HackTM 2020 - PLOP (488pt)

FEBRUARY 5, 2020 REVERSING

PLOP (488pt)

Reversing

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I've been playing around with mathy obfuscation, see if you can break this one!

P.S. there are multiple "flags" the binary would say are correct, but only one of them matches the flag format.

Files:

o **PLOP**

Solution:

This binary does some tricky things with signal handlers to obfuscate the control flow. To run it in gdb we need to do something like:

```
handle SIGSEGV noprint nostop pass
handle SIGALRM noprint nostop pass
```

We eventually find that fini_3 sets up a sigsecv handler that acts as an unpacker. Essentially, this handler is triggered with information about the faulting instruction and it will decode part of the subsequent code and return execution.

In fini_2 we hit a faulting instruction and trigger the handler. This happens several more times recursively and during each call we check 8 bytes of our input. The first unpacked segment looks like:

```
0x7fffff7ff7000:
                    mov
                           rax, QWORD PTR ds:0x1337000
0x7fffff7ff7008:
                    rol
                           rax,0xe
0x7fffff7ff700c:
                   movabs rdx,0xdc3126bd558bb7a5
0x7fffff7ff7016:
                           rax,rdx
                   xor
0x7fffff7ff7019:
                           r8,QWORD PTR ds:0x1337080
                   mov
0x7fffff7ff7021:
                           r8,0x0
                    cmp
0x7fffff7ff7025:
                           0x7ffff7ff7031
                    jne
0x7fffff7ff7027:
                           QWORD PTR ds:0x1337080, rax
                   mov
0x7fffff7ff702f:
                    jmp
                           0x7fffff7ff7051
0x7fffff7ff7031:
                           rax, QWORD PTR ds:0x1337080
                    cmp
0x7fffff7ff7039:
                   mov
                           bx, WORD PTR ds: 0x1337064
```

```
0x7ffff7ff7041: mov ax,0x1
0x7ffff7ff7045: cmovne bx,ax
0x7ffff7ff7049: mov WORD PTR ds:0x1337064,bx
```

We can encode all of these constraints into the following, *beautiful* z3 script and get the flag:

```
from z3 import *
import binascii
s = Solver()
a = BitVec('a', 64)
b = BitVec('b', 64)
c = BitVec('c', 64)
d = BitVec('d', 64)
e = BitVec('e', 64)
f = BitVec('f', 64)
g = BitVec('g', 64)
i = BitVec('i', 64)
t = RotateLeft(a, 0xe) ^ 0xdc3126bd558bb7a5
s.add(b == RotateRight(t ^ 0x76085304e4b4ccd5, 0x28))
h = RotateLeft(b, 0x28) ^ 0x76085304e4b4ccd5
s.add(RotateLeft(c, 0x3e) ^ 0x1cb8213f560270a0 == h)
s.add(RotateLeft(d, 2) ^ 0x4ef5a9b4344c0672 == h)
s.add(e == RotateRight(h ^ 0xe28a714820758df7, 0x2d))
h = RotateLeft(e, 0x2d) ^ 0xe28a714820758df7
s.add(RotateLeft(f, 0x27) ^ 0xa0d78b57bae31402 == h)
v = 0x4474f2ed7223940
s.add(RotateRight(v ^ g, 0x35) == h)
```

```
s.add(RotateRight(h^0xb18ceeb56b236b4b, 0x19) == i)
h = RotateLeft(i, 0x19) ^ 0xb18ceeb56b236b4b

s.add(Extract(7,0,a) == ord('H'))
s.add(Extract(15,8,a) == ord('a'))
s.add(Extract(23,16,a) == ord('c'))
s.add(Extract(31,24,a) == ord('k'))
s.add(Extract(39,32,a) == ord('T'))
s.add(Extract(47,40,a) == ord('M'))
s.add(Extract(55,48,a) == ord('{'}))
s.add(Extract(63,56,a) == ord('P'))

def pp(t):
    return binascii.unhexlify(hex(t)[2:].zfill(16))[::-1]

s.check()
m = s.model()
print(''.join([pp(m[x].as_long()) for x in [a,b,c,d,e,f,g,i]]))
```

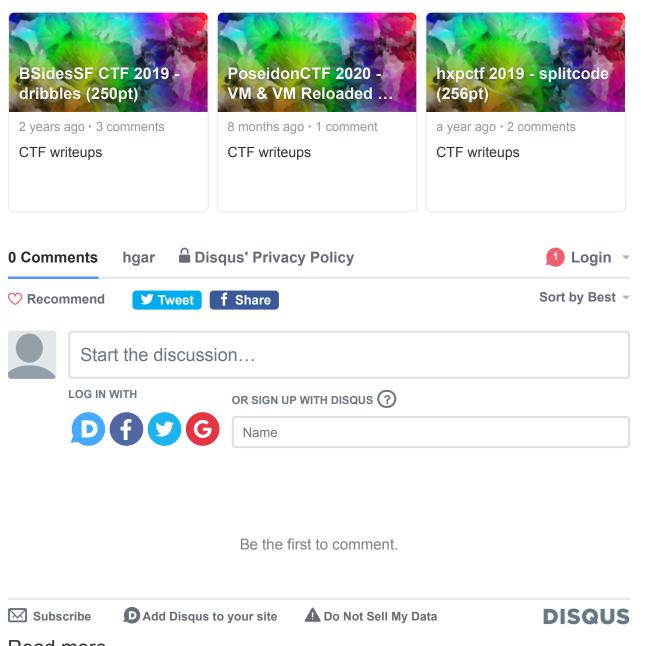
HackTM{PolynomialLookupOrientedProgramming_sounds_kinda_shit_xd}



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