逆向 Writeup：西湖论剑2020逆向第一题Cellular

原创

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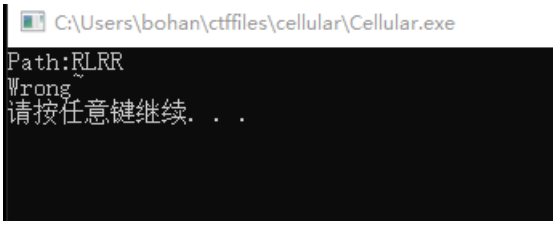
摘要

1. 题目为“蜜蜂如何筑巢”，问题的实质是`寻找路径`。应该将程序视为黑盒。刚开始解题思路不对，一直试图理清代码中的逻辑。
2. 解答的方法是尝试`将各种由‘L’和‘R'组合的长为25的字符串作为输入`，直到打印信息“Congratulations”。可采用遍历法，或逐步试错法。本篇采用后者。
3. 本篇方法概括：
   3.1 在OD中修改源码，改变关键函数CheckFlag的返回值为其中的大循环的循环次数（通过该次数可得知当前前行方向正确与否，从而调整路径方向）；修改打印部分代码，使其打印的信息能反映刚刚说的循环次数。
   3.2 写python脚本，生成输入字符串，借由其subprocess模块将字符串传给Cellular程序进行判断。通过逐步试错找到正确路径。
4. 如果有好的测试工具的话也许就不用自己写脚本这么麻烦了。但目前没找着。

题目概括

程序界面如下。需要输入’L’和’R’组成的字符串。



使用IDA解析，其主函数如下图。

关键函数CheckFlag的逻辑如下图。

在用OD调试时看到其中有类似链表的数据结构。

对于CheckFlag函数其实只要大概明白其意思即可，无需深究。其中for循环的i值会在解题时用到。

解题过程

修改原始程序

将程序拖入OD，找到CheckFlag函数结尾返回部分，修改其返回值为for循环的i值。

修改数据段，添加27个可打印的字符。

修改主函数中打印”Congratulations“信息的代码，使用CheckFlag返回的数值作为索引，从上一步添加的数据中按索引找一个字符并打印。这个字符将在下一步起判断作用。

编写搜索正确字符串的python脚本

```
# 定义一个函数,用于运行Cellular程序、接受输入、获取程序在标准输出流打印的信息.
def test_path(ans):
    path = "C:/Users/bohan/ctffiles/cellular/Cellular_pad2.exe"
    cellular = subprocess.Popen([path], stdin=subprocess.PIPE, stdout=subprocess.PIPE)
    output = cellular.communicate(ans.encode())[0]
    correct_len = output[output.index(b'Path') + 5] - ord('a')
    return correct_len
```

用于搜索路径的算法如下:

```
arr_len = 25
bit_arr = [0 for _ in range(arr_len)]
bit_arr
cur_index = 0
def select_path(path_is_adapted):
 '''path_is_adapted为True时则继续前进，为False则需改当前cur_index所指处的方向'''
    global cur_index
    if cur_index < arr_len and path_is_adapted:
        cur_index += 1
    elif cur_index > -1 and not path_is_adapted:
        bit_arr[cur_index] += 1  # 更改方向
        while bit_arr[cur_index] > 1 and cur_index > -1:  # 如果左右两个方向都试过了，则要向前移动，改前面的方向
#             print("cur_index ", cur_index)
            bit_arr[cur_index] = 0
            cur_index -= 1  # 向前移动指针
            bit_arr[cur_index] += 1  # 然后更改方向

    return cur_index

def get_cur_path():
    arr = bit_arr[0:cur_index + 1]
    lr = ['L', 'R']
    path_str = ''.join([lr[i] for i in arr])
    return arr, path_str
```

测试部分:

```
correct_len = 0
while correct_len != -49:  # correct_len为-49（字符'a'和字符'0'的ascii码值相减所得）时表明打印了字符零，也即找到了正确路径
    bit_path, path_str = get_cur_path()
    print(bit_path, path_str)
    try:
        correct_len = test_path(path_str)
        print(correct_len)
        if correct_len == len(path_str) and correct_len != 25:
            print("T")
            select_path(True)
        else:
            print("F")
            select_path(False)
    except:
        print("发生异常")
        select_path(False)

    if not path_str:
        print("无路径")
        break
```

运行后打印的情况如下（下图为打印结果的最后几行）：
从上图知最终路径为：'RLRLLRLLLRRLLRLLRLRLLRLLR'。当然最后还得用md5计算其散列值，才得到最终flag。

附一个搜索过程中列出的所有路径，方便理解上述路径搜索算法：

```
LL
LR
R
RL
RLL
RLLL
RLLR
RLLRL
RLLRLL
RLLRLLL
RLLRLLR
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RLLRLLRR
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