Malware Analysis & Reverse Engineering Midterm Report

Malware Bomb

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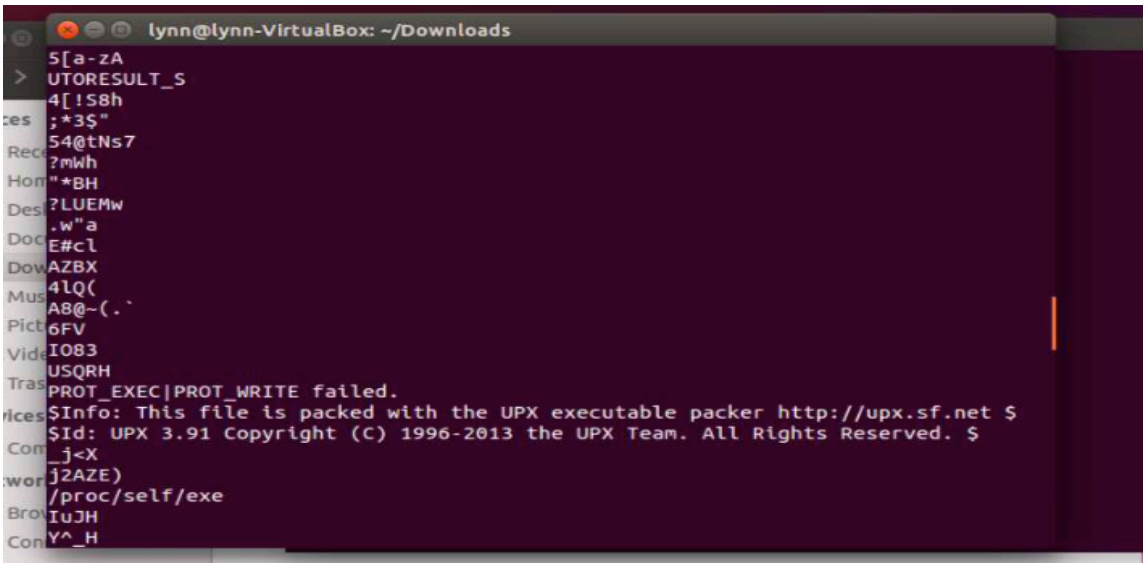
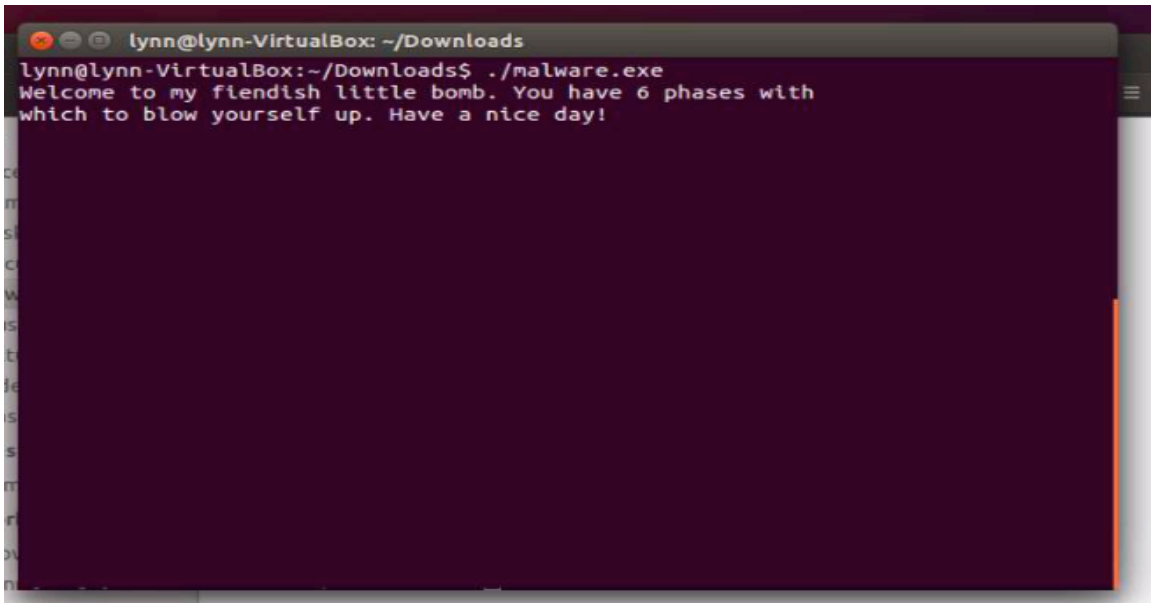
At first, I found that the malware Bomb is packed with UPX when I tried to find the Strings in Ubuntu. Therefore, I unpack the Bomb with UPX unpacker. Next, I load the bomb in IDA Pro, and it took 6 steps for me to diffuse the Bomb.





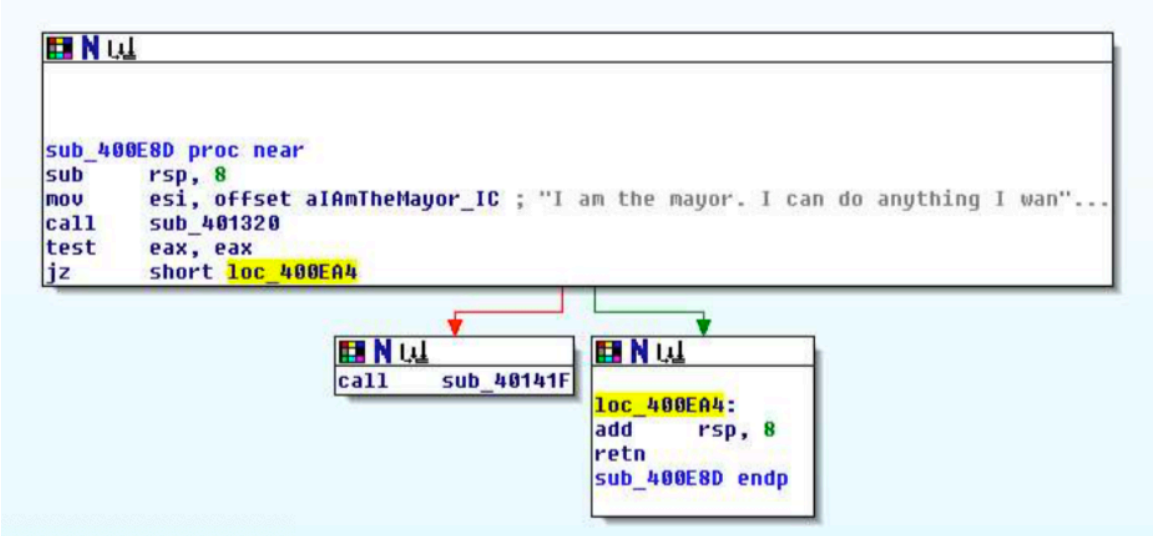
After looking through the Strings in Bomb with IDA Pro, I am pretty sure that the sub_401480 is for getting input and checking if it is generally valid. In other words, the sub_401480 is the entrance to the secret world inside malware Bomb, because it appears a lot of times.

```
call    sub_401387
mov     edi, offset aWelcomeToMyFie ; "Welcome to my fiendish little bomb. You"...
call    _puts
mov     edi, offset aWhichToBlowYou ; "which to blow yourself up. Have a nice "...
call    _puts
call    sub_401480
mov     rdi, rax
call    sub_400E8D
call    sub_4015A6
mov     edi, offset aPhase1Defused_ ; "Phase 1 defused. How about the next one"...
call    _puts
call    sub_401480
mov     rdi, rax
call    sub_400EA9
call    sub_4015A6
mov     edi, offset aThatSNumber2_K ; "That's number 2.  Keep going!"
call    _puts
call    sub_401480
mov     rdi, rax
call    sub_400F11
call    sub_4015A6
mov     edi, offset aHalfwayThere ; "Halfway there!"
call    _puts
call    sub_401480
mov     rdi, rax
call    sub_40101C
call    sub_4015A6
mov     edi, offset aSoYouGotThatOn ; "So you got that one.  Try this one."
call    _puts
call    sub_401480
mov     rdi, rax
call    sub_401089
call    sub_4015A6
mov     edi, offset aGoodWorkOnToTh ; "Good work!  On to the next..."
call    _puts
call    sub_401480
mov     rdi, rax
call    sub_4010CA
call    sub_4015A6
mov     eax, 0
```

Phase 1:

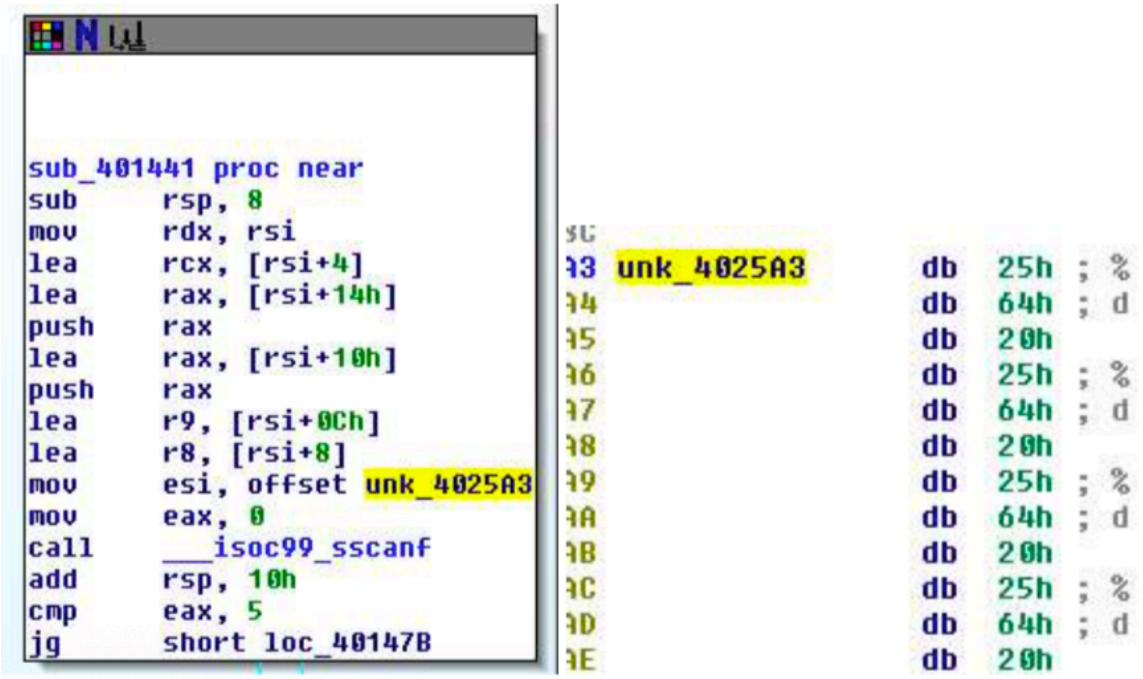
When checking the functions before the string ‘Phase 1 defused. How about the next one...’, I find that there is a test between Strings.

Therefore, I am sure that the answer to Phase 1 is ‘I am the mayor. I can do anything I want’.

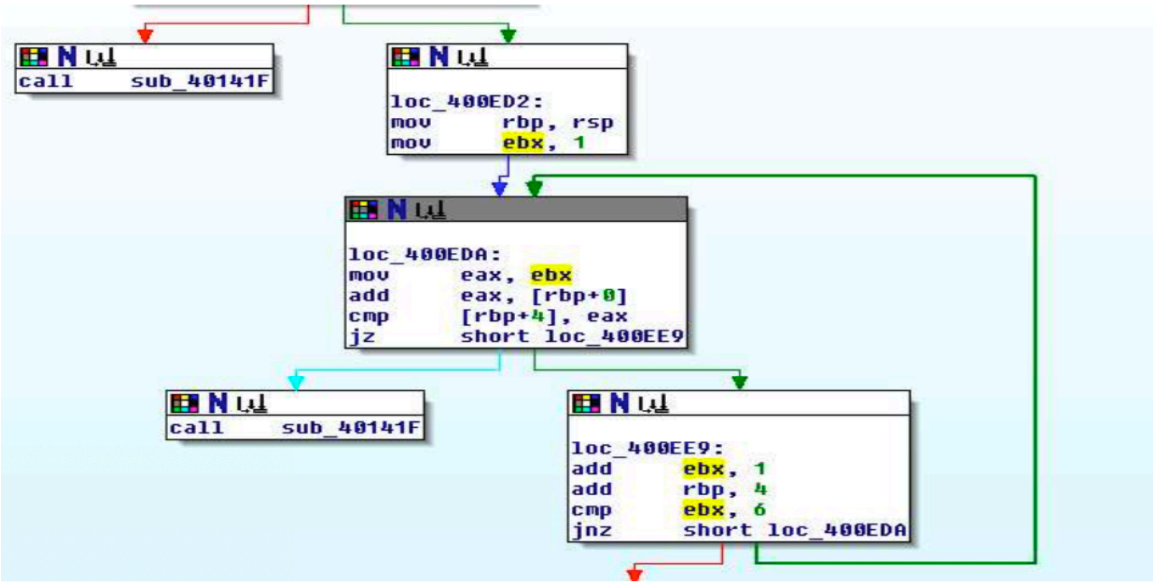


Phase 2:

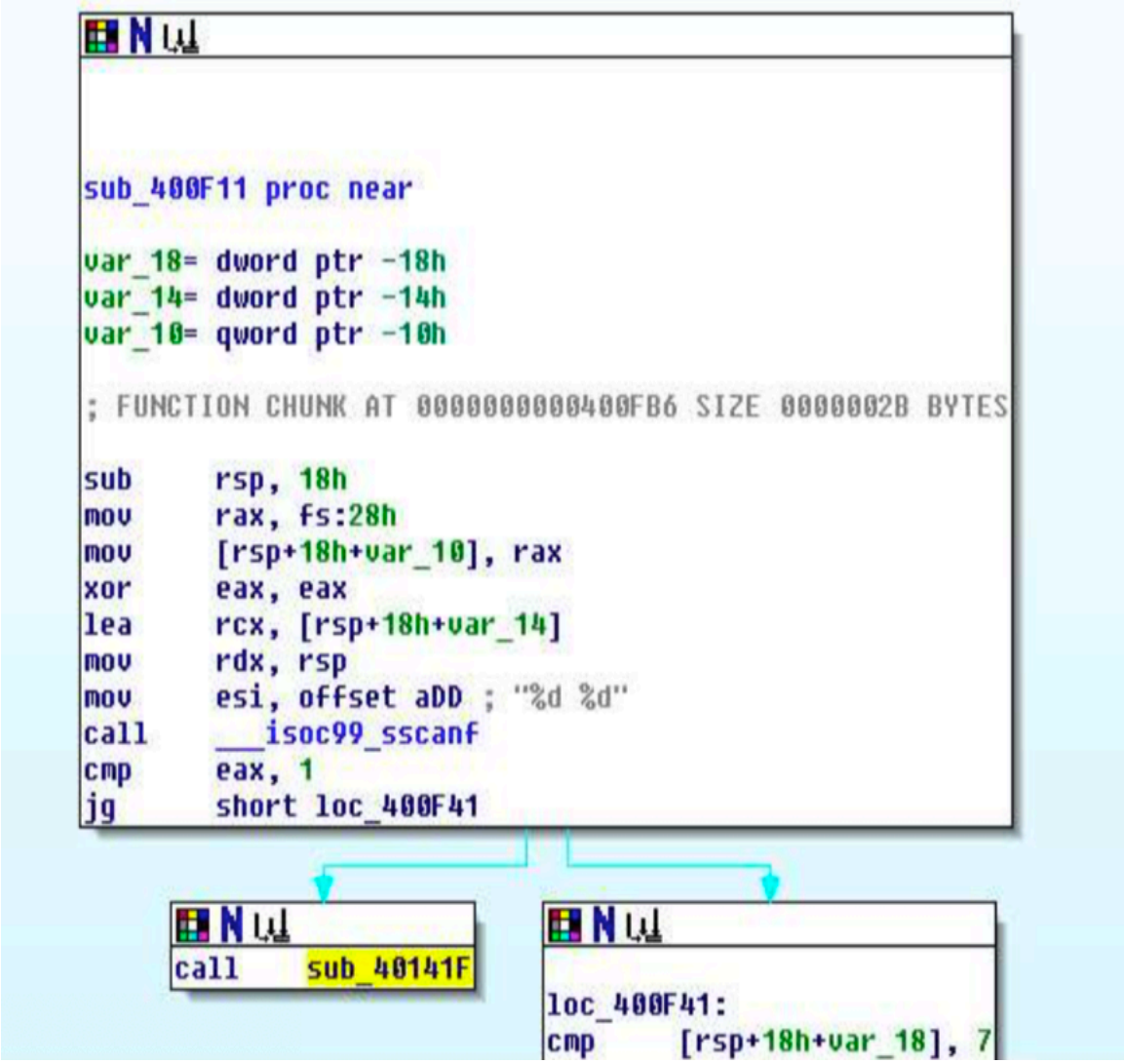
When checking the sub_400EA9, the string unk_4025A3 indicates that the input should be 4 integers. And among the parent calls in the left, the exa,5 indicates that the input should be larger than 5.



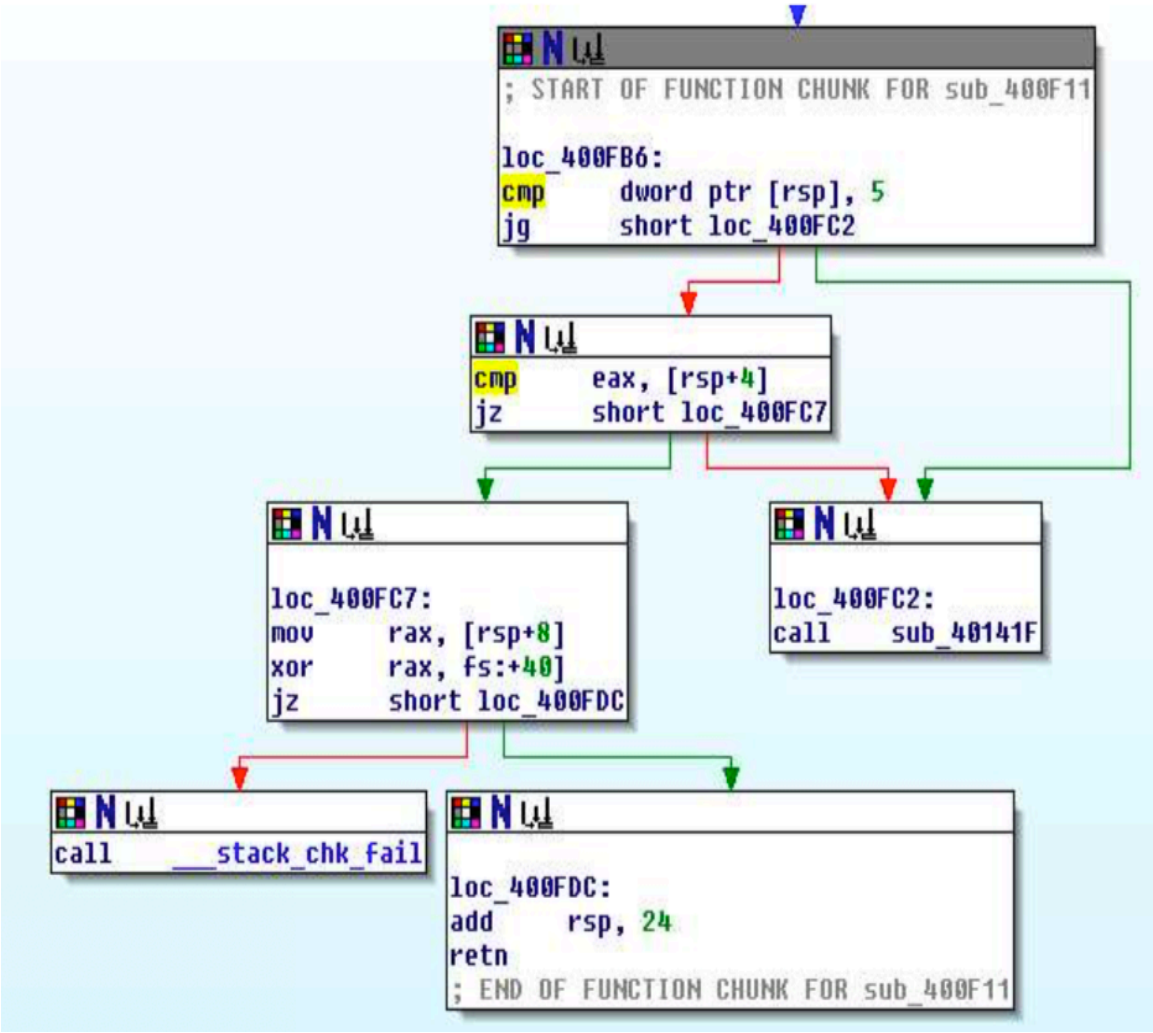
With the loop shown below, the rbp seems to be the input array. And the exa just comes from the exb, which recursively self-increases by 1 in each loop. Therefore, the loop shows that the next number should be the last number plus the index of the last number. According to the above analysis, there are two reasonable answers for phase 2, which should be[1,2,4,7,11,16] or [2,3,5,8,12,17] depending on the first number.



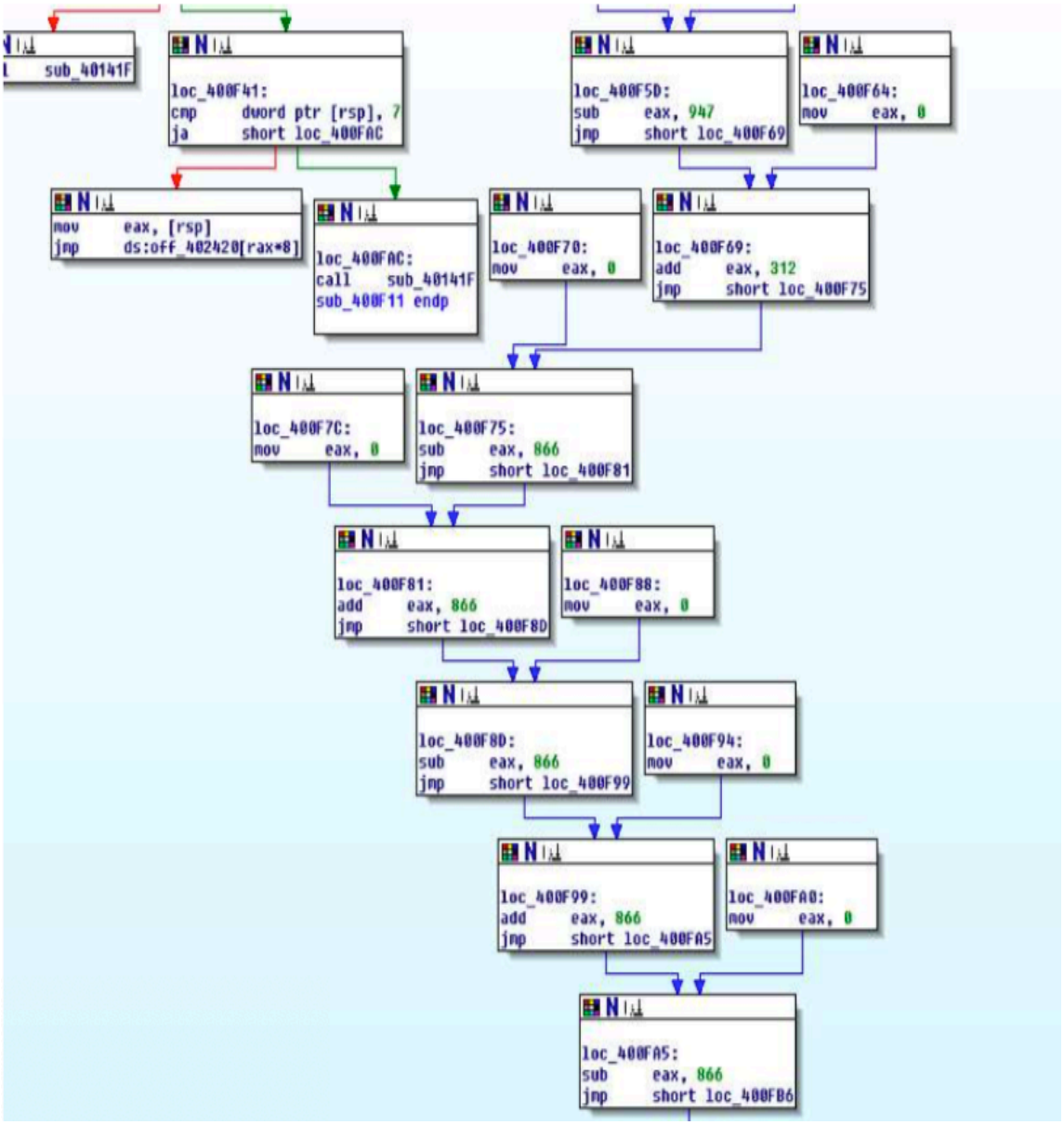
Phase 3:



The input should be at least 2 integers. And based on the compare operation [cmp, eax, 1], I finds that the input should be larger than 1. Moreover, according to the compare operation [cmp, [rsp+18h+var_18], 7], the first input should be larger than 7, which will call the explode function sub_40141F. Then, there are about 7 situations with the first input, in which they will jumps to 7 different functions.



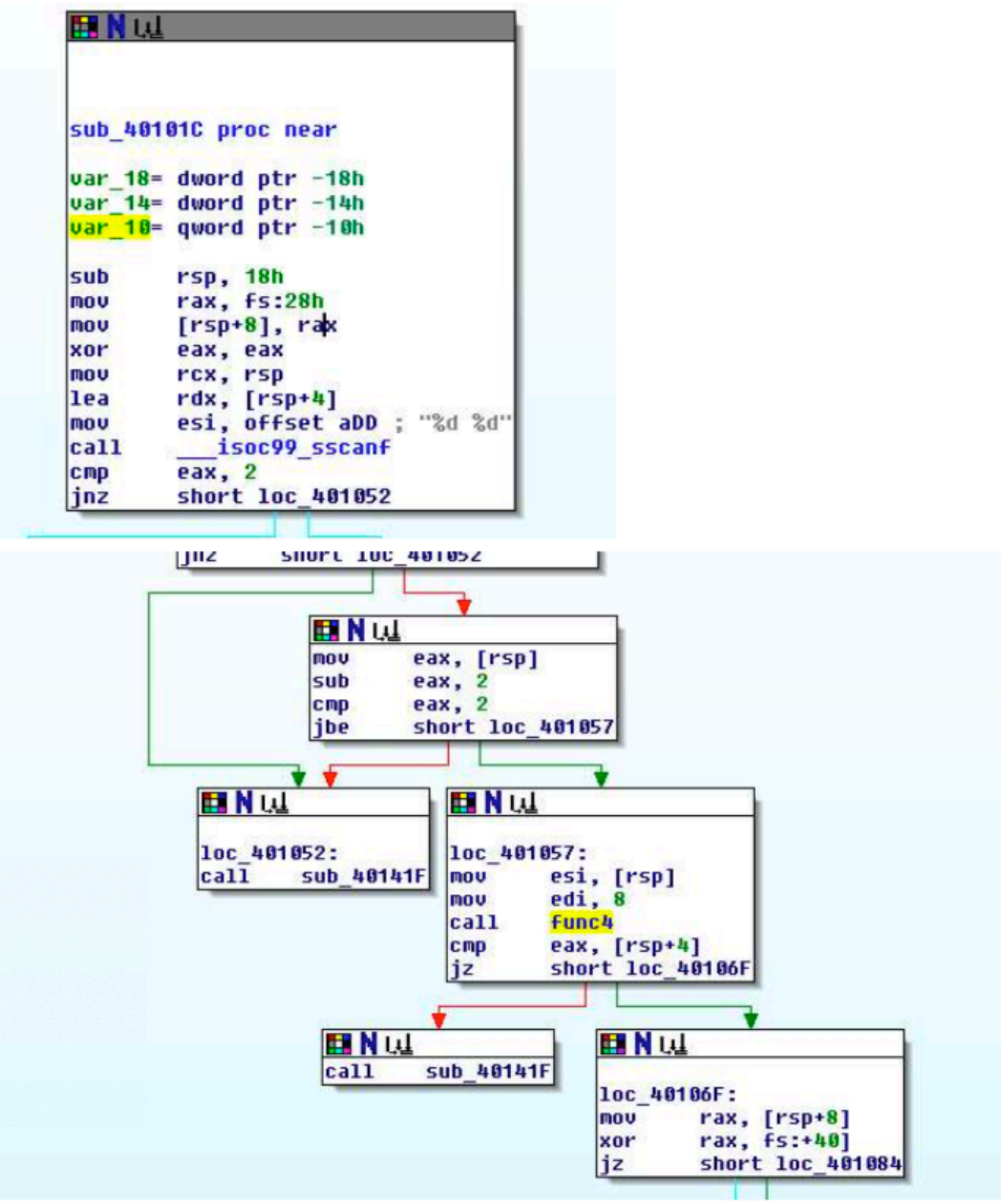
In the next comparison function [cmp, dword ptr [rsp], 5], the first input should be less or smaller than 5. And the next input is [rsp+4]. When exa= input2, it is the safe situation. Then the exa comes from different choice of the first input. Below show the logic bits of operations.



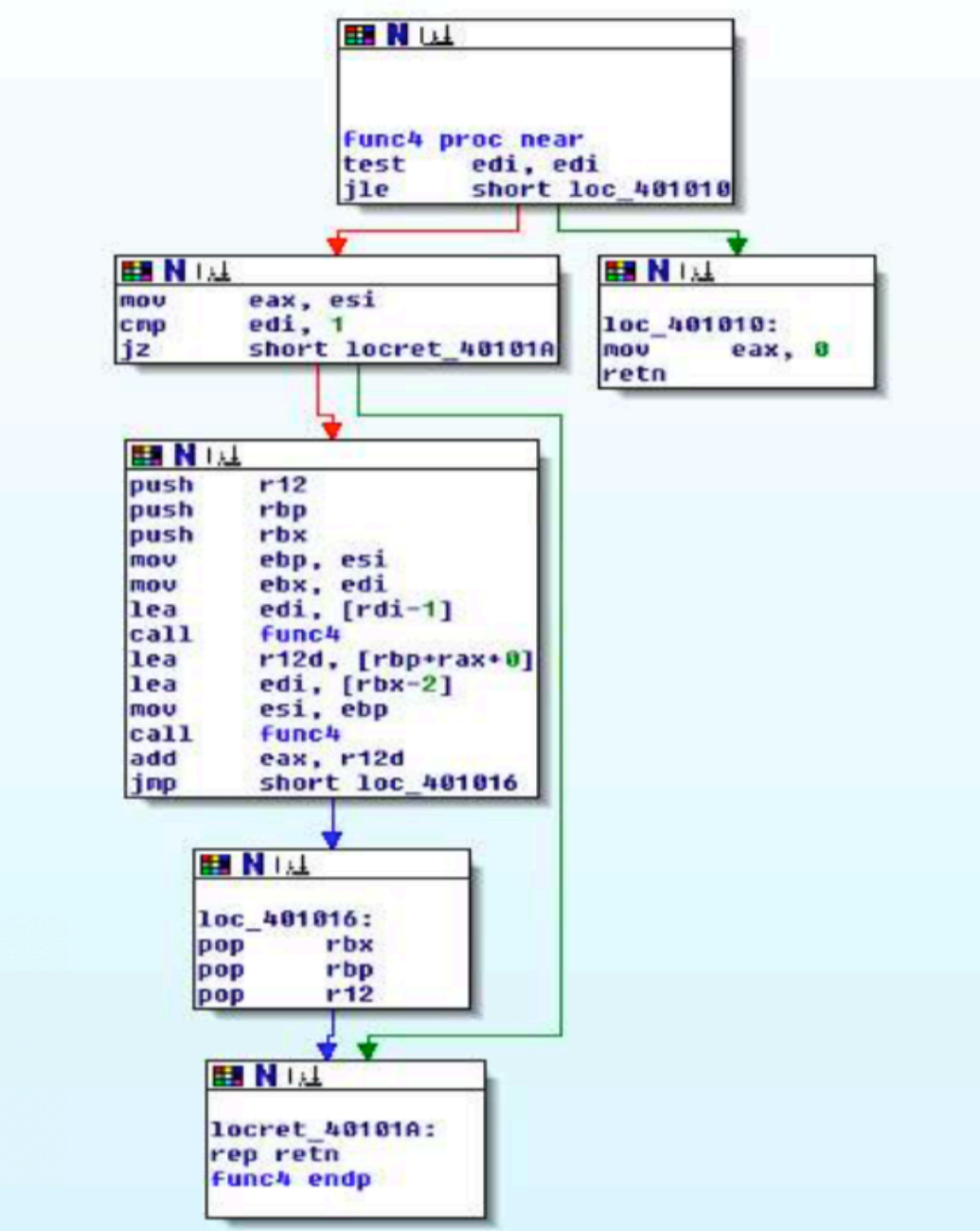
Therefore, totally, there are 6 combinations of inputs to pass the Phase 3 shown below.

1. 0-556
2. 1-1501
3. 2-554
4. 3-866
5. 0
6. 5-866

Phase 4:



With two integers as input, I follow the function calls next. Then, with the operation [sub, exa, 2], the second input gets minus by 2. Then, based on the operation next [cmp, exa, 2], it indicates that with the second minus by 2, it still should be smaller than 2. In other words, the valid input itself should be smaller than 4.

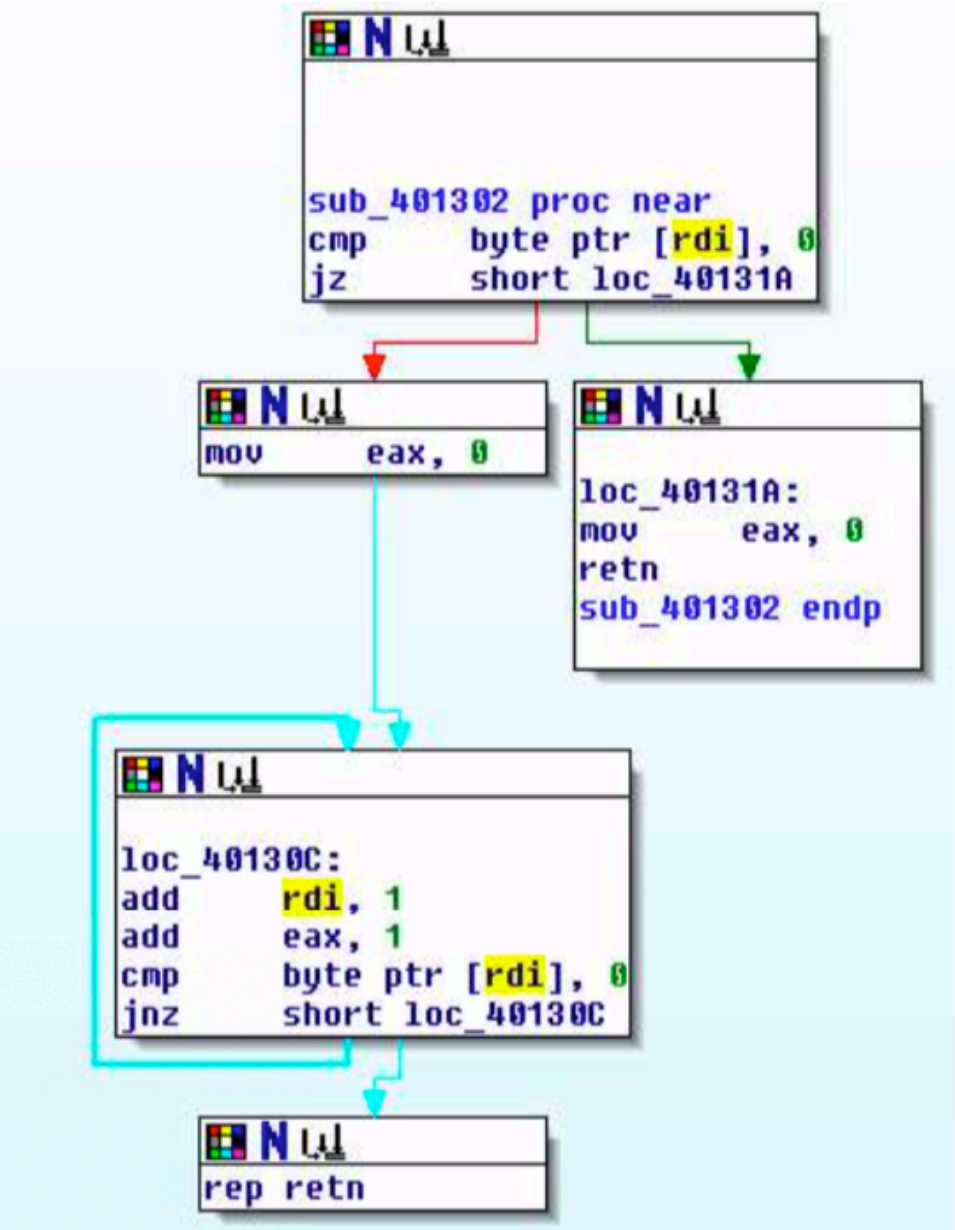


Basically, there is a recursive in function 4. And second input edi is initialized as 8. In the recursive, the second input gets added 54 times. If the input is 1 or 0, the function 4 just returns the same input as output. Otherwise, it will return the input number add next recursive with the input minus one and next recursive with input minus 2.

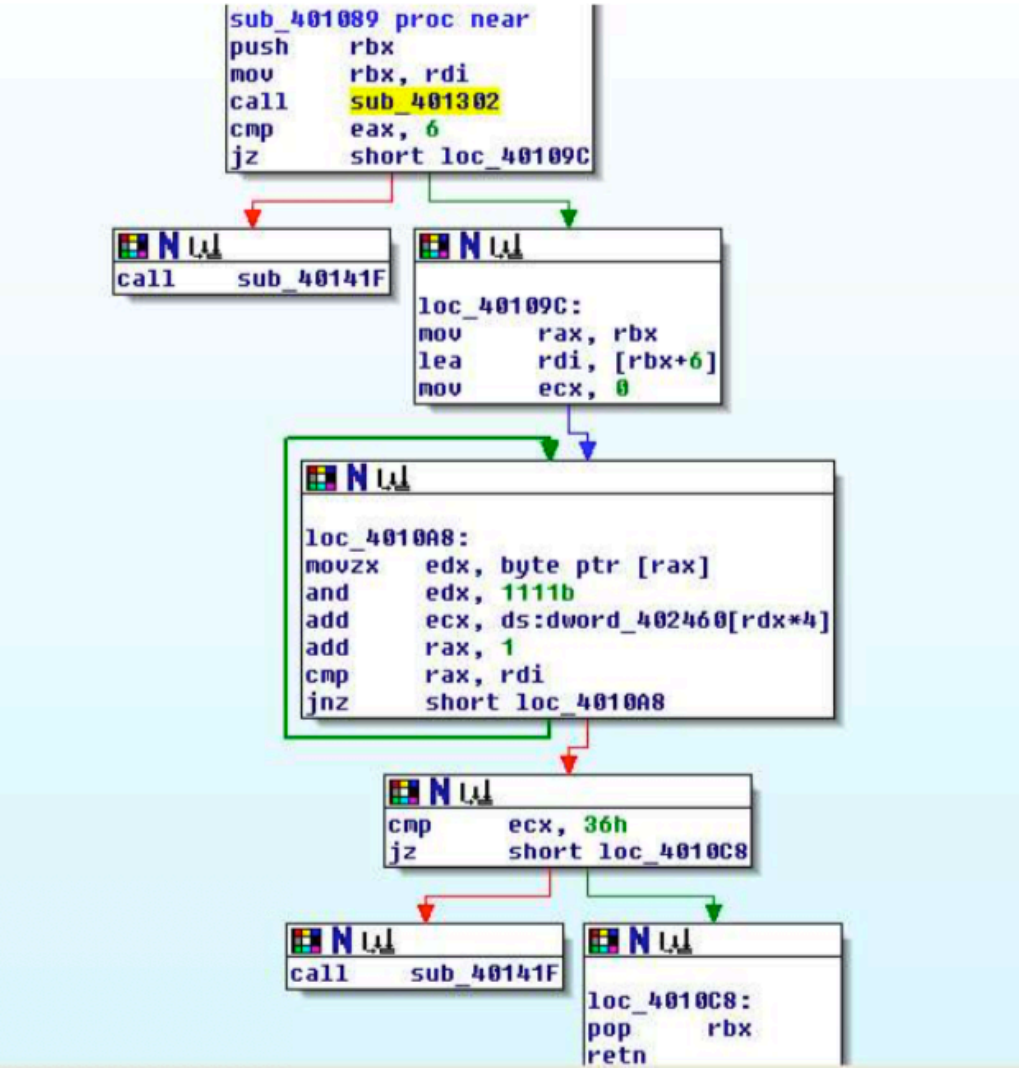
After the recursion session, matching with the outputs, the valid inputs show below

1. 216 4
2. 162 3
3. 108 2

Phase 5:



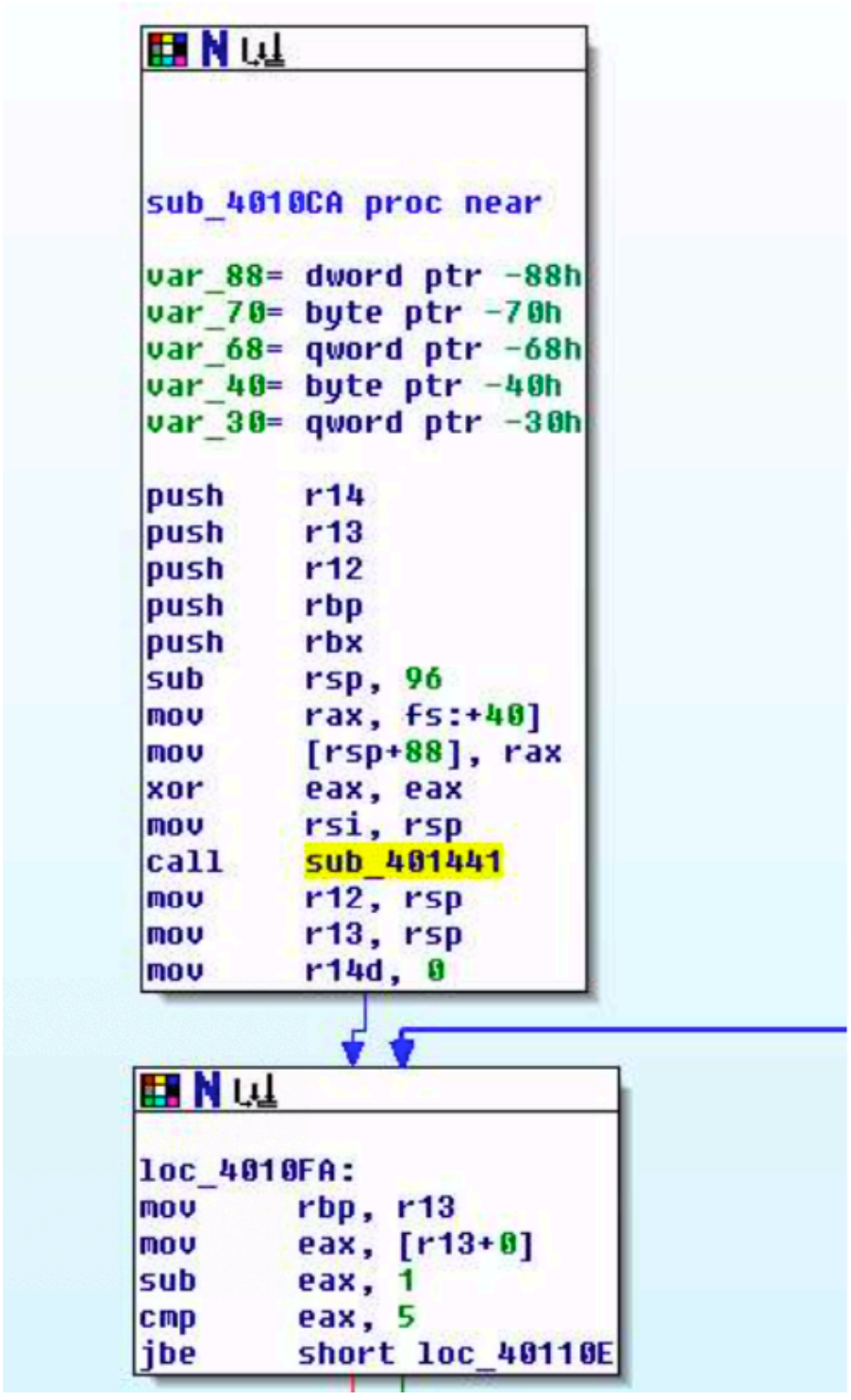
For Phase 5, I get the function call of sub_401302 compared to the exa with 6. In sub_401302, there is a loop going through the input array rdi. Therefore, I am sure that the function call is used to check the length of the input array.

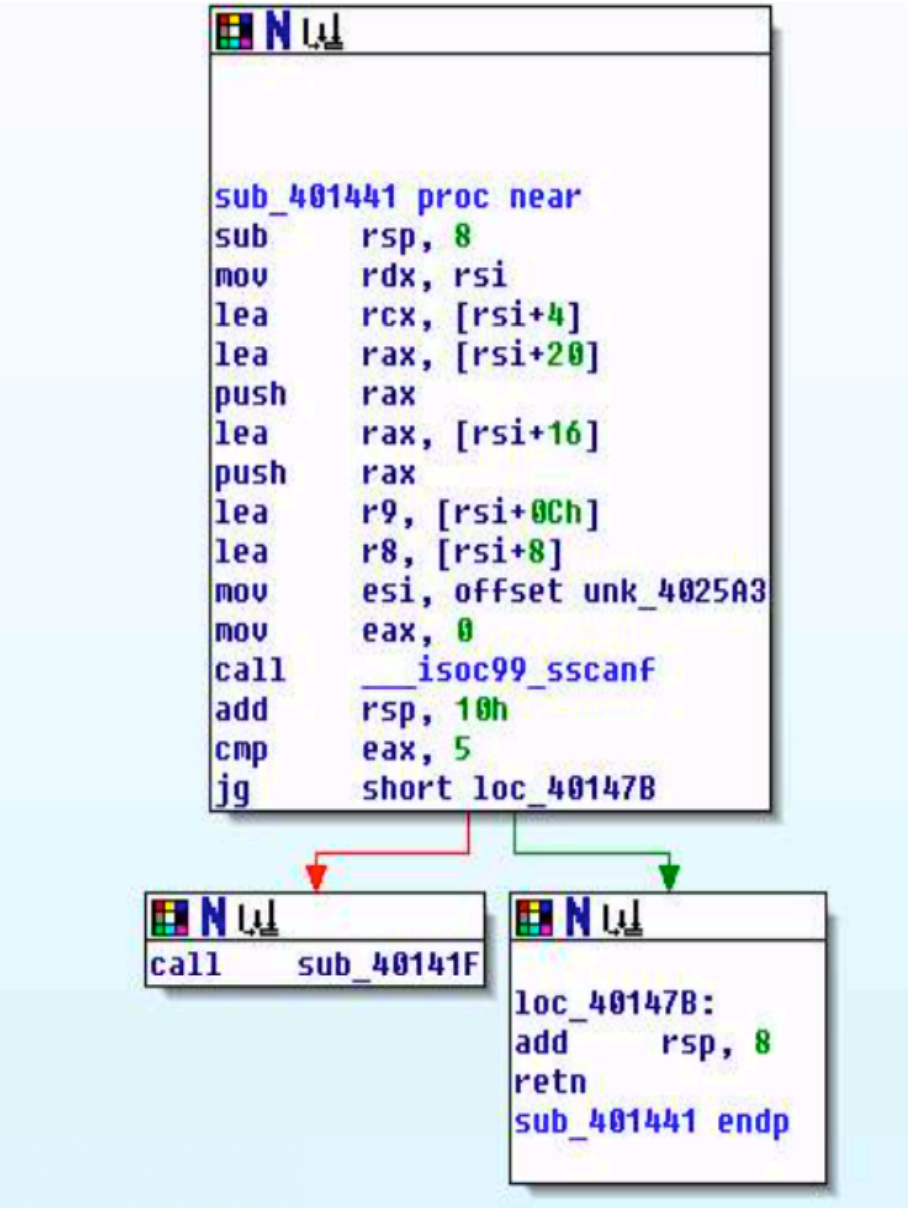


In loc_4010A8, I go through the loop. Based on the [add, ecx, ds:dword_402460[rdx*4]] operation, the input string is a sequence of index as ds:dword_402460[rdx*4] with the ras as the first character and rdi as the last one. Therefore, I got the answer to the Phase 5 is [123456].

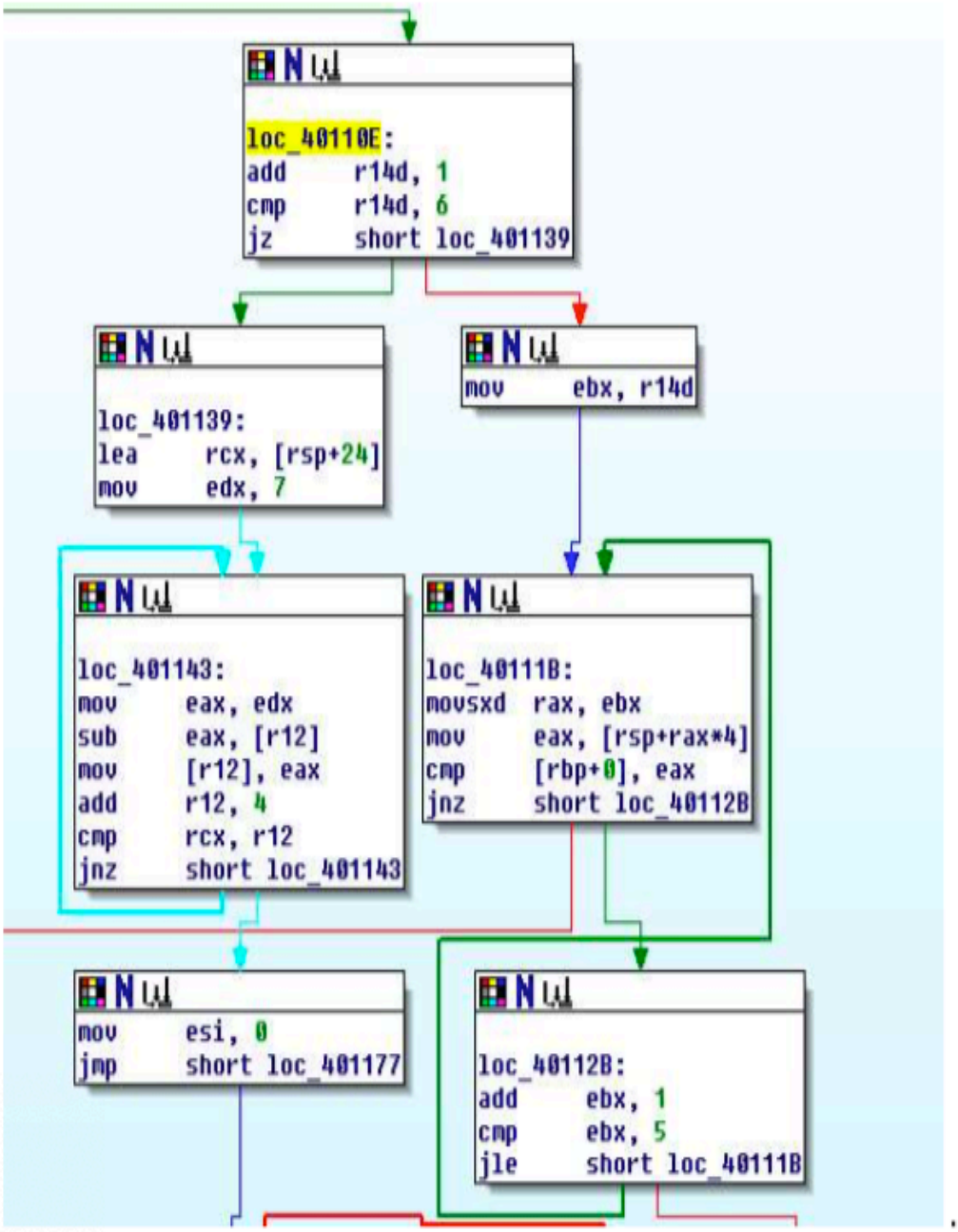
Phase 6:

The function called sub_401441 with 6 numbers' input.

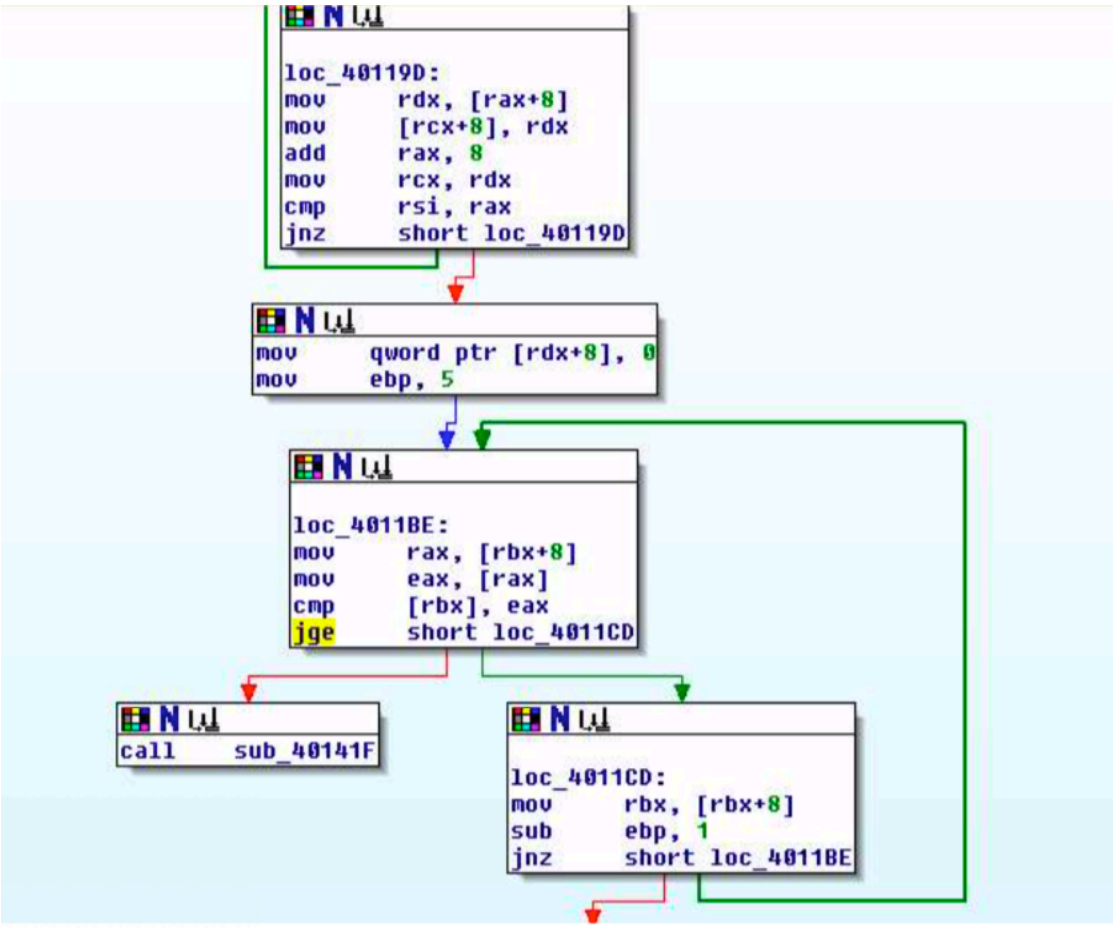

sub_4010CA proc near
var_88= dword ptr -88h
var_70= byte ptr -70h
var_68= qword ptr -68h
var_40= byte ptr -40h
var_30= qword ptr -30h
push r14
push r13
push r12
push rbp
push rbx
sub rsp, 96
mov rax, fs:+40]
mov [rsp+88], rax
xor eax, eax
mov rsi, rsp
call sub_401441
mov r12, rsp
mov r13, rsp
mov r14d, 0
loc_4010FA:
mov rbp, r13
mov eax, [r13+0]
sub eax, 1
cmp eax, 5
jbe short loc_40110E



With the oparetion [cmp, eax, 5], the program has a loop that requires each number should be equal or smaller than 6.



Next, in the loc_40110E, the left side indicates that the code subtracts our input number by 7. Then, it gets the new number to replace the old number.



The loop here requires the new sequence in a ascending order and the rbx is the first point of all input value. The edp is the controller of the loop. When edp reaches 0, the program would get finished. Backtracking, the answer of Phase 6 is [1,5,3,6,2,4].