2025.09.19

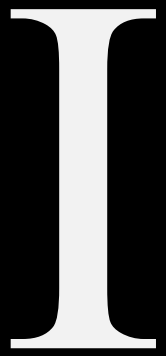
ROP

가디언 시스템 보안 & 취약점 분석 세미나 2.2

Guardian 2025

Security Mitigations

ASLR, PIE, NX, RELRO, CANRY



Security Mitigation

Summary

ASLR: stack 아무데나

Always on. Address Space Layout Randomization

NX: stack에서 shellcode 금지

No eXecute

PIE: .text 아무데나

Position Independent Executables

Security Mitigation

Summary

RELRO: .got overwrite 금지

RELocation Read-Only. 그리고 정확히는 Full RELRO

Canary: 스택에 parity 추가

Therefore, BOF 하다가 parity 건드리면 프로그램 터짐

Windows, Stack Cookie. Linux, Stack Canary

[카나리아] 또는 [카나리] 라고 읽는다

Security Mitigation

ASLR

Address Space Layout Randomization

Security Mitigation

NX

No-eXecute

Security Mitigation

PIE

Position Independent Executables

Security Mitigation

RELRO

RELocation Read-Only

Security Mitigation

Canary

Stack Smashing Protection

Security Mitigation

Canary

stack에 검증 값 삽입

return 과정에서 확인

틀리면 터짐

stack smashing detected!

첫번째 값은 \x00으로 고정. (출력 방지용)

Security Mitigation

NX

- Ret2ShellCode는 NX 옵션에서 불가
- 대부분 NX on

ROP

Ret2____

II

Return Oriented Programming

a.k.a. ROP

Somewhere in the code …

```
(0x00400700)
pop rdi;
ret;
```

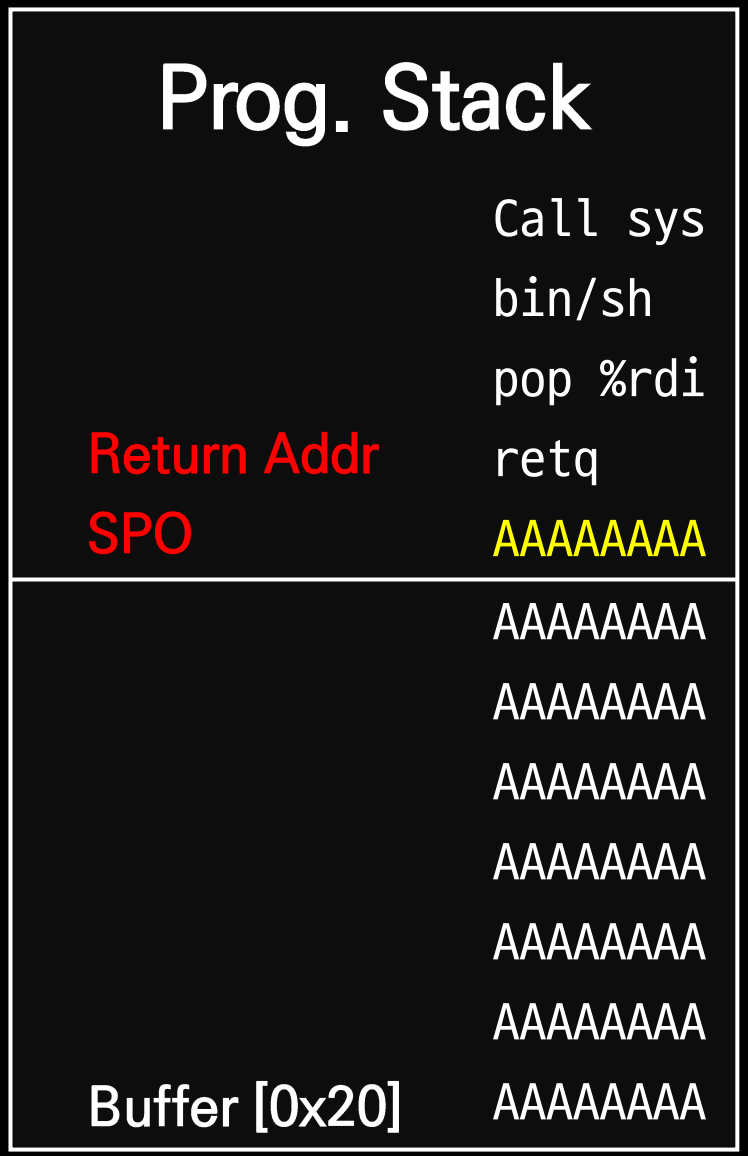
```
(0x00400900)
call system;
ret;
```

Ret2ShellCode

pop 하고 ret 하는 코드
조각을 사용하자!

RBP

RBP- 0x20 = RSP



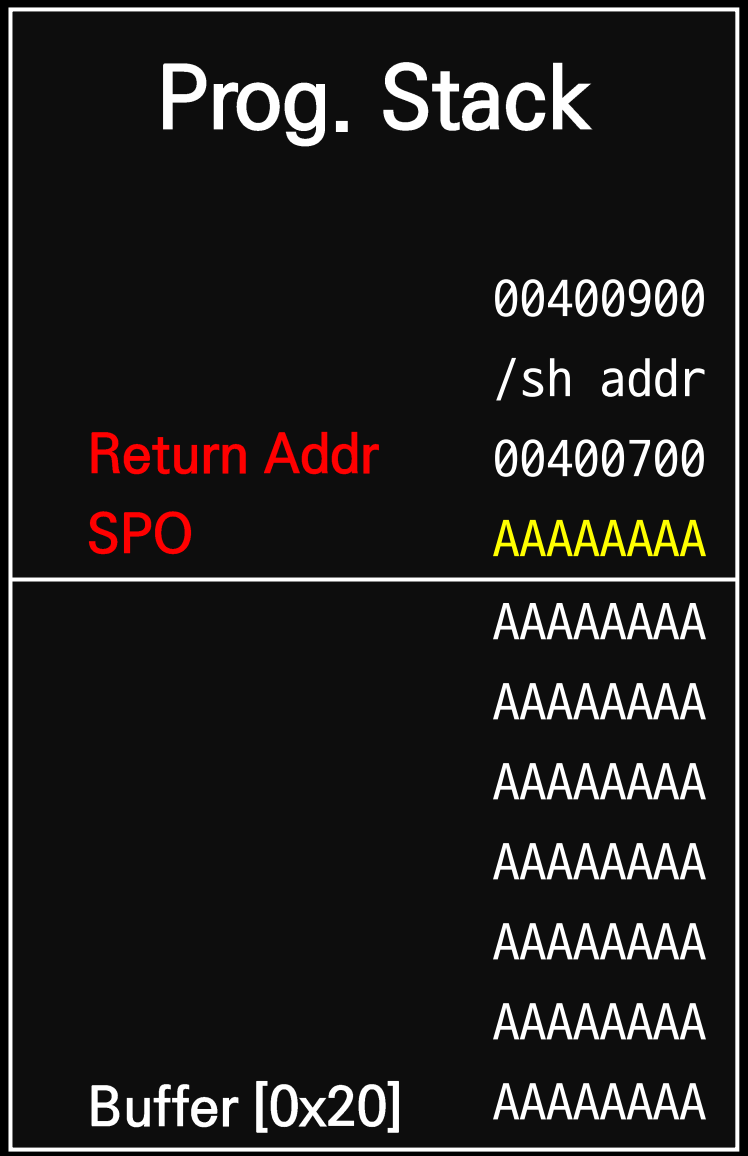
ROP

ReturnOrientedProgramming

pop ___; ret;
코드 조각들을 모아 조작

RBP

RBP- 0x20 = RSP



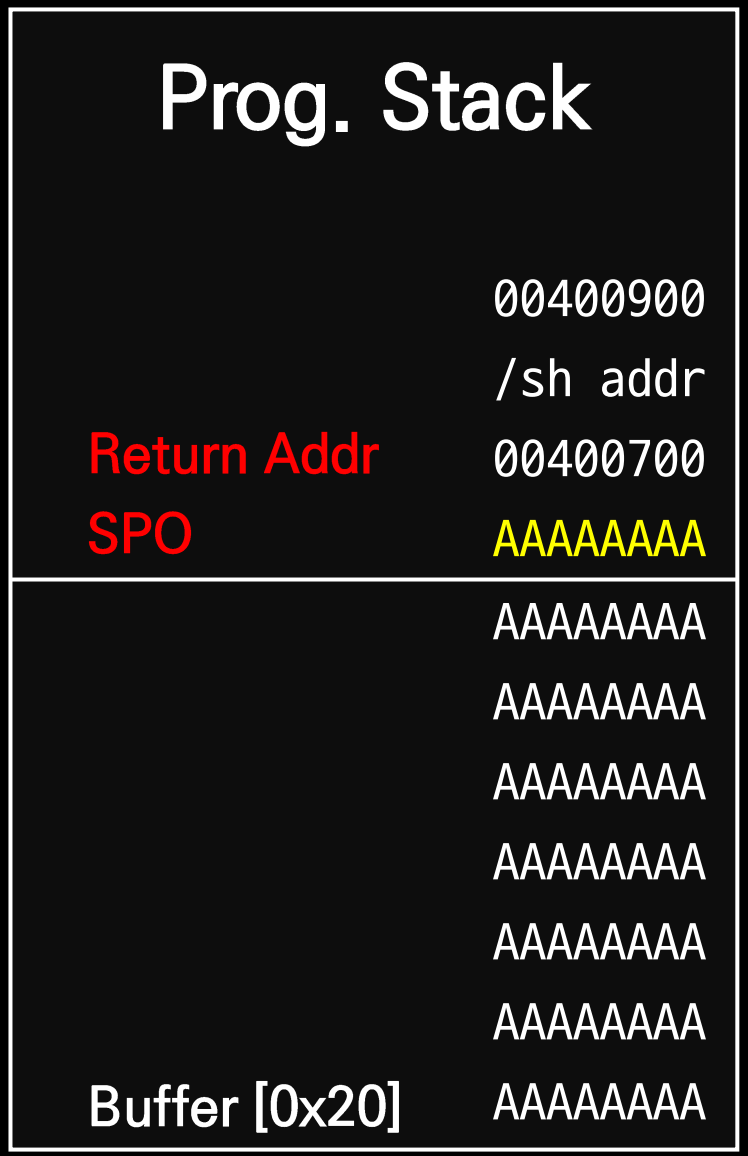
ROP

Return Oriented Programming

ROP에 쓰이는 코드조각을
gadget이라 한다.

RBP

RBP- 0x20 = RSP



도구라는 뜻임

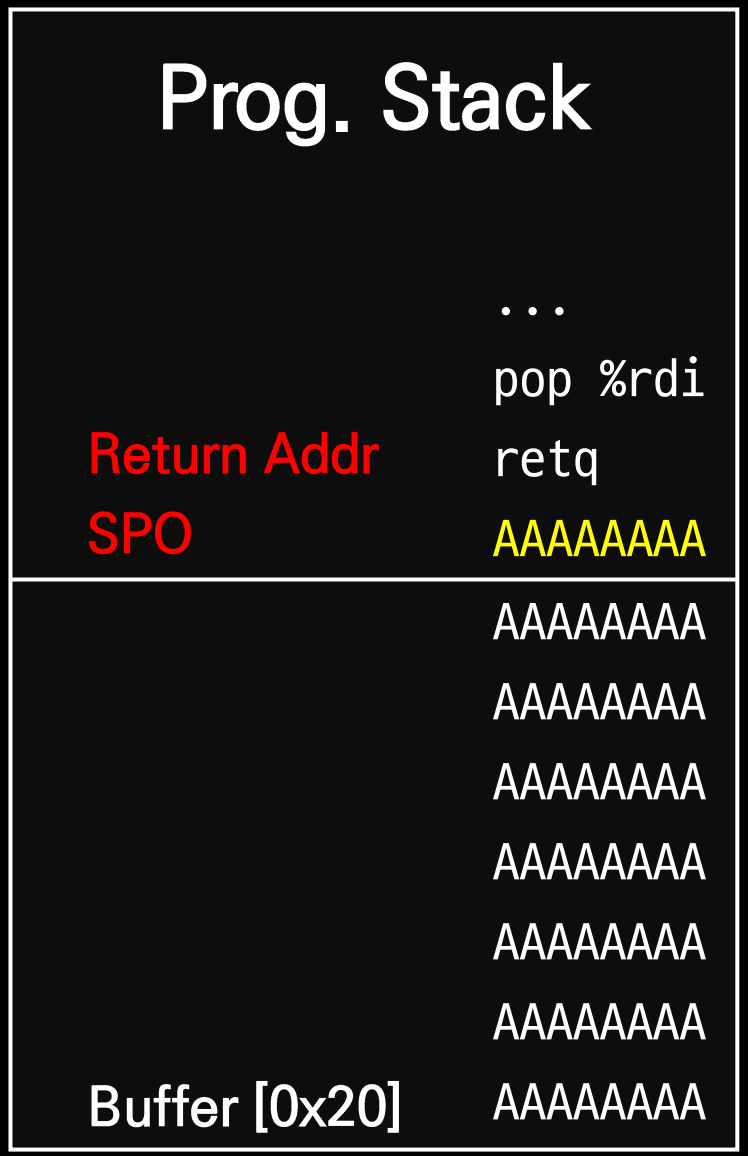
ROP

ReturnOrientedProgramming

call read
8
pop rdx; ret;
addr of GOT
pop rsi; ret
0
pop rdi;ret;

RBP

RBP- 0x20 = RSP



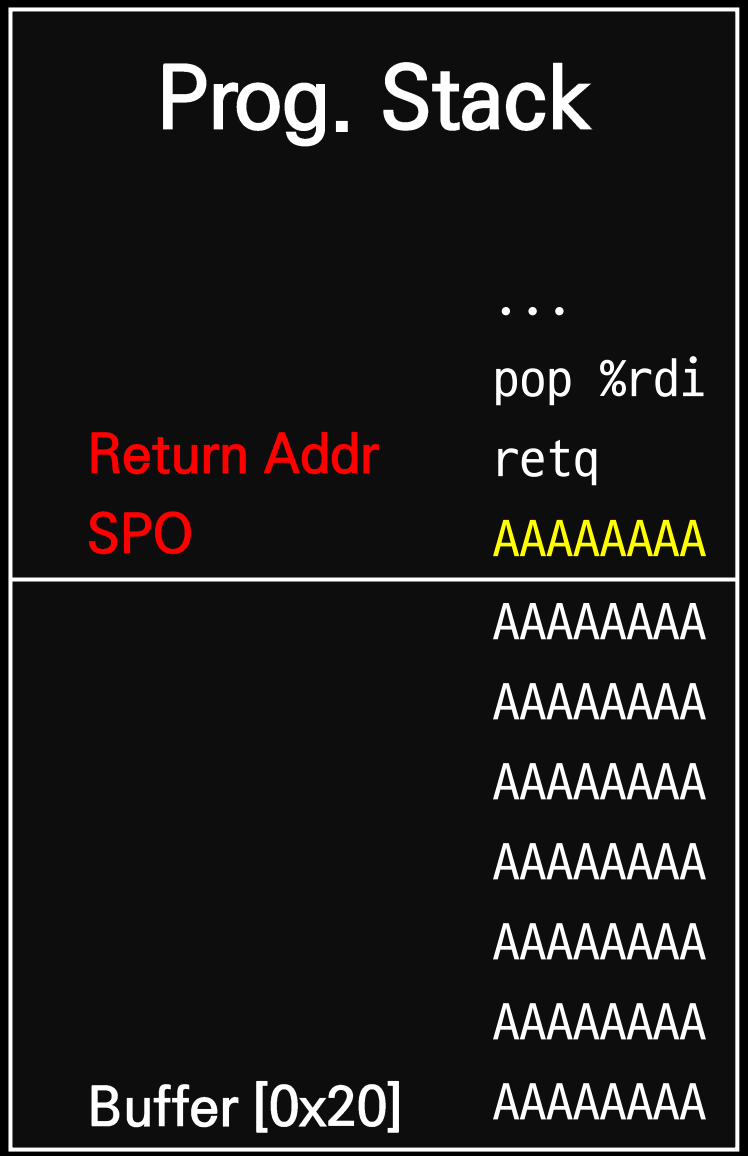
ROP

ReturnOrientedProgramming

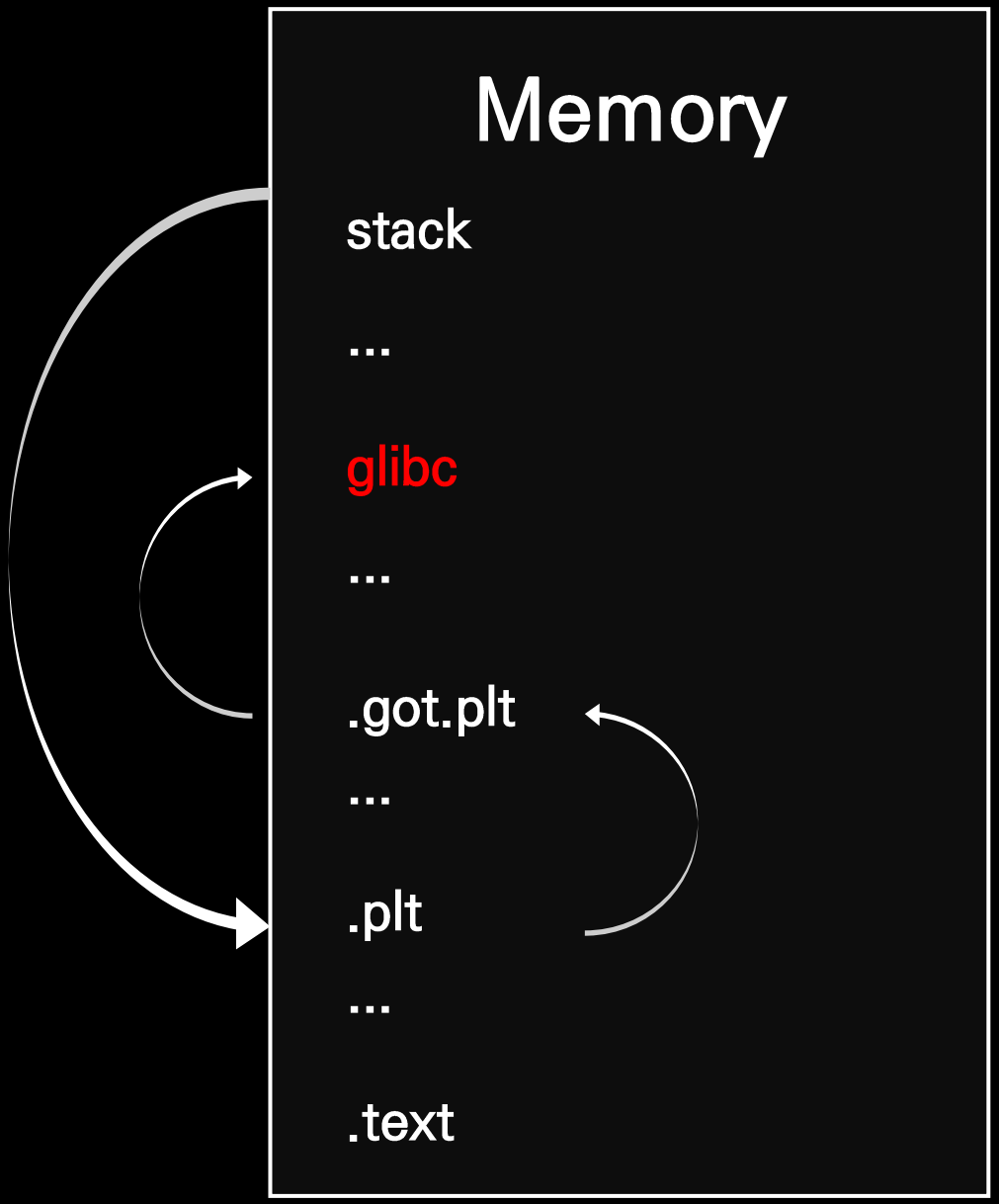
```
call read
8
pop rdx; ret;
addr of GOT
pop rsi; ret
0
pop rdi;ret;

read(0, GOT, 8);
```

RBP

RBP– 0x20 = RSP



Library



glib의 위치는 매번 바뀜 (ASLR...)

단, 하위 12비트(3글자)는 고정.

Library

```
.plt:0000000000400620 ; int puts(const char *s)
.plt:0000000000400620 _puts           proc near               ; CODE XREF: main+41↓p
.plt:0000000000400620                 jmp     cs:off_601018
.plt:0000000000400620 _puts           endp
.plt:0000000000400620
.plt:0000000000400626 ; ---------------------------------------------------------------------------
.plt:0000000000400626                 push    0
.plt:000000000040062B                 jmp     sub_400610
.plt:0000000000400630
.plt:0000000000400630 ; =============== S U B R O U T I N E =======================================
.plt:0000000000400630
.plt:0000000000400630 ; Attributes: thunk
.plt:0000000000400630
.plt:0000000000400630 ; size_t fread(void *ptr, size_t size, size_t n, FILE *stream)
.plt:0000000000400630 _fread          proc near               ; CODE XREF: main+C1↓p
.plt:0000000000400630                 jmp     cs:off_601020
.plt:0000000000400630 _fread          endp
.plt:0000000000400630
.plt:0000000000400636 ; ---------------------------------------------------------------------------
.plt:0000000000400636                 push    1
.plt:000000000040063B                 jmp     sub_400610
.plt:0000000000400640
.plt:0000000000400640 ; =============== S U B R O U T I N E =======================================
.plt:0000000000400640
.plt:0000000000400640 ; Attributes: thunk
.plt:0000000000400640
.plt:0000000000400640 ; int fclose(FILE *stream)
.plt:0000000000400640 _fclose         proc near               ; CODE XREF: main+D0↓p
.plt:0000000000400640                 jmp     cs:off_601028
.plt:0000000000400640 _fclose         endp
.plt:0000000000400640
.plt:0000000000400646 ; ---------------------------------------------------------------------------
```

Library

```
.got.plt:0000000000601000 ; ===========================================================================
.got.plt:0000000000601000
.got.plt:0000000000601000 ; Segment type: Pure data
.got.plt:0000000000601000 ; Segment permissions: Read/Write
.got.plt:0000000000601000 _got_plt        segment qword public 'DATA' use64
.got.plt:0000000000601000                 assume cs:_got_plt
.got.plt:0000000000601000                 ;org 601000h
.got.plt:0000000000601000 _GLOBAL_OFFSET_TABLE_ dq offset _DYNAMIC
.got.plt:0000000000601008 qword_601008    dq 0                    ; DATA XREF: sub_400610↑r
.got.plt:0000000000601010 qword_601010    dq 0                    ; DATA XREF: sub_400610+6↑r
.got.plt:0000000000601018 off_601018      dq offset puts          ; DATA XREF: _puts↑r
.got.plt:0000000000601020 off_601020      dq offset fread         ; DATA XREF: _fread↑r
.got.plt:0000000000601028 off_601028      dq offset fclose        ; DATA XREF: _fclose↑r
.got.plt:0000000000601030 off_601030      dq offset __stack_chk_fail
.got.plt:0000000000601030                                         ; DATA XREF: ___stack_chk_fail↑r
.got.plt:0000000000601038 off_601038      dq offset printf        ; DATA XREF: _printf↑r
.got.plt:0000000000601040 off_601040      dq offset __libc_start_main
.got.plt:0000000000601040                                         ; DATA XREF: ___libc_start_main↑r
.got.plt:0000000000601048 off_601048      dq offset ftell         ; DATA XREF: _ftell↑r
.got.plt:0000000000601050 off_601050      dq offset fseek         ; DATA XREF: _fseek↑r
.got.plt:0000000000601058 off_601058      dq offset fopen         ; DATA XREF: _fopen↑r
.got.plt:0000000000601060 off_601060      dq offset fwrite        ; DATA XREF: _fwrite↑r
.got.plt:0000000000601060 _got_plt        ends
```

ROP

GOT Overwrite

Read 호출 → PLT 호출

Procedure Linkage Table

read의 GOT 확인

system으로 overwrite

Read 실행 = system 호출

잘못 조작하면 프로그램 터짐

heap 조작으로 AAR/AAW할 때도 종종 쓰임

Security Mitigation

RELRO

RELocation Read-Only

```
No      RELRO

PARTIAL RELRO

FULL    RELRO
```

실습 [ROP]

dreamhack.io/wargame/challenges/354

```
$ checksec rop[*]
'/home/dreamhack/rop'
Arch:     amd64-64-little
RELRO:    Partial RELRO
Stack:    Canary found
NX:       NX enabled
PIE:      No PIE (0x400000)
```

```c
int main() {
  char buf[0x30];

  setvbuf(stdin, 0, _IONBF, 0);
  setvbuf(stdout, 0, _IONBF, 0);

  // Leak canary
  puts("[1] Leak Canary");
  write(1, "Buf: ", 5);
  read(0, buf, 0x100);
  printf("Buf: %s\n", buf);

  // Do ROP
  puts("[2] Input ROP payload");
  write(1, "Buf: ", 5);
  read(0, buf, 0x100);

  return 0;
}
```

Homework [dowell]

dreamhack.io/wargame/challenges/1568

여러번 입력을 받을 수는 없을까?

ROP

Ret2main

기회가 1번이면 ROP 어려움

return to main!

여러번 ROP가 가능하다

ROP 中 RTL

Return To Libc

원하는 gadget이 없다면?

Return To Libc!

libc에 좋은 gadget이 차고 넘친다. system, /bin/sh 까지 다 있다.

굉장히 유명하고 간편함

대신 libc의 시작 주소를 알아야 함.

ROP 中 RTL

One_gadget

libc 에 좋은게 많으니 한번에 쉘을 따자

onegadget ./libc.so.6

조건만 맞으면 한번에 쉘이 나온다.

libc의 버전이 높을수록 onegadget의 제약 조건이 많아진다

2025.09.19

Q&A

질문이 있다면 하십시오

Guardian 2025

2.5cm-2.5cm 떨어진 제목 36px

제목 하단의 부제목 18px

3.5cm 떨어진 내용 1 32px

좌측으로 0.5cm 떨어진 내용 하단의 설명 18px

3.5cm 떨어진 내용 2 32px

좌측으로 0.5cm 떨어진 내용 하단의 설명 18px

3.5cm 떨어진 내용 3 32px

좌측으로 0.5cm 떨어진 내용 하단의 설명 18px

1cm-1cm 떨어진 주석 12px

1cm-1cm 떨어진 주석 12px

2.5cm-3.5cm 떨어진 제목 36px

제목 하단의 부제목 18px

3.5cm 떨어진 내용 1 32px

```
Git init
Git status
Git add text.txt
Git add .
Git commit
Ctrl+C
Git commit -m “genesis”
Git log
Git log --oneline
```

```
Git add .
Git reset .
Git commit -m “add README”
Git log --oneline -n 3
Git commit –a –m “hello”
```

1cm-1cm 떨어진 주석 12px

1cm-1cm 떨어진 주석 12px

중심에서 0.3cm 떨어진 소속 18px