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CSIT-460-03

25 September 2023

Lab 1: Set-UID Program Vulnerability

1. **passwd:** The ‘passwd’ command is used to change a user’s password. It needs Set-UID privileges because it must write the new password to the ‘/etc/shadow’ file, which is normally only writable by the root user.

   If ‘passwd’ is not Set-UID, normal users would not be able to change their password, as they lack the required permission to modify the ‘/etc/shadow’ file.

   chsh: The ‘chsh’ command is used to change a user’s login shell. It needs Set-UID privileges because it must write changes to the ‘/etc/passwd’ file, which is typically only writable by the root user.

   If ‘chsh’ is not Set-UID, regular users would not be able to change their login shells, and only the root user could do so. This would limit users' ability to customize their environment.

   su: The ‘su’ command is used to switch to another user account. It needs Set-UID privileges to allow a user to switch to the root user or other user without requiring knowledge of that user’s password.

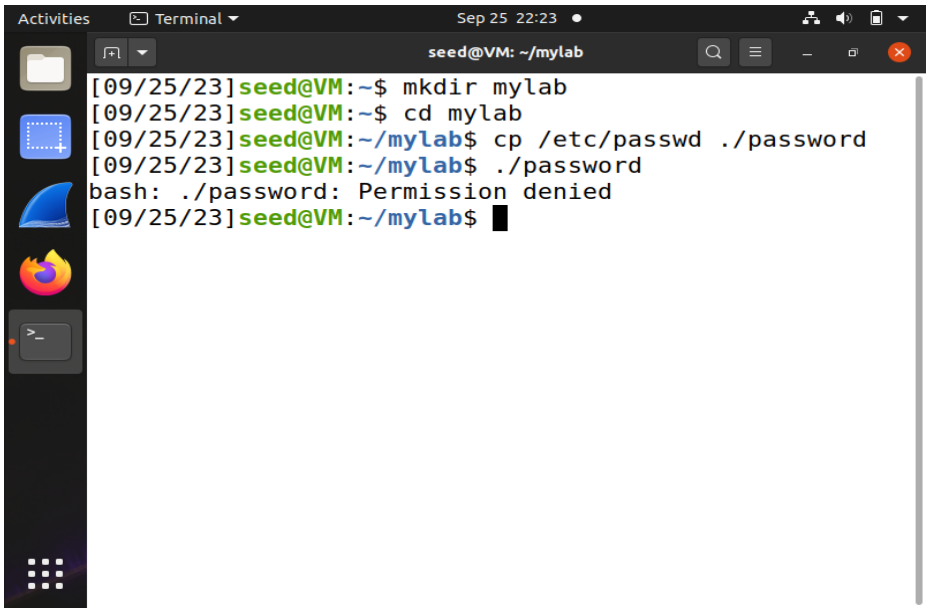
   If ‘su’ is not Set-UID, users would need to know the password of the target user to switch to that account, which can be impractical and insecure.

sudo: The ‘sudo’ command is used to execute commands with superuser privileges, typically by providing the user’s password. It needs Set-UID privileges to escalate privileges and execute commands as root without requiring the root password.

If ‘sudo’ is not Set-UID users would need to log in as the root user directly to perform administrative tasks, which is highly discouraged for security reasons. Set-UID ‘sudo’ allows for more granular control over who can perform administrative actions.

Testing the commands:

passwd:



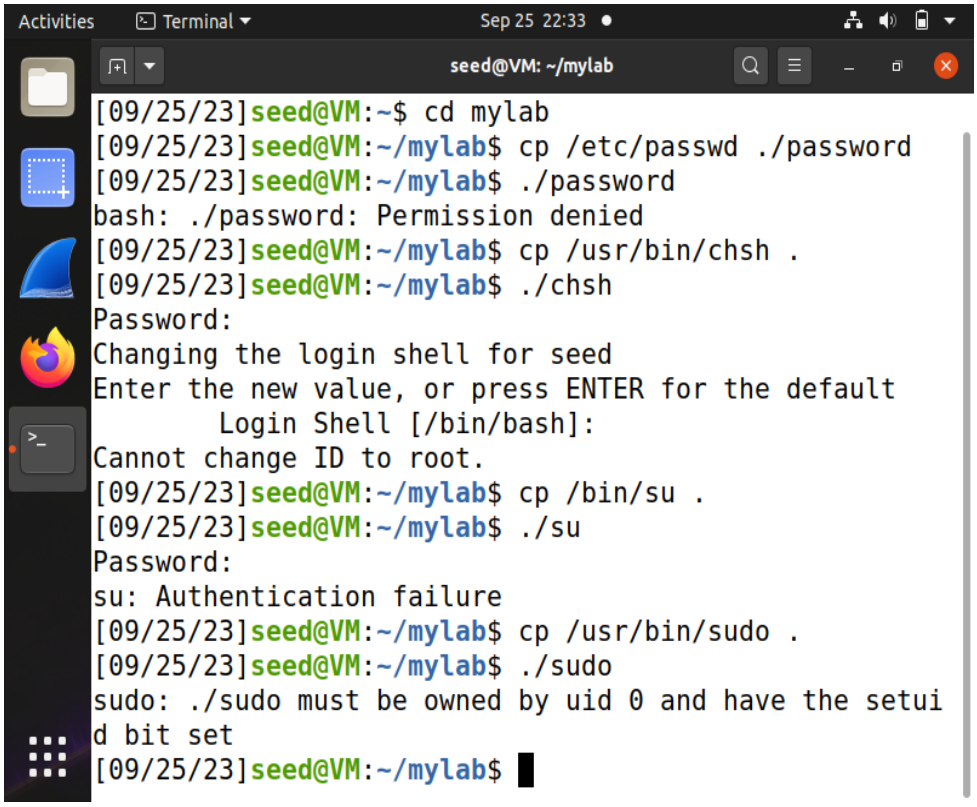
chsh:

```
[09/25/23]seed@VM:~$ mkdir mylab
[09/25/23]seed@VM:~$ cd mylab
[09/25/23]seed@VM:~/mylab$ cp /etc/passwd ./password
[09/25/23]seed@VM:~/mylab$ ./password
bash: ./password: Permission denied
[09/25/23]seed@VM:~/mylab$ cp /usr/bin/chsh .
[09/25/23]seed@VM:~/mylab$ ./chsh
Password:
Changing the login shell for seed
Enter the new value, or press ENTER for the default
        Login Shell [/bin/bash]:
Cannot change ID to root.
[09/25/23]seed@VM:~/mylab$
```

su:

```
[09/25/23]seed@VM:~$ cd mylab
[09/25/23]seed@VM:~/mylab$ cp /etc/passwd ./password
[09/25/23]seed@VM:~/mylab$ ./password
bash: ./password: Permission denied
[09/25/23]seed@VM:~/mylab$ cp /usr/bin/chsh .
[09/25/23]seed@VM:~/mylab$ ./chsh
Password:
Changing the login shell for seed
Enter the new value, or press ENTER for the default
        Login Shell [/bin/bash]:
Cannot change ID to root.
[09/25/23]seed@VM:~/mylab$ cp /bin/su .
[09/25/23]seed@VM:~/mylab$ ./su
Password:
su: Authentication failure
[09/25/23]seed@VM:~/mylab$ cp /usr/bin/sudo .
[09/25/23]seed@VM:~/mylab$ ./sudo
sudo: ./sudo must be owned by uid 0 and have the setui
d bit set
[09/25/23]seed@VM:~/mylab$
```

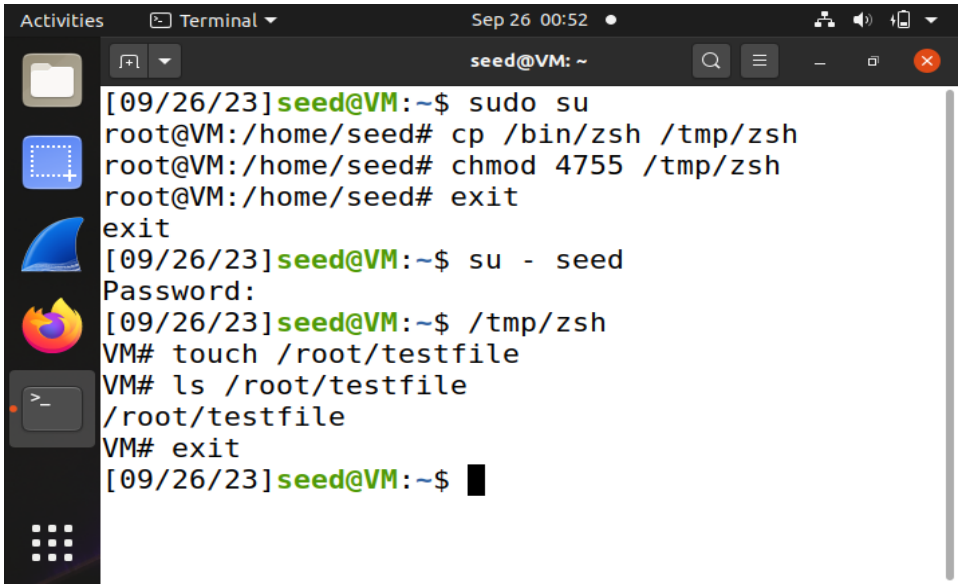
sudo:



When running these copies without Set-UID, I got permission denied error and other issues like cannot change ID to root, authentication failure and have the setuid bit set. This demonstrates Set-UID is necessary for these commands to function as intended.

2. (a)

Copy '/bin/zsh' to 'tmp':



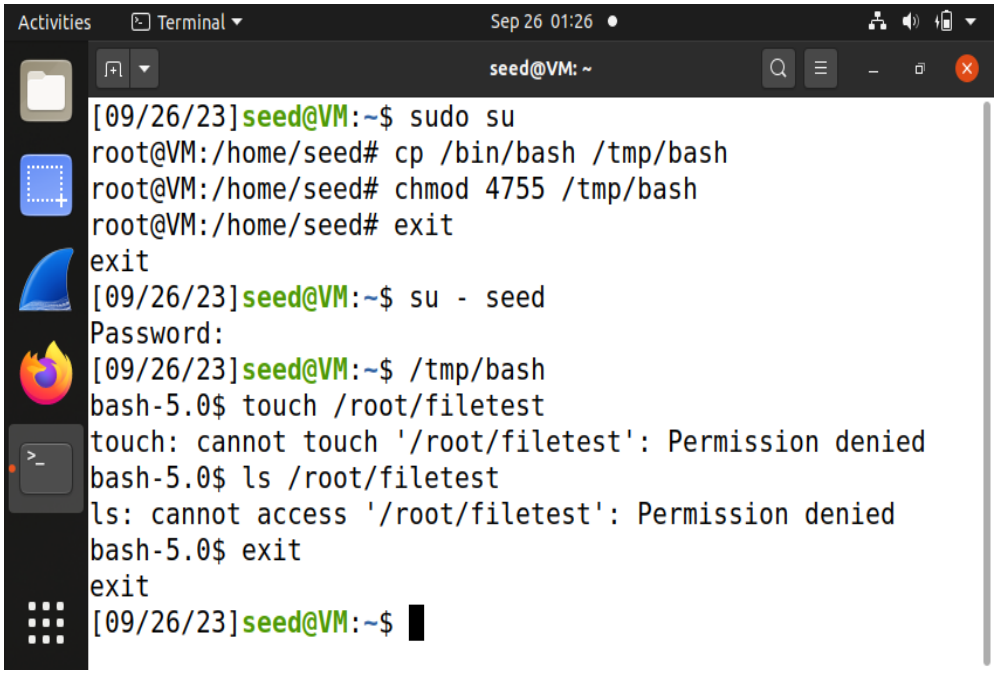
First, I logged in as root by using the command 'sudo su'. Then, copy '/bin/zsh' to '/tmp' and set it as the Set-Root-UID program with permission '4755'. Next, log in as a normal user and run '/tmp/zsh'. When I run '/tmp/zsh' as a normal user, I notice that I gain root privileges temporarily. I verify this by attempting to perform actions that are typically restricted to the root user, such as creating a file in a directory where only root has write permission.

I created a file in the '/root' directory, which is the home directory of the root user and is typically not writable by normal users. I successfully created the 'testfile' in '/root', it demonstrates that I have temporary root privileges while running the '/tmp/zsh' shell with the privileges of the file's owner.

After creating the file, I used the 'ls' command to check if it exists and it returned the filename as '/root/testfile' which means the file was successfully created and it exists.

(b)

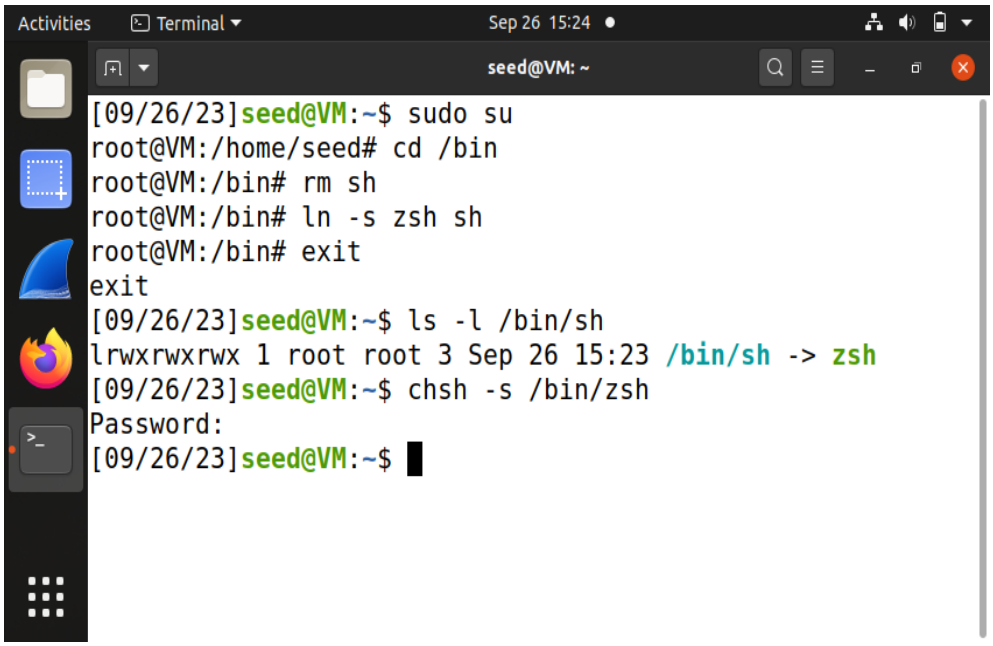
Copy '/bin/bash' to '/tmp':



I logged in as root by using the command 'sudo su'. Then, copy '/bin/bash' to '/tmp' and set it as the Set-Root-UID program with permission '4755'. Next, log in as a normal user and run '/tmp/bash'. Copying '/bin/bash' to '/tmp' and making it a Set-Root-UID program did not grant root privileges when run as a normal user. This is because '/bin/bash' is designed to drop privileges when it detects that it is run with the Set-UID bit. This means that even though I run '/tmp/bash' with the Set-Root-UID bit set, the shell will detect that it is being run with elevated privileges and will take measures to reduce those privileges to that of the invoking user. This is a security feature to prevent unauthorized escalation of privileges.

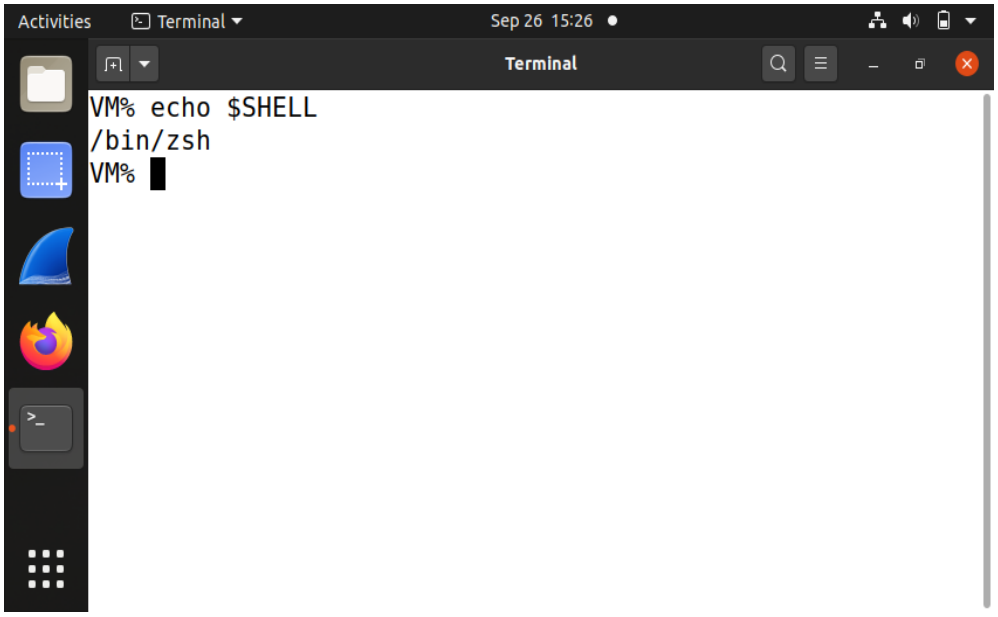
3. **Setup for the rest of the task:**

   Change the default shell from '/bin/bash' to '/bin/zsh'

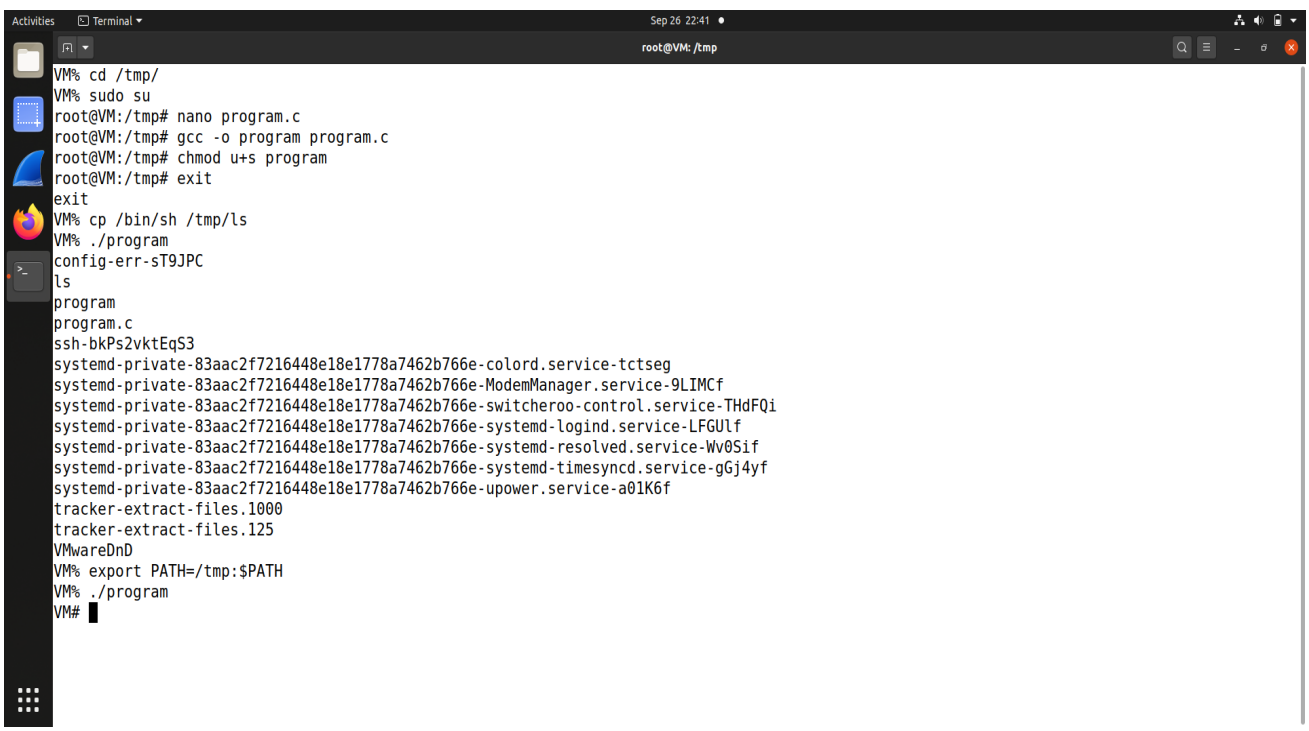


The default shell was '/bin/bash' . After following the steps to change it to '/bin/zsh' I also verified that the symbolic link had been created successfully by running 'ls -l /bin/sh', but my terminal was still opening with the Bash shell. So that means my default account was not changed. To set 'zsh' as the default shell I used the 'chsh' command 'chsh -s /bin/zsh' and entered my password. After successfully changing the shell, I logged out of the current terminal session and then logged back in. Upon logging back in, it opened the zsh shell as default shell.

Default zsh shell:



4. The PATH Environment variable:



a. Yes, it's possible for an attacker to manipulate the PATH environment variable and make the Set-UID program execute a different command. However, the program will still run

with the privileges of the Set-UID program. I copied /bin/sh to /tmp with the new name ls. Then set PATH to the current directory /tmp, compile and run the ./program and I got root privilege.

b. By restoring /bin/sh to /bin/bash, you effectively mitigate the vulnerability that allows the attacker to manipulate the PATH environment variable and execute arbitrary code. Bash, when used as the system shell, implements security measures to prevent PATH-based attacks in Set-UID programs. Changing /bin/sh back to /bin/bash eliminates the vulnerability to the PATH manipulation attack, and you cannot gain root privileges through the Set-UID program by manipulating the PATH environment variable.