Lab2 报告

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- 报告阶段：lab2
- 完成日期：2021.5.23
- 本次实验，我完成了所有内容。

目录

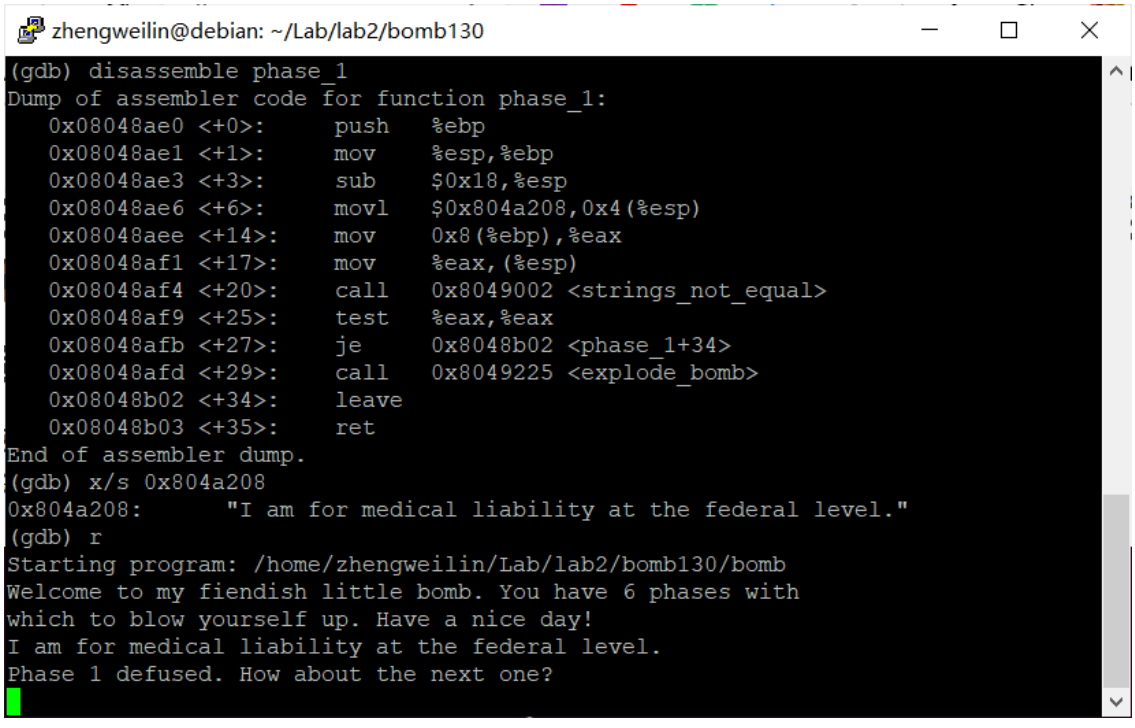
1. phase_1

- 思路

  查看`pahse_1`内容发现有一个`strings_not_equal`函数，则会进行字符串比较，观察到将`0x804a208`的内容赋值到`esp`中，查看目标地址即可得到答案。

  所以密码是`I am for medical liability at the federal level.`

- 完成截图



2. phase_2

- 思路

  由`read_six_numbers`可知输入位六个数字，

  由

```
    0x08048b3b <+55>:    add    $0x1,%ebx
    0x08048b3e <+58>:    cmp    $0x6,%ebx
    0x08048b41 <+61>:    jne    0x8048b2a <phase_2+38>
    0x08048b43 <+63>:    jmp    0x8048b4c <phase_2+72>
```

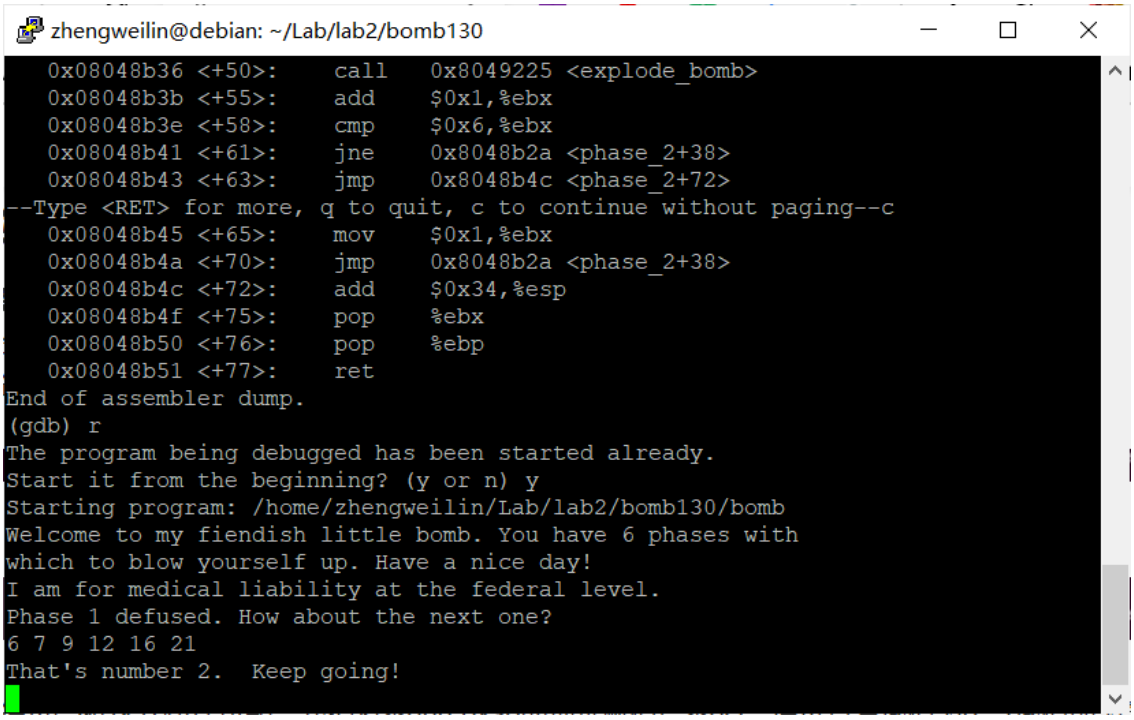
  这是个循环跳转，可知程序对六个数字进行循环处理

```
   0x08048b2a <+38>:    mov    %ebx,%eax
   0x08048b2c <+40>:    add    -0x24(%ebp,%ebx,4),%eax
   0x08048b30 <+44>:    cmp    %eax,-0x20(%ebp,%ebx,4)
   0x08048b34 <+48>:    je     0x8048b3b <phase_2+55>
   0x08048b36 <+50>:    call   0x8049225 <explode_bomb>
```

  由此看出循环体中将前一个数加上当前循环次数i与当前数比较，不相等的爆炸，即可推出六个数之差分别为1、2、3、4、5.

  因此密码可以是`6 7 9 12 16 21`

- 完成截图



3. phase_3

- 思路

  在输入前将`0x804a262`赋给了`esp+0x4`，查看该地址内容为`"%d %c %d"`，可知输入为数字、字符、数字。

  输入测试数据`4 a 100`，在输入完成后设置断点停下，然后单步执行，观察到执行到

```
   0x08048b97 <+69>:    jmp    *0x804a280(,%eax,4)
```

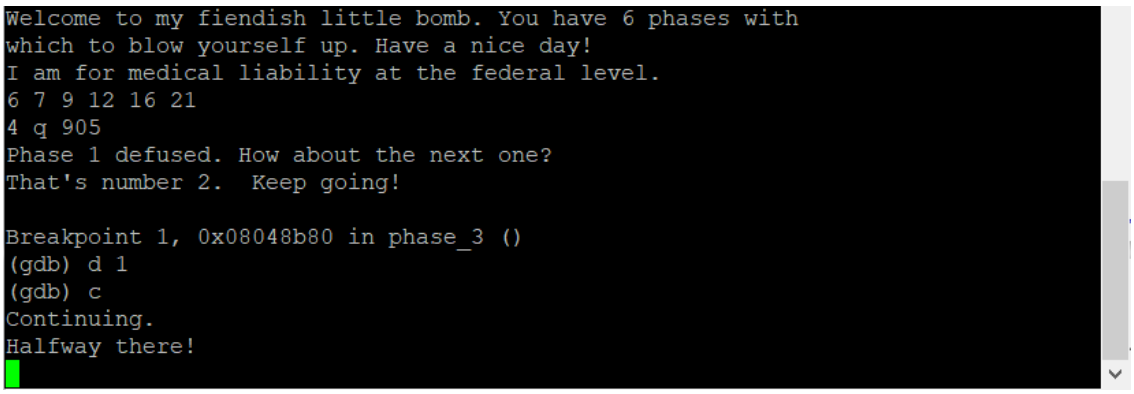
查看`x/10xg 0x804a280+16`，发现内容为`08048c1b`，继续查看`x/10i 0x08048c1b`

```
   0x8048c1b <phase_3+201>:     mov    $0x71,%eax
   0x8048c20 <phase_3+206>:     cmpl   $0x389,-0x10(%ebp)
   0x8048c27 <phase_3+213>:     je     0x8048c8d <phase_3+315>
   0x8048c29 <phase_3+215>:     call   0x8049225 <explode_bomb>
   0x8048c2e <phase_3+220>:     mov    $0x71,%eax
   0x8048c33 <phase_3+225>:     jmp    0x8048c8d <phase_3+315>
   0x8048c35 <phase_3+227>:     mov    $0x6e,%eax
   0x8048c3a <phase_3+232>:     cmpl   $0x32f,-0x10(%ebp)
   0x8048c41 <phase_3+239>:     je     0x8048c8d <phase_3+315>
   0x8048c43 <phase_3+241>:     call   0x8049225 <explode_bomb>
```

可发现第二个字符应该和`0x71`对应字符相等，第三个数据应为`0x389`.

所以密码为`4 q 905`

- 完成截图



4. phase_4

- 思路

  查看`0x804a4b1`内容可知输入为两个数字

```
0x08048d0f <+20>:    movl   $0x804a4b1,0x4(%esp)
......
(gdb) x/s 0x804a4b1
0x804a4b1:      "%d %d"
```

由

```
   0x08048d25 <+42>:    jne    0x8048d2d <phase_4+50>
   0x08048d27 <+44>:    cmpl   $0xe,-0xc(%ebp)
   0x08048d2b <+48>:    jbe    0x8048d32 <phase_4+55>
   0x08048d2d <+50>:    call   0x8049225 <explode_bomb>
   0x08048d32 <+55>:    movl   $0xe,0x8(%esp)
```

可知`ebp-0xc`中存放第一个数，应该`<=0xe`，接着程序调用了func4函数，结束后如果`eax`应该存放5，`ebp-0x10`应该存放5，否则爆炸。因此func4过程应该将`eax`和`ebp-0x10`都变为5.

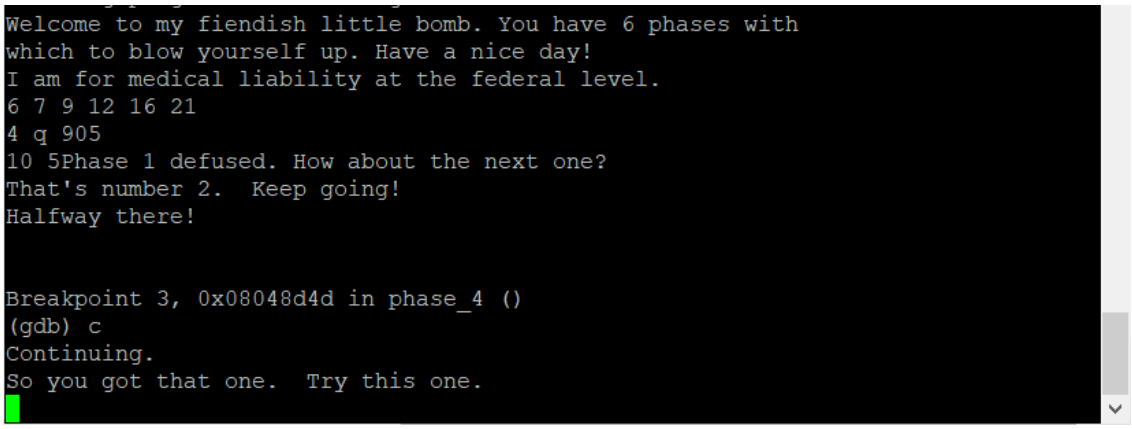
```
   0x08048d4d <+82>:    cmp    $0x5,%eax
   0x08048d50 <+85>:    jne    0x8048d58 <phase_4+93>
   0x08048d52 <+87>:    cmpl   $0x5,-0x10(%ebp)
   0x08048d56 <+91>:    je     0x8048d5d <phase_4+98>
   0x08048d58 <+93>:    call   0x8049225 <explode_bomb>
```

由于func4对`ebp-0x10`并无改变，则第二个数应该为5.

由于第一个数不大于15，因此可以尝试1~15，并在func4后断点查看eax。

最后的密码`10 5`

- 完成截图



5. phase_5

- 思路

  由

```
0x08048d75 <+20>:    movl   $0x804a4b1,0x4(%esp)

(gdb) x/s 0x804a4b1
0x804a4b1:      "%d %d"
```

得输入为两个数字x和y。

观察得`0x804a2a0`开始存放了一个数组，程序将从第x个数t开始，累加，然后找第t个数存放的数，累加，不断进行上述，直到加了十五次读到的t是`f`结束则不会爆炸，因此将数组列出来后可知从第5开始可以加十五次，第二个数由

```
   0x08048dbb <+90>:    mov    %eax,-0xc(%ebp)
   0x08048dbe <+93>:    cmp    $0xf,%edx
   0x08048dc1 <+96>:    jne    0x8048dc8 <phase_5+103>
   0x08048dc3 <+98>:    cmp    -0x10(%ebp),%ecx
   0x08048dc6 <+101>:   je     0x8048dcd <phase_5+108>
   0x08048dc8 <+103>:   call   0x8049225 <explode_bomb>
```

可知y为累加结果

因此密码为`5 115`

- 完成截图

```
Welcome to my fiendish little bomb. You have 6 phases with
which to blow yourself up. Have a nice day!
I am for medical liability at the federal level.
6 7 9 12 16 21
4 q 905
10 5 DrEvil
5 115
Phase 1 defused. How about the next one?
That's number 2.  Keep going!
Halfway there!
So you got that one.  Try this one.

Breakpoint 4, 0x08048dc3 in phase_5 ()
(gdb) c
Continuing.
Good work!  On to the next...
```

6. phase_6

- 思路

  由read_six_number可知读入六个数。

  注意到程序引用了`0x804c154`，查看发现这存了一个结构体数组node。

```
(gdb) x/10x 0x804c154
0x804c154 <node1>:      0x00000001000002e9      0x0000014c0804c160
0x804c164 <node2+4>:    0x0804c16c00000002      0x000000030000018d
0x804c174 <node3+8>:    0x0000014d0804c178      0x0804c18400000004
0x804c184 <node5>:      0x0000000500000137      0x000002140804c190
0x804c194 <node6+4>:    0x0000000000000006      0x3931363000000000
```

  由

```
   0x08048e6f <+158>:   add    $0x4,%eax
   0x08048e72 <+161>:   cmp    %esi,%eax
   0x08048e74 <+163>:   je     0x8048e7a <phase_6+169>
   0x08048e76 <+165>:   mov    %edx,%ecx
   0x08048e78 <+167>:   jmp    0x8048e6a <phase_6+153>
   0x08048e7a <+169>:   movl   $0x0,0x8(%edx)
   0x08048e81 <+176>:   mov    $0x5,%esi
   0x08048e86 <+181>:   mov    0x8(%ebx),%eax
   0x08048e89 <+184>:   mov    (%eax),%eax
   0x08048e8b <+186>:   cmp    %eax,(%ebx)
   0x08048e8d <+188>:   jle    0x8048e94 <phase_6+195>
   0x08048e8f <+190>:   call   0x8049225 <explode_bomb>
   0x08048e94 <+195>:   mov    0x8(%ebx),%ebx
```

  可知程序将前一个数A和当前数B比较，若A>B则爆炸，因此推测六个数顺序为结构体数组值从小到大的结点编号

  密码为`5 2 4 3 6 1`

- 完成截图

```
Welcome to my fiendish little bomb. You have 6 phases with
which to blow yourself up. Have a nice day!
I am for medical liability at the federal level.
6 7 9 12 16 21
4 q 905
10 5 DrEvil
5 115
5 2 4 3 6 1
Phase 1 defused. How about the next one?
That's number 2.  Keep going!
Halfway there!
So you got that one.  Try this one.
Good work!  On to the next...
```

7. 最终结果

- `bomblab` 完成截图

```
Welcome to my fiendish little bomb. You have 6 phases with
which to blow yourself up. Have a nice day!
I am for medical liability at the federal level.
6 7 9 12 16 21
4 q 905
10 5 DrEvil
5 115
5 2 4 3 6 1
40Phase 1 defused. How about the next one?
That's number 2.  Keep going!
Halfway there!
So you got that one.  Try this one.
Good work!  On to the next...
Curses, you've found the secret phase!
But finding it and solving it are quite different...

Wow! You've defused the secret stage!
Congratulations! You've defused the bomb!
Your instructor has been notified and will verify your solution.
[Inferior 1 (process 1466) exited normally]
(gdb)
```

- （可选）`bomblab` 隐藏关卡

  查看 `phase_defused` 中的信息，发现 `0x804a514`，查看发现

```
(gdb) x/s 0x804a514
0x804a514:      "DrEvil"
```

  因此开启密码为 `DrEvil`

  分析secret_phase，程序调用 `strtol` 获取了一个数值y。

  观察到0x804c0a0，查看内容

```
(gdb) x/20xg 0x804c0a0
0x804c0a0 <n1>: 0x0804c0ac00000024      0x000000080804c0b8
0x804c0b0 <n21+4>:      0x0804c0c40804c0dc      0x0804c0d000000032
0x804c0c0 <n22+8>:      0x000000160804c0e8      0x0804c1180804c130
0x804c0d0 <n33>:        0x0804c0f40000002d      0x000000060804c13c
0x804c0e0 <n31+4>:      0x0804c1240804c100      0x0804c10c0000006b
0x804c0f0 <n34+8>:      0x000000280804c148      0x0000000000000000
0x804c100 <n41>:        0x0000000000000001      0x0000006300000000
0x804c110 <n47+4>:      0x0000000000000000      0x0000000000000023
0x804c120 <n44+8>:      0x0000000700000000      0x0000000000000000
0x804c130 <n43>:        0x0000000000000014      0x0000002f00000000
```

发现这是个结构体node数组，如n1包含一个值24，左孩子地址0x0804c0ac，右孩子地址0x0804c0b8。

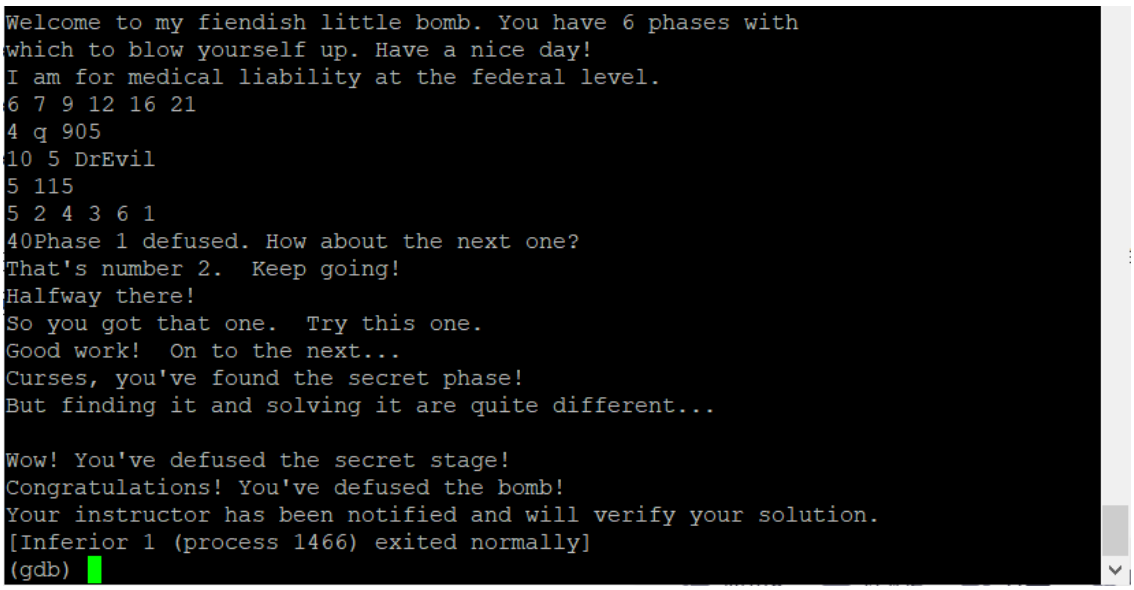
调用了func7(node,y)，其功能为y大于node的值递归左孩子，否则递归右孩子。

根据最后

```
   0x08048f3b <+69>:    cmp    $0x1,%eax
   0x08048f3e <+72>:    je     0x8048f45 <secret_phase+79>
   0x08048f40 <+74>:    call   0x8049225 <explode_bomb>
   0x08048f45 <+79>:    movl   $0x804a23c,(%esp)
```

可知要让结果为1，则最后需递归到n41结点。符合要求的y满足y>36,y<60,y<45

所以密码可以是40.



8. 备注