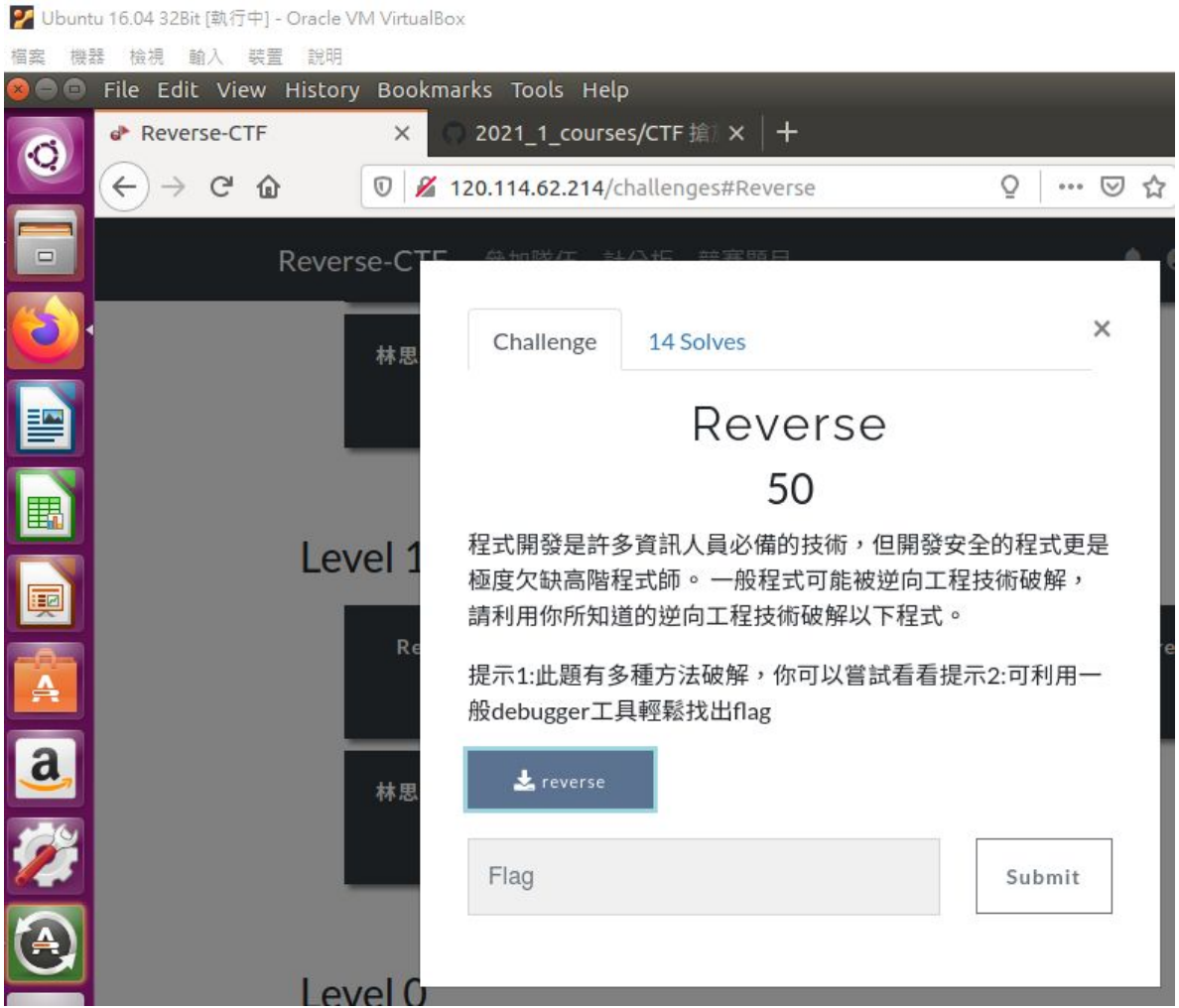
CTF
2021 03 13

http://120.114.62.214/challenges


Ubuntu 16.04 32Bit [執行中] - Oracle VM VirtualBox
檔案 機器 檢視 輸入 裝置 說明
File Edit View History Bookmarks Tools Help
Reverse-CTF
2021_1_courses/CTF
120.114.62.214/challenges#Reverse
Challenge
14 Solves
Reverse
50
程式開發是許多資訊人員必備的技術，但開發安全的程式更是極度欠缺高階程式師。一般程式可能被逆向工程技術破解，請利用你所知道的逆向工程技術破解以下程式。
提示1:此題有多種方法破解，你可以嘗試看看提示2:可利用一般debugger工具輕鬆找出flag
reverse
Flag
Submit

Ubuntu 16.04 32Bit [執行中] - Oracle VM VirtualBox

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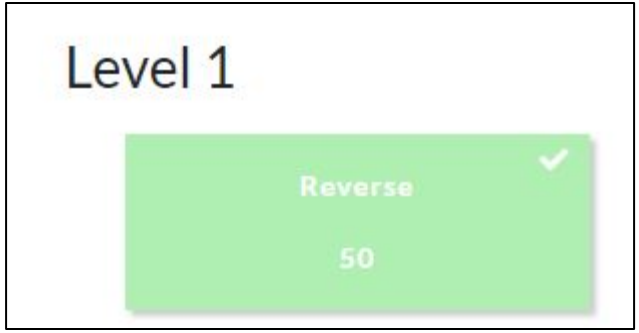
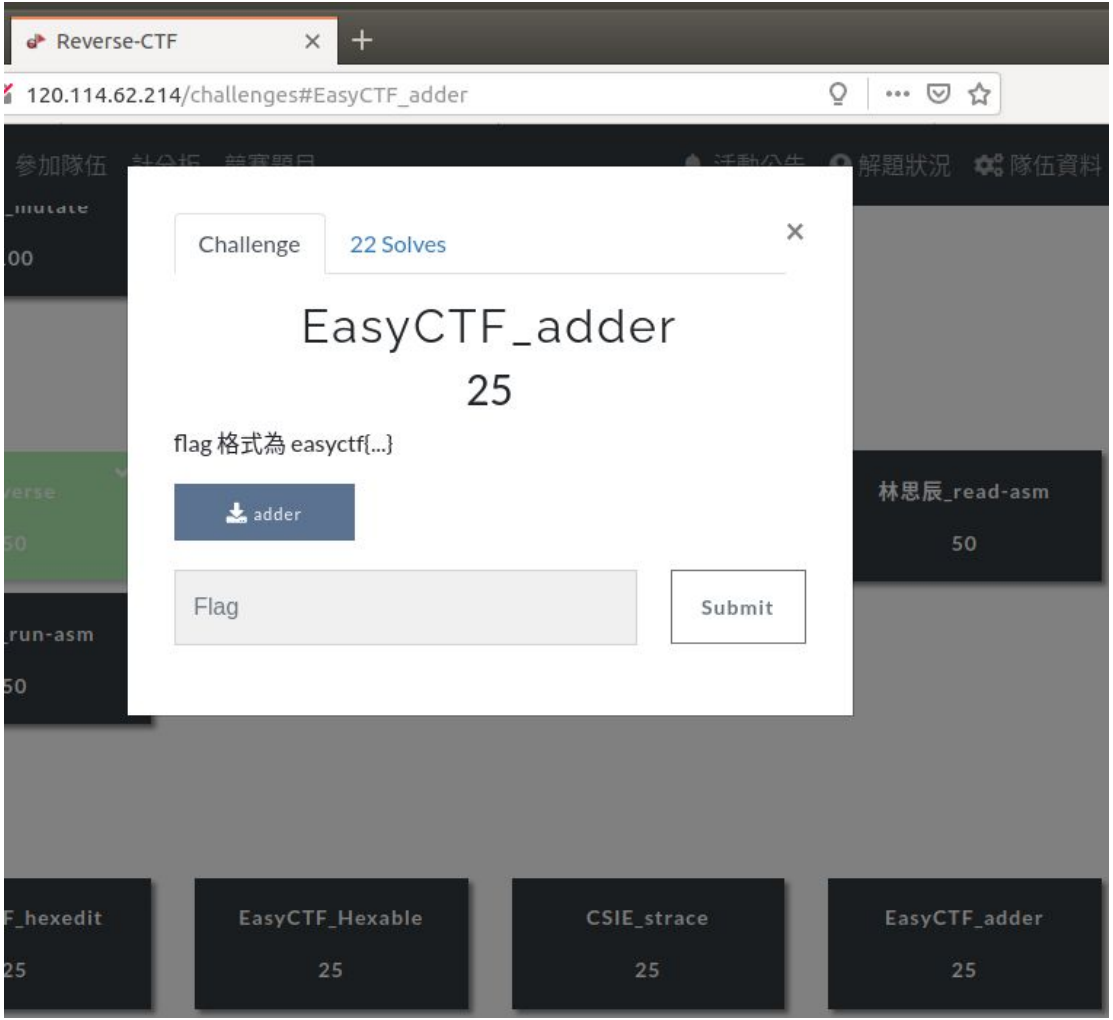
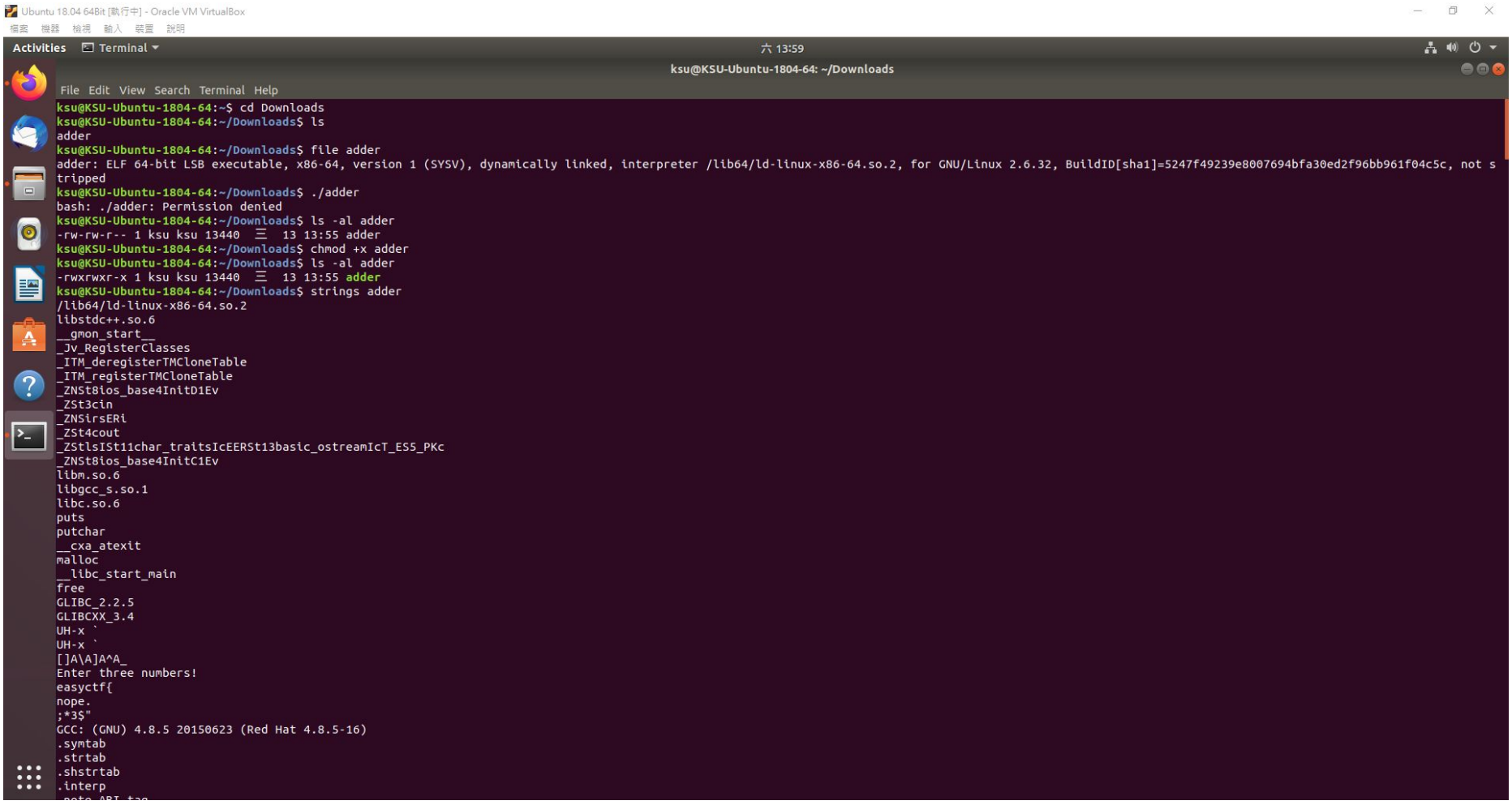
```
ksu@KSU-Ubuntu-1604-32:~$ cd Downloads
ksu@KSU-Ubuntu-1604-32:~/Downloads$ ls
adder         ezreverse  hexedit  LuckyGuess  strace
Coffee.class  hexable    liar     reverse
ksu@KSU-Ubuntu-1604-32:~/Downloads$ file reverse
reverse: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linu
x.so.2, for GNU/Linux 2.6.32, BuildID[sha1]=0eae3e9fd6d9a63980d737561cba79a68e655c9f, not stripped
ksu@KSU-Ubuntu-1604-32:~/Downloads$ ls -al reverse
-rw-rw-r-- 1 ksu ksu 7380  三  13 11:32 reverse
ksu@KSU-Ubuntu-1604-32:~/Downloads$ chmod +x reverse
ksu@KSU-Ubuntu-1604-32:~/Downloads$ ls -al reverse
-rwxrwxr-x 1 ksu ksu 7380  三  13 11:32 reverse
ksu@KSU-Ubuntu-1604-32:~/Downloads$ strings reverse
/lib/ld-linux.so.2
libc.so.6
_IO_stdin_used
gets
puts
__libc_start_main
__gmon_start__
GLIBC_2.0
PTRh
QVh;
UWVS
t$,U
[^_]
BreakALLCTF{4U49uY7OJCrJL0vtbXjd}
Try again?
;*2$"(
GCC: (Ubuntu 5.4.0-6ubuntu1~16.04.4) 5.4.0 20160609
crtstuff.c
__JCR_LIST__
deregister_tm_clones
__do_global_dtors_aux
completed.7200
__do_global_dtors_aux_fini_array_entry
frame_dummy
__frame_dummy_init_array_entry
re-1.c
__FRAME_END__
__JCR_END__
__init_array_end
_DYNAMIC
__init_array_start
__GNU_EH_FRAME_HDR
_GLOBAL_OFFSET_TABLE_
__libc_csu_fini
_ITM_deregisterTMCloneTable
__x86.get_pc_thunk.bx
gets@@GLIBC_2.0
_edata
__data_start
puts@@GLIBC_2.0
__gmon_start__
__dso_handle
_IO_stdin_used
```

```
__libc_start_main@@GLIBC_2.0
__libc_csu_init
_fp_hw
__bss_start
main
_Jv_RegisterClasses
__TMC_END__
_ITM_registerTMCloneTable
.symtab
.strtab
.shstrtab
.interp
.note.ABI-tag
.note.gnu.build-id
.gnu.hash
.dynsym
.dynstr
.gnu.version
.gnu.version_r
.rel.dyn
.rel.plt
.init
.plt.got
.text
.fini
.rodata
.eh_frame_hdr
.eh_frame
.init_array
.fini_array
.jcr
.dynamic
.got.plt
.data
.bss
.comment
ksu@KSU-Ubuntu-1604-32:~/Downloads$
```



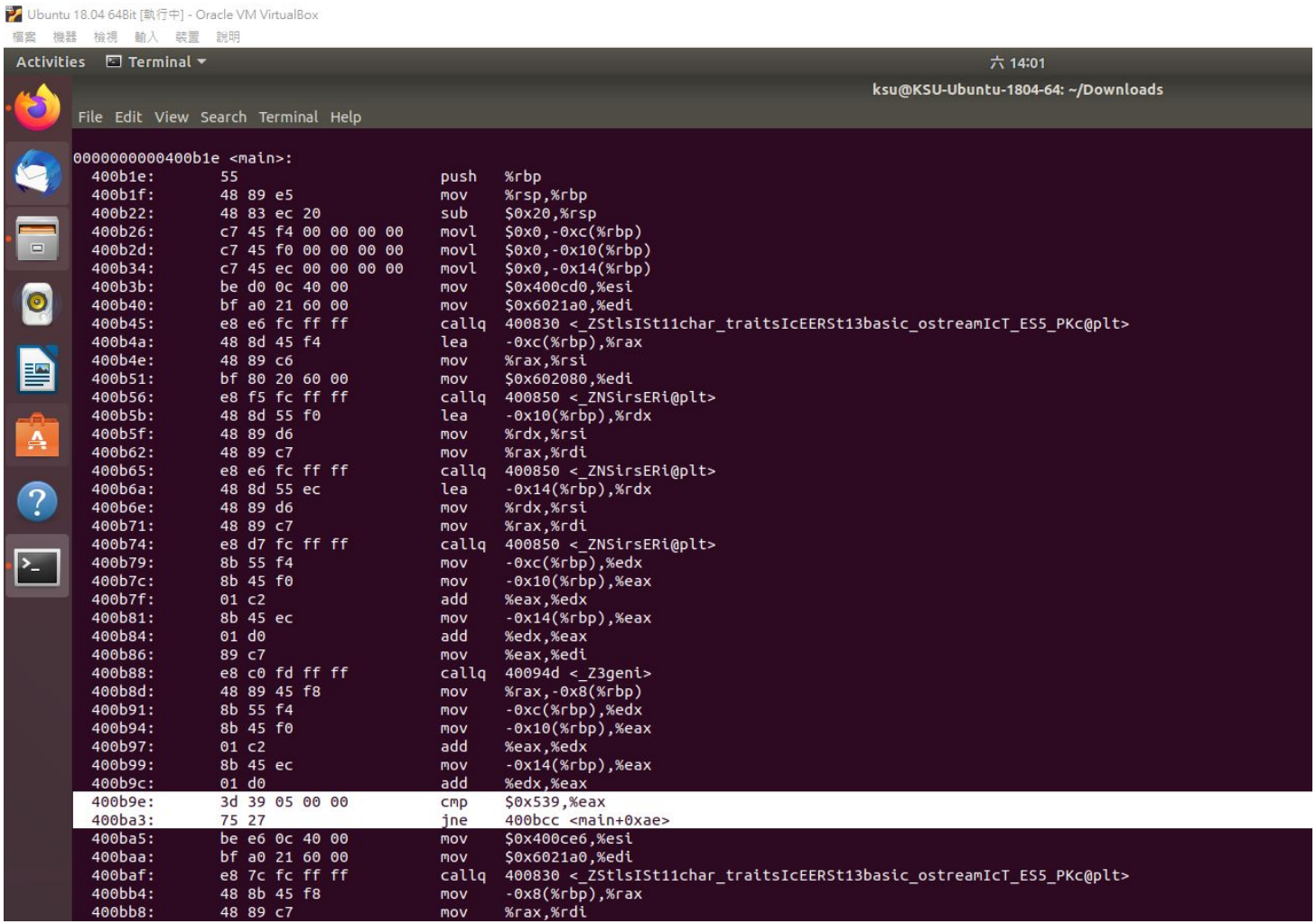

Reverse-CTF
120.114.62.214/challenges#EasyCTF_adder
參加隊伍
解題狀況
隊伍資料
Challenge
22 Solves
EasyCTF_adder
25
flag 格式為 easyctf{...}
adder
Flag
Submit
林思辰_read-asm
50
EasyCTF_Hexable
25
CSIE_strace
25
EasyCTF_adder
25


Ubuntu 18.04 64Bit [執行中] - Oracle VM VirtualBox
檔案 機器 檢視 輸入 裝置 說明
Activities
Terminal
六 13:59
ksu@KSU-Ubuntu-1804-64: ~/Downloads
File Edit View Search Terminal Help
ksu@KSU-Ubuntu-1804-64:~$ cd Downloads
ksu@KSU-Ubuntu-1804-64:~/Downloads$ ls
adder
ksu@KSU-Ubuntu-1804-64:~/Downloads$ file adder
adder: ELF 64-bit LSB executable, x86-64, version 1 (SYSV), dynamically linked, interpreter /lib64/ld-linux-x86-64.so.2, for GNU/Linux 2.6.32, BuildID[sha1]=5247f49239e8007694bfa30ed2f96bb961f04c5c, not s
tripped
ksu@KSU-Ubuntu-1804-64:~/Downloads$ ./adder
bash: ./adder: Permission denied
ksu@KSU-Ubuntu-1804-64:~/Downloads$ ls -al adder
-rw-rw-r-- 1 ksu ksu 13440 三 13 13:55 adder
ksu@KSU-Ubuntu-1804-64:~/Downloads$ chmod +x adder
ksu@KSU-Ubuntu-1804-64:~/Downloads$ ls -al adder
-rwxrwxr-x 1 ksu ksu 13440 三 13 13:55 adder
ksu@KSU-Ubuntu-1804-64:~/Downloads$ strings adder
/lib64/ld-linux-x86-64.so.2
libstdc++.so.6
__gmon_start__
_Jv_RegisterClasses
_ITM_deregisterTMCloneTable
_ITM_registerTMCloneTable
_ZNSt8ios_base4InitD1Ev
_ZSt3cin
_ZNSirsERi
_ZSt4cout
_ZStlsISt11char_traitsIcEERSt13basic_ostreamIcT_ES5_PKc
_ZNSt8ios_base4InitC1Ev
libm.so.6
libgcc_s.so.1
libc.so.6
puts
putchar
__cxa_atexit
malloc
__libc_start_main
free
GLIBC_2.2.5
GLIBCXX_3.4
UH-x `
UH-x `
[]A\A]A^A_
Enter three numbers!
easyctf{
nope.
;*3$"
GCC: (GNU) 4.8.5 20150623 (Red Hat 4.8.5-16)
.symtab
.strtab
.shstrtab
.interp

ksu@KSU-Ubuntu-1804-64: ~/Downloads

File Edit View Search Terminal Help

```
ksu@KSU-Ubuntu-1804-64:~/Downloads$ objdump -S adder

adder:     file format elf64-x86-64


Disassembly of section .init:

0000000000400778 <_init>:
  400778:       48 83 ec 08             sub    $0x8,%rsp
  40077c:       48 8b 05 75 18 20 00    mov    0x201875(%rip),%rax        # 601ff8 <__gmon_start__>
  400783:       48 85 c0                test   %rax,%rax
  400786:       74 05                   je     40078d <_init+0x15>
  400788:       e8 23 00 00 00          callq  4007b0 <__gmon_start__@plt>
  40078d:       48 83 c4 08             add    $0x8,%rsp
  400791:       c3                      retq

Disassembly of section .plt:

00000000004007a0 <.plt>:
  4007a0:       ff 35 62 18 20 00       pushq  0x201862(%rip)        # 602008 <_GLOBAL_OFFSET_TABLE_+0x8>
  4007a6:       ff 25 64 18 20 00       jmpq   *0x201864(%rip)        # 602010 <_GLOBAL_OFFSET_TABLE_+0x10>
  4007ac:       0f 1f 40 00             nopl   0x0(%rax)

00000000004007b0 <__gmon_start__@plt>:
  4007b0:       ff 25 62 18 20 00       jmpq   *0x201862(%rip)        # 602018 <__gmon_start__>
  4007b6:       68 00 00 00 00          pushq  $0x0
  4007bb:       e9 e0 ff ff ff          jmpq   4007a0 <.plt>

00000000004007c0 <puts@plt>:
  4007c0:       ff 25 5a 18 20 00       jmpq   *0x20185a(%rip)        # 602020 <puts@GLIBC_2.2.5>
  4007c6:       68 01 00 00 00          pushq  $0x1
  4007cb:       e9 d0 ff ff ff          jmpq   4007a0 <.plt>

00000000004007d0 <putchar@plt>:
  4007d0:       ff 25 52 18 20 00       jmpq   *0x201852(%rip)        # 602028 <putchar@GLIBC_2.2.5>
  4007d6:       68 02 00 00 00          pushq  $0x2
  4007db:       e9 c0 ff ff ff          jmpq   4007a0 <.plt>

00000000004007e0 <_ZNSt8ios_base4InitC1Ev@plt>:
  4007e0:       ff 25 4a 18 20 00       jmpq   *0x20184a(%rip)        # 602030 <_ZNSt8ios_base4InitC1Ev@GLIBCXX_3.4>
  4007e6:       68 03 00 00 00          pushq  $0x3
  4007eb:       e9 b0 ff ff ff          jmpq   4007a0 <.plt>

00000000004007f0 <malloc@plt>:
  4007f0:       ff 25 42 18 20 00       jmpq   *0x201842(%rip)        # 602038 <malloc@GLIBC_2.2.5>
  4007f6:       68 04 00 00 00          pushq  $0x4
  4007fb:       e9 a0 ff ff ff          jmpq   4007a0 <.plt>

0000000000400800 <__libc_start_main@plt>:
  400800:       ff 25 3a 18 20 00       jmpq   *0x20183a(%rip)        # 602040 <__libc_start_main@GLIBC_2.2.5>
```


Ubuntu 18.04 64Bit [執行中] - Oracle VM VirtualBox
檔案 機器 檢視 輸入 裝置 說明
Activities
Terminal
六 14:01
ksu@KSU-Ubuntu-1804-64: ~/Downloads
File Edit View Search Terminal Help
0000000000400b1e <main>:
400b1e: 55 push %rbp
400b1f: 48 89 e5 mov %rsp,%rbp
400b22: 48 83 ec 20 sub $0x20,%rsp
400b26: c7 45 f4 00 00 00 00 movl $0x0,-0xc(%rbp)
400b2d: c7 45 f0 00 00 00 00 movl $0x0,-0x10(%rbp)
400b34: c7 45 ec 00 00 00 00 movl $0x0,-0x14(%rbp)
400b3b: be d0 0c 40 00 mov $0x400cd0,%esi
400b40: bf a0 21 60 00 mov $0x6021a0,%edi
400b45: e8 e6 fc ff ff callq 400830 <_ZStlsISt11char_traitsIcEERSt13basic_ostreamIcT_ES5_PKc@plt>
400b4a: 48 8d 45 f4 lea -0xc(%rbp),%rax
400b4e: 48 89 c6 mov %rax,%rsi
400b51: bf 80 20 60 00 mov $0x602080,%edi
400b56: e8 f5 fc ff ff callq 400850 <_ZNSirsERi@plt>
400b5b: 48 8d 55 f0 lea -0x10(%rbp),%rdx
400b5f: 48 89 d6 mov %rdx,%rsi
400b62: 48 89 c7 mov %rax,%rdi
400b65: e8 e6 fc ff ff callq 400850 <_ZNSirsERi@plt>
400b6a: 48 8d 55 ec lea -0x14(%rbp),%rdx
400b6e: 48 89 d6 mov %rdx,%rsi
400b71: 48 89 c7 mov %rax,%rdi
400b74: e8 d7 fc ff ff callq 400850 <_ZNSirsERi@plt>
400b79: 8b 55 f4 mov -0xc(%rbp),%edx
400b7c: 8b 45 f0 mov -0x10(%rbp),%eax
400b7f: 01 c2 add %eax,%edx
400b81: 8b 45 ec mov -0x14(%rbp),%eax
400b84: 01 d0 add %edx,%eax
400b86: 89 c7 mov %eax,%edi
400b88: e8 c0 fd ff ff callq 40094d <_Z3geni>
400b8d: 48 89 45 f8 mov %rax,-0x8(%rbp)
400b91: 8b 55 f4 mov -0xc(%rbp),%edx
400b94: 8b 45 f0 mov -0x10(%rbp),%eax
400b97: 01 c2 add %eax,%edx
400b99: 8b 45 ec mov -0x14(%rbp),%eax
400b9c: 01 d0 add %edx,%eax
400b9e: 3d 39 05 00 00 cmp $0x539,%eax
400ba3: 75 27 jne 400bcc <main+0xae>
400ba5: be e6 0c 40 00 mov $0x400ce6,%esi
400baa: bf a0 21 60 00 mov $0x6021a0,%edi
400baf: e8 7c fc ff ff callq 400830 <_ZStlsISt11char_traitsIcEERSt13basic_ostreamIcT_ES5_PKc@plt>
400bb4: 48 8b 45 f8 mov -0x8(%rbp),%rax
400bb8: 48 89 c7 mov %rax,%rdi

I have the following src:

```
1  #include<stdio.h>
2
3  int main(void) {
4      int i= 1337; // breakpoint after this value is assigned
!5     return 0;
6  }
```

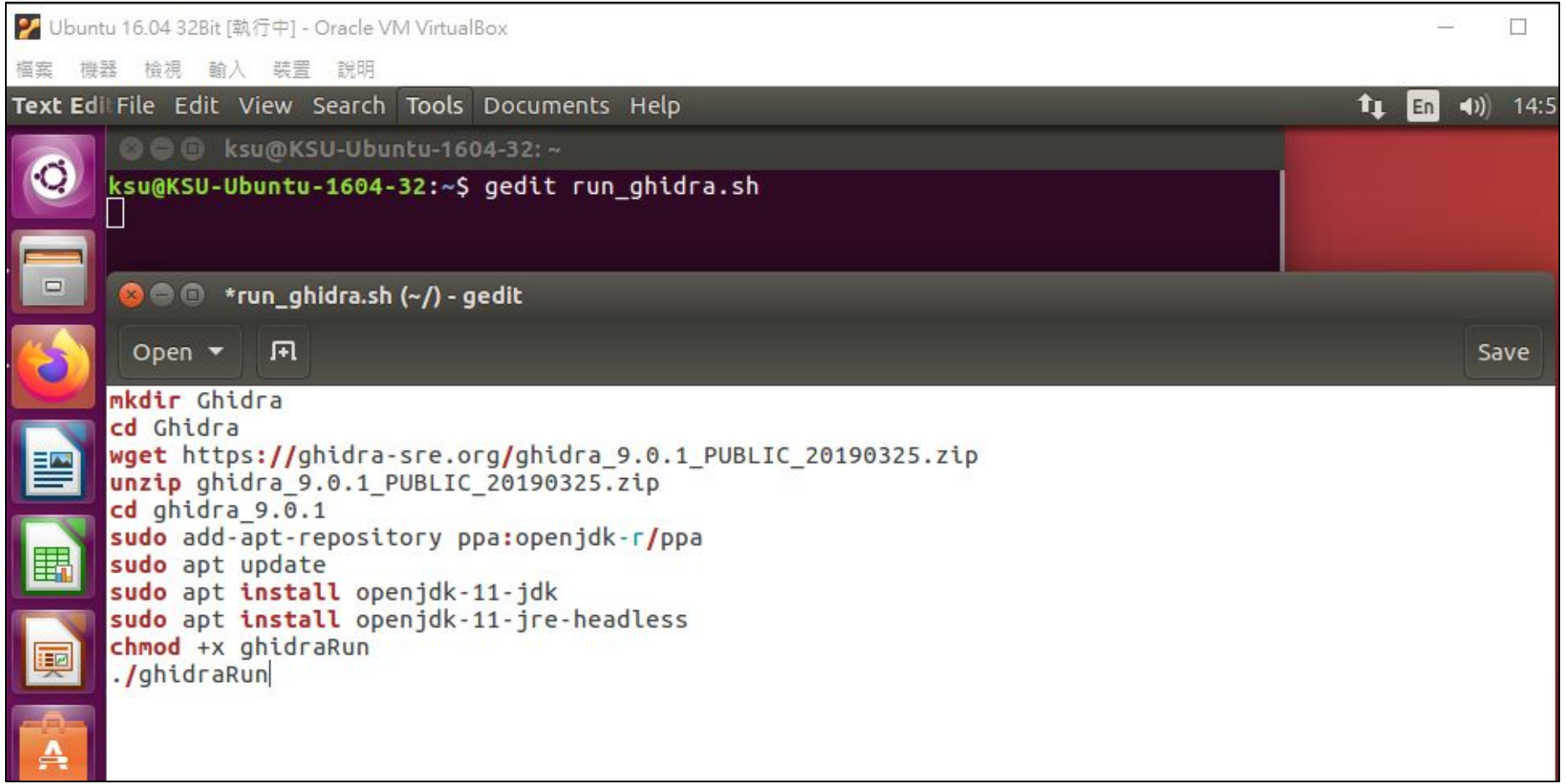
In the asm from `gdb` I get:

```
ksu@KSU-Ubuntu-1804-64:~/Downloads$ ./adder
Enter three numbers!
1337
0
0
easyctf{y0u_added_thr33_nums!}
ksu@KSU-Ubuntu-1804-64:~/Downloads$
```

```
!0x0000000004004f1  main+4  movl   $0x539,-0x4(%rbp)
```

And I verified that `$0x539` = `1337`. How can I see the memory address where the value `1337` is stored? The value of the `rbp` memory address shows:

```
rbp 0x00007fffffffeb20
```


Ubuntu 16.04 32Bit [執行中] - Oracle VM VirtualBox
檔案 機器 檢視 輸入 裝置 說明
Text Edi File Edit View Search Tools Documents Help
En
14:5
ksu@KSU-Ubuntu-1604-32: ~
ksu@KSU-Ubuntu-1604-32:~$ gedit run_ghidra.sh
*run_ghidra.sh (~/) - gedit
Open
Save
mkdir Ghidra
cd Ghidra
wget https://ghidra-sre.org/ghidra_9.0.1_PUBLIC_20190325.zip
unzip ghidra_9.0.1_PUBLIC_20190325.zip
cd ghidra_9.0.1
sudo add-apt-repository ppa:openjdk-r/ppa
sudo apt update
sudo apt install openjdk-11-jdk
sudo apt install openjdk-11-jre-headless
chmod +x ghidraRun
./ghidraRun

```
ksu@KSU-Ubuntu-1604-32:~$ chmod +x run_ghidra.sh
ksu@KSU-Ubuntu-1604-32:~$ ./run_ghidra.sh
--2021-03-13 14:56:09--  https://ghidra-sre.org/ghidra_9.0.1_PUBLIC_20190325.zip
Resolving ghidra-sre.org (ghidra-sre.org)... 13.227.73.28, 13.227.73.84, 13.227.73.9, ...
Connecting to ghidra-sre.org (ghidra-sre.org)|13.227.73.28|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 296076039 (282M) [application/zip]
Saving to: ‘ghidra_9.0.1_PUBLIC_20190325.zip’

ghidra_9.0.1_PUBLIC 100%[===================>] 282.36M  2.73MB/s    in 64s

2021-03-13 14:57:14 (4.40 MB/s) - ‘ghidra_9.0.1_PUBLIC_20190325.zip’ saved [296076039/296076039]

Archive:  ghidra_9.0.1_PUBLIC_20190325.zip
   creating: ghidra_9.0.1/
  inflating: ghidra_9.0.1/ghidraRun.bat
  inflating: ghidra_9.0.1/ghidraRun
   creating: ghidra_9.0.1/licenses/
  inflating: ghidra_9.0.1/licenses/Modified_Nuvola_Icons_-_LGPL_2.1.txt
  inflating: ghidra_9.0.1/licenses/Tango_Icons_-_Public_Domain.txt
  inflating: ghidra_9.0.1/licenses/Nuvola_Icons_-_LGPL_2.1.txt
  inflating: ghidra_9.0.1/licenses/Oxygen_Icons_-_LGPL_3.0.txt
  inflating: ghidra_9.0.1/licenses/LGPL_2.1.txt
  inflating: ghidra_9.0.1/licenses/GPL_2_With_Classpath_Exception.txt
  inflating: ghidra_9.0.1/licenses/Public_Domain.txt
  inflating: ghidra_9.0.1/licenses/Jython_License.txt
  inflating: ghidra_9.0.1/licenses/JDOM_License.txt
  inflating: ghidra_9.0.1/licenses/Apache_License_2.0.txt
  inflating: ghidra_9.0.1/licenses/FAMFAMFAM_MINI_ICONS_-_Public_Domain.txt
  inflating: ghidra_9.0.1/licenses/MIT.txt
  inflating: ghidra_9.0.1/licenses/BSD.txt
  inflating: ghidra_9.0.1/licenses/Christian_Plattner.txt
  inflating: ghidra_9.0.1/licenses/Crystal_Clear_Icons_-_LGPL_2.1.txt
  inflating: ghidra_9.0.1/licenses/Creative_Commons_Attribution_2.5.html
  inflating: ghidra_9.0.1/licenses/FAMFAMFAM_Icons_-_CC_2.5.txt
  inflating: ghidra_9.0.1/licenses/LGPL_3.0.html
```


Ghidra User Agreement
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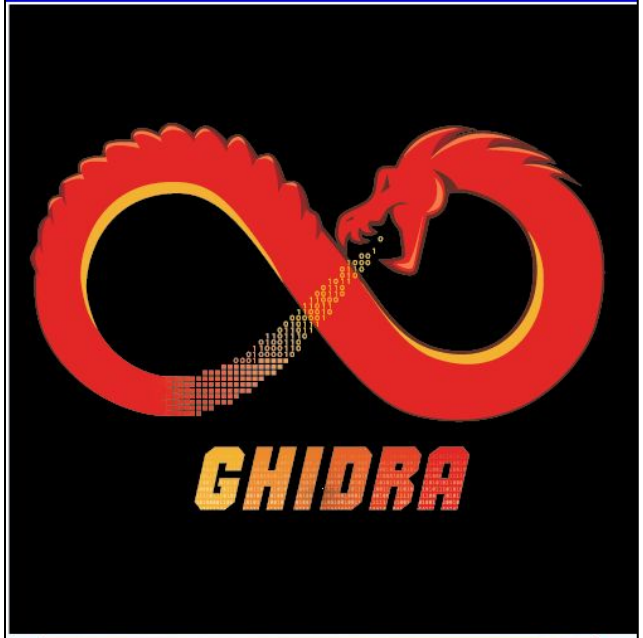
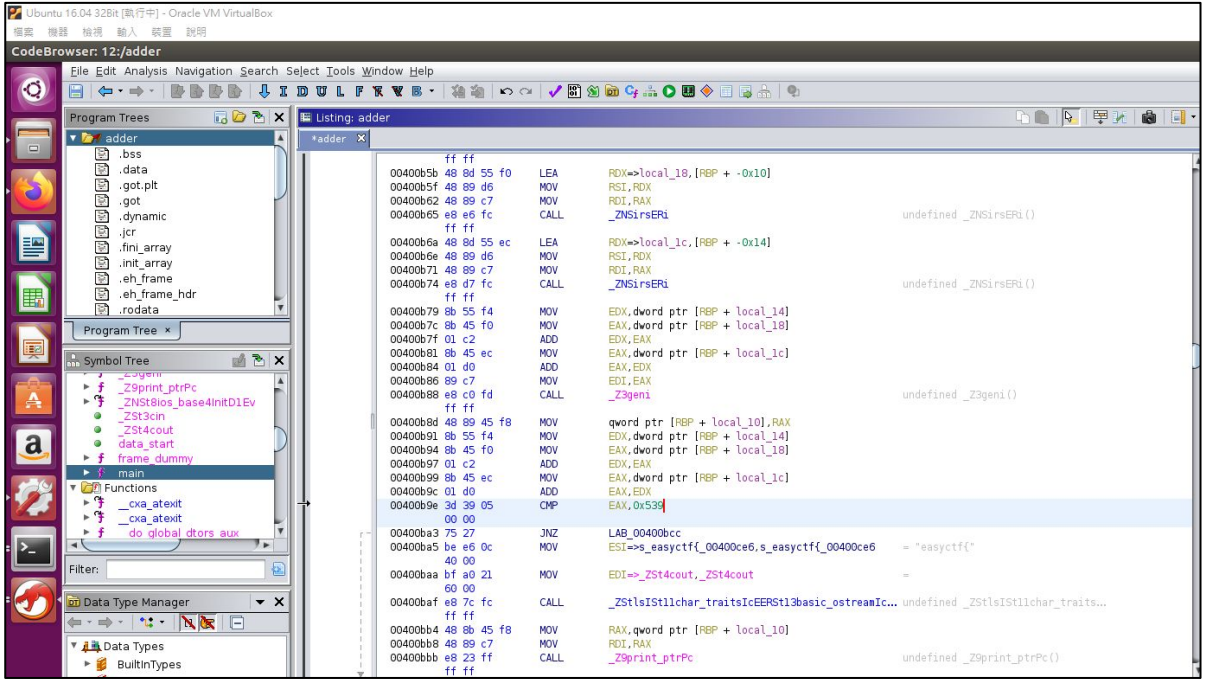
I Agree
I Don't Agree
Reading state information... Done
openjdk-11-jre-headless is already the newest version (11.0.11+4-0ubuntu3~16.04~1).
openjdk-11-jre-headless set to manually installed.
The following package was automatically installed and is no longer required:
snapd-login-service
Use 'sudo apt autoremove' to remove it.
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
ksu@KSU-Ubuntu-1604-32:~$

Welcome To Ghidra



Version 9.0.1
Build PUBLIC
2019-Mar-25 1752 EDT
Java Version 11.0.11-ea

Scanning jar: DATA.jar


Ubuntu 16.04 32Bit [執行中] - Oracle VM VirtualBox
CodeBrowser: 12:/adder
File Edit Analysis Navigation Search Select Tools Window Help
Program Trees
adder
.bss
.data
.got.plt
.got
.dynamic
.jcr
.fini_array
.init_array
.eh_frame
.eh_frame_hdr
.rodata
Program Tree
Symbol Tree
_Z9print_ptrPc
_ZNSt8ios_base4InitD1Ev
_ZSt3cin
_ZSt4cout
data_start
frame_dummy
main
Functions
__cxa_atexit
__cxa_atexit
__do_global_dtors_aux
Filter:
Data Type Manager
Data Types
BuiltInTypes
Listing: adder
*adder
ff ff
00400b5b 48 8d 55 f0 LEA RDX=>local_18,[RBP + -0x10]
00400b5f 48 89 d6 MOV RSI,RDX
00400b62 48 89 c7 MOV RDI,RAX
00400b65 e8 e6 fc CALL _ZNSirsERi undefined _ZNSirsERi()
ff ff
00400b6a 48 8d 55 ec LEA RDX=>local_1c,[RBP + -0x14]
00400b6e 48 89 d6 MOV RSI,RDX
00400b71 48 89 c7 MOV RDI,RAX
00400b74 e8 d7 fc CALL _ZNSirsERi undefined _ZNSirsERi()
ff ff
00400b79 8b 55 f4 MOV EDX,dword ptr [RBP + local_14]
00400b7c 8b 45 f0 MOV EAX,dword ptr [RBP + local_18]
00400b7f 01 c2 ADD EDX,EAX
00400b81 8b 45 ec MOV EAX,dword ptr [RBP + local_1c]
00400b84 01 d0 ADD EAX,EDX
00400b86 89 c7 MOV EDI,EAX
00400b88 e8 c0 fd CALL _Z3geni undefined _Z3geni()
ff ff
00400b8d 48 89 45 f8 MOV qword ptr [RBP + local_10],RAX
00400b91 8b 55 f4 MOV EDX,dword ptr [RBP + local_14]
00400b94 8b 45 f0 MOV EAX,dword ptr [RBP + local_18]
00400b97 01 c2 ADD EDX,EAX
00400b99 8b 45 ec MOV EAX,dword ptr [RBP + local_1c]
00400b9c 01 d0 ADD EAX,EDX
00400b9e 3d 39 05 CMP EAX,0x539
00 00
00400ba3 75 27 JNZ LAB_00400bcc
00400ba5 be e6 0c MOV ESI=>s_easyctf{_00400ce6,s_easyctf{_00400ce6 = "easyctf{"
40 00
00400baa bf a0 21 MOV EDI=>_ZSt4cout,_ZSt4cout =
60 00
00400baf e8 7c fc CALL _ZStlsISt11char_traitsIcEERSt13basic_ostreamIc... undefined _ZStlsISt11char_traits...
ff ff
00400bb4 48 8b 45 f8 MOV RAX,qword ptr [RBP + local_10]
00400bb8 48 89 c7 MOV RDI,RAX
00400bbb e8 23 ff CALL _Z9print_ptrPc undefined _Z9print_ptrPc()
ff ff