1
.data:0000000000458D12                 db    2
```

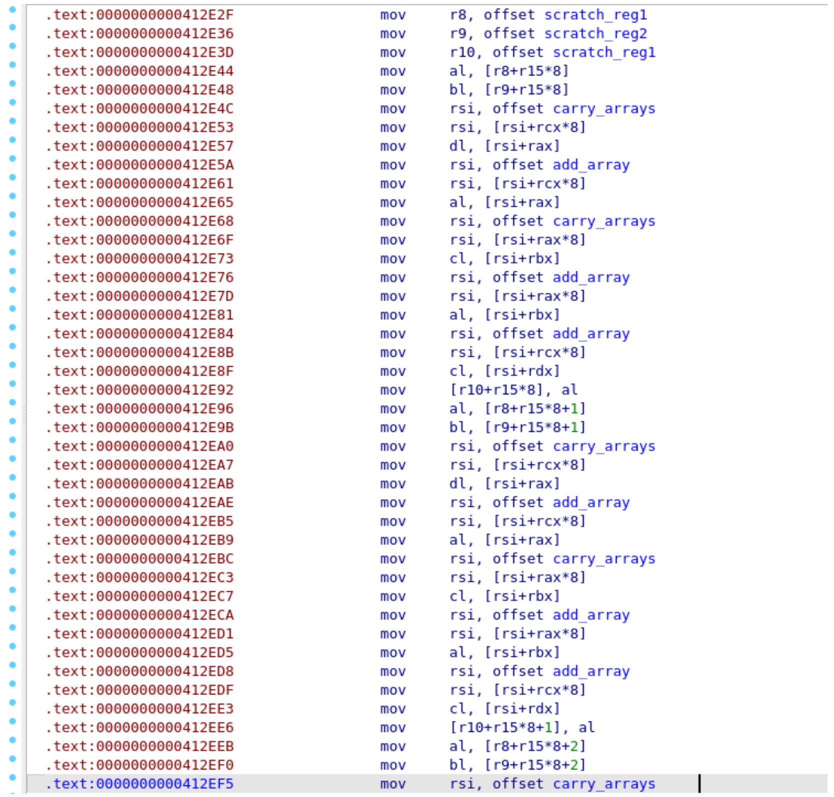
- **These are lookup tables for a “AND” operation**
  - Ex: 7 AND 0xE → array[7][0xE] → 6

Step 3 – Identify all arrays

- **AND: 0x457E00**
- **OR: 0x447600**
- **XOR: 0x468600**
- **ADD: 0x426500**
  - Carrys: 0x436D00
- **NOT (boolean): 0x447500**

Step3 – Add 64bits

SYNACKTIV

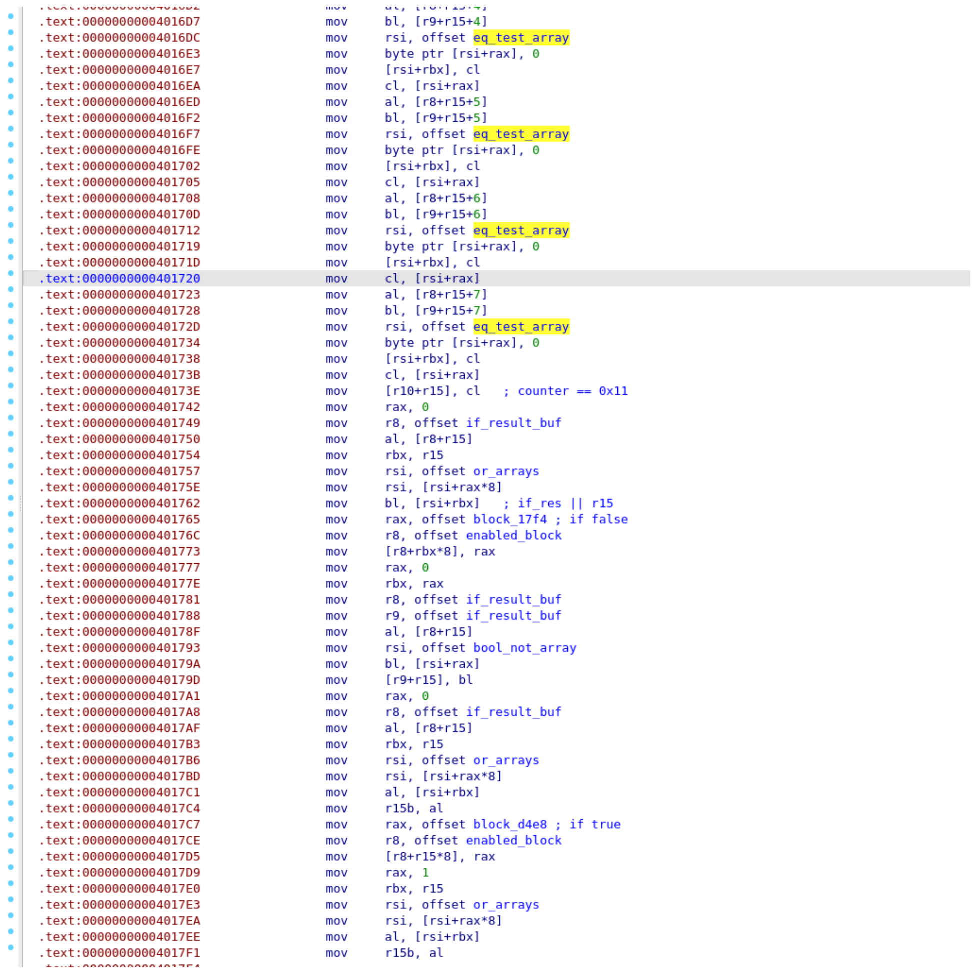


```
.text:0000000000412E2F                 mov     r8, offset scratch_reg1
.text:0000000000412E36                 mov     r9, offset scratch_reg2
.text:0000000000412E3D                 mov     r10, offset scratch_reg1
.text:0000000000412E44                 mov     al, [r8+r15*8]
.text:0000000000412E48                 mov     bl, [r9+r15*8]
.text:0000000000412E4C                 mov     rsi, offset carry_arrays
.text:0000000000412E53                 mov     rsi, [rsi+rcx*8]
.text:0000000000412E57                 mov     dl, [rsi+rax]
.text:0000000000412E5A                 mov     rsi, offset add_array
.text:0000000000412E61                 mov     rsi, [rsi+rcx*8]
.text:0000000000412E65                 mov     al, [rsi+rax]
.text:0000000000412E68                 mov     rsi, offset carry_arrays
.text:0000000000412E6F                 mov     rsi, [rsi+rax*8]
.text:0000000000412E73                 mov     cl, [rsi+rbx]
.text:0000000000412E76                 mov     rsi, offset add_array
.text:0000000000412E7D                 mov     rsi, [rsi+rax*8]
.text:0000000000412E81                 mov     al, [rsi+rbx]
.text:0000000000412E84                 mov     rsi, offset add_array
.text:0000000000412E8B                 mov     rsi, [rsi+rcx*8]
.text:0000000000412E8F                 mov     cl, [rsi+rdx]
.text:0000000000412E92                 mov     [r10+r15*8], al
.text:0000000000412E96                 mov     al, [r8+r15*8+1]
.text:0000000000412E9B                 mov     bl, [r9+r15*8+1]
.text:0000000000412EA0                 mov     rsi, offset carry_arrays
.text:0000000000412EA7                 mov     rsi, [rsi+rcx*8]
.text:0000000000412EAB                 mov     dl, [rsi+rax]
.text:0000000000412EAE                 mov     rsi, offset add_array
.text:0000000000412EB5                 mov     rsi, [rsi+rcx*8]
.text:0000000000412EB9                 mov     al, [rsi+rax]
.text:0000000000412EBC                 mov     rsi, offset carry_arrays
.text:0000000000412EC3                 mov     rsi, [rsi+rax*8]
.text:0000000000412EC7                 mov     cl, [rsi+rbx]
.text:0000000000412ECA                 mov     rsi, offset add_array
.text:0000000000412ED1                 mov     rsi, [rsi+rax*8]
.text:0000000000412ED5                 mov     al, [rsi+rbx]
.text:0000000000412ED8                 mov     rsi, offset add_array
.text:0000000000412EDF                 mov     rsi, [rsi+rcx*8]
.text:0000000000412EE3                 mov     cl, [rsi+rdx]
.text:0000000000412EE6                 mov     [r10+r15*8+1], al
.text:0000000000412EEB                 mov     al, [r8+r15*8+2]
.text:0000000000412EF0                 mov     bl, [r9+r15*8+2]
.text:0000000000412EF5                 mov     rsi, offset carry_arrays
```

Beginning of a 64bits add

(here, only 2 bytes added)

Step3 – IF



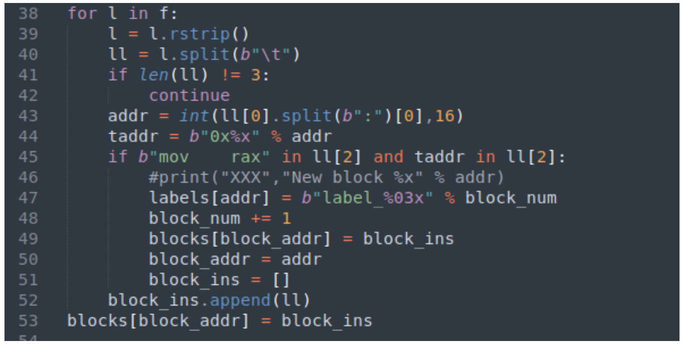
```
.text:00000000004016D7                 mov     bl, [r9+r15+4]
.text:00000000004016DC                 mov     rsi, offset eq_test_array
.text:00000000004016E3                 mov     byte ptr [rsi+rax], 0
.text:00000000004016E7                 mov     [rsi+rbx], cl
.text:00000000004016EA                 mov     cl, [rsi+rax]
.text:00000000004016ED                 mov     al, [r8+r15+5]
.text:00000000004016F2                 mov     bl, [r9+r15+5]
.text:00000000004016F7                 mov     rsi, offset eq_test_array
.text:00000000004016FE                 mov     byte ptr [rsi+rax], 0
.text:0000000000401702                 mov     [rsi+rbx], cl
.text:0000000000401705                 mov     cl, [rsi+rax]
.text:0000000000401708                 mov     al, [r8+r15+6]
.text:000000000040170D                 mov     bl, [r9+r15+6]
.text:0000000000401712                 mov     rsi, offset eq_test_array
.text:0000000000401719                 mov     byte ptr [rsi+rax], 0
.text:000000000040171D                 mov     [rsi+rbx], cl
.text:0000000000401720                 mov     cl, [rsi+rax]
.text:0000000000401723                 mov     al, [r8+r15+7]
.text:0000000000401728                 mov     bl, [r9+r15+7]
.text:000000000040172D                 mov     rsi, offset eq_test_array
.text:0000000000401734                 mov     byte ptr [rsi+rax], 0
.text:0000000000401738                 mov     [rsi+rbx], cl
.text:000000000040173B                 mov     cl, [rsi+rax]
.text:000000000040173E                 mov     [r10+r15], cl   ; counter == 0x11
.text:0000000000401742                 mov     rax, 0
.text:0000000000401749                 mov     r8, offset if_result_buf
.text:0000000000401750                 mov     al, [r8+r15]
.text:0000000000401754                 mov     rbx, r15
.text:0000000000401757                 mov     rsi, offset or_arrays
.text:000000000040175E                 mov     rsi, [rsi+rax*8]
.text:0000000000401762                 mov     bl, [rsi+rbx]   ; if_res || r15
.text:0000000000401765                 mov     rax, offset block_17f4 ; if false
.text:000000000040176C                 mov     r8, offset enabled_block
.text:0000000000401773                 mov     [r8+rbx*8], rax
.text:0000000000401777                 mov     rax, 0
.text:000000000040177E                 mov     rbx, rax
.text:0000000000401781                 mov     r8, offset if_result_buf
.text:0000000000401788                 mov     r9, offset if_result_buf
.text:000000000040178F                 mov     al, [r8+r15]
.text:0000000000401793                 mov     rsi, offset bool_not_array
.text:000000000040179A                 mov     bl, [rsi+rax]
.text:000000000040179D                 mov     [r9+r15], bl
.text:00000000004017A1                 mov     rax, 0
.text:00000000004017A8                 mov     r8, offset if_result_buf
.text:00000000004017AF                 mov     al, [r8+r15]
.text:00000000004017B3                 mov     rbx, r15
.text:00000000004017B6                 mov     rsi, offset or_arrays
.text:00000000004017BD                 mov     rsi, [rsi+rax*8]
.text:00000000004017C1                 mov     al, [rsi+rbx]
.text:00000000004017C4                 mov     r15b, al
.text:00000000004017C7                 mov     rax, offset block_d4e8 ; if true
.text:00000000004017CE                 mov     r8, offset enabled_block
.text:00000000004017D5                 mov     [r8+r15*8], rax
.text:00000000004017D9                 mov     rax, 1
.text:00000000004017E0                 mov     rbx, r15
.text:00000000004017E3                 mov     rsi, offset or_arrays
.text:00000000004017EA                 mov     rsi, [rsi+rax*8]
.text:00000000004017EE                 mov     al, [rsi+rbx]
.text:00000000004017F1                 mov     r15b, al
```

Depending on test, set “enabled block” to a block address

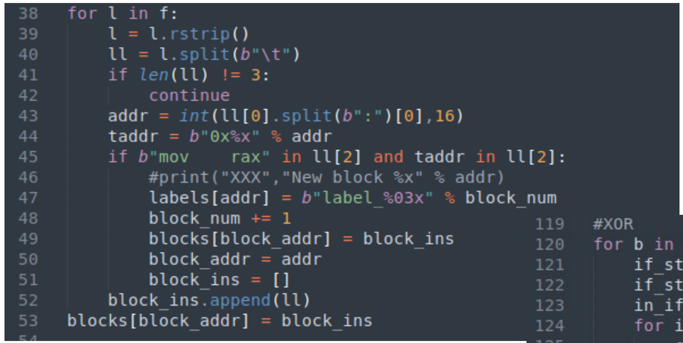
Step 3 – Strategy

- **“Patterns” can be recognized**
- **Deobfuscate all the things!**
  - Create labels for each block
  - Rename some variables
  - Identify all operations
- **From 31000 mov instructions…**
  - … to ~500 lines of pseudo assembly

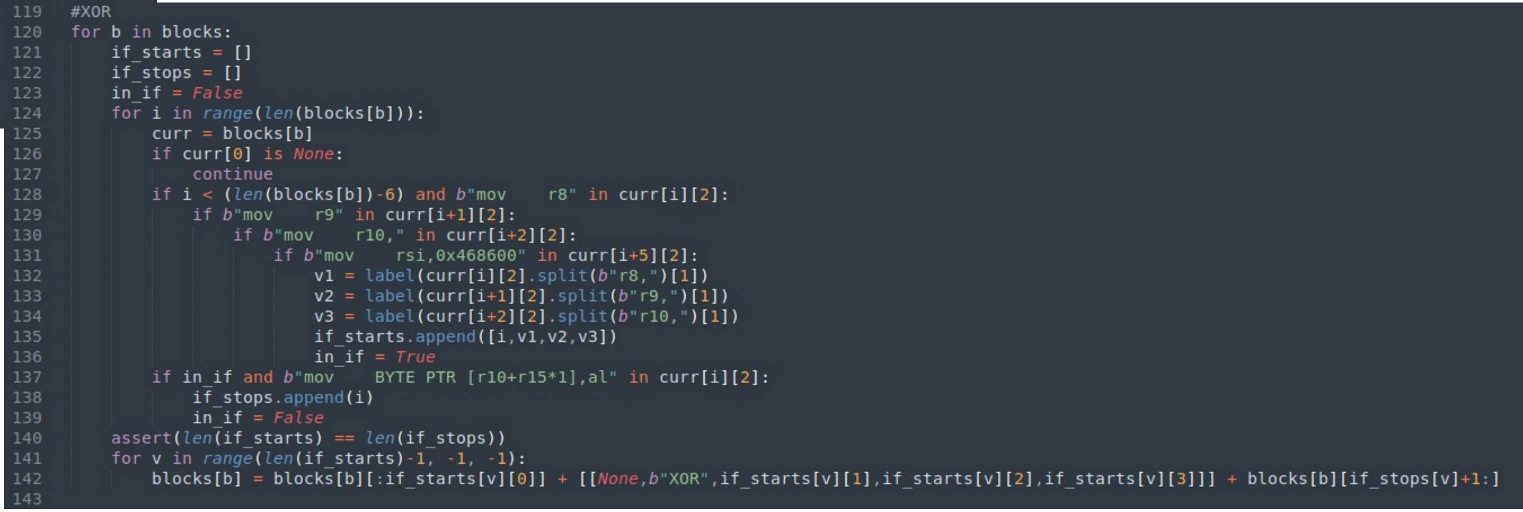
Step 3 – (not so dirty) Deobfuscator


```
for l in f:
    l = l.rstrip()
    ll = l.split(b"\t")
    if len(ll) != 3:
        continue
    addr = int(ll[0].split(b":")[0],16)
    taddr = b"0x%x" % addr
    if b"mov    rax" in ll[2] and taddr in ll[2]:
        #print("XXX","New block %x" % addr)
        labels[addr] = b"label_%03x" % block_num
        block_num += 1
        blocks[block_addr] = block_ins
        block_addr = addr
        block_ins = []
    block_ins.append(ll)
blocks[block_addr] = block_ins
```

Step 3 – (not so dirty) Deobfuscator

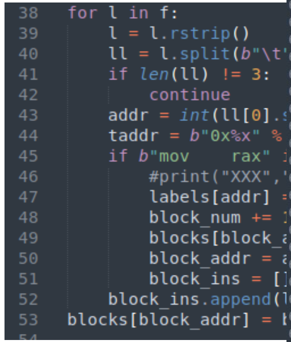


```python
for l in f:
    l = l.rstrip()
    ll = l.split(b"\t")
    if len(ll) != 3:
        continue
    addr = int(ll[0].split(b":")[0],16)
    taddr = b"0x%x" % addr
    if b"mov    rax" in ll[2] and taddr in ll[2]:
        #print("XXX","New block %x" % addr)
        labels[addr] = b"label_%03x" % block_num
        block_num += 1
        blocks[block_addr] = block_ins
        block_addr = addr
        block_ins = []
    block_ins.append(ll)
blocks[block_addr] = block_ins
```

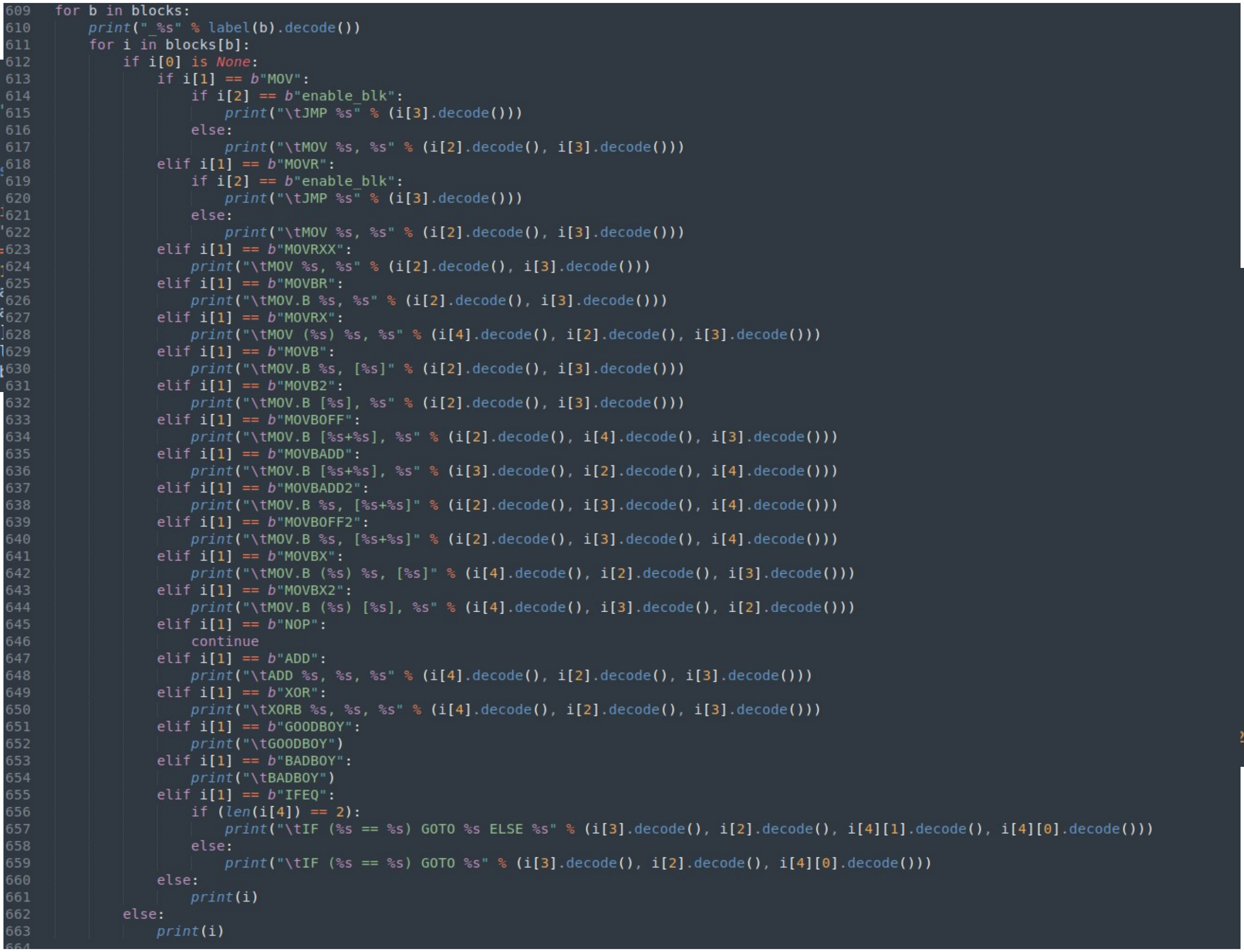


```python
#XOR
for b in blocks:
    if_starts = []
    if_stops = []
    in_if = False
    for i in range(len(blocks[b])):
        curr = blocks[b]
        if curr[0] is None:
            continue
        if i < (len(blocks[b])-6) and b"mov    r8" in curr[i][2]:
            if b"mov    r9" in curr[i+1][2]:
                if b"mov    r10," in curr[i+2][2]:
                    if b"mov    rsi,0x468600" in curr[i+5][2]:
                        v1 = label(curr[i][2].split(b"r8,")[1])
                        v2 = label(curr[i+1][2].split(b"r9,")[1])
                        v3 = label(curr[i+2][2].split(b"r10,")[1])
                        if_starts.append([i,v1,v2,v3])
                        in_if = True
        if in_if and b"mov    BYTE PTR [r10+r15*1],al" in curr[i][2]:
            if_stops.append(i)
            in_if = False
    assert(len(if_starts) == len(if_stops))
    for v in range(len(if_starts)-1, -1, -1):
        blocks[b] = blocks[b][:if_starts[v][0]] + [[None,b"XOR",if_starts[v][1],if_starts[v][2],if_starts[v][3]]] + blocks[b][if_stops[v]+1:]
```

Step 3 – (not so dirty) Deobfuscator



```
for l in f:
    l = l.rstrip()
    ll = l.split(b"\t'
    if len(ll) != 3:
        continue
    addr = int(ll[0].
    taddr = b"0x%x" %
    if b"mov     rax"
        #print("XXX",'
        labels[addr] =
        block_num +=
        blocks[block_
        block_addr =
        block_ins = [
    block_ins.append(
blocks[block_addr] =
```



```
for b in blocks:
    print("_%s" % label(b).decode())
    for i in blocks[b]:
        if i[0] is None:
            if i[1] == b"MOV":
                if i[2] == b"enable_blk":
                    print("\tJMP %s" % (i[3].decode()))
                else:
                    print("\tMOV %s, %s" % (i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVR":
                if i[2] == b"enable_blk":
                    print("\tJMP %s" % (i[3].decode()))
                else:
                    print("\tMOV %s, %s" % (i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVRXX":
                print("\tMOV %s, %s" % (i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVBR":
                print("\tMOV.B %s, %s" % (i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVRX":
                print("\tMOV (%s) %s, %s" % (i[4].decode(), i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVB":
                print("\tMOV.B %s, [%s]" % (i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVB2":
                print("\tMOV.B [%s], %s" % (i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVBOFF":
                print("\tMOV.B [%s+%s], %s" % (i[2].decode(), i[4].decode(), i[3].decode()))
            elif i[1] == b"MOVBADD":
                print("\tMOV.B [%s+%s], %s" % (i[3].decode(), i[2].decode(), i[4].decode()))
            elif i[1] == b"MOVBADD2":
                print("\tMOV.B %s, [%s+%s]" % (i[2].decode(), i[3].decode(), i[4].decode()))
            elif i[1] == b"MOVBOFF2":
                print("\tMOV.B %s, [%s+%s]" % (i[2].decode(), i[3].decode(), i[4].decode()))
            elif i[1] == b"MOVBX":
                print("\tMOV.B (%s) %s, [%s]" % (i[4].decode(), i[2].decode(), i[3].decode()))
            elif i[1] == b"MOVBX2":
                print("\tMOV.B (%s) [%s], %s" % (i[4].decode(), i[3].decode(), i[2].decode()))
            elif i[1] == b"NOP":
                continue
            elif i[1] == b"ADD":
                print("\tADD %s, %s, %s" % (i[4].decode(), i[2].decode(), i[3].decode()))
            elif i[1] == b"XOR":
                print("\tXORB %s, %s, %s" % (i[4].decode(), i[2].decode(), i[3].decode()))
            elif i[1] == b"GOODBOY":
                print("\tGOODBOY")
            elif i[1] == b"BADBOY":
                print("\tBADBOY")
            elif i[1] == b"IFEQ":
                if (len(i[4]) == 2):
                    print("\tIF (%s == %s) GOTO %s ELSE %s" % (i[3].decode(), i[2].decode(), i[4][1].decode(), i[4][0].decode()))
                else:
                    print("\tIF (%s == %s) GOTO %s" % (i[3].decode(), i[2].decode(), i[4][0].decode()))
            else:
                print(i)
        else:
            print(i)
```

```
2],if_starts[v][3]]] + blocks[b][if_stops[v]+1:]
```

Step 3 – (not so dirty) Deobfuscator

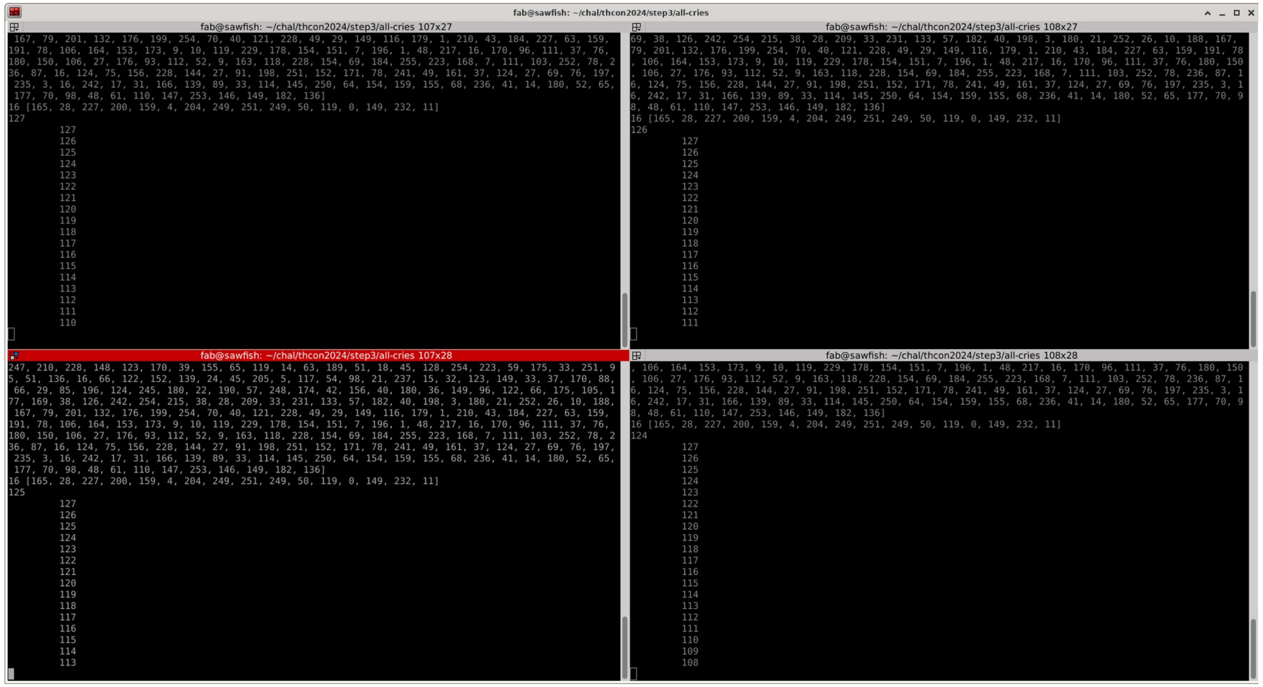
```
$ python simp.py listing | head -n 40
_start
        MOV counter, 0x0
_label_000
        MOV var_000, 0x11
        IF (var_000 == counter) GOTO label_01a ELSE label_001
_label_001
        MOV var_000, 0x0
        MOV (0x0) var_010, var_000
        ADD var_010, var_010, var_010
        MOV var_011, input_key
        ADD var_010, var_010, var_011
        MOV.B var_03b, [var_010]
        MOV var_000, 0x0
        MOV var_013, 0x20
        MOV var_001, 0x0
        MOV var_012, 0x0
_label_002
        IF (counter == var_001) GOTO label_004 ELSE label_003
_label_003
        ADD var_012, var_012, var_013
        MOV var_014, 0x1
        ADD var_001, var_001, var_014
        JMP label_002
_label_004
        MOV var_013, var_012
        ADD var_015, var_000, var_000
        ADD var_013, var_013, var_015
        MOV var_015, weird
        ADD var_013, var_013, var_015
        MOV.B (r8) var_00e, [var_013]
        XORB var_00f, var_03b, var_00e
        MOV var_000, 0x0
        MOV var_017, 0x20
        MOV var_002, 0x0
        MOV var_016, 0x0
_label_005
        IF (counter == var_002) GOTO label_007 ELSE label_006
_label_006
        ADD var_016, var_016, var_017
        MOV var_018, 0x1
```

Step 3 – Big picture

- **AES Sbox**
- **“Hardcoded” key schedule**
  - 4 bytes secret input used to alter key schedule
- **CTR mode**
- **Weird # of rounds (17 ?)**
- **A hash is computed during the deciphering of the file**
  - And compared to a hardcoded one
- **Let’s bruteforce!**

Step 3 – Bruteforce

- Took a few hours
- Python executed using pypy
- 4 instances running



fab@sawfish: ~/chal/thcon2024/step3/all-cries

fab@sawfish: ~/chal/thcon2024/step3/all-cries 107x27

```
 167, 79, 201, 132, 176, 199, 254, 70, 40, 121, 228, 49, 29, 149, 116, 179, 1, 210, 43, 184, 227, 63, 159,
191, 78, 106, 164, 153, 173, 9, 10, 119, 229, 178, 154, 151, 7, 196, 1, 48, 217, 16, 170, 96, 111, 37, 76,
180, 150, 106, 27, 176, 93, 112, 52, 9, 163, 118, 228, 154, 69, 184, 255, 223, 168, 7, 111, 103, 252, 78, 2
36, 87, 16, 124, 75, 156, 228, 144, 27, 91, 198, 251, 152, 171, 78, 241, 49, 161, 37, 124, 27, 69, 76, 197,
 235, 3, 16, 242, 17, 31, 166, 139, 89, 33, 114, 145, 250, 64, 154, 159, 155, 68, 236, 41, 14, 180, 52, 65,
 177, 70, 98, 48, 61, 110, 147, 253, 146, 149, 182, 136]
16 [165, 28, 227, 200, 159, 4, 204, 249, 251, 249, 50, 119, 0, 149, 232, 11]
127
         127
         126
         125
         124
         123
         122
         121
         120
         119
         118
         117
         116
         115
         114
         113
         112
         111
         110
```

fab@sawfish: ~/chal/thcon2024/step3/all-cries 108x27

```
69, 38, 126, 242, 254, 215, 38, 28, 209, 33, 231, 133, 57, 182, 40, 198, 3, 180, 21, 252, 26, 10, 188, 167,
79, 201, 132, 176, 199, 254, 70, 40, 121, 228, 49, 29, 149, 116, 179, 1, 210, 43, 184, 227, 63, 159, 191, 78
, 106, 164, 153, 173, 9, 10, 119, 229, 178, 154, 151, 7, 196, 1, 48, 217, 16, 170, 96, 111, 37, 76, 180, 150
, 106, 27, 176, 93, 112, 52, 9, 163, 118, 228, 154, 69, 184, 255, 223, 168, 7, 111, 103, 252, 78, 236, 87, 1
6, 124, 75, 156, 228, 144, 27, 91, 198, 251, 152, 171, 78, 241, 49, 161, 37, 124, 27, 69, 76, 197, 235, 3, 1
6, 242, 17, 31, 166, 139, 89, 33, 114, 145, 250, 64, 154, 159, 155, 68, 236, 41, 14, 180, 52, 65, 177, 70, 9
8, 48, 61, 110, 147, 253, 146, 149, 182, 136]
16 [165, 28, 227, 200, 159, 4, 204, 249, 251, 249, 50, 119, 0, 149, 232, 11]
126
         127
         126
         125
         124
         123
         122
         121
         120
         119
         118
         117
         116
         115
         114
         113
         112
         111
```

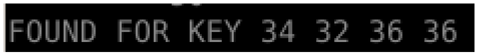
fab@sawfish: ~/chal/thcon2024/step3/all-cries 107x28

```
247, 210, 228, 148, 123, 170, 39, 155, 65, 119, 14, 63, 189, 51, 18, 45, 128, 254, 223, 59, 175, 33, 251, 9
5, 51, 136, 16, 66, 122, 152, 139, 24, 45, 205, 5, 117, 54, 98, 21, 237, 15, 32, 123, 149, 33, 37, 170, 88,
 66, 29, 85, 196, 124, 245, 180, 22, 190, 57, 248, 174, 42, 156, 40, 180, 36, 149, 96, 122, 66, 175, 105, 1
77, 169, 38, 126, 242, 254, 215, 38, 28, 209, 33, 231, 133, 57, 182, 40, 198, 3, 180, 21, 252, 26, 10, 188,
 167, 79, 201, 132, 176, 199, 254, 70, 40, 121, 228, 49, 29, 149, 116, 179, 1, 210, 43, 184, 227, 63, 159,
191, 78, 106, 164, 153, 173, 9, 10, 119, 229, 178, 154, 151, 7, 196, 1, 48, 217, 16, 170, 96, 111, 37, 76,
180, 150, 106, 27, 176, 93, 112, 52, 9, 163, 118, 228, 154, 69, 184, 255, 223, 168, 7, 111, 103, 252, 78, 2
36, 87, 16, 124, 75, 156, 228, 144, 27, 91, 198, 251, 152, 171, 78, 241, 49, 161, 37, 124, 27, 69, 76, 197,
 235, 3, 16, 242, 17, 31, 166, 139, 89, 33, 114, 145, 250, 64, 154, 159, 155, 68, 236, 41, 14, 180, 52, 65,
 177, 70, 98, 48, 61, 110, 147, 253, 146, 149, 182, 136]
16 [165, 28, 227, 200, 159, 4, 204, 249, 251, 249, 50, 119, 0, 149, 232, 11]
125
         127
         126
         125
         124
         123
         122
         121
         120
         119
         118
         117
         116
         115
         114
         113
```

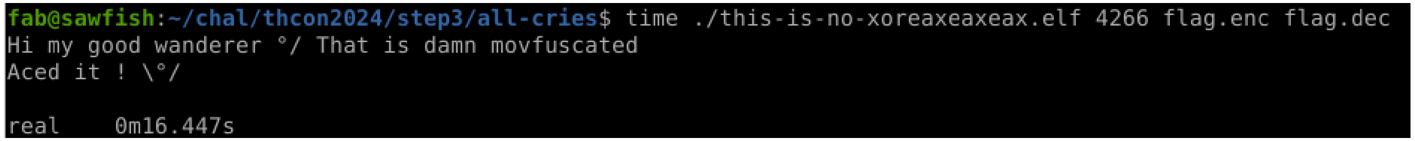
fab@sawfish: ~/chal/thcon2024/step3/all-cries 108x28

```
, 106, 164, 153, 173, 9, 10, 119, 229, 178, 154, 151, 7, 196, 1, 48, 217, 16, 170, 96, 111, 37, 76, 180, 150
, 106, 27, 176, 93, 112, 52, 9, 163, 118, 228, 154, 69, 184, 255, 223, 168, 7, 111, 103, 252, 78, 236, 87, 1
6, 124, 75, 156, 228, 144, 27, 91, 198, 251, 152, 171, 78, 241, 49, 161, 37, 124, 27, 69, 76, 197, 235, 3, 1
6, 242, 17, 31, 166, 139, 89, 33, 114, 145, 250, 64, 154, 159, 155, 68, 236, 41, 14, 180, 52, 65, 177, 70, 9
8, 48, 61, 110, 147, 253, 146, 149, 182, 136]
16 [165, 28, 227, 200, 159, 4, 204, 249, 251, 249, 50, 119, 0, 149, 232, 11]
124
         127
         126
         125
         124
         123
         122
         121
         120
         119
         118
         117
         116
         115
         114
         113
         112
         111
         110
         109
         108
```

Step 3 - Finally



```
FOUND FOR KEY 34 32 36 36
```



```
fab@sawfish:~/chal/thcon2024/step3/all-cries$ time ./this-is-no-xoreaxeaxeax.elf 4266 flag.enc flag.dec
Hi my good wanderer °/ That is damn movfuscated
Aced it ! \°/

real    0m16.447s
```

```
$ file flag.dec
flag.dec: JPEG image data, JFIF standard 1.01, resolution (DPI), density 300x300, segment length 16, comment: "thc-2024-flag-2kv0iayavqir6ybnfnipcryc6cr5r22zvmsnmys7eye6fgi1k1qjlndsxyeb@m0rgan.net
", progressive, precision 8, 200x152, components 3
```

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https://synacktiv.com