华东师范大学软件工程学院实验报告

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实验编号:	Lab 02	实验名称:	Defusing a Binary Bomb

1 实验目的

1) 练习汇编代码的阅读

2) 学习基础的逆向工程和反编译知识

3) 学习 gdb 调试工具的使用

2 实验内容与实验步骤

2.1 实验内容

二进制炸弹是一个由一系列阶段（六个阶段）组成的程序。每个阶段都希望您在标准输入中键入一个特定的字符串。如果您键入正确的字符串，则该阶段将被拆除，炸弹将进入下一阶段。否则，炸弹通过打印 “BOOM!!!” 爆炸，然后终止。当每个阶段都被拆除时，炸弹就会被拆除。

你在这个实验中的任务是拆除你的炸弹。

1) phase_1 阅读反汇编得到的代码中的 phase_1 函数，发现其调用了 strings_not_equal 函数，并检测其返回值是否为 0。当返回值不为零时，调用函数 explode_bomb 引爆炸弹，否则正常进行。

prase_1 反汇编代码及注释

```
346 0000000000400ee0 <phase_1>:
347   400ee0:    48 83 ec 08             sub    $0x8,%rsp                   ; %rsp -= 0x8;
348   400ee4:    be 00 24 40 00          mov    $0x402400,%esi              ; %esi = 0x402400;
349   400ee9:    e8 4a 04 00 00          callq  401338 <strings_not_equal>  ; strings_not_equal(...);
350   400eee:    85 c0                   test   %eax,%eax                   ; if (%eax != 0)
351   400ef0:    74 05                   je     400ef7 <phase_1+0x17>       ;     goto #351;
352   400ef2:    e8 43 05 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...)
353   400ef7:    48 83 c4 08             add    $0x8,%rsp                   ; %rsp += 8;
354   400efb:    c3                      retq                               ; return;
```

接下来阅读代码中的 strings_not_equal 函数，不难发现，该函数通过逐字符比较来判断两个字符串是否相同，相同时返回 0，不相同时返回 1。

在 phase_1 中，程序将输入与地址为 0x402400 的字符串进行了比较，我们可以使用 gdb 调试工具来展示该地址的字符串。

```
(gdb) x/s 0x402400
```

获得结果如下：

```
0x402400: "Border relations with Canada have never been better."
```

因此答案为 “Border relations with Canada have never been better.”

2) phase_2 阅读反汇编得到的代码中的 phase_2 函数，发现其调用了函数 read_six_numbers，因此，我们先阅读函数 read_six_numbers。

read_six_numbers 反汇编代码及注释

```
804 000000000040145c <read_six_numbers>:
805    40145c:   48 83 ec 18             sub    $0x18,%rsp                      ; %rsp -= 0x18;
806    401460:   48 89 f2                mov    %rsi,%rdx                       ; %rdx = %rsi;
807    401463:   48 8d 4e 04             lea    0x4(%rsi),%rcx                  ; %rcx = %rsi + 0x4;
808    401467:   48 8d 46 14             lea    0x14(%rsi),%rax                 ; %rax = %rsi + 0x14;
809    40146b:   48 89 44 24 08          mov    %rax,0x8(%rsp)                  ; M[%rsp + 0x8] = %rax;
810    401470:   48 8d 46 10             lea    0x10(%rsi),%rax                 ; %rax = %rsi + 0x10;
811    401474:   48 89 04 24             mov    %rax,(%rsp)                     ; M[%rsp] = %rax;
812    401478:   4c 8d 4e 0c             lea    0xc(%rsi),%r9                   ; %r9 = %rsi + 0xc;
813    40147c:   4c 8d 46 08             lea    0x8(%rsi),%r8                   ; %r8 = %rsi + 0x8;
814    401480:   be c3 25 40 00          mov    $0x4025c3,%esi                  ; %esi = 0x4025c3;
815    401485:   b8 00 00 00 00          mov    $0x0,%eax                       ; %eax = 0;
816    40148a:   e8 61 f7 ff ff          callq  400bf0 <__isoc99_sscanf@plt>    ; sscanf(...);
817    40148f:   83 f8 05                cmp    $0x5,%eax                       ; if (%eax > 5)
818    401492:   7f 05                   jg     401499 <read_six_numbers+0x3d>  ;     goto #820;
819    401494:   e8 a1 ff ff ff          callq  40143a <explode_bomb>           ; explode_bomb(...);
820    401499:   48 83 c4 18             add    $0x18,%rsp                      ; %rsp += 0x18;
821    40149d:   c3                      retq                                   ; return;
```

可以发现，在这段代码中，其令%rdx = %rsi, %rcx = %rsi + 4, %r8 = %rsi + 8, %r9 = %rsi + 12, M[%rsp] = %rsi + 16, M[%rsp + 8] = %rsi + 20。可以猜测，其调用 sscanf 函数将读取的六个数字分别存储到了%rdx, %rcx, %r8, %r9, M[%rsp], M[%rsp + 8] 中，进而存储到了 $M[\%rsi + k \cdot 4]$ 中。

接下来阅读 phase_2 的反汇编代码。

phase_2 反汇编代码及注释

```
356 0000000000400efc <phase_2>:
357    400efc:   55                      push   %rbp
358    400efd:   53                      push   %rbx
359    400efe:   48 83 ec 28             sub    $0x28,%rsp                 ; %rsp -= 0x28;
```

```
360   400f02:   48 89 e6                mov    %rsp,%rsi                 ; %rsi = %rsp;
361   400f05:   e8 52 05 00 00          callq  40145c <read_six_numbers>  ; read_six_numbers(...);
362   400f0a:   83 3c 24 01             cmpl   $0x1,(%rsp)               ; if (M[%rsp] == 1)
363   400f0e:   74 20                   je     400f30 <phase_2+0x34>     ;     goto #375;
364   400f10:   e8 25 05 00 00          callq  40143a <explode_bomb>     ; explode_bomb(...);
365   400f15:   eb 19                   jmp    400f30 <phase_2+0x34>     ; goto #375;
366   400f17:   8b 43 fc                mov    -0x4(%rbx),%eax           ; %eax = M[%rbx - 4];
367   400f1a:   01 c0                   add    %eax,%eax                 ; %eax += %eax;
368   400f1c: 39 03                  cmp    %eax,(%rbx)              ; if (%eax == M[%rbx])
369   400f1e:   74 05                   je     400f25 <phase_2+0x29>     ;     goto #371;
370   400f20:   e8 15 05 00 00          callq  40143a <explode_bomb>     ; explode_bomb(...);
371   400f25:   48 83 c3 04             add    $0x4,%rbx                 ; %rbx += 4;
372   400f29:   48 39 eb                cmp    %rbp,%rbx                 ; if (%rbp != %rbx)
373   400f2c:   75 e9                   jne    400f17 <phase_2+0x1b>     ;     goto #366;
374   400f2e:   eb 0c                   jmp    400f3c <phase_2+0x40>     ; goto #378;
375   400f30:   48 8d 5c 24 04          lea    0x4(%rsp),%rbx            ; %rbx = %rsp + 0x4;
376   400f35:   48 8d 6c 24 18          lea    0x18(%rsp),%rbp           ; %rbp = %rsp + 0x18;
377   400f3a:   eb db                   jmp    400f17 <phase_2+0x1b>     ; goto #366;
378   400f3c:   48 83 c4 28             add    $0x28,%rsp                ; %rsp += 0x28;
379   400f40:   5b                      pop    %rbx
380   400f41:   5d                      pop    %rbp
381   400f42:   c3                      retq
```

可以发现，其令%rsp = %rsi，因此，读取的六个数字被存储到 $M[\%rsp + k \cdot 4]$ $(0 \le k \le 5)$ 中。根据 362 行的代码可知，第一个数字为 1。阅读代码可以发现，其循环判断后一个数字是否为前一个数字的两倍。因此，可以得知这六个数字为 1，2，4，8，16，32。

3) phase_3 阅读反汇编得到的代码中的 phase_3 函数，发现其令 sscanf 的第二个参数%esi = 0x4025cf，使用 gdb 调试工具得到其内容为 “%d %d”。

```
(gdb) x/s 0x4025cf
0x4025cf:       "%d %d"
```

同时，我们发现程序中使用了间接跳转指令，我们可以使用 gdb 调试工具来显示跳转表。

```
(gdb) x/8gx 0x402470
0x402470:       0x0000000000400f7c      0x0000000000400fb9
0x402480:       0x0000000000400f83      0x0000000000400f8a
0x402490:       0x0000000000400f91      0x0000000000400f98
0x4024a0:       0x0000000000400f9f      0x0000000000400fa6
```

我们可以发现，该程序通过 sscanf 函数读取的两个数字分别存储在 $M[\%rsp + 8]$ 和 $M[\%rsp + 0xc]$ 中。根据第一个数字的不同，其通过 switch 语句进行不同的处理。当其小于 8 时，分别进行处理，否则引爆炸弹。

phase_3 反汇编代码及注释

```
383 0000000000400f43 <phase_3>:
384   400f43:   48 83 ec 18            sub    $0x18,%rsp                ; %rsp -= 0x18;
385   400f47:   48 8d 4c 24 0c         lea    0xc(%rsp),%rcx            ; %rcx = %rsp + 0xc;
386   400f4c:   48 8d 54 24 08         lea    0x8(%rsp),%rdx            ; %rdx = %rsp + 0x8;
387   400f51:   be cf 25 40 00         mov    $0x4025cf,%esi            ; %esi = 0x4025cf;
388   400f56:   b8 00 00 00 00         mov    $0x0,%eax                 ; %eax = 0;
389   400f5b:   e8 90 fc ff ff         callq  400bf0 <__isoc99_sscanf@plt> ; sscanf(...)
390   400f60:   83 f8 01               cmp    $0x1,%eax                 ; if (%eax > 1)
391   400f63:   7f 05                  jg     400f6a <phase_3+0x27>     ;     goto #393;
392   400f65:   e8 d0 04 00 00         callq  40143a <explode_bomb>     ; explode_bomb;
393   400f6a:   83 7c 24 08 07         cmpl   $0x7,0x8(%rsp)            ; if (M[%rsp + 0x8] > 7)
394   400f6f:   77 3c                  ja     400fad <phase_3+0x6a>     ;     goto #411;
395   400f71:   8b 44 24 08            mov    0x8(%rsp),%eax            ; %eax = M[%rsp + 0x8];
396   400f75:   ff 24 c5 70 24 40 00   jmpq   *0x402470(,%rax,8)        ; goto 8 * %rax + 0x402470;
397   400f7c:   b8 cf 00 00 00         mov    $0xcf,%eax            ; 0:  %eax = 0xcf;
398   400f81:   eb 3b                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
399   400f83:   b8 c3 02 00 00         mov    $0x2c3,%eax           ; 2:  %eax = 0x2c3;
400   400f88:   eb 34                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
401   400f8a:   b8 00 01 00 00         mov    $0x100,%eax           ; 3:  %eax = 0x100;
402   400f8f:   eb 2d                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
403   400f91:   b8 85 01 00 00         mov    $0x185,%eax           ; 4:  %eax = 0x185;
404   400f96:   eb 26                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
405   400f98:   b8 ce 00 00 00         mov    $0xce,%eax            ; 5:  %eax = 0xce;
406   400f9d:   eb 1f                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
407   400f9f:   b8 aa 02 00 00         mov    $0x2aa,%eax           ; 6:  %eax = 0x2aa;
408   400fa4:   eb 18                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
409   400fa6:   b8 47 01 00 00         mov    $0x147,%eax           ; 7:  %eax = 0x147;
410   400fab:   eb 11                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
411   400fad:   e8 88 04 00 00         callq  40143a <explode_bomb>     ; explode_bomb(...);
412   400fb2:   b8 00 00 00 00         mov    $0x0,%eax                 ; %eax = 0;
413   400fb7:   eb 05                  jmp    400fbe <phase_3+0x7b>     ; goto #415;
414   400fb9:   b8 37 01 00 00         mov    $0x137,%eax           ; 1:  %eax = 0x137;
415   400fbe:   3b 44 24 0c            cmp    0xc(%rsp),%eax            ; if (%eax == M[%rsp + 0xc])
416   400fc2:   74 05                  je     400fc9 <phase_3+0x86>     ;     goto #418;
417   400fc4:   e8 71 04 00 00         callq  40143a <explode_bomb>     ; explode_bomb(...);
418   400fc9:   48 83 c4 18            add    $0x18,%rsp                ; %rsp += 0x18;
419   400fcd:   c3                     retq                             ; return;
```

根据代码可以得出，可能的答案有 8 种，分别是："0 207"，"1 311"，"2 707"，"3 256"，"4 389"，"5 206"，"6 682" 和 "7 327"。

4) phase_4 阅读反汇编得到的代码中的 phase_4 函数，发现其令 sscanf 的第二个参数%esi = 0x4025cf，使用 gdb 调试工具得到其内容为 "%d %d"。说明其也需读取两个整数。

根据代码可以得出，其读取的第二个整数必须为 0，而第一个数必须为小于等于 14 的数，且当第一个数为参数一，参数二为 0，参数三为 14 时，调用函数 func4() 时返回值必须为 0，否则炸弹将爆炸。

phase_4 反汇编代码及注释

```
445 000000000040100c <phase_4>:
446   40100c:   48 83 ec 18             sub    $0x18,%rsp                  ; %rsp -= 0x18;
447   401010:   48 8d 4c 24 0c          lea    0xc(%rsp),%rcx              ; %rcx = %rsp + 0xc;
448   401015:   48 8d 54 24 08          lea    0x8(%rsp),%rdx              ; %rdx = %rsp + 0x8;
449   40101a:   be cf 25 40 00          mov    $0x4025cf,%esi              ; %esi = 0x4025cf;
450   40101f:   b8 00 00 00 00          mov    $0x0,%eax                   ; %eax = 0;
451   401024:   e8 c7 fb ff ff          callq  400bf0 <__isoc99_sscanf@plt> ; sscanf(...)
452   401029:   83 f8 02                cmp    $0x2,%eax                   ; if (%eax != 2)
453   40102c:   75 07                   jne    401035 <phase_4+0x29>       ;     goto #456;
454   40102e:   83 7c 24 08 0e          cmpl   $0xe,0x8(%rsp)              ; if (M[%rsp + 0x8] <= 0xe)
455   401033:   76 05                   jbe    40103a <phase_4+0x2e>       ;     goto #457;
456   401035:   e8 00 04 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...);
457   40103a:   ba 0e 00 00 00          mov    $0xe,%edx                   ; %edx = 0xe;
458   40103f:   be 00 00 00 00          mov    $0x0,%esi                   ; %rsi = 0;
459   401044:   8b 7c 24 08             mov    0x8(%rsp),%edi              ; %edi = M[%rsp + 0x8];
460   401048:   e8 81 ff ff ff          callq  400fce <func4>              ; func4(%edi, %esi, %edx);
461   40104d:   85 c0                   test   %eax,%eax                   ; if (%eax != 0)
462   40104f:   75 07                   jne    401058 <phase_4+0x4c>       ;     goto #465;
463   401051:   83 7c 24 0c 00          cmpl   $0x0,0xc(%rsp)              ; if (M[%rsp + 0xc] == 0)
464   401056:   74 05                   je     40105d <phase_4+0x51>       ;     goto #466;
465   401058:   e8 dd 03 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...);
466   40105d:   48 83 c4 18             add    $0x18,%rsp                  ; %rsp += 0x18;
467   401061:   c3                      retq                               ; return;
```

接下来阅读函数 func4。由于其含有递归，较难分析，我们写出其对应的 C 代码。

func4 反汇编代码及注释

```
421 0000000000400fce <func4>:
422   400fce:   48 83 ec 08             sub    $0x8,%rsp                   ; %rsp -= 0x8;
423   400fd2:   89 d0                   mov    %edx,%eax                   ; %eax = %rdx;
424   400fd4:   29 f0                   sub    %esi,%eax                   ; %eax -= %esi;
425   400fd6:   89 c1                   mov    %eax,%ecx                   ; %ecx = %eax;
426   400fd8:   c1 e9 1f                shr    $0x1f,%ecx                  ; %ecx >>=(H) 0x1f;
427   400fdb:   01 c8                   add    %ecx,%eax                   ; %eax += %ecx;
428   400fdd:   d1 f8                   sar    %eax                        ; %eax >>= 1;
429   400fdf:   8d 0c 30                lea    (%rax,%rsi,1),%ecx          ; %ecx = %rax + %rsi;
430   400fe2:   39 f9                   cmp    %edi,%ecx                   ; if (%ecx <= %edi)
431   400fe4:   7e 0c                   jle    400ff2 <func4+0x24>         ;     goto #436;
432   400fe6:   8d 51 ff                lea    -0x1(%rcx),%edx             ; %edx = %rcx - 1;
433   400fe9:   e8 e0 ff ff ff          callq  400fce <func4>              ; func4(%rdi, %rsi, %rdx);
434   400fee:   01 c0                   add    %eax,%eax                   ; %eax += %eax;
435   400ff0:   eb 15                   jmp    401007 <func4+0x39>         ; goto #442;
436   400ff2:   b8 00 00 00 00          mov    $0x0,%eax                   ; %eax = 0;
437   400ff7:   39 f9                   cmp    %edi,%ecx                   ; if (%ecx >= %edi)
438   400ff9:   7d 0c                   jge    401007 <func4+0x39>         ;     goto #442;
439   400ffb:   8d 71 01                lea    0x1(%rcx),%esi              ; %esi = %rcx + 1;
440   400ffe:   e8 cb ff ff ff          callq  400fce <func4>              ; func4(%rdi, %rsi, %rdx);
441   401003:   8d 44 00 01             lea    0x1(%rax,%rax,1),%eax       ; %eax = 2 * %rax + 1;
442   401007:   48 83 c4 08             add    $0x8,%rsp                   ; %rsp += 8;
443   40100b:   c3                      retq                               ; return %eax;
```

func4 对应的 C 代码

```c
int func4(int a, int b, int c) {
// a in %rdi, b in %rsi, c in %rdx
    int d = (c - b) / 2;
    int e = (c + b) / 2;
    if (e <= a) {
        d = 0;
        if (e >= a) {
            return d;
        } else {
            d = func4(a, e + 1, c);
            d = 2 * d + 1;
            return d;
        }
    } else {
        d = func4(a, b, e - 1);
        d = 2 * d;
        return d;
    }
}
```

对这份 C 代码进行测试，可以得知：0，1，3 和 7 是满足返回值为 0 的参数 a。

因此，满足要求的答案为："0 0"，"1 0"，"3 0" 和 "7 0"。

5) phase_5 阅读反汇编得到的代码中的 phase_5 函数，可以发现，其读取了一个字符串，并判断了字符串的长度，在字符串长度不等于 6 时引爆炸弹。

并且，其通过循环，将读取的字符串中的每一个字符进行了处理。设字符为 c，其将 $c \& 0xf$ 的结果作为下标，令 $M[\%rsp + 0x10 + i] = M[c\&0xf + 0x4024b0]$。

接着，它判断了 M[%rsp + 10] 处的字符串与 0x40245e 处的字符串是否相同。如果不同，则引爆炸弹。

phase_5 对应的反汇编代码及注释

```
469 0000000000401062 <phase_5>:
470   401062:   53                      push   %rbx
471   401063:   48 83 ec 20             sub    $0x20,%rsp              ; %rsp -= 0x20;
472   401067:   48 89 fb                mov    %rdi,%rbx               ; %rbx = %rdi;
473   40106a:   64 48 8b 04 25 28 00    mov    %fs:0x28,%rax           ; %rax = 0x28;
474   401071:   00 00
475   401073:   48 89 44 24 18          mov    %rax,0x18(%rsp)         ; M[%rsp + 0x18] = %rax;
476   401078:   31 c0                   xor    %eax,%eax               ; %eax ^= %eax;
477   40107a:   e8 9c 02 00 00          callq  40131b <string_length>  ; string_length(%rdi);
478   40107f:   83 f8 06                cmp    $0x6,%eax               ; if (%eax == 6)
479   401082:   74 4e                   je     4010d2 <phase_5+0x70>   ;     goto #500;
```

```
480   401084:   e8 b1 03 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...);
481   401089:   eb 47                   jmp    4010d2 <phase_5+0x70>       ; goto #500;
482   40108b:   0f b6 0c 03             movzbl (%rbx,%rax,1),%ecx          ; %ecx = %rbx + %rax;
483   40108f:   88 0c 24                mov    %cl,(%rsp)                  ; M[%rsp] = %cl;
484   401092:   48 8b 14 24             mov    (%rsp),%rdx                 ; %rdx = M[%rsp];
485   401096:   83 e2 0f                and    $0xf,%edx                   ; %edx &= 0xf;
486   401099:   0f b6 92 b0 24 40 00    movzbl 0x4024b0(%rdx),%edx         ; %edx = M[%rdx + 0x4024b0];
487   4010a0:   88 54 04 10             mov    %dl,0x10(%rsp,%rax,1)       ; M[%rsp + %rax + 0x10] = %dl;
488   4010a4:   48 83 c0 01             add    $0x1,%rax                   ; %rax++;
489   4010a8:   48 83 f8 06             cmp    $0x6,%rax                   ; if (%rax != 0x6)
490   4010ac:   75 dd                   jne    40108b <phase_5+0x29>       ;     goto #482;
491   4010ae:   c6 44 24 16 00          movb   $0x0,0x16(%rsp)             ; M[%rsp + 0x16] = 0;
492   4010b3:   be 5e 24 40 00          mov    $0x40245e,%esi              ; %esi = 0x40245e;
493   4010b8:   48 8d 7c 24 10          lea    0x10(%rsp),%rdi             ; %rdi = %rsp + 0x10;
494   4010bd:   e8 76 02 00 00          callq  401338 <strings_not_equal>  ; strings_not_equal(%rdi, %rsi
 );
495   4010c2:   85 c0                   test   %eax,%eax                   ; if (%eax == 0)
496   4010c4:   74 13                   je     4010d9 <phase_5+0x77>       ;     goto #502;
497   4010c6:   e8 6f 03 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...);
498   4010cb:   0f 1f 44 00 00          nopl   0x0(%rax,%rax,1)            ; ???
499   4010d0:   eb 07                   jmp    4010d9 <phase_5+0x77>       ; goto #502;
500   4010d2:   b8 00 00 00 00          mov    $0x0,%eax                   ; %eax = 0;
501   4010d7:   eb b2                   jmp    40108b <phase_5+0x29>       ; goto #482;
502   4010d9:   48 8b 44 24 18          mov    0x18(%rsp),%rax             ; %rax = M[%rsp + 0x18];
503   4010de:   64 48 33 04 25 28 00    xor    %fs:0x28,%rax               ; %rax ^= 0x28;
504   4010e5:   00 00
505   4010e7:   74 05                   je     4010ee <phase_5+0x8c>       ; goto #507;
506   4010e9:   e8 42 fa ff ff          callq  400b30 <__stack_chk_fail@plt>;
507   4010ee:   48 83 c4 20             add    $0x20,%rsp                  ; %rsp += 0x20;
508   4010f2:   5b                      pop    %rbx
509   4010f3:   c3                      retq
```

使用 gdb 调试工具可以得到 0x4024b0 和 0x40245e 处的字符串内容。

```
(gdb) x/s 0x40245e
0x40245e:        "flyers"
(gdb) x/s 0x4024b0
0x4024b0 <array.3449>:  "maduiersnfotvbylSo you think you can stop the bomb with
     ctrl-c, do you?"
```

为了找出满足条件的字符串，我们可以使用 C++ 编程解决。

解决此问题的 C++ 代码

```
#include <iostream>
#include <vector>
int main() {
    std::string tar = "flyers";
    std::string s = "maduiersnfotvbylSo you think you can stop the bomb with
        ctrl-c, do you?";
    std::vector<std::vector<char>> ans(6, std::vector<char>(0));
    for (int i = 0; i < 6; i++) {
        for (int j = 32; j < 127; j++) {
            char k = j & 0xf;
            if (k < s.size() && s[k] == tar[i]) {
                ans[i].push_back(j);
            }
        }
    }
    for (auto i : ans) {
        for (auto j : i) {
            std::cout << j << ' ';
        }
        std::cout << std::endl;
    }
}
```

答案如下表所示，共有 38880 种组合。

可能的字符 / 位置（下标）	1	2	3	4	5	6
0	)	9	I	Y	i	y
1	/	?	O	_	o	无
2	.	>	N	^	n	~
3	%	5	E	U	e	u
4	&	6	F	V	f	v
5	'	7	G	W	g	w

6) phase_6 阅读反汇编得到的代码中的 phase_6 函数，可以发现其首先读取了六个数字。

接着，它判断了读取到的第一个数字与 6 的大小关系，如果第一个数字不满足小于等于 6，则引爆炸弹。

接下来，其使用%ebx 和%r12d 作为计数器，循环检查了剩余五个数字是否与%rbp 相同，如果与%rbp 相同，则引爆炸弹。而在循环中，%rbp 依次被赋给前五个数字的值，即这段代码检查了输入的数字中是否存在相同的数字，如果存在，则引爆炸弹。同时，循环中也再次检查了每一个数字是否满足小于等于 6，如果不满足，则引爆炸弹。

接着，程序通过循环，令 $M[\%rsp+4\cdot k]=7-M[\%rsp+4\cdot k]$。即用 7 分别减去了读入的 6 个数字。

此时，代码中出现了内存地址 0x6032d0，可以用 gdb 调试器列出其值，经过尝试，可以发现它是一个链表。

```
(gdb) x/24x 0x6032d0
0x6032d0 <node1>:       0x0000014c      0x00000001      0x006032e0      0x00000000
0x6032e0 <node2>:       0x000000a8      0x00000002      0x006032f0      0x00000000
0x6032f0 <node3>:       0x0000039c      0x00000003      0x00603300      0x00000000
0x603300 <node4>:       0x000002b3      0x00000004      0x00603310      0x00000000
0x603310 <node5>:       0x000001dd      0x00000005      0x00603320      0x00000000
0x603320 <node6>:       0x000001bb      0x00000006      0x00000000      0x00000000
```

设经过操作后的数为 x_k，地址为 $\%rsp+4\cdot k$，若 $x_k\le 1$（即操作前 ≥ 6），则令 $M[\%rsp+0x20+2\cdot k]=0x6032d0$，即链表的第一个节点。实际上，由于每一个读入的数字都是不重复且小于等于 6 的，只有在其等于 6 时，即操作后 $x_k=1$ 时，才能满足这个条件。若 $x_k>1$，即操作前 <6，则先通过循环，找到链表中第 x_k 个节点 $nodex_k$，再令 $M[\%rsp+0x20+2\cdot k]=\&nodex_k$。简要来说，这段代码完成了令 $M[\%rsp+0x20+8\cdot k]=\&nodex_k$ 的操作。

接下来，代码通过循环重新链接了链表的六个节点。重新链接后的顺序与其陈列在 $M[\%rsp+0x20]$ 处的顺序相同。

最后，程序通过循环，判断重新链接后的链表中是否满足前一个数大于后一个数。只要有一个不满足，炸弹将爆炸。

phase_6 对应的反汇编代码及注释

```
511 00000000004010f4 <phase_6>:
512   4010f4:   41 56                   push   %r14
513   4010f6:   41 55                   push   %r13
514   4010f8:   41 54                   push   %r12
515   4010fa:   55                      push   %rbp
516   4010fb:   53                      push   %rbx
517   4010fc:   48 83 ec 50             sub    $0x50,%rsp                ; %rsp -= 0x50;
518   401100:   49 89 e5                mov    %rsp,%r13                 ; %r13 = %rsp;
519   401103:   48 89 e6                mov    %rsp,%rsi                 ; %rsi = %rsp;
520   401106:   e8 51 03 00 00          callq  40145c <read_six_numbers> ; read_six_numbers(...);
521   40110b:   49 89 e6                mov    %rsp,%r14                 ; %r14 = %rsp;
522   40110e:   41 bc 00 00 00 00       mov    $0x0,%r12d                ; %r12d = 0;
523   401114:   4c 89 ed                mov    %r13,%rbp                 ; %rbp = %r13;
524   401117:   41 8b 45 00             mov    0x0(%r13),%eax            ; %eax = M[%r13];
525   40111b:   83 e8 01                sub    $0x1,%eax                 ; %eax--;
526   40111e:   83 f8 05                cmp    $0x5,%eax                 ; if (%eax <= 5)
527   401121:   76 05                   jbe    401128 <phase_6+0x34>     ;     goto #529;
528   401123:   e8 12 03 00 00          callq  40143a <explode_bomb>     ; explode_bomb(...);
529   401128:   41 83 c4 01             add    $0x1,%r12d                ; %r12d++;
530   40112c:   41 83 fc 06             cmp    $0x6,%r12d                ; if (%r12d == 6)
```

```
531   401130:   74 21                   je     401153 <phase_6+0x5f>        ;     goto #543;
532   401132:   44 89 e3                mov    %r12d,%ebx                   ; %ebx = %r12d;
533   401135:   48 63 c3                movslq %ebx,%rax                    ; %rax = %ebx;
534   401138:   8b 04 84                mov    (%rsp,%rax,4),%eax           ; %eax = M[%rsp + %eax * 4];
535   40113b:   39 45 00                cmp    %eax,0x0(%rbp)               ; if (M[%rbp] != %eax)
536   40113e:   75 05                   jne    401145 <phase_6+0x51>        ;     goto #538;
537   401140:   e8 f5 02 00 00          callq  40143a <explode_bomb>        ; explode_bomb(...);
538   401145:   83 c3 01                add    $0x1,%ebx                    ; %ebx++;
539   401148:   83 fb 05                cmp    $0x5,%ebx                    ; if (%ebx <= 5)
540   40114b:   7e e8                   jle    401135 <phase_6+0x41>        ;     goto #533;
541   40114d:   49 83 c5 04             add    $0x4,%r13                    ; %r13 += 4;
542   401151:   eb c1                   jmp    401114 <phase_6+0x20>        ; goto #523;
543   401153:   48 8d 74 24 18          lea    0x18(%rsp),%rsi              ; %rsi = %rsp + 0x18;
544   401158:   4c 89 f0                mov    %r14,%rax                    ; %rax = %r14;
545   40115b:   b9 07 00 00 00          mov    $0x7,%ecx                    ; %ecx = 0x7;
546   401160:   89 ca                   mov    %ecx,%edx                    ; %edx = %ecx;
547   401162:   2b 10                   sub    (%rax),%edx                  ; %edx -= M[%rax];
548   401164:   89 10                   mov    %edx,(%rax)                  ; M[%rax] = %edx;
549   401166:   48 83 c0 04             add    $0x4,%rax                    ; %rax += 4;
550   40116a:   48 39 f0                cmp    %rsi,%rax                    ; if (%rax != %rsi)
551   40116d:   75 f1                   jne    401160 <phase_6+0x6c>        ;     goto #546;
552   40116f:   be 00 00 00 00          mov    $0x0,%esi                    ; %esi = 0;
553   401174:   eb 21                   jmp    401197 <phase_6+0xa3>        ; goto #564;
554   401176:   48 8b 52 08             mov    0x8(%rdx),%rdx               ; %rdx = M[%rdx + 8];
555   40117a:   83 c0 01                add    $0x1,%eax                    ; %eax++;
556   40117d:   39 c8                   cmp    %ecx,%eax                    ; if (%eax != %ecx)
557   40117f:   75 f5                   jne    401176 <phase_6+0x82>        ;     goto #554;
558   401181:   eb 05                   jmp    401188 <phase_6+0x94>        ; goto #560;
559   401183:   ba d0 32 60 00          mov    $0x6032d0,%edx               ; %edx = 0x6032d0;
560   401188:   48 89 54 74 20          mov    %rdx,0x20(%rsp,%rsi,2)       ; M[%rsp + %rsi * 2 + 0x20] =
    %rdx;
561   40118d:   48 83 c6 04             add    $0x4,%rsi                    ; %rsi += 4;
562   401191:   48 83 fe 18             cmp    $0x18,%rsi                   ; if (%rsi == 0x18)
563   401195:   74 14                   je     4011ab <phase_6+0xb7>        ;     goto #570;
564   401197:   8b 0c 34                mov    (%rsp,%rsi,1),%ecx           ; %ecx = M[%rsp + %rsi];
565   40119a:   83 f9 01                cmp    $0x1,%ecx                    ; if (%ecx <= 1)
566   40119d:   7e e4                   jle    401183 <phase_6+0x8f>        ;     goto #559;
567   40119f:   b8 01 00 00 00          mov    $0x1,%eax                    ; %eax = 1;
568   4011a4:   ba d0 32 60 00          mov    $0x6032d0,%edx               ; %edx = 0x6032d0;
569   4011a9:   eb cb                   jmp    401176 <phase_6+0x82>        ; goto #554;
570   4011ab:   48 8b 5c 24 20          mov    0x20(%rsp),%rbx              ; %rbx = M[%rsp + 0x20];
571   4011b0:   48 8d 44 24 28          lea    0x28(%rsp),%rax              ; %rax = %rsp + 0x28;
572   4011b5:   48 8d 74 24 50          lea    0x50(%rsp),%rsi              ; %rsi = %rsp + 0x50;
573   4011ba:   48 89 d9                mov    %rbx,%rcx                    ; %rcx = %rbx;
574   4011bd:   48 8b 10                mov    (%rax),%rdx                  ; %rdx = M[%rax];
575   4011c0:   48 89 51 08             mov    %rdx,0x8(%rcx)               ; M[%rcx + 0x8] = %rdx;
576   4011c4:   48 83 c0 08             add    $0x8,%rax                    ; %rax += 8;
577   4011c8:   48 39 f0                cmp    %rsi,%rax                    ; if (%rax == %rsi)
578   4011cb:   74 05                   je     4011d2 <phase_6+0xde>        ;     goto #581;
579   4011cd:   48 89 d1                mov    %rdx,%rcx                    ; %rcx = %rdx;
580   4011d0:   eb eb                   jmp    4011bd <phase_6+0xc9>        ; goto #574;
581   4011d2:   48 c7 42 08 00 00 00    movq   $0x0,0x8(%rdx)               ; M[%rdx + 8] = 0;
582   4011d9:   00
```

```
583   4011da:   bd 05 00 00 00          mov    $0x5,%ebp                   ; %ebp = 5;
584   4011df:   48 8b 43 08             mov    0x8(%rbx),%rax              ; %rax = M[%rbx + 8];
585   4011e3:   8b 00                   mov    (%rax),%eax                 ; %eax = M[%rax];
586   4011e5:   39 03                   cmp    %eax,(%rbx)                 ; if (M[%rbx] >= %eax)
587   4011e7:   7d 05                   jge    4011ee <phase_6+0xfa>       ;     goto #589;
588   4011e9:   e8 4c 02 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...);
589   4011ee:   48 8b 5b 08             mov    0x8(%rbx),%rbx              ; %rbx = M[%rbx + 8];
590   4011f2:   83 ed 01                sub    $0x1,%ebp                   ; %ebp--;
591   4011f5:   75 e8                   jne    4011df <phase_6+0xeb>       ; goto #584;
592   4011f7:   48 83 c4 50             add    $0x50,%rsp                  ; %rsp += 0x50;
593   4011fb:   5b                      pop    %rbx
594   4011fc:   5d                      pop    %rbp
595   4011fd:   41 5c                   pop    %r12
596   4011ff:   41 5d                   pop    %r13
597   401201:   41 5e                   pop    %r14
598   401203:   c3                      retq
```

通过 gdb 调试工具可以得知，原链表中的值为 322，168，924，691，477，443。

```
(gdb) x/24d 0x6032d0
0x6032d0 <node1>:       332     1       6304480 0
0x6032e0 <node2>:       168     2       6304496 0
0x6032f0 <node3>:       924     3       6304512 0
0x603300 <node4>:       691     4       6304528 0
0x603310 <node5>:       477     5       6304544 0
0x603320 <node6>:       443     6       0       0
```

其中，节点按从大到小依次排序为 3，4，5，6，1，2。用 7 减去后为 4，3，2，1，6，5。即答案为 “4 3 2 1 6 5”。

7) secret_phase 首先我们需要找到 secret_phase 的入口。

在文件中搜索，可以发现在 phase_defused 函数中调用了 secret_phase。可以发现，在这个函数中，其调用了 sscanf 函数以 0x603870 作为源，0x402619 作为格式读取了内容，当且仅当 $num\_input\_strings = 6$ 且读取到的内容为三个且读取到的第三个内容与 0x402622 处的字符串相同时，secret_phase 才会被调用。

phase_defused 对应的反汇编代码

```
892 00000000004015c4 <phase_defused>:
893   4015c4:   48 83 ec 78             sub    $0x78,%rsp
894   4015c8:   64 48 8b 04 25 28 00    mov    %fs:0x28,%rax
895   4015cf:   00 00
896   4015d1:   48 89 44 24 68          mov    %rax,0x68(%rsp)
897   4015d6:   31 c0                   xor    %eax,%eax
898   4015d8:   83 3d 81 21 20 00 06    cmpl   $0x6,0x202181(%rip)        # 603760 <num_input_strings>
899   4015df:   75 5e                   jne    40163f <phase_defused+0x7b>
900   4015e1:   4c 8d 44 24 10          lea    0x10(%rsp),%r8
```

```
4015e6:   48 8d 4c 24 0c          lea    0xc(%rsp),%rcx
4015eb:   48 8d 54 24 08          lea    0x8(%rsp),%rdx
4015f0:   be 19 26 40 00          mov    $0x402619,%esi
4015f5:   bf 70 38 60 00          mov    $0x603870,%edi
4015fa:   e8 f1 f5 ff ff          callq  400bf0 <__isoc99_sscanf@plt>
4015ff:   83 f8 03                cmp    $0x3,%eax
401602:   75 31                   jne    401635 <phase_defused+0x71>
401604:   be 22 26 40 00          mov    $0x402622,%esi
401609:   48 8d 7c 24 10          lea    0x10(%rsp),%rdi
40160e:   e8 25 fd ff ff          callq  401338 <strings_not_equal>
401613:   85 c0                   test   %eax,%eax
401615:   75 1e                   jne    401635 <phase_defused+0x71>
401617:   bf f8 24 40 00          mov    $0x4024f8,%edi
40161c:   e8 ef f4 ff ff          callq  400b10 <puts@plt>
401621:   bf 20 25 40 00          mov    $0x402520,%edi
401626:   e8 e5 f4 ff ff          callq  400b10 <puts@plt>
40162b:   b8 00 00 00 00          mov    $0x0,%eax
401630:   e8 0d fc ff ff          callq  401242 <secret_phase>
401635:   bf 58 25 40 00          mov    $0x402558,%edi
40163a:   e8 d1 f4 ff ff          callq  400b10 <puts@plt>
40163f:   48 8b 44 24 68          mov    0x68(%rsp),%rax
401644:   64 48 33 04 25 28 00    xor    %fs:0x28,%rax
40164b:   00 00
40164d:   74 05                   je     401654 <phase_defused+0x90>
40164f:   e8 dc f4 ff ff          callq  400b30 <__stack_chk_fail@plt>
401654:   48 83 c4 78             add    $0x78,%rsp
401658:   c3                      retq
401659:   90                      nop
40165a:   90                      nop
40165b:   90                      nop
40165c:   90                      nop
40165d:   90                      nop
40165e:   90                      nop
40165f:   90                      nop
```

使用 gdb 调试工具打印这些地址所对应的内容。

```
(gdb) x/s 0x603870
0x603870 <input_strings+240>:   ""
(gdb) x/s 0x402619
0x402619:         "%d %d %s"
(gdb) x/s 0x402622
0x402622:         "DrEvil"
```

可以发现，0x603870 所对应的内容是我们之前输入的内容的一部分，因此我们使用调试工具，在完成前 6 个 phase 后再查看此地址的内容。

```
(gdb) b phase_defused if ((int)num_input_strings == 6)
Breakpoint 1 at 0x4015c4
(gdb) r
```

```
Starting program: /home/pdli/Desktop/lab2/bomb/bomb
Welcome to my fiendish little bomb. You have 6 phases with
which to blow yourself up. Have a nice day!
Border relations with Canada have never been better.
Phase 1 defused. How about the next one?
1 2 4 8 16 32
That's number 2.  Keep going!
7 327
Halfway there!
0 0
So you got that one.  Try this one.
9?>567
Good work!  On to the next...
4 3 2 1 6 5

Breakpoint 1, 0x00000000004015c4 in phase_defused ()
(gdb) x/s 0x603870
0x603870 <input_strings+240>:   "0 0"
```

可以发现，其对应的是在 phase_4 中我们输入的字符串。因此，若想要进入 secret_phase，我们需要在 phase_4 的答案后加上 “DrEvil”。

接下来，我们分析 secret_phase 的内容。

secret_phase 对应的反汇编代码及注释

```
622 0000000000401242 <secret_phase>:
623   401242:   53                      push   %rbx
624   401243:   e8 56 02 00 00          callq  40149e <read_line>          ; read_line(...);
625   401248:   ba 0a 00 00 00          mov    $0xa,%edx                   ; %edx = 0xa;
626   40124d:   be 00 00 00 00          mov    $0x0,%esi                   ; %esi = 0x0;
627   401252:   48 89 c7                mov    %rax,%rdi                   ; %rdi = %rax;
628   401255:   e8 76 f9 ff ff          callq  400bd0 <strtol@plt>         ; strtol(...);
629   40125a:   48 89 c3                mov    %rax,%rbx                   ; %rbx = %rax;
630   40125d:   8d 40 ff                lea    -0x1(%rax),%eax             ; %eax--;
631   401260:   3d e8 03 00 00          cmp    $0x3e8,%eax                 ; if (%eax <= 0x3e8)
632   401265:   76 05                   jbe    40126c <secret_phase+0x2a>  ;     goto #634;
633   401267:   e8 ce 01 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...);
634   40126c:   89 de                   mov    %ebx,%esi                   ; %esi = %ebx;
635   40126e:   bf f0 30 60 00          mov    $0x6030f0,%edi              ; %edi = 0x6030f0;
636   401273:   e8 8c ff ff ff          callq  401204 <fun7>               ; fun7(%rdi, %rsi);
637   401278:   83 f8 02                cmp    $0x2,%eax                   ; if (%eax == 2)
638   40127b:   74 05                   je     401282 <secret_phase+0x40>  ;     goto #640;
639   40127d:   e8 b8 01 00 00          callq  40143a <explode_bomb>       ; explode_bomb(...);
640   401282:   bf 38 24 40 00          mov    $0x402438,%edi              ; %edi = 0x402438;
641   401287:   e8 84 f8 ff ff          callq  400b10 <puts@plt>           ; puts(%rdi);
642   40128c:   e8 33 03 00 00          callq  4015c4 <phase_defused>      ; phase_defused(...);
643   401291:   5b                      pop    %rbx
644   401292:   c3                      retq
```

```
401293:   90                      nop
401294:   90                      nop
401295:   90                      nop
401296:   90                      nop
401297:   90                      nop
401298:   90                      nop
401299:   90                      nop
40129a:   90                      nop
40129b:   90                      nop
40129c:   90                      nop
40129d:   90                      nop
40129e:   90                      nop
40129f:   90                      nop
```

可以发现其与地址 0x6030f0 的内容有关，我们可以使用 gdb 调试工具尝试获取该地址的内容，经过尝试，可以发现此处存储的数据结构是一个二叉树。

```
0x6030f0 <n1>:  0x0000000000000024      0x0000000000603110
0x603100 <n1+16>:       0x0000000000603130      0x0000000000000000
0x603110 <n21>: 0x0000000000000008      0x0000000000603190
0x603120 <n21+16>:      0x0000000000603150      0x0000000000000000
0x603130 <n22>: 0x0000000000000032      0x0000000000603170
0x603140 <n22+16>:      0x00000000006031b0      0x0000000000000000
0x603150 <n32>: 0x0000000000000016      0x0000000000603270
0x603160 <n32+16>:      0x0000000000603230      0x0000000000000000
0x603170 <n33>: 0x000000000000002d      0x00000000006031d0
0x603180 <n33+16>:      0x0000000000603290      0x0000000000000000
0x603190 <n31>: 0x0000000000000006      0x00000000006031f0
0x6031a0 <n31+16>:      0x0000000000603250      0x0000000000000000
0x6031b0 <n34>: 0x000000000000006b      0x0000000000603210
0x6031c0 <n34+16>:      0x00000000006032b0      0x0000000000000000
0x6031d0 <n45>: 0x0000000000000028      0x0000000000000000
0x6031e0 <n45+16>:      0x0000000000000000      0x0000000000000000
0x6031f0 <n41>: 0x0000000000000001      0x0000000000000000
0x603200 <n41+16>:      0x0000000000000000      0x0000000000000000
0x603210 <n47>: 0x0000000000000063      0x0000000000000000
0x603220 <n47+16>:      0x0000000000000000      0x0000000000000000
0x603230 <n44>: 0x0000000000000023      0x0000000000000000
0x603240 <n44+16>:      0x0000000000000000      0x0000000000000000
0x603250 <n42>: 0x0000000000000007      0x0000000000000000
0x603260 <n42+16>:      0x0000000000000000      0x0000000000000000
0x603270 <n43>: 0x0000000000000014      0x0000000000000000
0x603280 <n43+16>:      0x0000000000000000      0x0000000000000000
0x603290 <n46>: 0x000000000000002f      0x0000000000000000
0x6032a0 <n46+16>:      0x0000000000000000      0x0000000000000000
--Type <RET> for more, q to quit, c to continue without paging--
```

```
30  0x6032b0 <n48>: 0x00000000000003e9      0x0000000000000000
31  0x6032c0 <n48+16>:      0x0000000000000000      0x0000000000000000
```

画出此二叉树的结构和内容。

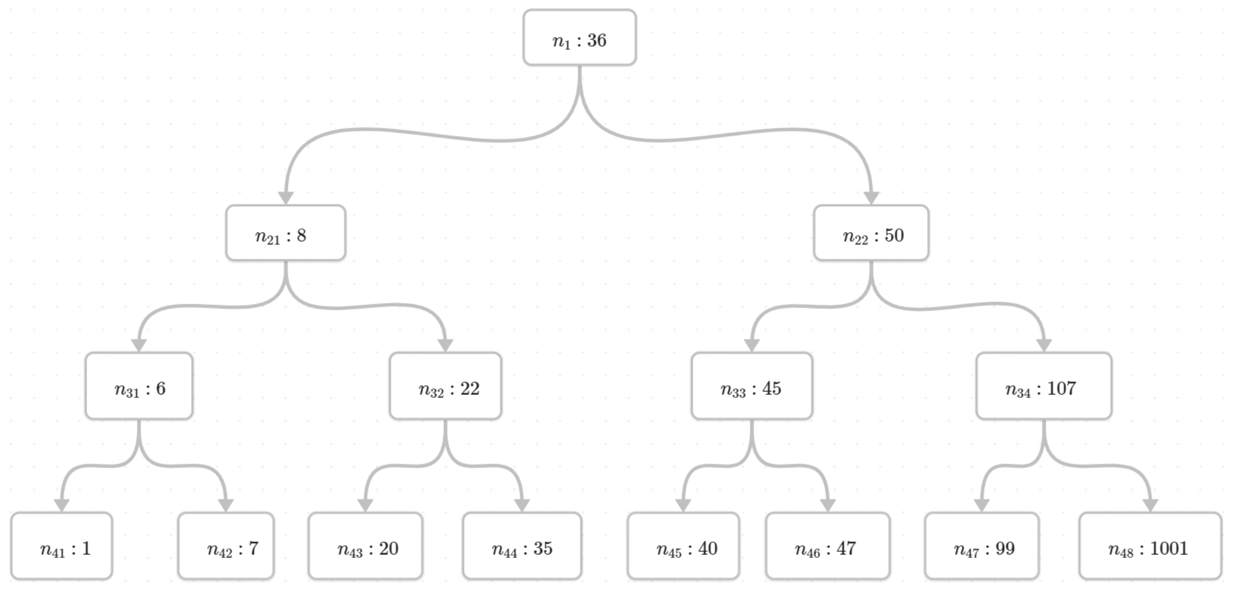


图 1: 此二叉树的结构和内容

同时，secret_phase 中还调用了函数 fun7。可以写出函数 func7 等效的 C 代码。

fun7 对应的反汇编代码及注释

```
600 0000000000401204 <fun7>:
601   401204:   48 83 ec 08             sub    $0x8,%rsp                  ; %rsp -= 0x8;
602   401208:   48 85 ff                test   %rdi,%rdi                  ; if (%rdi == 0)
603   40120b:   74 2b                   je     401238 <fun7+0x34>         ;    goto #618;
604   40120d:   8b 17                   mov    (%rdi),%edx                ; %edx = M[%rdi];
605   40120f:   39 f2                   cmp    %esi,%edx                  ; if (%edx <= %esi)
606   401211:   7e 0d                   jle    401220 <fun7+0x1c>         ;     goto #611;
607   401213:   48 8b 7f 08             mov    0x8(%rdi),%rdi             ; %rdi = M[%rdi + 0x8];
608   401217:   e8 e8 ff ff ff          callq  401204 <fun7>              ; fun7(%rdi, %rsi);
609   40121c:   01 c0                   add    %eax,%eax                  ; %eax += %eax;
610   40121e:   eb 1d                   jmp    40123d <fun7+0x39>         ; goto #619;
611   401220:   b8 00 00 00 00          mov    $0x0,%eax                  ; %eax = 0;
612   401225:   39 f2                   cmp    %esi,%edx                  ; if (%edx == %esi)
613   401227:   74 14                   je     40123d <fun7+0x39>         ;     goto #619;
614   401229:   48 8b 7f 10             mov    0x10(%rdi),%rdi            ; %rdi = M[%rdi + 0x10];
615   40122d:   e8 d2 ff ff ff          callq  401204 <fun7>              ; fun7(%rdi, %rsi);
616   401232:   8d 44 00 01             lea    0x1(%rax,%rax,1),%eax      ; %eax = 2 * %rax + 1;
617   401236:   eb 05                   jmp    40123d <fun7+0x39>         ; goto #619;
618   401238:   b8 ff ff ff ff          mov    $0xffffffff,%eax           ; %eax = -1;
```

```
619   40123d:   48 83 c4 08             add    $0x8,%rsp                       ; %rsp += 0x8;
620   401241:   c3                      retq                                   ; return %rax;
```

与 fun7 等效的 C 代码

```c
typedef struct _node {
    int entry;
    node* left;
    node* right;
} node;
int fun7(node* a, int b) {
    int ret;
    if (a == NULL) {
            return -1;
        }
    if (a->entry <= b) {
        ret = 0;
        if (a->entry == b) {
            return 0;
        } else {
            ret = fun7(a->right, b);
            return 2 * ret + 1;
        }
    } else {
        ret = fun7(a->left, b);
        return 2 * ret;
    }
}
```

可以发现，其实现了一个二叉树上的查找。在当前节点找到时返回 0，在左孩子处找到时，返回 $ret \times 2$，在右孩子处找到时，返回 $ret \times 2 + 1$。

根据 secret_phase 的汇编代码，我们可以得知，要想不引爆炸弹，需使 fun7 返回 2。因此，需在 n_{32} 或 n_{43} 处找到。根据二叉树的内容，答案为 “20” 或 “22”。

2.2 实验步骤

1) 解打包 bomb.tar

```
linux> tar -xvf bomb.tar
```

2) 阅读 bomb.c 源代码

3) 对可执行程序 bomb 进行反汇编，生成 bomb.s 文件

```
linux> objdump -d bomb > bomb.s
```

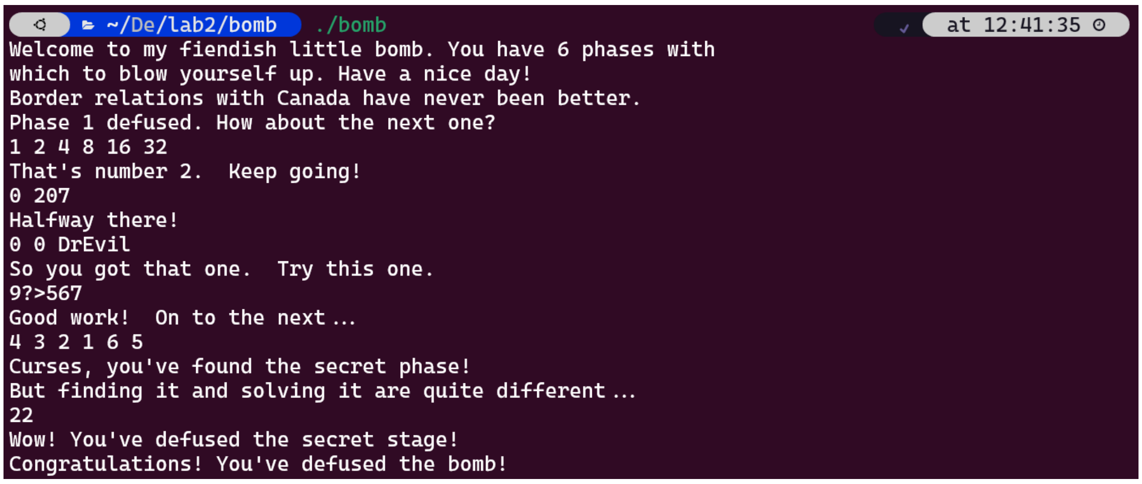
4) 阅读 bomb.s 文件中的汇编代码，对炸弹的每个阶段进行分析

5) 使用 gdb 调试工具对 bomb 进行调试，进一步分析

```
linux> gdb bomb
```

3 实验过程与分析

实验的运行结果如下：



```
~/De/lab2/bomb  ./bomb                                            at 12:41:35
Welcome to my fiendish little bomb. You have 6 phases with
which to blow yourself up. Have a nice day!
Border relations with Canada have never been better.
Phase 1 defused. How about the next one?
1 2 4 8 16 32
That's number 2.  Keep going!
0 207
Halfway there!
0 0 DrEvil
So you got that one.  Try this one.
9?>567
Good work!  On to the next...
4 3 2 1 6 5
Curses, you've found the secret phase!
But finding it and solving it are quite different...
22
Wow! You've defused the secret stage!
Congratulations! You've defused the bomb!
```

图 2: 运行结果

4 实验结果总结

在本次实验中，首先我学习到了反汇编工具 objdump 的使用，并用其生成了 bomb 的汇编文件。通过阅读汇编程序，我成功的破译了它的 7 个 phase，在此过程中，我进一步加深了对汇编代码的理解，阅读汇编代码的能力也有所提高。

同时，我还学习到了 gdb 调试工具的基本应用，能用其解决一些简单的问题。

5 附录（源代码）

bomb 的反汇编代码及部分注释如下：

bomb 的反汇编代码及部分注释

```

bomb：     文件格式 elf64-x86-64


Disassembly of section .init:

0000000000400ac0 <_init>:
  400ac0:   48 83 ec 08             sub    $0x8,%rsp
  400ac4:   e8 f3 01 00 00          callq  400cbc <call_gmon_start>
  400ac9:   48 83 c4 08             add    $0x8,%rsp
  400acd:   c3                      retq

Disassembly of section .plt:

0000000000400ad0 <.plt>:
  400ad0:   ff 35 1a 25 20 00       pushq  0x20251a(%rip)        # 602ff0 <_GLOBAL_OFFSET_TABLE_+0x8>
  400ad6:   ff 25 1c 25 20 00       jmpq   *0x20251c(%rip)        # 602ff8 <_GLOBAL_OFFSET_TABLE_+0x10>
  400adc:   0f 1f 40 00             nopl   0x0(%rax)

0000000000400ae0 <getenv@plt>:
  400ae0:   ff 25 1a 25 20 00       jmpq   *0x20251a(%rip)        # 603000 <getenv@GLIBC_2.2.5>
  400ae6:   68 00 00 00 00          pushq  $0x0
  400aeb:   e9 e0 ff ff ff          jmpq   400ad0 <.plt>

0000000000400af0 <__errno_location@plt>:
  400af0:   ff 25 12 25 20 00       jmpq   *0x202512(%rip)        # 603008 <__errno_location@GLIBC_2.2.5>
  400af6:   68 01 00 00 00          pushq  $0x1
  400afb:   e9 d0 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b00 <strcpy@plt>:
  400b00:   ff 25 0a 25 20 00       jmpq   *0x20250a(%rip)        # 603010 <strcpy@GLIBC_2.2.5>
  400b06:   68 02 00 00 00          pushq  $0x2
  400b0b:   e9 c0 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b10 <puts@plt>:
  400b10:   ff 25 02 25 20 00       jmpq   *0x202502(%rip)        # 603018 <puts@GLIBC_2.2.5>
  400b16:   68 03 00 00 00          pushq  $0x3
  400b1b:   e9 b0 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b20 <write@plt>:
  400b20:   ff 25 fa 24 20 00       jmpq   *0x2024fa(%rip)        # 603020 <write@GLIBC_2.2.5>
  400b26:   68 04 00 00 00          pushq  $0x4
  400b2b:   e9 a0 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b30 <__stack_chk_fail@plt>:
  400b30:   ff 25 f2 24 20 00       jmpq   *0x2024f2(%rip)        # 603028 <__stack_chk_fail@GLIBC_2.4>
  400b36:   68 05 00 00 00          pushq  $0x5
  400b3b:   e9 90 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b40 <alarm@plt>:
  400b40:   ff 25 ea 24 20 00       jmpq   *0x2024ea(%rip)        # 603030 <alarm@GLIBC_2.2.5>
  400b46:   68 06 00 00 00          pushq  $0x6
  400b4b:   e9 80 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b50 <close@plt>:
  400b50:   ff 25 e2 24 20 00       jmpq   *0x2024e2(%rip)        # 603038 <close@GLIBC_2.2.5>
  400b56:   68 07 00 00 00          pushq  $0x7
  400b5b:   e9 70 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b60 <read@plt>:
  400b60:   ff 25 da 24 20 00       jmpq   *0x2024da(%rip)        # 603040 <read@GLIBC_2.2.5>
  400b66:   68 08 00 00 00          pushq  $0x8
  400b6b:   e9 60 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b70 <__libc_start_main@plt>:
  400b70:   ff 25 d2 24 20 00       jmpq   *0x2024d2(%rip)        # 603048 <__libc_start_main@GLIBC_2.2.5>
  400b76:   68 09 00 00 00          pushq  $0x9
  400b7b:   e9 50 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b80 <fgets@plt>:
  400b80:   ff 25 ca 24 20 00       jmpq   *0x2024ca(%rip)        # 603050 <fgets@GLIBC_2.2.5>
  400b86:   68 0a 00 00 00          pushq  $0xa
  400b8b:   e9 40 ff ff ff          jmpq   400ad0 <.plt>

0000000000400b90 <signal@plt>:
  400b90:   ff 25 c2 24 20 00       jmpq   *0x2024c2(%rip)        # 603058 <signal@GLIBC_2.2.5>
  400b96:   68 0b 00 00 00          pushq  $0xb
  400b9b:   e9 30 ff ff ff          jmpq   400ad0 <.plt>

0000000000400ba0 <gethostbyname@plt>:
  400ba0:   ff 25 ba 24 20 00       jmpq   *0x2024ba(%rip)        # 603060 <gethostbyname@GLIBC_2.2.5>
  400ba6:   68 0c 00 00 00          pushq  $0xc
  400bab:   e9 20 ff ff ff          jmpq   400ad0 <.plt>

0000000000400bb0 <__memmove_chk@plt>:
  400bb0:   ff 25 b2 24 20 00       jmpq   *0x2024b2(%rip)        # 603068 <__memmove_chk@GLIBC_2.3.4>
  400bb6:   68 0d 00 00 00          pushq  $0xd
  400bbb:   e9 10 ff ff ff          jmpq   400ad0 <.plt>

0000000000400bc0 <__memcpy_chk@plt>:
  400bc0:   ff 25 aa 24 20 00       jmpq   *0x2024aa(%rip)        # 603070 <__memcpy_chk@GLIBC_2.3.4>
  400bc6:   68 0e 00 00 00          pushq  $0xe
  400bcb:   e9 00 ff ff ff          jmpq   400ad0 <.plt>

0000000000400bd0 <strtol@plt>:
  400bd0:   ff 25 a2 24 20 00       jmpq   *0x2024a2(%rip)        # 603078 <strtol@GLIBC_2.2.5>
  400bd6:   68 0f 00 00 00          pushq  $0xf
  400bdb:   e9 f0 fe ff ff          jmpq   400ad0 <.plt>

0000000000400be0 <fflush@plt>:
  400be0:   ff 25 9a 24 20 00       jmpq   *0x20249a(%rip)        # 603080 <fflush@GLIBC_2.2.5>
  400be6:   68 10 00 00 00          pushq  $0x10
  400beb:   e9 e0 fe ff ff          jmpq   400ad0 <.plt>

0000000000400bf0 <__isoc99_sscanf@plt>:
  400bf0:   ff 25 92 24 20 00       jmpq   *0x202492(%rip)        # 603088 <__isoc99_sscanf@GLIBC_2.7>
  400bf6:   68 11 00 00 00          pushq  $0x11
  400bfb:   e9 d0 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c00 <__printf_chk@plt>:
  400c00:   ff 25 8a 24 20 00       jmpq   *0x20248a(%rip)        # 603090 <__printf_chk@GLIBC_2.3.4>
  400c06:   68 12 00 00 00          pushq  $0x12
  400c0b:   e9 c0 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c10 <fopen@plt>:
  400c10:   ff 25 82 24 20 00       jmpq   *0x202482(%rip)        # 603098 <fopen@GLIBC_2.2.5>
  400c16:   68 13 00 00 00          pushq  $0x13
  400c1b:   e9 b0 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c20 <exit@plt>:
  400c20:   ff 25 7a 24 20 00       jmpq   *0x20247a(%rip)        # 6030a0 <exit@GLIBC_2.2.5>
  400c26:   68 14 00 00 00          pushq  $0x14
  400c2b:   e9 a0 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c30 <connect@plt>:
  400c30:   ff 25 72 24 20 00       jmpq   *0x202472(%rip)        # 6030a8 <connect@GLIBC_2.2.5>
  400c36:   68 15 00 00 00          pushq  $0x15
  400c3b:   e9 90 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c40 <__fprintf_chk@plt>:
  400c40:   ff 25 6a 24 20 00       jmpq   *0x20246a(%rip)        # 6030b0 <__fprintf_chk@GLIBC_2.3.4>
  400c46:   68 16 00 00 00          pushq  $0x16
  400c4b:   e9 80 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c50 <sleep@plt>:
  400c50:   ff 25 62 24 20 00       jmpq   *0x202462(%rip)        # 6030b8 <sleep@GLIBC_2.2.5>
  400c56:   68 17 00 00 00          pushq  $0x17
  400c5b:   e9 70 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c60 <__ctype_b_loc@plt>:
  400c60:   ff 25 5a 24 20 00       jmpq   *0x20245a(%rip)        # 6030c0 <__ctype_b_loc@GLIBC_2.3>
  400c66:   68 18 00 00 00          pushq  $0x18
  400c6b:   e9 60 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c70 <__sprintf_chk@plt>:
  400c70:   ff 25 52 24 20 00       jmpq   *0x202452(%rip)        # 6030c8 <__sprintf_chk@GLIBC_2.3.4>
  400c76:   68 19 00 00 00          pushq  $0x19
  400c7b:   e9 50 fe ff ff          jmpq   400ad0 <.plt>

0000000000400c80 <socket@plt>:
  400c80:   ff 25 4a 24 20 00       jmpq   *0x20244a(%rip)        # 6030d0 <socket@GLIBC_2.2.5>
  400c86:   68 1a 00 00 00          pushq  $0x1a
  400c8b:   e9 40 fe ff ff          jmpq   400ad0 <.plt>

Disassembly of section .text:

0000000000400c90 <_start>:
  400c90:   31 ed                   xor    %ebp,%ebp
  400c92:   49 89 d1                mov    %rdx,%r9
  400c95:   5e                      pop    %rsi
  400c96:   48 89 e2                mov    %rsp,%rdx
  400c99:   48 83 e4 f0             and    $0xfffffffffffffff0,%rsp
  400c9d:   50                      push   %rax
  400c9e:   54                      push   %rsp
  400c9f:   49 c7 c0 a0 22 40 00    mov    $0x4022a0,%r8
  400ca6:   48 c7 c1 10 22 40 00    mov    $0x402210,%rcx
  400cad:   48 c7 c7 a0 0d 40 00    mov    $0x400da0,%rdi
  400cb4:   e8 b7 fe ff ff          callq  400b70 <__libc_start_main@plt>
  400cb9:   f4                      hlt
  400cba:   90                      nop
  400cbb:   90                      nop

0000000000400cbc <call_gmon_start>:
  400cbc:   48 83 ec 08             sub    $0x8,%rsp
  400cc0:   48 8b 05 19 23 20 00    mov    0x202319(%rip),%rax        # 602fe0 <__gmon_start__>
  400cc7:   48 85 c0                test   %rax,%rax
  400cca:   74 02                   je     400cce <call_gmon_start+0x12>
  400ccc:   ff d0                   callq  *%rax
  400cce:   48 83 c4 08             add    $0x8,%rsp
  400cd2:   c3                      retq
  400cd3:   90                      nop
  400cd4:   90                      nop
  400cd5:	90                   	nop
  400cd6:	90                   	nop
  400cd7:	90                   	nop
  400cd8:	90                   	nop
  400cd9:	90                   	nop
  400cda:	90                   	nop
  400cdb:	90                   	nop
  400cdc:	90                   	nop
  400cdd:	90                   	nop
  400cde:	90                   	nop
  400cdf:	90                   	nop

0000000000400ce0 <deregister_tm_clones>:
  400ce0:	b8 47 37 60 00       	mov    $0x603747,%eax
  400ce5:	55                   	push   %rbp
  400ce6:	48 2d 40 37 60 00    	sub    $0x603740,%rax
  400cec:	48 83 f8 0e          	cmp    $0xe,%rax
  400cf0:	48 89 e5             	mov    %rsp,%rbp
  400cf3:	77 02                	ja     400cf7 <deregister_tm_clones+0x17>
  400cf5:	5d                   	pop    %rbp
  400cf6:	c3                   	retq
  400cf7:	b8 00 00 00 00       	mov    $0x0,%eax
  400cfc:	48 85 c0             	test   %rax,%rax
  400cff:	74 f4                	je     400cf5 <deregister_tm_clones+0x15>
  400d01:	5d                   	pop    %rbp
  400d02:	bf 40 37 60 00       	mov    $0x603740,%edi
  400d07:	ff e0                	jmpq   *%rax
  400d09:	0f 1f 80 00 00 00 00 	nopl   0x0(%rax)

0000000000400d10 <register_tm_clones>:
  400d10:	b8 40 37 60 00       	mov    $0x603740,%eax
  400d15:	55                   	push   %rbp
  400d16:	48 2d 40 37 60 00    	sub    $0x603740,%rax
  400d1c:	48 c1 f8 03          	sar    $0x3,%rax
  400d20:	48 89 e5             	mov    %rsp,%rbp
  400d23:	48 89 c2             	mov    %rax,%rdx
  400d26:	48 c1 ea 3f          	shr    $0x3f,%rdx
  400d2a:	48 01 d0             	add    %rdx,%rax
  400d2d:	48 d1 f8             	sar    %rax
  400d30:	75 02                	jne    400d34 <register_tm_clones+0x24>
  400d32:	5d                   	pop    %rbp
  400d33:	c3                   	retq
  400d34:	ba 00 00 00 00       	mov    $0x0,%edx
  400d39:	48 85 d2             	test   %rdx,%rdx
  400d3c:	74 f4                	je     400d32 <register_tm_clones+0x22>
  400d3e:	5d                   	pop    %rbp
  400d3f:	48 89 c6             	mov    %rax,%rsi
  400d42:	bf 40 37 60 00       	mov    $0x603740,%edi
  400d47:	ff e2                	jmpq   *%rdx
  400d49:	0f 1f 80 00 00 00 00 	nopl   0x0(%rax)

0000000000400d50 <__do_global_dtors_aux>:
  400d50:	80 3d 01 2a 20 00 00 	cmpb   $0x0,0x202a01(%rip)        # 603758 <completed.6976>
  400d57:	75 11                	jne    400d6a <__do_global_dtors_aux+0x1a>
  400d59:	55                   	push   %rbp
  400d5a:	48 89 e5             	mov    %rsp,%rbp
  400d5d:	e8 7e ff ff ff       	callq  400ce0 <deregister_tm_clones>
  400d62:	5d                   	pop    %rbp
  400d63:	c6 05 ee 29 20 00 01 	movb   $0x1,0x2029ee(%rip)        # 603758 <completed.6976>
  400d6a:	f3 c3                	repz retq
  400d6c:	0f 1f 40 00          	nopl   0x0(%rax)
```

```

0000000000400d70 <frame_dummy>:
  400d70:	48 83 3d 90 20 20 00 	cmpq   $0x0,0x202090(%rip)        # 602e08 <__JCR_END__>
  400d77:	00 
  400d78:	74 1e                	je     400d98 <frame_dummy+0x28>
  400d7a:	b8 00 00 00 00       	mov    $0x0,%eax
  400d7f:	48 85 c0             	test   %rax,%rax
  400d82:	74 14                	je     400d98 <frame_dummy+0x28>
  400d84:	55                   	push   %rbp
  400d85:	bf 08 2e 60 00       	mov    $0x602e08,%edi
  400d8a:	48 89 e5             	mov    %rsp,%rbp
  400d8d:	ff d0                	callq  *%rax
  400d8f:	5d                   	pop    %rbp
  400d90:	e9 7b ff ff ff       	jmpq   400d10 <register_tm_clones>
  400d95:	0f 1f 00             	nopl   (%rax)
  400d98:	e9 73 ff ff ff       	jmpq   400d10 <register_tm_clones>
  400d9d:	90                   	nop
  400d9e:	90                   	nop
  400d9f:	90                   	nop

0000000000400da0 <main>:
  400da0:	53                   	push   %rbx
  400da1:	83 ff 01             	cmp    $0x1,%edi
  400da4:	75 10                	jne    400db6 <main+0x16>
  400da6:	48 8b 05 9b 29 20 00 	mov    0x20299b(%rip),%rax        # 603748 <stdin@@GLIBC_2.2.5>
  400dad:	48 89 05 b4 29 20 00 	mov    %rax,0x2029b4(%rip)        # 603768 <infile>
  400db4:	eb 63                	jmp    400e19 <main+0x79>
  400db6:	48 89 f3             	mov    %rsi,%rbx
  400db9:	83 ff 02             	cmp    $0x2,%edi
  400dbc:	75 3a                	jne    400df8 <main+0x58>
  400dbe:	48 8b 7e 08          	mov    0x8(%rsi),%rdi
  400dc2:	be b4 22 40 00       	mov    $0x4022b4,%esi
  400dc7:	e8 44 fe ff ff       	callq  400c10 <fopen@plt>
  400dcc:	48 89 05 95 29 20 00 	mov    %rax,0x202995(%rip)        # 603768 <infile>
  400dd3:	48 85 c0             	test   %rax,%rax
  400dd6:	75 41                	jne    400e19 <main+0x79>
  400dd8:	48 8b 4b 08          	mov    0x8(%rbx),%rcx
  400ddc:	48 8b 13             	mov    (%rbx),%rdx
  400ddf:	be b6 22 40 00       	mov    $0x4022b6,%esi
  400de4:	bf 01 00 00 00       	mov    $0x1,%edi
  400de9:	e8 12 fe ff ff       	callq  400c00 <__printf_chk@plt>
  400dee:	bf 08 00 00 00       	mov    $0x8,%edi
  400df3:	e8 28 fe ff ff       	callq  400c20 <exit@plt>
  400df8:	48 8b 16             	mov    (%rsi),%rdx
  400dfb:	be d3 22 40 00       	mov    $0x4022d3,%esi
  400e00:	bf 01 00 00 00       	mov    $0x1,%edi
  400e05:	b8 00 00 00 00       	mov    $0x0,%eax
  400e0a:	e8 f1 fd ff ff       	callq  400c00 <__printf_chk@plt>
  400e0f:	bf 08 00 00 00       	mov    $0x8,%edi
  400e14:	e8 07 fe ff ff       	callq  400c20 <exit@plt>
  400e19:	e8 84 05 00 00       	callq  4013a2 <initialize_bomb>
  400e1e:	bf 38 23 40 00       	mov    $0x402338,%edi
  400e23:	e8 e8 fc ff ff       	callq  400b10 <puts@plt>
  400e28:	bf 78 23 40 00       	mov    $0x402378,%edi
  400e2d:	e8 de fc ff ff       	callq  400b10 <puts@plt>
  400e32:	e8 67 06 00 00       	callq  40149e <read_line>
  400e37:	48 89 c7             	mov    %rax,%rdi
  400e3a:	e8 a1 00 00 00       	callq  400ee0 <phase_1>
  400e3f:	e8 80 07 00 00       	callq  4015c4 <phase_defused>
  400e44:	bf a8 23 40 00       	mov    $0x4023a8,%edi
  400e49:	e8 c2 fc ff ff       	callq  400b10 <puts@plt>
```

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305   400e4e:   e8 4b 06 00 00          callq  40149e <read_line>
306   400e53:   48 89 c7                mov    %rax,%rdi
307   400e56:   e8 a1 00 00 00          callq  400efc <phase_2>
308   400e5b:   e8 64 07 00 00          callq  4015c4 <phase_defused>
309   400e60:   bf ed 22 40 00          mov    $0x4022ed,%edi
310   400e65:   e8 a6 fc ff ff          callq  400b10 <puts@plt>
311   400e6a:   e8 2f 06 00 00          callq  40149e <read_line>
312   400e6f:   48 89 c7                mov    %rax,%rdi
313   400e72:   e8 cc 00 00 00          callq  400f43 <phase_3>
314   400e77:   e8 48 07 00 00          callq  4015c4 <phase_defused>
315   400e7c:   bf 0b 23 40 00          mov    $0x40230b,%edi
316   400e81:   e8 8a fc ff ff          callq  400b10 <puts@plt>
317   400e86:   e8 13 06 00 00          callq  40149e <read_line>
318   400e8b:   48 89 c7                mov    %rax,%rdi
319   400e8e:   e8 79 01 00 00          callq  40100c <phase_4>
320   400e93:   e8 2c 07 00 00          callq  4015c4 <phase_defused>
321   400e98:   bf d8 23 40 00          mov    $0x4023d8,%edi
322   400e9d:   e8 6e fc ff ff          callq  400b10 <puts@plt>
323   400ea2:   e8 f7 05 00 00          callq  40149e <read_line>
324   400ea7:   48 89 c7                mov    %rax,%rdi
325   400eaa:   e8 b3 01 00 00          callq  401062 <phase_5>
326   400eaf:   e8 10 07 00 00          callq  4015c4 <phase_defused>
327   400eb4:   bf 1a 23 40 00          mov    $0x40231a,%edi
328   400eb9:   e8 52 fc ff ff          callq  400b10 <puts@plt>
329   400ebe:   e8 db 05 00 00          callq  40149e <read_line>
330   400ec3:   48 89 c7                mov    %rax,%rdi
331   400ec6:   e8 29 02 00 00          callq  4010f4 <phase_6>
332   400ecb:   e8 f4 06 00 00          callq  4015c4 <phase_defused>
333   400ed0:   b8 00 00 00 00          mov    $0x0,%eax
334   400ed5:   5b                      pop    %rbx
335   400ed6:   c3                      retq
336   400ed7:   90                      nop
337   400ed8:   90                      nop
338   400ed9:   90                      nop
339   400eda:   90                      nop
340   400edb:   90                      nop
341   400edc:   90                      nop
342   400edd:   90                      nop
343   400ede:   90                      nop
344   400edf:   90                      nop
345
346 0000000000400ee0 <phase_1>:
347   400ee0:   48 83 ec 08             sub    $0x8,%rsp                                    ; %rsp -= 0x8;
348   400ee4:   be 00 24 40 00          mov    $0x402400,%esi                           ; %esi = 0x402400;
349   400ee9:   e8 4a 04 00 00          callq  401338 <strings_not_equal>       ; strings_not_equal(...);
350   400eee:   85 c0                   test   %eax,%eax                                    ; if (%eax != 0)
351   400ef0:   74 05                   je     400ef7 <phase_1+0x17>            ;     goto #351;
352   400ef2:   e8 43 05 00 00          callq  40143a <explode_bomb>            ; explode_bomb(...)
353   400ef7:   48 83 c4 08             add    $0x8,%rsp                                    ; %rsp += 8;
354   400efb:   c3                      retq                                                        ; return;
355
356 0000000000400efc <phase_2>:
357   400efc:   55                      push   %rbp
358   400efd:   53                      push   %rbx
359   400efe:   48 83 ec 28             sub    $0x28,%rsp                                   ; %rsp -= 0x28;
360   400f02:   48 89 e6                mov    %rsp,%rsi                                    ; %rsi = %rsp;
361   400f05:   e8 52 05 00 00          callq  40145c <read_six_numbers>        ; read_six_numbers(...);
362   400f0a:   83 3c 24 01             cmpl   $0x1,(%rsp)                                  ; if (M[%rsp] == 1)
363   400f0e:   74 20                   je     400f30 <phase_2+0x34>            ;         goto #375;
364   400f10:   e8 25 05 00 00          callq  40143a <explode_bomb>            ; explode_bomb(...);
365   400f15:   eb 19                   jmp    400f30 <phase_2+0x34>            ; goto #375;
```

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366   400f17:   8b 43 fc                mov    -0x4(%rbx),%eax                   ; %eax = M[%rbx - 4];
367   400f1a:   01 c0                   add    %eax,%eax                                 ; %eax += %eax;
368   400f1c:   39 03                   cmp    %eax,(%rbx)                               ; if (%eax == M[%rbx])
369   400f1e:   74 05                   je     400f25 <phase_2+0x29>           ;         goto #371;
370   400f20:   e8 15 05 00 00          callq  40143a <explode_bomb>           ; explode_bomb(...);
371   400f25:   48 83 c3 04             add    $0x4,%rbx                                 ; %rbx += 4;
372   400f29:   48 39 eb                cmp    %rbp,%rbx                                 ; if (%rbp != %rbx)
373   400f2c:   75 e9                   jne    400f17 <phase_2+0x1b>           ;         goto #366;
374   400f2e:   eb 0c                   jmp    400f3c <phase_2+0x40>           ; goto #378;
375   400f30:   48 8d 5c 24 04          lea    0x4(%rsp),%rbx                    ; %rbx = %rsp + 0x4;
376   400f35:   48 8d 6c 24 18          lea    0x18(%rsp),%rbp                   ; %rbp = %rsp + 0x18;
377   400f3a:   eb db                   jmp    400f17 <phase_2+0x1b>           ; goto #366;
378   400f3c:   48 83 c4 28             add    $0x28,%rsp                                ; %rsp += 0x28;
379   400f40:   5b                      pop    %rbx
380   400f41:   5d                      pop    %rbp
381   400f42:   c3                      retq
382
383 0000000000400f43 <phase_3>:
384   400f43:   48 83 ec 18             sub    $0x18,%rsp                                ; %rsp -= 0x18;
385   400f47:   48 8d 4c 24 0c          lea    0xc(%rsp),%rcx                    ; %rcx = %rsp + 0xc;
386   400f4c:   48 8d 54 24 08          lea    0x8(%rsp),%rdx                    ; %rdx = %rsp + 0x8;
387   400f51:   be cf 25 40 00          mov    $0x4025cf,%esi                    ; %esi = 0x4025cf;
388   400f56:   b8 00 00 00 00          mov    $0x0,%eax                                 ; %eax = 0;
389   400f5b:   e8 90 fc ff ff          callq  400bf0 <__isoc99_sscanf@plt>    ; sscanf(...)
390   400f60:   83 f8 01                cmp    $0x1,%eax                                 ; if (%eax > 1)
391   400f63:   7f 05                   jg     400f6a <phase_3+0x27>           ;         goto #393;
392   400f65:   e8 d0 04 00 00          callq  40143a <explode_bomb>           ; explode_bomb;
393   400f6a:   83 7c 24 08 07          cmpl   $0x7,0x8(%rsp)                    ; if (M[%rsp + 0x8] > 7)
394   400f6f:   77 3c                   ja     400fad <phase_3+0x6a>           ;         goto #411;
395   400f71:   8b 44 24 08             mov    0x8(%rsp),%eax                    ; %eax = M[%rsp + 0x8];
396   400f75:   ff 24 c5 70 24 40 00    jmpq   *0x402470(,%rax,8)                ; goto 8 * %rax + 0x402470;
397   400f7c:   b8 cf 00 00 00          mov    $0xcf,%eax                        ; 0:  %eax = 0xcf;
398   400f81:   eb 3b                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
399   400f83:   b8 c3 02 00 00          mov    $0x2c3,%eax                       ; 2:  %eax = 0x2c3;
400   400f88:   eb 34                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
401   400f8a:   b8 00 01 00 00          mov    $0x100,%eax                       ; 3:  %eax = 0x100;
402   400f8f:   eb 2d                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
403   400f91:   b8 85 01 00 00          mov    $0x185,%eax                       ; 4:  %eax = 0x185;
404   400f96:   eb 26                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
405   400f98:   b8 ce 00 00 00          mov    $0xce,%eax                        ; 5:  %eax = 0xce;
406   400f9d:   eb 1f                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
407   400f9f:   b8 aa 02 00 00          mov    $0x2aa,%eax                       ; 6:  %eax = 0x2aa;
408   400fa4:   eb 18                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
409   400fa6:   b8 47 01 00 00          mov    $0x147,%eax                       ; 7:  %eax = 0x147;
410   400fab:   eb 11                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
411   400fad:   e8 88 04 00 00          callq  40143a <explode_bomb>           ; explode_bomb(...);
412   400fb2:   b8 00 00 00 00          mov    $0x0,%eax                                 ; %eax = 0;
413   400fb7:   eb 05                   jmp    400fbe <phase_3+0x7b>           ; goto #415;
414   400fb9:   b8 37 01 00 00          mov    $0x137,%eax                       ; 1:  %eax = 0x137;
415   400fbe:   3b 44 24 0c             cmp    0xc(%rsp),%eax                    ; if (%eax == M[%rsp + 0xc])
416   400fc2:   74 05                   je     400fc9 <phase_3+0x86>           ;         goto #418;
417   400fc4:   e8 71 04 00 00          callq  40143a <explode_bomb>           ; explode_bomb(...);
418   400fc9:   48 83 c4 18             add    $0x18,%rsp                                ; %rsp += 0x18;
419   400fcd:   c3                      retq                                                     ; return;
420
421 0000000000400fce <func4>:
422   400fce:   48 83 ec 08             sub    $0x8,%rsp                                 ; %rsp -= 0x8;
423   400fd2:   89 d0                   mov    %edx,%eax                                 ; %eax = %rdx;
424   400fd4:   29 f0                   sub    %esi,%eax                                 ; %eax -= %esi;
425   400fd6:   89 c1                   mov    %eax,%ecx                                 ; %ecx = %eax;
426   400fd8:   c1 e9 1f                shr    $0x1f,%ecx                                ; %ecx >>=(H) 0x1f;
```

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427   400fdb:   01 c8                   add    %ecx,%eax                                ; %eax += %ecx;
428   400fdd:   d1 f8                   sar    %eax                                             ; %eax >>= 1;
429   400fdf:   8d 0c 30                lea    (%rax,%rsi,1),%ecx                   ; %ecx = %rax + %rsi;
430   400fe2:   39 f9                   cmp    %edi,%ecx                                ; if (%ecx <= %edi)
431   400fe4:   7e 0c                   jle    400ff2 <func4+0x24>                  ;         goto #436;
432   400fe6:   8d 51 ff                lea    -0x1(%rcx),%edx                      ; %edx = %rcx - 1;
433   400fe9:   e8 e0 ff ff ff          callq  400fce <func4>                       ; func4(%rdi, %rsi, %rdx);
434   400fee:   01 c0                   add    %eax,%eax                                ; %eax += %eax;
435   400ff0:   eb 15                   jmp    401007 <func4+0x39>                  ; goto #442;
436   400ff2:   b8 00 00 00 00          mov    $0x0,%eax                                ; %eax = 0;
437   400ff7:   39 f9                   cmp    %edi,%ecx                                ; if (%ecx >= %edi)
438   400ff9:   7d 0c                   jge    401007 <func4+0x39>                  ;         goto #442;
439   400ffb:   8d 71 01                lea    0x1(%rcx),%esi                       ; %esi = %rcx + 1;
440   400ffe:   e8 cb ff ff ff          callq  400fce <func4>                       ; func4(%rdi, %rsi, %rdx);
441   401003:   8d 44 00 01             lea    0x1(%rax,%rax,1),%eax        ; %eax = 2 * %rax + 1;
442   401007:   48 83 c4 08             add    $0x8,%rsp                                ; %rsp += 8;
443   40100b:   c3                      retq                                                    ; return %eax;
444
445 000000000040100c <phase_4>:
446   40100c:   48 83 ec 18             sub    $0x18,%rsp                               ; %rsp -= 0x18;
447   401010:   48 8d 4c 24 0c          lea    0xc(%rsp),%rcx                       ; %rcx = %rsp + 0xc;
448   401015:   48 8d 54 24 08          lea    0x8(%rsp),%rdx                       ; %rdx = %rsp + 0x8;
449   40101a:   be cf 25 40 00          mov    $0x4025cf,%esi                       ; %esi = 0x4025cf;
450   40101f:   b8 00 00 00 00          mov    $0x0,%eax                                ; %eax = 0;
451   401024:   e8 c7 fb ff ff          callq  400bf0 <__isoc99_sscanf@plt>     ; sscanf(...)
452   401029:   83 f8 02                cmp    $0x2,%eax                                ; if (%eax != 2)
453   40102c:   75 07                   jne    401035 <phase_4+0x29>        ;         goto #456;
454   40102e:   83 7c 24 08 0e          cmpl   $0xe,0x8(%rsp)                       ; if (M[%rsp + 0x8] <= 0xe)
455   401033:   76 05                   jbe    40103a <phase_4+0x2e>        ;         goto #457;
456   401035:   e8 00 04 00 00          callq  40143a <explode_bomb>        ; explode_bomb(...);
457   40103a:   ba 0e 00 00 00          mov    $0xe,%edx                                ; %edx = 0xe;
458   40103f:   be 00 00 00 00          mov    $0x0,%esi                                ; %rsi = 0;
459   401044:   8b 7c 24 08             mov    0x8(%rsp),%edi                       ; %edi = M[%rsp + 0x8];
460   401048:   e8 81 ff ff ff          callq  400fce <func4>                       ; func4(%edi, %esi, %edx);
461   40104d:   85 c0                   test   %eax,%eax                                ; if (%eax != 0)
462   40104f:   75 07                   jne    401058 <phase_4+0x4c>        ;         goto #465;
463   401051:   83 7c 24 0c 00          cmpl   $0x0,0xc(%rsp)                       ; if (M[%rsp + 0xc] == 0)
464   401056:   74 05                   je     40105d <phase_4+0x51>        ;         goto #466;
465   401058:   e8 dd 03 00 00          callq  40143a <explode_bomb>        ; explode_bomb(...);
466   40105d:   48 83 c4 18             add    $0x18,%rsp                               ; %rsp += 0x18;
467   401061:   c3                      retq                                                    ; return;
468
469 0000000000401062 <phase_5>:
470   401062:   53                      push   %rbx
471   401063:   48 83 ec 20             sub    $0x20,%rsp                               ; %rsp -= 0x20;
472   401067:   48 89 fb                mov    %rdi,%rbx                                ; %rbx = %rdi;
473   40106a:   64 48 8b 04 25 28 00    mov    %fs:0x28,%rax                        ; %rax = 0x28;
474   401071:   00 00
475   401073:   48 89 44 24 18          mov    %rax,0x18(%rsp)                      ; M[%rsp + 0x18] = %rax;
476   401078:   31 c0                   xor    %eax,%eax                                ; %eax ^= %eax;
477   40107a:   e8 9c 02 00 00          callq  40131b <string_length>       ; string_length(%rdi);
478   40107f:   83 f8 06                cmp    $0x6,%eax                                ; if (%eax == 6)
479   401082:   74 4e                   je     4010d2 <phase_5+0x70>        ;         goto #500;
480   401084:   e8 b1 03 00 00          callq  40143a <explode_bomb>        ; explode_bomb(...);
481   401089:   eb 47                   jmp    4010d2 <phase_5+0x70>        ; goto #500;
482   40108b:   0f b6 0c 03             movzbl (%rbx,%rax,1),%ecx                   ; %ecx = %rbx + %rax;
483   40108f:   88 0c 24                mov    %cl,(%rsp)                               ; M[%rsp] = %cl;
484   401092:   48 8b 14 24             mov    (%rsp),%rdx                              ; %rdx = M[%rsp];
485   401096:   83 e2 0f                and    $0xf,%edx                                ; %edx &= 0xf;
486   401099:   0f b6 92 b0 24 40 00    movzbl 0x4024b0(%rdx),%edx                  ; %edx = M[%rdx + 0x4024b0];
487   4010a0:   88 54 04 10             mov    %dl,0x10(%rsp,%rax,1)        ; M[%rsp + %rax + 0x10] = %dl;
```

```
488  4010a4:   48 83 c0 01            add    $0x1,%rax                               ; %rax++;
489  4010a8:   48 83 f8 06            cmp    $0x6,%rax                               ; if (%rax != 0x6)
490  4010ac:   75 dd                  jne    40108b <phase_5+0x29>           ;         goto #482;
491  4010ae:   c6 44 24 16 00         movb   $0x0,0x16(%rsp)                 ; M[%rsp + 0x16] = 0;
492  4010b3:   be 5e 24 40 00         mov    $0x40245e,%esi                  ; %esi = 0x40245e;
493  4010b8:   48 8d 7c 24 10         lea    0x10(%rsp),%rdi                 ; %rdi = %rsp + 0x10;
494  4010bd:   e8 76 02 00 00         callq  401338 <strings_not_equal>      ; strings_not_equal(%rdi, %rsi);
495  4010c2:   85 c0                  test   %eax,%eax                               ; if (%eax == 0)
496  4010c4:   74 13                  je     4010d9 <phase_5+0x77>           ;         goto #502;
497  4010c6:   e8 6f 03 00 00         callq  40143a <explode_bomb>           ; explode_bomb(...);
498  4010cb:   0f 1f 44 00 00         nopl   0x0(%rax,%rax,1)                ; ???
499  4010d0:   eb 07                  jmp    4010d9 <phase_5+0x77>           ; goto #502;
500  4010d2:   b8 00 00 00 00         mov    $0x0,%eax                               ; %eax = 0;
501  4010d7:   eb b2                  jmp    40108b <phase_5+0x29>           ; goto #482;
502  4010d9:   48 8b 44 24 18         mov    0x18(%rsp),%rax                 ; %rax = M[%rsp + 0x18];
503  4010de:   64 48 33 04 25 28 00   xor    %fs:0x28,%rax                   ; %rax ^= 0x28;
504  4010e5:   00 00
505  4010e7:   74 05                  je     4010ee <phase_5+0x8c>           ; goto #507;
506  4010e9:   e8 42 fa ff ff         callq  400b30 <__stack_chk_fail@plt>;
507  4010ee:   48 83 c4 20            add    $0x20,%rsp                              ; %rsp += 0x20;
508  4010f2:   5b                     pop    %rbx
509  4010f3:   c3                     retq
510
511 00000000004010f4 <phase_6>:
512  4010f4:   41 56                  push   %r14
513  4010f6:   41 55                  push   %r13
514  4010f8:   41 54                  push   %r12
515  4010fa:   55                     push   %rbp
516  4010fb:   53                     push   %rbx
517  4010fc:   48 83 ec 50            sub    $0x50,%rsp                              ; %rsp -= 0x50;
518  401100:   49 89 e5               mov    %rsp,%r13                               ; %r13 = %rsp;
519  401103:   48 89 e6               mov    %rsp,%rsi                               ; %rsi = %rsp;
520  401106:   e8 51 03 00 00         callq  40145c <read_six_numbers>       ; read_six_numbers(...);
521  40110b:   49 89 e6               mov    %rsp,%r14                               ; %r14 = %rsp;
522  40110e:   41 bc 00 00 00 00      mov    $0x0,%r12d                              ; %r12d = 0;
523  401114:   4c 89 ed               mov    %r13,%rbp                               ; %rbp = %r13;
524  401117:   41 8b 45 00            mov    0x0(%r13),%eax                  ; %eax = M[%r13];
525  40111b:   83 e8 01               sub    $0x1,%eax                               ; %eax--;
526  40111e:   83 f8 05               cmp    $0x5,%eax                               ; if (%eax <= 5)
527  401121:   76 05                  jbe    401128 <phase_6+0x34>           ;         goto #529;
528  401123:   e8 12 03 00 00         callq  40143a <explode_bomb>           ; explode_bomb(...);
529  401128:   41 83 c4 01            add    $0x1,%r12d                              ; %r12d++;
530  40112c:   41 83 fc 06            cmp    $0x6,%r12d                              ; if (%r12d == 6)
531  401130:   74 21                  je     401153 <phase_6+0x5f>           ;         goto #543;
532  401132:   44 89 e3               mov    %r12d,%ebx                              ; %ebx = %r12d;
533  401135:   48 63 c3               movslq %ebx,%rax                               ; %rax = %ebx;
534  401138:   8b 04 84               mov    (%rsp,%rax,4),%eax              ; %eax = M[%rsp + %eax * 4];
535  40113b:   39 45 00               cmp    %eax,0x0(%rbp)                  ; if (M[%rbp] != %eax)
536  40113e:   75 05                  jne    401145 <phase_6+0x51>           ;         goto #538;
537  401140:   e8 f5 02 00 00         callq  40143a <explode_bomb>           ; explode_bomb(...);
538  401145:   83 c3 01               add    $0x1,%ebx                               ; %ebx++;
539  401148:   83 fb 05               cmp    $0x5,%ebx                               ; if (%ebx <= 5)
540  40114b:   7e e8                  jle    401135 <phase_6+0x41>           ;         goto #533;
541  40114d:   49 83 c5 04            add    $0x4,%r13                               ; %r13 += 4;
542  401151:   eb c1                  jmp    401114 <phase_6+0x20>           ; goto #523;
543  401153:   48 8d 74 24 18         lea    0x18(%rsp),%rsi                 ; %rsi = %rsp + 0x18;
544  401158:   4c 89 f0               mov    %r14,%rax                               ; %rax = %r14;
545  40115b:   b9 07 00 00 00         mov    $0x7,%ecx                               ; %ecx = 0x7;
546  401160:   89 ca                  mov    %ecx,%edx                               ; %edx = %ecx;
547  401162:   2b 10                  sub    (%rax),%edx                             ; %edx -= M[%rax];
548  401164:   89 10                  mov    %edx,(%rax)                             ; M[%rax] = %edx;
```

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549   401166:   48 83 c0 04             add    $0x4,%rax                                   ; %rax += 4;
550   40116a:   48 39 f0                cmp    %rsi,%rax                                   ; if (%rax != %rsi)
551   40116d:   75 f1                   jne    401160 <phase_6+0x6c>          ;         goto #546;
552   40116f:   be 00 00 00 00          mov    $0x0,%esi                                   ; %esi = 0;
553   401174:   eb 21                   jmp    401197 <phase_6+0xa3>          ; goto #564;
554   401176:   48 8b 52 08             mov    0x8(%rdx),%rdx                      ; %rdx = M[%rdx + 8];
555   40117a:   83 c0 01                add    $0x1,%eax                                   ; %eax++;
556   40117d:   39 c8                   cmp    %ecx,%eax                                   ; if (%eax != %ecx)
557   40117f:   75 f5                   jne    401176 <phase_6+0x82>          ;         goto #554;
558   401181:   eb 05                   jmp    401188 <phase_6+0x94>          ; goto #560;
559   401183:   ba d0 32 60 00          mov    $0x6032d0,%edx                      ; %edx = 0x6032d0;
560   401188:   48 89 54 74 20          mov    %rdx,0x20(%rsp,%rsi,2)         ; M[%rsp + %rsi * 2 + 0x20] = %rdx;
561   40118d:   48 83 c6 04             add    $0x4,%rsi                                   ; %rsi += 4;
562   401191:   48 83 fe 18             cmp    $0x18,%rsi                                  ; if (%rsi == 0x18)
563   401195:   74 14                   je     4011ab <phase_6+0xb7>          ;         goto #570;
564   401197:   8b 0c 34                mov    (%rsp,%rsi,1),%ecx                  ; %ecx = M[%rsp + %rsi];
565   40119a:   83 f9 01                cmp    $0x1,%ecx                                   ; if (%ecx <= 1)
566   40119d:   7e e4                   jle    401183 <phase_6+0x8f>          ;         goto #559;
567   40119f:   b8 01 00 00 00          mov    $0x1,%eax                                   ; %eax = 1;
568   4011a4:   ba d0 32 60 00          mov    $0x6032d0,%edx                      ; %edx = 0x6032d0;
569   4011a9:   eb cb                   jmp    401176 <phase_6+0x82>          ; goto #554;
570   4011ab:   48 8b 5c 24 20          mov    0x20(%rsp),%rbx                     ; %rbx = M[%rsp + 0x20];
571   4011b0:   48 8d 44 24 28          lea    0x28(%rsp),%rax                     ; %rax = %rsp + 0x28;
572   4011b5:   48 8d 74 24 50          lea    0x50(%rsp),%rsi                     ; %rsi = %rsp + 0x50;
573   4011ba:   48 89 d9                mov    %rbx,%rcx                                   ; %rcx = %rbx;
574   4011bd:   48 8b 10                mov    (%rax),%rdx                                 ; %rdx = M[%rax];
575   4011c0:   48 89 51 08             mov    %rdx,0x8(%rcx)                      ; M[%rcx + 0x8] = %rdx;
576   4011c4:   48 83 c0 08             add    $0x8,%rax                                   ; %rax += 8;
577   4011c8:   48 39 f0                cmp    %rsi,%rax                                   ; if (%rax == %rsi)
578   4011cb:   74 05                   je     4011d2 <phase_6+0xde>          ;         goto #581;
579   4011cd:   48 89 d1                mov    %rdx,%rcx                                   ; %rcx = %rdx;
580   4011d0:   eb eb                   jmp    4011bd <phase_6+0xc9>          ; goto #574;
581   4011d2:   48 c7 42 08 00 00 00    movq   $0x0,0x8(%rdx)                      ; M[%rdx + 8] = 0;
582   4011d9:   00
583   4011da:   bd 05 00 00 00          mov    $0x5,%ebp                                   ; %ebp = 5;
584   4011df:   48 8b 43 08             mov    0x8(%rbx),%rax                      ; %rax = M[%rbx + 8];
585   4011e3:   8b 00                   mov    (%rax),%eax                                 ; %eax = M[%rax];
586   4011e5:   39 03                   cmp    %eax,(%rbx)                                 ; if (M[%rbx] >= %eax)
587   4011e7:   7d 05                   jge    4011ee <phase_6+0xfa>          ;         goto #589;
588   4011e9:   e8 4c 02 00 00          callq  40143a <explode_bomb>          ; explode_bomb(...);
589   4011ee:   48 8b 5b 08             mov    0x8(%rbx),%rbx                      ; %rbx = M[%rbx + 8];
590   4011f2:   83 ed 01                sub    $0x1,%ebp                                   ; %ebp--;
591   4011f5:   75 e8                   jne    4011df <phase_6+0xeb>          ; goto #584;
592   4011f7:   48 83 c4 50             add    $0x50,%rsp                                  ; %rsp += 0x50;
593   4011fb:   5b                      pop    %rbx
594   4011fc:   5d                      pop    %rbp
595   4011fd:   41 5c                   pop    %r12
596   4011ff:   41 5d                   pop    %r13
597   401201:   41 5e                   pop    %r14
598   401203:   c3                      retq
599
600 0000000000401204 <fun7>:
601   401204:   48 83 ec 08             sub    $0x8,%rsp                                   ; %rsp -= 0x8;
602   401208:   48 85 ff                test   %rdi,%rdi                                   ; if (%rdi == 0)
603   40120b:   74 2b                   je     401238 <fun7+0x34>                  ;    goto #618;
604   40120d:   8b 17                   mov    (%rdi),%edx                                 ; %edx = M[%rdi];
605   40120f:   39 f2                   cmp    %esi,%edx                                   ; if (%edx <= %esi)
606   401211:   7e 0d                   jle    401220 <fun7+0x1c>                  ;         goto #611;
607   401213:   48 8b 7f 08             mov    0x8(%rdi),%rdi                      ; %rdi = M[%rdi + 0x8];
608   401217:   e8 e8 ff ff ff          callq  401204 <fun7>                       ; fun7(%rdi, %rsi);
609   40121c:   01 c0                   add    %eax,%eax                                   ; %eax += %eax;
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610   40121e:   eb 1d                   jmp    40123d <fun7+0x39>                ; goto #619;
611   401220:   b8 00 00 00 00          mov    $0x0,%eax                                 ; %eax = 0;
612   401225:   39 f2                   cmp    %esi,%edx                                 ; if (%edx == %esi)
613   401227:   74 14                   je     40123d <fun7+0x39>                ;      goto #619;
614   401229:   48 8b 7f 10             mov    0x10(%rdi),%rdi                   ; %rdi = M[%rdi + 0x10];
615   40122d:   e8 d2 ff ff ff          callq  401204 <fun7>                     ; fun7(%rdi, %rsi);
616   401232:   8d 44 00 01             lea    0x1(%rax,%rax,1),%eax     ; %eax = 2 * %rax + 1;
617   401236:   eb 05                   jmp    40123d <fun7+0x39>                ; goto #619;
618   401238:   b8 ff ff ff ff          mov    $0xffffffff,%eax                  ; %eax = -1;
619   40123d:   48 83 c4 08             add    $0x8,%rsp                                 ; %rsp += 0x8;
620   401241:   c3                      retq                                                     ; return %rax;
621
622 0000000000401242 <secret_phase>:
623   401242:   53                      push   %rbx
624   401243:   e8 56 02 00 00          callq  40149e <read_line>                ; read_line(...);
625   401248:   ba 0a 00 00 00          mov    $0xa,%edx                                 ; %edx = 0xa;
626   40124d:   be 00 00 00 00          mov    $0x0,%esi                                 ; %esi = 0x0;
627   401252:   48 89 c7                mov    %rax,%rdi                                 ; %rdi = %rax;
628   401255:   e8 76 f9 ff ff          callq  400bd0 <strtol@plt>               ; strtol(...);
629   40125a:   48 89 c3                mov    %rax,%rbx                                 ; %rbx = %rax;
630   40125d:   8d 40 ff                lea    -0x1(%rax),%eax                   ; %eax--;
631   401260:   3d e8 03 00 00          cmp    $0x3e8,%eax                               ; if (%eax <= 0x3e8)
632   401265:   76 05                   jbe    40126c <secret_phase+0x2a>        ;          goto #634;
633   401267:   e8 ce 01 00 00          callq  40143a <explode_bomb>             ; explode_bomb(...);
634   40126c:   89 de                   mov    %ebx,%esi                                 ; %esi = %ebx;
635   40126e:   bf f0 30 60 00          mov    $0x6030f0,%edi                    ; %edi = 0x6030f0;
636   401273:   e8 8c ff ff ff          callq  401204 <fun7>                     ; fun7(%rdi, %rsi);
637   401278:   83 f8 02                cmp    $0x2,%eax                                 ; if (%eax == 2)
638   40127b:   74 05                   je     401282 <secret_phase+0x40>        ;          goto #640;
639   40127d:   e8 b8 01 00 00          callq  40143a <explode_bomb>             ; explode_bomb(...);
640   401282:   bf 38 24 40 00          mov    $0x402438,%edi                    ; %edi = 0x402438;
641   401287:   e8 84 f8 ff ff          callq  400b10 <puts@plt>                 ; puts(%rdi);
642   40128c:   e8 33 03 00 00          callq  4015c4 <phase_defused>            ; phase_defused(...);
643   401291:   5b                      pop    %rbx
644   401292:   c3                      retq
645   401293:   90                      nop
646   401294:   90                      nop
647   401295:   90                      nop
648   401296:   90                      nop
649   401297:   90                      nop
650   401298:   90                      nop
651   401299:   90                      nop
652   40129a:   90                      nop
653   40129b:   90                      nop
654   40129c:   90                      nop
655   40129d:   90                      nop
656   40129e:   90                      nop
657   40129f:   90                      nop
658
659 00000000004012a0 <sig_handler>:
660   4012a0:   48 83 ec 08             sub    $0x8,%rsp
661   4012a4:   bf c0 24 40 00          mov    $0x4024c0,%edi
662   4012a9:   e8 62 f8 ff ff          callq  400b10 <puts@plt>
663   4012ae:   bf 03 00 00 00          mov    $0x3,%edi
664   4012b3:   e8 98 f9 ff ff          callq  400c50 <sleep@plt>
665   4012b8:   be 82 25 40 00          mov    $0x402582,%esi
666   4012bd:   bf 01 00 00 00          mov    $0x1,%edi
667   4012c2:   b8 00 00 00 00          mov    $0x0,%eax
668   4012c7:   e8 34 f9 ff ff          callq  400c00 <__printf_chk@plt>
669   4012cc:   48 8b 3d 6d 24 20 00    mov    0x20246d(%rip),%rdi        # 603740 <stdout@@GLIBC_2.2.5>
670   4012d3:   e8 08 f9 ff ff          callq  400be0 <fflush@plt>
```

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  4012d8:   bf 01 00 00 00          mov    $0x1,%edi
  4012dd:   e8 6e f9 ff ff          callq  400c50 <sleep@plt>
  4012e2:   bf 8a 25 40 00          mov    $0x40258a,%edi
  4012e7:   e8 24 f8 ff ff          callq  400b10 <puts@plt>
  4012ec:   bf 10 00 00 00          mov    $0x10,%edi
  4012f1:   e8 2a f9 ff ff          callq  400c20 <exit@plt>

00000000004012f6 <invalid_phase>:
  4012f6:   48 83 ec 08             sub    $0x8,%rsp
  4012fa:   48 89 fa                mov    %rdi,%rdx
  4012fd:   be 92 25 40 00          mov    $0x402592,%esi
  401302:   bf 01 00 00 00          mov    $0x1,%edi
  401307:   b8 00 00 00 00          mov    $0x0,%eax
  40130c:   e8 ef f8 ff ff          callq  400c00 <__printf_chk@plt>
  401311:   bf 08 00 00 00          mov    $0x8,%edi
  401316:   e8 05 f9 ff ff          callq  400c20 <exit@plt>

000000000040131b <string_length>:
  40131b:   80 3f 00                cmpb   $0x0,(%rdi)
  40131e:   74 12                   je     401332 <string_length+0x17>
  401320:   48 89 fa                mov    %rdi,%rdx
  401323:   48 83 c2 01             add    $0x1,%rdx
  401327:   89 d0                   mov    %edx,%eax
  401329:   29 f8                   sub    %edi,%eax
  40132b:   80 3a 00                cmpb   $0x0,(%rdx)
  40132e:   75 f3                   jne    401323 <string_length+0x8>
  401330:   f3 c3                   repz retq
  401332:   b8 00 00 00 00          mov    $0x0,%eax
  401337:   c3                      retq

0000000000401338 <strings_not_equal>:
  401338:   41 54                   push   %r12
  40133a:   55                      push   %rbp
  40133b:   53                      push   %rbx
  40133c:   48 89 fb                mov    %rdi,%rbx
  40133f:   48 89 f5                mov    %rsi,%rbp
  401342:   e8 d4 ff ff ff          callq  40131b <string_length>
  401347:   41 89 c4                mov    %eax,%r12d
  40134a:   48 89 ef                mov    %rbp,%rdi
  40134d:   e8 c9 ff ff ff          callq  40131b <string_length>
  401352:   ba 01 00 00 00          mov    $0x1,%edx
  401357:   41 39 c4                cmp    %eax,%r12d
  40135a:   75 3f                   jne    40139b <strings_not_equal+0x63>
  40135c:   0f b6 03                movzbl (%rbx),%eax
  40135f:   84 c0                   test   %al,%al
  401361:   74 25                   je     401388 <strings_not_equal+0x50>
  401363:   3a 45 00                cmp    0x0(%rbp),%al
  401366:   74 0a                   je     401372 <strings_not_equal+0x3a>
  401368:   eb 25                   jmp    40138f <strings_not_equal+0x57>
  40136a:   3a 45 00                cmp    0x0(%rbp),%al
  40136d:   0f 1f 00                nopl   (%rax)
  401370:   75 24                   jne    401396 <strings_not_equal+0x5e>
  401372:   48 83 c3 01             add    $0x1,%rbx
  401376:   48 83 c5 01             add    $0x1,%rbp
  40137a:   0f b6 03                movzbl (%rbx),%eax
  40137d:   84 c0                   test   %al,%al
  40137f:   75 e9                   jne    40136a <strings_not_equal+0x32>
  401381:   ba 00 00 00 00          mov    $0x0,%edx
  401386:   eb 13                   jmp    40139b <strings_not_equal+0x63>
  401388:   ba 00 00 00 00          mov    $0x0,%edx
  40138d:   eb 0c                   jmp    40139b <strings_not_equal+0x63>
  40138f:   ba 01 00 00 00          mov    $0x1,%edx
  401394:   eb 05                   jmp    40139b <strings_not_equal+0x63>
  401396:   ba 01 00 00 00          mov    $0x1,%edx
  40139b:   89 d0                   mov    %edx,%eax
  40139d:   5b                      pop    %rbx
  40139e:   5d                      pop    %rbp
  40139f:   41 5c                   pop    %r12
  4013a1:   c3                      retq

00000000004013a2 <initialize_bomb>:
  4013a2:   48 83 ec 08             sub    $0x8,%rsp
  4013a6:   be a0 12 40 00          mov    $0x4012a0,%esi
  4013ab:   bf 02 00 00 00          mov    $0x2,%edi
  4013b0:   e8 db f7 ff ff          callq  400b90 <signal@plt>
  4013b5:   48 83 c4 08             add    $0x8,%rsp
  4013b9:   c3                      retq

00000000004013ba <initialize_bomb_solve>:
  4013ba:   f3 c3                   repz retq

00000000004013bc <blank_line>:
  4013bc:   55                      push   %rbp
  4013bd:   53                      push   %rbx
  4013be:   48 83 ec 08             sub    $0x8,%rsp
  4013c2:   48 89 fb                mov    %rdi,%rbx
  4013c5:   eb 17                   jmp    4013de <blank_line+0x22>
  4013c7:   e8 94 f8 ff ff          callq  400c60 <__ctype_b_loc@plt>
  4013cc:   48 83 c3 01             add    $0x1,%rbx
  4013d0:   48 0f be ed             movsbq %bpl,%rbp
  4013d4:   48 8b 00                mov    (%rax),%rax
  4013d7:   f6 44 68 01 20          testb  $0x20,0x1(%rax,%rbp,2)
  4013dc:   74 0f                   je     4013ed <blank_line+0x31>
  4013de:   0f b6 2b                movzbl (%rbx),%ebp
  4013e1:   40 84 ed                test   %bpl,%bpl
  4013e4:   75 e1                   jne    4013c7 <blank_line+0xb>
  4013e6:   b8 01 00 00 00          mov    $0x1,%eax
  4013eb:   eb 05                   jmp    4013f2 <blank_line+0x36>
  4013ed:   b8 00 00 00 00          mov    $0x0,%eax
  4013f2:   48 83 c4 08             add    $0x8,%rsp
  4013f6:   5b                      pop    %rbx
  4013f7:   5d                      pop    %rbp
  4013f8:   c3                      retq

00000000004013f9 <skip>:
  4013f9:   53                      push   %rbx
  4013fa:   48 63 05 5f 23 20 00    movslq 0x20235f(%rip),%rax        # 603760 <num_input_strings>
  401401:   48 8d 3c 80             lea    (%rax,%rax,4),%rdi
  401405:   48 c1 e7 04             shl    $0x4,%rdi
  401409:   48 81 c7 80 37 60 00    add    $0x603780,%rdi
  401410:   48 8b 15 51 23 20 00    mov    0x202351(%rip),%rdx        # 603768 <infile>
  401417:   be 50 00 00 00          mov    $0x50,%esi
  40141c:   e8 5f f7 ff ff          callq  400b80 <fgets@plt>
  401421:   48 89 c3                mov    %rax,%rbx
  401424:   48 85 c0                test   %rax,%rax
  401427:   74 0c                   je     401435 <skip+0x3c>
  401429:   48 89 c7                mov    %rax,%rdi
  40142c:   e8 8b ff ff ff          callq  4013bc <blank_line>
  401431:   85 c0                   test   %eax,%eax
  401433:   75 c5                   jne    4013fa <skip+0x1>
  401435:   48 89 d8                mov    %rbx,%rax
  401438:   5b                      pop    %rbx
```

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793   401439:   c3                      retq
794
795 000000000040143a <explode_bomb>:
796   40143a:   48 83 ec 08             sub    $0x8,%rsp
797   40143e:   bf a3 25 40 00          mov    $0x4025a3,%edi
798   401443:   e8 c8 f6 ff ff          callq  400b10 <puts@plt>
799   401448:   bf ac 25 40 00          mov    $0x4025ac,%edi
800   40144d:   e8 be f6 ff ff          callq  400b10 <puts@plt>
801   401452:   bf 08 00 00 00          mov    $0x8,%edi
802   401457:   e8 c4 f7 ff ff          callq  400c20 <exit@plt>
803
804 000000000040145c <read_six_numbers>:
805   40145c:   48 83 ec 18             sub    $0x18,%rsp                                ; %rsp -= 0x18;
806   401460:   48 89 f2                mov    %rsi,%rdx                                 ; %rdx = %rsi;
807   401463:   48 8d 4e 04             lea    0x4(%rsi),%rcx                        ; %rcx = %rsi + 0x4;
808   401467:   48 8d 46 14             lea    0x14(%rsi),%rax                       ; %rax = %rsi + 0x14;
809   40146b:   48 89 44 24 08          mov    %rax,0x8(%rsp)                        ; M[%rsp + 0x8] = %rax;
810   401470:   48 8d 46 10             lea    0x10(%rsi),%rax                       ; %rax = %rsi + 0x10;
811   401474:   48 89 04 24             mov    %rax,(%rsp)                               ; M[%rsp] = %rax;
812   401478:   4c 8d 4e 0c             lea    0xc(%rsi),%r9                         ; %r9 = %rsi + 0xc;
813   40147c:   4c 8d 46 08             lea    0x8(%rsi),%r8                         ; %r8 = %rsi + 0x8;
814   401480:   be c3 25 40 00          mov    $0x4025c3,%esi                        ; %esi = 0x4025c3;
815   401485:   b8 00 00 00 00          mov    $0x0,%eax                                 ; %eax = 0;
816   40148a:   e8 61 f7 ff ff          callq  400bf0 <__isoc99_sscanf@plt>          ; sscanf(...);
817   40148f:   83 f8 05                cmp    $0x5,%eax                                 ; if (%eax > 5)
818   401492:   7f 05                   jg     401499 <read_six_numbers+0x3d>   ;      goto #820;
819   401494:   e8 a1 ff ff ff          callq  40143a <explode_bomb>                 ; explode_bomb(...);
820   401499:   48 83 c4 18             add    $0x18,%rsp                                ; %rsp += 0x18;
821   40149d:   c3                      retq                                                     ; return;
822
823 000000000040149e <read_line>:
824   40149e:   48 83 ec 08             sub    $0x8,%rsp
825   4014a2:   b8 00 00 00 00          mov    $0x0,%eax
826   4014a7:   e8 4d ff ff ff          callq  4013f9 <skip>
827   4014ac:   48 85 c0                test   %rax,%rax
828   4014af:   75 6e                   jne    40151f <read_line+0x81>
829   4014b1:   48 8b 05 90 22 20 00    mov    0x202290(%rip),%rax        # 603748 <stdin@@GLIBC_2.2.5>
830   4014b8:   48 39 05 a9 22 20 00    cmp    %rax,0x2022a9(%rip)        # 603768 <infile>
831   4014bf:   75 14                   jne    4014d5 <read_line+0x37>
832   4014c1:   bf d5 25 40 00          mov    $0x4025d5,%edi
833   4014c6:   e8 45 f6 ff ff          callq  400b10 <puts@plt>
834   4014cb:   bf 08 00 00 00          mov    $0x8,%edi
835   4014d0:   e8 4b f7 ff ff          callq  400c20 <exit@plt>
836   4014d5:   bf f3 25 40 00          mov    $0x4025f3,%edi
837   4014da:   e8 01 f6 ff ff          callq  400ae0 <getenv@plt>
838   4014df:   48 85 c0                test   %rax,%rax
839   4014e2:   74 0a                   je     4014ee <read_line+0x50>
840   4014e4:   bf 00 00 00 00          mov    $0x0,%edi
841   4014e9:   e8 32 f7 ff ff          callq  400c20 <exit@plt>
842   4014ee:   48 8b 05 53 22 20 00    mov    0x202253(%rip),%rax        # 603748 <stdin@@GLIBC_2.2.5>
843   4014f5:   48 89 05 6c 22 20 00    mov    %rax,0x20226c(%rip)        # 603768 <infile>
844   4014fc:   b8 00 00 00 00          mov    $0x0,%eax
845   401501:   e8 f3 fe ff ff          callq  4013f9 <skip>
846   401506:   48 85 c0                test   %rax,%rax
847   401509:   75 14                   jne    40151f <read_line+0x81>
848   40150b:   bf d5 25 40 00          mov    $0x4025d5,%edi
849   401510:   e8 fb f5 ff ff          callq  400b10 <puts@plt>
850   401515:   bf 00 00 00 00          mov    $0x0,%edi
851   40151a:   e8 01 f7 ff ff          callq  400c20 <exit@plt>
852   40151f:   8b 15 3b 22 20 00       mov    0x20223b(%rip),%edx        # 603760 <num_input_strings>
853   401525:   48 63 c2                movslq %edx,%rax
```

```
  401528:   48 8d 34 80             lea    (%rax,%rax,4),%rsi
  40152c:   48 c1 e6 04             shl    $0x4,%rsi
  401530:   48 81 c6 80 37 60 00    add    $0x603780,%rsi
  401537:   48 89 f7                mov    %rsi,%rdi
  40153a:   b8 00 00 00 00          mov    $0x0,%eax
  40153f:   48 c7 c1 ff ff ff ff    mov    $0xffffffffffffffff,%rcx
  401546:   f2 ae                   repnz scas %es:(%rdi),%al
  401548:   48 f7 d1                not    %rcx
  40154b:   48 83 e9 01             sub    $0x1,%rcx
  40154f:   83 f9 4e                cmp    $0x4e,%ecx
  401552:   7e 46                   jle    40159a <read_line+0xfc>
  401554:   bf fe 25 40 00          mov    $0x4025fe,%edi
  401559:   e8 b2 f5 ff ff          callq  400b10 <puts@plt>
  40155e:   8b 05 fc 21 20 00       mov    0x2021fc(%rip),%eax        # 603760 <num_input_strings>
  401564:   8d 50 01                lea    0x1(%rax),%edx
  401567:   89 15 f3 21 20 00       mov    %edx,0x2021f3(%rip)        # 603760 <num_input_strings>
  40156d:   48 98                   cltq
  40156f:   48 6b c0 50             imul   $0x50,%rax,%rax
  401573:   48 bf 2a 2a 2a 74 72    movabs $0x636e7572742a2a2a,%rdi
  40157a:   75 6e 63
  40157d:   48 89 b8 80 37 60 00    mov    %rdi,0x603780(%rax)
  401584:   48 bf 61 74 65 64 2a    movabs $0x2a2a2a64657461,%rdi
  40158b:   2a 2a 00
  40158e:   48 89 b8 88 37 60 00    mov    %rdi,0x603788(%rax)
  401595:   e8 a0 fe ff ff          callq  40143a <explode_bomb>
  40159a:   83 e9 01                sub    $0x1,%ecx
  40159d:   48 63 c9                movslq %ecx,%rcx
  4015a0:   48 63 c2                movslq %edx,%rax
  4015a3:   48 8d 04 80             lea    (%rax,%rax,4),%rax
  4015a7:   48 c1 e0 04             shl    $0x4,%rax
  4015ab:   c6 84 01 80 37 60 00    movb   $0x0,0x603780(%rcx,%rax,1)
  4015b2:   00
  4015b3:   83 c2 01                add    $0x1,%edx
  4015b6:   89 15 a4 21 20 00       mov    %edx,0x2021a4(%rip)        # 603760 <num_input_strings>
  4015bc:   48 89 f0                mov    %rsi,%rax
  4015bf:   48 83 c4 08             add    $0x8,%rsp
  4015c3:   c3                      retq

00000000004015c4 <phase_defused>:
  4015c4:   48 83 ec 78             sub    $0x78,%rsp
  4015c8:   64 48 8b 04 25 28 00    mov    %fs:0x28,%rax
  4015cf:   00 00
  4015d1:   48 89 44 24 68          mov    %rax,0x68(%rsp)
  4015d6:   31 c0                   xor    %eax,%eax
  4015d8:   83 3d 81 21 20 00 06    cmpl   $0x6,0x202181(%rip)        # 603760 <num_input_strings>
  4015df:   75 5e                   jne    40163f <phase_defused+0x7b>
  4015e1:   4c 8d 44 24 10          lea    0x10(%rsp),%r8
  4015e6:   48 8d 4c 24 0c          lea    0xc(%rsp),%rcx
  4015eb:   48 8d 54 24 08          lea    0x8(%rsp),%rdx
  4015f0:   be 19 26 40 00          mov    $0x402619,%esi
  4015f5:   bf 70 38 60 00          mov    $0x603870,%edi
  4015fa:   e8 f1 f5 ff ff          callq  400bf0 <__isoc99_sscanf@plt>
  4015ff:   83 f8 03                cmp    $0x3,%eax
  401602:   75 31                   jne    401635 <phase_defused+0x71>
  401604:   be 22 26 40 00          mov    $0x402622,%esi
  401609:   48 8d 7c 24 10          lea    0x10(%rsp),%rdi
  40160e:   e8 25 fd ff ff          callq  401338 <strings_not_equal>
  401613:   85 c0                   test   %eax,%eax
  401615:   75 1e                   jne    401635 <phase_defused+0x71>
  401617:   bf f8 24 40 00          mov    $0x4024f8,%edi
  40161c:   e8 ef f4 ff ff          callq  400b10 <puts@plt>
  401621:   bf 20 25 40 00          mov    $0x402520,%edi
  401626:   e8 e5 f4 ff ff          callq  400b10 <puts@plt>
  40162b:   b8 00 00 00 00          mov    $0x0,%eax
  401630:   e8 0d fc ff ff          callq  401242 <secret_phase>
  401635:   bf 58 25 40 00          mov    $0x402558,%edi
  40163a:   e8 d1 f4 ff ff          callq  400b10 <puts@plt>
  40163f:   48 8b 44 24 68          mov    0x68(%rsp),%rax
  401644:   64 48 33 04 25 28 00    xor    %fs:0x28,%rax
  40164b:   00 00
  40164d:   74 05                   je     401654 <phase_defused+0x90>
  40164f:   e8 dc f4 ff ff          callq  400b30 <__stack_chk_fail@plt>
  401654:   48 83 c4 78             add    $0x78,%rsp
  401658:   c3                      retq
  401659:   90                      nop
  40165a:   90                      nop
  40165b:   90                      nop
  40165c:   90                      nop
  40165d:   90                      nop
  40165e:   90                      nop
  40165f:   90                      nop

0000000000401660 <sigalrm_handler>:
  401660:   48 83 ec 08             sub    $0x8,%rsp
  401664:   b9 00 00 00 00          mov    $0x0,%ecx
  401669:   ba 78 26 40 00          mov    $0x402678,%edx
  40166e:   be 01 00 00 00          mov    $0x1,%esi
  401673:   48 8b 3d d6 20 20 00    mov    0x2020d6(%rip),%rdi        # 603750 <stderr@@GLIBC_2.2.5>
  40167a:   b8 00 00 00 00          mov    $0x0,%eax
  40167f:   e8 bc f5 ff ff          callq  400c40 <__fprintf_chk@plt>
  401684:   bf 01 00 00 00          mov    $0x1,%edi
  401689:   e8 92 f5 ff ff          callq  400c20 <exit@plt>

000000000040168e <rio_readlineb>:
  40168e:   41 57                   push   %r15
  401690:   41 56                   push   %r14
  401692:   41 55                   push   %r13
  401694:   41 54                   push   %r12
  401696:   55                      push   %rbp
  401697:   53                      push   %rbx
  401698:   48 83 ec 38             sub    $0x38,%rsp
  40169c:   49 89 f6                mov    %rsi,%r14
  40169f:   48 89 54 24 18          mov    %rdx,0x18(%rsp)
  4016a4:   48 83 fa 01             cmp    $0x1,%rdx
  4016a8:   0f 86 c9 00 00 00       jbe    401777 <rio_readlineb+0xe9>
  4016ae:   48 89 fb                mov    %rdi,%rbx
  4016b1:   41 bd 01 00 00 00       mov    $0x1,%r13d
  4016b7:   4c 8d 67 10             lea    0x10(%rdi),%r12
  4016bb:   eb 30                   jmp    4016ed <rio_readlineb+0x5f>
  4016bd:   ba 00 20 00 00          mov    $0x2000,%edx
  4016c2:   4c 89 e6                mov    %r12,%rsi
  4016c5:   8b 3b                   mov    (%rbx),%edi
  4016c7:   e8 94 f4 ff ff          callq  400b60 <read@plt>
  4016cc:   89 43 04                mov    %eax,0x4(%rbx)
  4016cf:   85 c0                   test   %eax,%eax
  4016d1:   79 12                   jns    4016e5 <rio_readlineb+0x57>
  4016d3:   e8 18 f4 ff ff          callq  400af0 <__errno_location@plt>
  4016d8:   83 38 04                cmpl   $0x4,(%rax)
  4016db:   74 10                   je     4016ed <rio_readlineb+0x5f>
  4016dd:   0f 1f 00                nopl   (%rax)
  4016e0:   e9 a1 00 00 00          jmpq   401786 <rio_readlineb+0xf8>
  4016e5:   85 c0                   test   %eax,%eax
```

```
4016e7:	74 71                	je     40175a <rio_readlineb+0xcc>
4016e9:	4c 89 63 08          	mov    %r12,0x8(%rbx)
4016ed:	8b 6b 04             	mov    0x4(%rbx),%ebp
4016f0:	85 ed                	test   %ebp,%ebp
4016f2:	7e c9                	jle    4016bd <rio_readlineb+0x2f>
4016f4:	85 ed                	test   %ebp,%ebp
4016f6:	41 0f 95 c7          	setne  %r15b
4016fa:	41 0f b6 c7          	movzbl %r15b,%eax
4016fe:	89 44 24 0c          	mov    %eax,0xc(%rsp)
401702:	45 0f b6 ff          	movzbl %r15b,%r15d
401706:	48 8b 4b 08          	mov    0x8(%rbx),%rcx
40170a:	48 89 ce             	mov    %rcx,%rsi
40170d:	b9 01 00 00 00       	mov    $0x1,%ecx
401712:	4c 89 fa             	mov    %r15,%rdx
401715:	48 89 74 24 10       	mov    %rsi,0x10(%rsp)
40171a:	48 8d 7c 24 2f       	lea    0x2f(%rsp),%rdi
40171f:	e8 9c f4 ff ff       	callq  400bc0 <__memcpy_chk@plt>
401724:	4c 03 7c 24 10       	add    0x10(%rsp),%r15
401729:	4c 89 7b 08          	mov    %r15,0x8(%rbx)
40172d:	8b 44 24 0c          	mov    0xc(%rsp),%eax
401731:	29 c5                	sub    %eax,%ebp
401733:	89 6b 04             	mov    %ebp,0x4(%rbx)
401736:	83 f8 01             	cmp    $0x1,%eax
401739:	75 13                	jne    40174e <rio_readlineb+0xc0>
40173b:	49 83 c6 01          	add    $0x1,%r14
40173f:	0f b6 44 24 2f       	movzbl 0x2f(%rsp),%eax
401744:	41 88 46 ff          	mov    %al,-0x1(%r14)
401748:	3c 0a                	cmp    $0xa,%al
40174a:	75 18                	jne    401764 <rio_readlineb+0xd6>
40174c:	eb 2f                	jmp    40177d <rio_readlineb+0xef>
40174e:	83 7c 24 0c 00       	cmpl   $0x0,0xc(%rsp)
401753:	75 3a                	jne    40178f <rio_readlineb+0x101>
401755:	44 89 e8             	mov    %r13d,%eax
401758:	eb 03                	jmp    40175d <rio_readlineb+0xcf>
40175a:	44 89 e8             	mov    %r13d,%eax
40175d:	83 f8 01             	cmp    $0x1,%eax
401760:	75 1b                	jne    40177d <rio_readlineb+0xef>
401762:	eb 34                	jmp    401798 <rio_readlineb+0x10a>
401764:	41 83 c5 01          	add    $0x1,%r13d
401768:	49 63 c5             	movslq %r13d,%rax
40176b:	48 3b 44 24 18       	cmp    0x18(%rsp),%rax
401770:	73 0b                	jae    40177d <rio_readlineb+0xef>
401772:	e9 76 ff ff ff       	jmpq   4016ed <rio_readlineb+0x5f>
401777:	41 bd 01 00 00 00    	mov    $0x1,%r13d
40177d:	41 c6 06 00          	movb   $0x0,(%r14)
401781:	49 63 c5             	movslq %r13d,%rax
401784:	eb 17                	jmp    40179d <rio_readlineb+0x10f>
401786:	48 c7 c0 ff ff ff ff 	mov    $0xffffffffffffffff,%rax
40178d:	eb 0e                	jmp    40179d <rio_readlineb+0x10f>
40178f:	48 c7 c0 ff ff ff ff 	mov    $0xffffffffffffffff,%rax
401796:	eb 05                	jmp    40179d <rio_readlineb+0x10f>
401798:	b8 00 00 00 00       	mov    $0x0,%eax
40179d:	48 83 c4 38          	add    $0x38,%rsp
4017a1:	5b                   	pop    %rbx
4017a2:	5d                   	pop    %rbp
4017a3:	41 5c                	pop    %r12
4017a5:	41 5d                	pop    %r13
4017a7:	41 5e                	pop    %r14
4017a9:	41 5f                	pop    %r15
4017ab:	c3                   	retq

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```
00000000004017ac <submitr>:
  4017ac:	41 57                	push   %r15
  4017ae:	41 56                	push   %r14
  4017b0:	41 55                	push   %r13
  4017b2:	41 54                	push   %r12
  4017b4:	55                   	push   %rbp
  4017b5:	53                   	push   %rbx
  4017b6:	48 81 ec 68 a0 00 00 	sub    $0xa068,%rsp
  4017bd:	48 89 fd             	mov    %rdi,%rbp
  4017c0:	41 89 f5             	mov    %esi,%r13d
  4017c3:	48 89 54 24 10       	mov    %rdx,0x10(%rsp)
  4017c8:	48 89 4c 24 18       	mov    %rcx,0x18(%rsp)
  4017cd:	4d 89 c7             	mov    %r8,%r15
  4017d0:	4c 89 cb             	mov    %r9,%rbx
  4017d3:	4c 8b b4 24 a0 a0 00 	mov    0xa0a0(%rsp),%r14
  4017da:	00 
  4017db:	64 48 8b 04 25 28 00 	mov    %fs:0x28,%rax
  4017e2:	00 00 
  4017e4:	48 89 84 24 58 a0 00 	mov    %rax,0xa058(%rsp)
  4017eb:	00 
  4017ec:	31 c0                	xor    %eax,%eax
  4017ee:	c7 44 24 2c 00 00 00 	movl   $0x0,0x2c(%rsp)
  4017f5:	00 
  4017f6:	ba 00 00 00 00       	mov    $0x0,%edx
  4017fb:	be 01 00 00 00       	mov    $0x1,%esi
  401800:	bf 02 00 00 00       	mov    $0x2,%edi
  401805:	e8 76 f4 ff ff       	callq  400c80 <socket@plt>
  40180a:	41 89 c4             	mov    %eax,%r12d
  40180d:	85 c0                	test   %eax,%eax
  40180f:	79 50                	jns    401861 <submitr+0xb5>
  401811:	48 b8 45 72 72 6f 72 	movabs $0x43203a726f727245,%rax
  401818:	3a 20 43 
  40181b:	49 89 06             	mov    %rax,(%r14)
  40181e:	48 b8 6c 69 65 6e 74 	movabs $0x6e7520746e65696c,%rax
  401825:	20 75 6e 
  401828:	49 89 46 08          	mov    %rax,0x8(%r14)
  40182c:	48 b8 61 62 6c 65 20 	movabs $0x206f7420656c6261,%rax
  401833:	74 6f 20 
  401836:	49 89 46 10          	mov    %rax,0x10(%r14)
  40183a:	48 b8 63 72 65 61 74 	movabs $0x7320657461657263,%rax
  401841:	65 20 73 
  401844:	49 89 46 18          	mov    %rax,0x18(%r14)
  401848:	41 c7 46 20 6f 63 6b 	movl   $0x656b636f,0x20(%r14)
  40184f:	65 
  401850:	66 41 c7 46 24 74 00 	movw   $0x74,0x24(%r14)
  401857:	b8 ff ff ff ff       	mov    $0xffffffff,%eax
  40185c:	e9 07 06 00 00       	jmpq   401e68 <submitr+0x6bc>
  401861:	48 89 ef             	mov    %rbp,%rdi
  401864:	e8 37 f3 ff ff       	callq  400ba0 <gethostbyname@plt>
  401869:	48 85 c0             	test   %rax,%rax
  40186c:	75 6b                	jne    4018d9 <submitr+0x12d>
  40186e:	48 b8 45 72 72 6f 72 	movabs $0x44203a726f727245,%rax
  401875:	3a 20 44 
  401878:	49 89 06             	mov    %rax,(%r14)
  40187b:	48 b8 4e 53 20 69 73 	movabs $0x6e7520736920534e,%rax
  401882:	20 75 6e 
  401885:	49 89 46 08          	mov    %rax,0x8(%r14)
  401889:	48 b8 61 62 6c 65 20 	movabs $0x206f7420656c6261,%rax
  401890:	74 6f 20 
  401893:	49 89 46 10          	mov    %rax,0x10(%r14)
  401897:	48 b8 72 65 73 6f 6c 	movabs $0x2065766c6f736572,%rax
```

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40189e:	76 65 20
4018a1:	49 89 46 18          	mov    %rax,0x18(%r14)
4018a5:	48 b8 73 65 72 76 65 	movabs $0x6120726576726573,%rax
4018ac:	72 20 61
4018af:	49 89 46 20          	mov    %rax,0x20(%r14)
4018b3:	41 c7 46 28 64 64 72 	movl   $0x65726464,0x28(%r14)
4018ba:	65
4018bb:	66 41 c7 46 2c 73 73 	movw   $0x7373,0x2c(%r14)
4018c2:	41 c6 46 2e 00       	movb   $0x0,0x2e(%r14)
4018c7:	44 89 e7             	mov    %r12d,%edi
4018ca:	e8 81 f2 ff ff       	callq  400b50 <close@plt>
4018cf:	b8 ff ff ff ff       	mov    $0xffffffff,%eax
4018d4:	e9 8f 05 00 00       	jmpq   401e68 <submitr+0x6bc>
4018d9:	48 c7 44 24 30 00 00 	movq   $0x0,0x30(%rsp)
4018e0:	00 00
4018e2:	48 c7 44 24 38 00 00 	movq   $0x0,0x38(%rsp)
4018e9:	00 00
4018eb:	66 c7 44 24 30 02 00 	movw   $0x2,0x30(%rsp)
4018f2:	48 63 50 14          	movslq 0x14(%rax),%rdx
4018f6:	48 8b 40 18          	mov    0x18(%rax),%rax
4018fa:	48 8d 7c 24 34       	lea    0x34(%rsp),%rdi
4018ff:	b9 0c 00 00 00       	mov    $0xc,%ecx
401904:	48 8b 30             	mov    (%rax),%rsi
401907:	e8 a4 f2 ff ff       	callq  400bb0 <__memmove_chk@plt>
40190c:	66 41 c1 cd 08       	ror    $0x8,%r13w
401911:	66 44 89 6c 24 32    	mov    %r13w,0x32(%rsp)
401917:	ba 10 00 00 00       	mov    $0x10,%edx
40191c:	48 8d 74 24 30       	lea    0x30(%rsp),%rsi
401921:	44 89 e7             	mov    %r12d,%edi
401924:	e8 07 f3 ff ff       	callq  400c30 <connect@plt>
401929:	85 c0                	test   %eax,%eax
40192b:	79 5d                	jns    40198a <submitr+0x1de>
40192d:	48 b8 45 72 72 6f 72 	movabs $0x55203a726f727245,%rax
401934:	3a 20 55
401937:	49 89 06             	mov    %rax,(%r14)
40193a:	48 b8 6e 61 62 6c 65 	movabs $0x6f7420656c62616e,%rax
401941:	20 74 6f
401944:	49 89 46 08          	mov    %rax,0x8(%r14)
401948:	48 b8 20 63 6f 6e 6e 	movabs $0x7463656e6e6f6320,%rax
40194f:	65 63 74
401952:	49 89 46 10          	mov    %rax,0x10(%r14)
401956:	48 b8 20 74 6f 20 74 	movabs $0x20656874206f7420,%rax
40195d:	68 65 20
401960:	49 89 46 18          	mov    %rax,0x18(%r14)
401964:	41 c7 46 20 73 65 72 	movl   $0x76726573,0x20(%r14)
40196b:	76
40196c:	66 41 c7 46 24 65 72 	movw   $0x7265,0x24(%r14)
401973:	41 c6 46 26 00       	movb   $0x0,0x26(%r14)
401978:	44 89 e7             	mov    %r12d,%edi
40197b:	e8 d0 f1 ff ff       	callq  400b50 <close@plt>
401980:	b8 ff ff ff ff       	mov    $0xffffffff,%eax
401985:	e9 de 04 00 00       	jmpq   401e68 <submitr+0x6bc>
40198a:	48 c7 c2 ff ff ff ff 	mov    $0xffffffffffffffff,%rdx
401991:	48 89 df             	mov    %rbx,%rdi
401994:	b8 00 00 00 00       	mov    $0x0,%eax
401999:	48 89 d1             	mov    %rdx,%rcx
40199c:	f2 ae                	repnz scas %es:(%rdi),%al
40199e:	48 f7 d1             	not    %rcx
4019a1:	48 89 ce             	mov    %rcx,%rsi
4019a4:	48 8b 7c 24 10       	mov    0x10(%rsp),%rdi
4019a9:	48 89 d1             	mov    %rdx,%rcx
```

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4019ac:   f2 ae                   repnz scas %es:(%rdi),%al
4019ae:   49 89 c8                mov    %rcx,%r8
4019b1:   48 8b 7c 24 18          mov    0x18(%rsp),%rdi
4019b6:   48 89 d1                mov    %rdx,%rcx
4019b9:   f2 ae                   repnz scas %es:(%rdi),%al
4019bb:   48 f7 d1                not    %rcx
4019be:   49 89 c9                mov    %rcx,%r9
4019c1:   4c 89 ff                mov    %r15,%rdi
4019c4:   48 89 d1                mov    %rdx,%rcx
4019c7:   f2 ae                   repnz scas %es:(%rdi),%al
4019c9:   4d 29 c1                sub    %r8,%r9
4019cc:   49 29 c9                sub    %rcx,%r9
4019cf:   48 8d 44 76 fd          lea    -0x3(%rsi,%rsi,2),%rax
4019d4:   49 8d 44 01 7b          lea    0x7b(%r9,%rax,1),%rax
4019d9:   48 3d 00 20 00 00       cmp    $0x2000,%rax
4019df:   76 73                   jbe    401a54 <submitr+0x2a8>
4019e1:   48 b8 45 72 72 6f 72    movabs $0x52203a726f727245,%rax
4019e8:   3a 20 52
4019eb:   49 89 06                mov    %rax,(%r14)
4019ee:   48 b8 65 73 75 6c 74    movabs $0x747320746c757365,%rax
4019f5:   20 73 74
4019f8:   49 89 46 08             mov    %rax,0x8(%r14)
4019fc:   48 b8 72 69 6e 67 20    movabs $0x6f6f7420676e6972,%rax
401a03:   74 6f 6f
401a06:   49 89 46 10             mov    %rax,0x10(%r14)
401a0a:   48 b8 20 6c 61 72 67    movabs $0x202e656772616c20,%rax
401a11:   65 2e 20
401a14:   49 89 46 18             mov    %rax,0x18(%r14)
401a18:   48 b8 49 6e 63 72 65    movabs $0x6573616572636e49,%rax
401a1f:   61 73 65
401a22:   49 89 46 20             mov    %rax,0x20(%r14)
401a26:   48 b8 20 53 55 42 4d    movabs $0x5254494d42555320,%rax
401a2d:   49 54 52
401a30:   49 89 46 28             mov    %rax,0x28(%r14)
401a34:   48 b8 5f 4d 41 58 42    movabs $0x46554258414d5f,%rax
401a3b:   55 46 00
401a3e:   49 89 46 30             mov    %rax,0x30(%r14)
401a42:   44 89 e7                mov    %r12d,%edi
401a45:   e8 06 f1 ff ff          callq  400b50 <close@plt>
401a4a:   b8 ff ff ff ff          mov    $0xffffffff,%eax
401a4f:   e9 14 04 00 00          jmpq   401e68 <submitr+0x6bc>
401a54:   48 8d 94 24 40 20 00    lea    0x2040(%rsp),%rdx
401a5b:   00
401a5c:   b9 00 04 00 00          mov    $0x400,%ecx
401a61:   b8 00 00 00 00          mov    $0x0,%eax
401a66:   48 89 d7                mov    %rdx,%rdi
401a69:   f3 48 ab                rep stos %rax,%es:(%rdi)
401a6c:   48 89 df                mov    %rbx,%rdi
401a6f:   48 c7 c1 ff ff ff ff    mov    $0xffffffffffffffff,%rcx
401a76:   f2 ae                   repnz scas %es:(%rdi),%al
401a78:   48 f7 d1                not    %rcx
401a7b:   48 83 e9 01             sub    $0x1,%rcx
401a7f:   85 c9                   test   %ecx,%ecx
401a81:   0f 84 fd 03 00 00       je     401e84 <submitr+0x6d8>
401a87:   83 e9 01                sub    $0x1,%ecx
401a8a:   4c 8d 6c 0b 01          lea    0x1(%rbx,%rcx,1),%r13
401a8f:   48 89 d5                mov    %rdx,%rbp
401a92:   44 0f b6 03             movzbl (%rbx),%r8d
401a96:   41 80 f8 2a             cmp    $0x2a,%r8b
401a9a:   74 23                   je     401abf <submitr+0x313>
401a9c:   41 8d 40 d3             lea    -0x2d(%r8),%eax
```

```
401aa0:   3c 01                   cmp    $0x1,%al
401aa2:   76 1b                   jbe    401abf <submitr+0x313>
401aa4:   41 80 f8 5f             cmp    $0x5f,%r8b
401aa8:   74 15                   je     401abf <submitr+0x313>
401aaa:   41 8d 40 d0             lea    -0x30(%r8),%eax
401aae:   3c 09                   cmp    $0x9,%al
401ab0:   76 0d                   jbe    401abf <submitr+0x313>
401ab2:   44 89 c0                mov    %r8d,%eax
401ab5:   83 e0 df                and    $0xffffffdf,%eax
401ab8:   83 e8 41                sub    $0x41,%eax
401abb:   3c 19                   cmp    $0x19,%al
401abd:   77 0a                   ja     401ac9 <submitr+0x31d>
401abf:   48 8d 45 01             lea    0x1(%rbp),%rax
401ac3:   44 88 45 00             mov    %r8b,0x0(%rbp)
401ac7:   eb 6c                   jmp    401b35 <submitr+0x389>
401ac9:   41 80 f8 20             cmp    $0x20,%r8b
401acd:   75 0a                   jne    401ad9 <submitr+0x32d>
401acf:   48 8d 45 01             lea    0x1(%rbp),%rax
401ad3:   c6 45 00 2b             movb   $0x2b,0x0(%rbp)
401ad7:   eb 5c                   jmp    401b35 <submitr+0x389>
401ad9:   41 8d 40 e0             lea    -0x20(%r8),%eax
401add:   3c 5f                   cmp    $0x5f,%al
401adf:   76 0a                   jbe    401aeb <submitr+0x33f>
401ae1:   41 80 f8 09             cmp    $0x9,%r8b
401ae5:   0f 85 02 04 00 00       jne    401eed <submitr+0x741>
401aeb:   45 0f b6 c0             movzbl %r8b,%r8d
401aef:   b9 48 27 40 00          mov    $0x402748,%ecx
401af4:   ba 08 00 00 00          mov    $0x8,%edx
401af9:   be 01 00 00 00          mov    $0x1,%esi
401afe:   48 8d bc 24 40 80 00    lea    0x8040(%rsp),%rdi
401b05:   00
401b06:   b8 00 00 00 00          mov    $0x0,%eax
401b0b:   e8 60 f1 ff ff          callq  400c70 <__sprintf_chk@plt>
401b10:   0f b6 84 24 40 80 00    movzbl 0x8040(%rsp),%eax
401b17:   00
401b18:   88 45 00                mov    %al,0x0(%rbp)
401b1b:   0f b6 84 24 41 80 00    movzbl 0x8041(%rsp),%eax
401b22:   00
401b23:   88 45 01                mov    %al,0x1(%rbp)
401b26:   48 8d 45 03             lea    0x3(%rbp),%rax
401b2a:   0f b6 94 24 42 80 00    movzbl 0x8042(%rsp),%edx
401b31:   00
401b32:   88 55 02                mov    %dl,0x2(%rbp)
401b35:   48 83 c3 01             add    $0x1,%rbx
401b39:   4c 39 eb                cmp    %r13,%rbx
401b3c:   0f 84 42 03 00 00       je     401e84 <submitr+0x6d8>
401b42:   48 89 c5                mov    %rax,%rbp
401b45:   e9 48 ff ff ff          jmpq   401a92 <submitr+0x2e6>
401b4a:   48 89 da                mov    %rbx,%rdx
401b4d:   48 89 ee                mov    %rbp,%rsi
401b50:   44 89 e7                mov    %r12d,%edi
401b53:   e8 c8 ef ff ff          callq  400b20 <write@plt>
401b58:   48 85 c0                test   %rax,%rax
401b5b:   7f 0f                   jg     401b6c <submitr+0x3c0>
401b5d:   e8 8e ef ff ff          callq  400af0 <__errno_location@plt>
401b62:   83 38 04                cmpl   $0x4,(%rax)
401b65:   75 12                   jne    401b79 <submitr+0x3cd>
401b67:   b8 00 00 00 00          mov    $0x0,%eax
401b6c:   48 01 c5                add    %rax,%rbp
401b6f:   48 29 c3                sub    %rax,%rbx
401b72:   75 d6                   jne    401b4a <submitr+0x39e>
```

```
401b74:   4d 85 ed                test   %r13,%r13
401b77:   79 5f                   jns    401bd8 <submitr+0x42c>
401b79:   48 b8 45 72 72 6f 72    movabs $0x43203a726f727245,%rax
401b80:   3a 20 43
401b83:   49 89 06                mov    %rax,(%r14)
401b86:   48 b8 6c 69 65 6e 74    movabs $0x6e7520746e65696c,%rax
401b8d:   20 75 6e
401b90:   49 89 46 08             mov    %rax,0x8(%r14)
401b94:   48 b8 61 62 6c 65 20    movabs $0x206f7420656c6261,%rax
401b9b:   74 6f 20
401b9e:   49 89 46 10             mov    %rax,0x10(%r14)
401ba2:   48 b8 77 72 69 74 65    movabs $0x6f74206574697277,%rax
401ba9:   20 74 6f
401bac:   49 89 46 18             mov    %rax,0x18(%r14)
401bb0:   48 b8 20 74 68 65 20    movabs $0x7265732065687420,%rax
401bb7:   73 65 72
401bba:   49 89 46 20             mov    %rax,0x20(%r14)
401bbe:   41 c7 46 28 76 65 72    movl   $0x726576,0x28(%r14)
401bc5:   00
401bc6:   44 89 e7                mov    %r12d,%edi
401bc9:   e8 82 ef ff ff          callq  400b50 <close@plt>
401bce:   b8 ff ff ff ff          mov    $0xffffffff,%eax
401bd3:   e9 90 02 00 00          jmpq   401e68 <submitr+0x6bc>
401bd8:   44 89 a4 24 40 80 00    mov    %r12d,0x8040(%rsp)
401bdf:   00
401be0:   c7 84 24 44 80 00 00    movl   $0x0,0x8044(%rsp)
401be7:   00 00 00 00
401beb:   48 8d 84 24 50 80 00    lea    0x8050(%rsp),%rax
401bf2:   00
401bf3:   48 89 84 24 48 80 00    mov    %rax,0x8048(%rsp)
401bfa:   00
401bfb:   ba 00 20 00 00          mov    $0x2000,%edx
401c00:   48 8d 74 24 40          lea    0x40(%rsp),%rsi
401c05:   48 8d bc 24 40 80 00    lea    0x8040(%rsp),%rdi
401c0c:   00
401c0d:   e8 7c fa ff ff          callq  40168e <rio_readlineb>
401c12:   48 85 c0                test   %rax,%rax
401c15:   7f 74                   jg     401c8b <submitr+0x4df>
401c17:   48 b8 45 72 72 6f 72    movabs $0x43203a726f727245,%rax
401c1e:   3a 20 43
401c21:   49 89 06                mov    %rax,(%r14)
401c24:   48 b8 6c 69 65 6e 74    movabs $0x6e7520746e65696c,%rax
401c2b:   20 75 6e
401c2e:   49 89 46 08             mov    %rax,0x8(%r14)
401c32:   48 b8 61 62 6c 65 20    movabs $0x206f7420656c6261,%rax
401c39:   74 6f 20
401c3c:   49 89 46 10             mov    %rax,0x10(%r14)
401c40:   48 b8 72 65 61 64 20    movabs $0x7269662064616572,%rax
401c47:   66 69 72
401c4a:   49 89 46 18             mov    %rax,0x18(%r14)
401c4e:   48 b8 73 74 20 68 65    movabs $0x6564616568207473,%rax
401c55:   61 64 65
401c58:   49 89 46 20             mov    %rax,0x20(%r14)
401c5c:   48 b8 72 20 66 72 6f    movabs $0x73206d6f72662072,%rax
401c63:   6d 20 73
401c66:   49 89 46 28             mov    %rax,0x28(%r14)
401c6a:   41 c7 46 30 65 72 76    movl   $0x65767265,0x30(%r14)
401c71:   65
401c72:   66 41 c7 46 34 72 00    movw   $0x72,0x34(%r14)
401c79:   44 89 e7                mov    %r12d,%edi
401c7c:   e8 cf ee ff ff          callq  400b50 <close@plt>
```

```
401c81:  b8 ff ff ff ff          mov    $0xffffffff,%eax
401c86:  e9 dd 01 00 00          jmpq   401e68 <submitr+0x6bc>
401c8b:  4c 8d 84 24 40 60 00    lea    0x6040(%rsp),%r8
401c92:  00
401c93:  48 8d 4c 24 2c          lea    0x2c(%rsp),%rcx
401c98:  48 8d 94 24 40 40 00    lea    0x4040(%rsp),%rdx
401c9f:  00
401ca0:  be 4f 27 40 00          mov    $0x40274f,%esi
401ca5:  48 8d 7c 24 40          lea    0x40(%rsp),%rdi
401caa:  b8 00 00 00 00          mov    $0x0,%eax
401caf:  e8 3c ef ff ff          callq  400bf0 <__isoc99_sscanf@plt>
401cb4:  44 8b 44 24 2c          mov    0x2c(%rsp),%r8d
401cb9:  41 81 f8 c8 00 00 00    cmp    $0xc8,%r8d
401cc0:  0f 84 be 00 00 00       je     401d84 <submitr+0x5d8>
401cc6:  4c 8d 8c 24 40 60 00    lea    0x6040(%rsp),%r9
401ccd:  00
401cce:  b9 a0 26 40 00          mov    $0x4026a0,%ecx
401cd3:  48 c7 c2 ff ff ff ff    mov    $0xffffffffffffffff,%rdx
401cda:  be 01 00 00 00          mov    $0x1,%esi
401cdf:  4c 89 f7                mov    %r14,%rdi
401ce2:  b8 00 00 00 00          mov    $0x0,%eax
401ce7:  e8 84 ef ff ff          callq  400c70 <__sprintf_chk@plt>
401cec:  44 89 e7                mov    %r12d,%edi
401cef:  e8 5c ee ff ff          callq  400b50 <close@plt>
401cf4:  b8 ff ff ff ff          mov    $0xffffffff,%eax
401cf9:  e9 6a 01 00 00          jmpq   401e68 <submitr+0x6bc>
401cfe:  ba 00 20 00 00          mov    $0x2000,%edx
401d03:  48 8d 74 24 40          lea    0x40(%rsp),%rsi
401d08:  48 8d bc 24 40 80 00    lea    0x8040(%rsp),%rdi
401d0f:  00
401d10:  e8 79 f9 ff ff          callq  40168e <rio_readlineb>
401d15:  48 85 c0                test   %rax,%rax
401d18:  7f 6a                   jg     401d84 <submitr+0x5d8>
401d1a:  48 b8 45 72 72 6f 72    movabs $0x43203a726f727245,%rax
401d21:  3a 20 43
401d24:  49 89 06                mov    %rax,(%r14)
401d27:  48 b8 6c 69 65 6e 74    movabs $0x6e7520746e65696c,%rax
401d2e:  20 75 6e
401d31:  49 89 46 08             mov    %rax,0x8(%r14)
401d35:  48 b8 61 62 6c 65 20    movabs $0x206f7420656c6261,%rax
401d3c:  74 6f 20
401d3f:  49 89 46 10             mov    %rax,0x10(%r14)
401d43:  48 b8 72 65 61 64 20    movabs $0x6165682064616572,%rax
401d4a:  68 65 61
401d4d:  49 89 46 18             mov    %rax,0x18(%r14)
401d51:  48 b8 64 65 72 73 20    movabs $0x6f72662073726564,%rax
401d58:  66 72 6f
401d5b:  49 89 46 20             mov    %rax,0x20(%r14)
401d5f:  48 b8 6d 20 73 65 72    movabs $0x726576726573206d,%rax
401d66:  76 65 72
401d69:  49 89 46 28             mov    %rax,0x28(%r14)
401d6d:  41 c6 46 30 00          movb   $0x0,0x30(%r14)
401d72:  44 89 e7                mov    %r12d,%edi
401d75:  e8 d6 ed ff ff          callq  400b50 <close@plt>
401d7a:  b8 ff ff ff ff          mov    $0xffffffff,%eax
401d7f:  e9 e4 00 00 00          jmpq   401e68 <submitr+0x6bc>
401d84:  80 7c 24 40 0d          cmpb   $0xd,0x40(%rsp)
401d89:  0f 85 6f ff ff ff       jne    401cfe <submitr+0x552>
401d8f:  80 7c 24 41 0a          cmpb   $0xa,0x41(%rsp)
401d94:  0f 85 64 ff ff ff       jne    401cfe <submitr+0x552>
401d9a:  80 7c 24 42 00          cmpb   $0x0,0x42(%rsp)
```

```
401d9f:   0f 85 59 ff ff ff       jne    401cfe <submitr+0x552>
401da5:   ba 00 20 00 00          mov    $0x2000,%edx
401daa:   48 8d 74 24 40          lea    0x40(%rsp),%rsi
401daf:   48 8d bc 24 40 80 00    lea    0x8040(%rsp),%rdi
401db6:   00
401db7:   e8 d2 f8 ff ff          callq  40168e <rio_readlineb>
401dbc:   48 85 c0                test   %rax,%rax
401dbf:   7f 70                   jg     401e31 <submitr+0x685>
401dc1:   48 b8 45 72 72 6f 72    movabs $0x43203a726f727245,%rax
401dc8:   3a 20 43
401dcb:   49 89 06                mov    %rax,(%r14)
401dce:   48 b8 6c 69 65 6e 74    movabs $0x6e7520746e65696c,%rax
401dd5:   20 75 6e
401dd8:   49 89 46 08             mov    %rax,0x8(%r14)
401ddc:   48 b8 61 62 6c 65 20    movabs $0x206f7420656c6261,%rax
401de3:   74 6f 20
401de6:   49 89 46 10             mov    %rax,0x10(%r14)
401dea:   48 b8 72 65 61 64 20    movabs $0x6174732064616572,%rax
401df1:   73 74 61
401df4:   49 89 46 18             mov    %rax,0x18(%r14)
401df8:   48 b8 74 75 73 20 6d    movabs $0x7373656d20737574,%rax
401dff:   65 73 73
401e02:   49 89 46 20             mov    %rax,0x20(%r14)
401e06:   48 b8 61 67 65 20 66    movabs $0x6d6f726620656761,%rax
401e0d:   72 6f 6d
401e10:   49 89 46 28             mov    %rax,0x28(%r14)
401e14:   48 b8 20 73 65 72 76    movabs $0x72657672657320,%rax
401e1b:   65 72 00
401e1e:   49 89 46 30             mov    %rax,0x30(%r14)
401e22:   44 89 e7                mov    %r12d,%edi
401e25:   e8 26 ed ff ff          callq  400b50 <close@plt>
401e2a:   b8 ff ff ff ff          mov    $0xffffffff,%eax
401e2f:   eb 37                   jmp    401e68 <submitr+0x6bc>
401e31:   48 8d 74 24 40          lea    0x40(%rsp),%rsi
401e36:   4c 89 f7                mov    %r14,%rdi
401e39:   e8 c2 ec ff ff          callq  400b00 <strcpy@plt>
401e3e:   44 89 e7                mov    %r12d,%edi
401e41:   e8 0a ed ff ff          callq  400b50 <close@plt>
401e46:   41 0f b6 06             movzbl (%r14),%eax
401e4a:   83 e8 4f                sub    $0x4f,%eax
401e4d:   75 0f                   jne    401e5e <submitr+0x6b2>
401e4f:   41 0f b6 46 01          movzbl 0x1(%r14),%eax
401e54:   83 e8 4b                sub    $0x4b,%eax
401e57:   75 05                   jne    401e5e <submitr+0x6b2>
401e59:   41 0f b6 46 02          movzbl 0x2(%r14),%eax
401e5e:   85 c0                   test   %eax,%eax
401e60:   0f 95 c0                setne  %al
401e63:   0f b6 c0                movzbl %al,%eax
401e66:   f7 d8                   neg    %eax
401e68:   48 8b 94 24 58 a0 00    mov    0xa058(%rsp),%rdx
401e6f:   00
401e70:   64 48 33 14 25 28 00    xor    %fs:0x28,%rdx
401e77:   00 00
401e79:   0f 84 00 01 00 00       je     401f7f <submitr+0x7d3>
401e7f:   e9 f6 00 00 00          jmpq   401f7a <submitr+0x7ce>
401e84:   48 8d 84 24 40 20 00    lea    0x2040(%rsp),%rax
401e8b:   00
401e8c:   48 89 44 24 08          mov    %rax,0x8(%rsp)
401e91:   4c 89 3c 24             mov    %r15,(%rsp)
401e95:   4c 8b 4c 24 18          mov    0x18(%rsp),%r9
401e9a:   4c 8b 44 24 10          mov    0x10(%rsp),%r8
```

```
  401e9f:	b9 d0 26 40 00       	mov    $0x4026d0,%ecx
  401ea4:	ba 00 20 00 00       	mov    $0x2000,%edx
  401ea9:	be 01 00 00 00       	mov    $0x1,%esi
  401eae:	48 8d 7c 24 40       	lea    0x40(%rsp),%rdi
  401eb3:	b8 00 00 00 00       	mov    $0x0,%eax
  401eb8:	e8 b3 ed ff ff       	callq  400c70 <__sprintf_chk@plt>
  401ebd:	48 8d 7c 24 40       	lea    0x40(%rsp),%rdi
  401ec2:	b8 00 00 00 00       	mov    $0x0,%eax
  401ec7:	48 c7 c1 ff ff ff ff 	mov    $0xffffffffffffffff,%rcx
  401ece:	f2 ae                	repnz scas %es:(%rdi),%al
  401ed0:	48 f7 d1             	not    %rcx
  401ed3:	48 83 e9 01          	sub    $0x1,%rcx
  401ed7:	49 89 cd             	mov    %rcx,%r13
  401eda:	0f 84 f8 fc ff ff    	je     401bd8 <submitr+0x42c>
  401ee0:	48 89 cb             	mov    %rcx,%rbx
  401ee3:	48 8d 6c 24 40       	lea    0x40(%rsp),%rbp
  401ee8:	e9 5d fc ff ff       	jmpq   401b4a <submitr+0x39e>
  401eed:	48 b8 45 72 72 6f 72 	movabs $0x52203a726f727245,%rax
  401ef4:	3a 20 52 
  401ef7:	49 89 06             	mov    %rax,(%r14)
  401efa:	48 b8 65 73 75 6c 74 	movabs $0x747320746c757365,%rax
  401f01:	20 73 74 
  401f04:	49 89 46 08          	mov    %rax,0x8(%r14)
  401f08:	48 b8 72 69 6e 67 20 	movabs $0x6e6f6320676e6972,%rax
  401f0f:	63 6f 6e 
  401f12:	49 89 46 10          	mov    %rax,0x10(%r14)
  401f16:	48 b8 74 61 69 6e 73 	movabs $0x6e6120736e696174,%rax
  401f1d:	20 61 6e 
  401f20:	49 89 46 18          	mov    %rax,0x18(%r14)
  401f24:	48 b8 20 69 6c 6c 65 	movabs $0x6c6167656c6c6920,%rax
  401f2b:	67 61 6c 
  401f2e:	49 89 46 20          	mov    %rax,0x20(%r14)
  401f32:	48 b8 20 6f 72 20 75 	movabs $0x72706e7520726f20,%rax
  401f39:	6e 70 72 
  401f3c:	49 89 46 28          	mov    %rax,0x28(%r14)
  401f40:	48 b8 69 6e 74 61 62 	movabs $0x20656c6261746e69,%rax
  401f47:	6c 65 20 
  401f4a:	49 89 46 30          	mov    %rax,0x30(%r14)
  401f4e:	48 b8 63 68 61 72 61 	movabs $0x6574636172616863,%rax
  401f55:	63 74 65 
  401f58:	49 89 46 38          	mov    %rax,0x38(%r14)
  401f5c:	66 41 c7 46 40 72 2e 	movw   $0x2e72,0x40(%r14)
  401f63:	41 c6 46 42 00       	movb   $0x0,0x42(%r14)
  401f68:	44 89 e7             	mov    %r12d,%edi
  401f6b:	e8 e0 eb ff ff       	callq  400b50 <close@plt>
  401f70:	b8 ff ff ff ff       	mov    $0xffffffff,%eax
  401f75:	e9 ee fe ff ff       	jmpq   401e68 <submitr+0x6bc>
  401f7a:	e8 b1 eb ff ff       	callq  400b30 <__stack_chk_fail@plt>
  401f7f:	48 81 c4 68 a0 00 00 	add    $0xa068,%rsp
  401f86:	5b                   	pop    %rbx
  401f87:	5d                   	pop    %rbp
  401f88:	41 5c                	pop    %r12
  401f8a:	41 5d                	pop    %r13
  401f8c:	41 5e                	pop    %r14
  401f8e:	41 5f                	pop    %r15
  401f90:	c3                   	retq   

0000000000401f91 <init_timeout>:
  401f91:	53                   	push   %rbx
  401f92:	89 fb                	mov    %edi,%ebx
  401f94:	85 ff                	test   %edi,%edi
  401f96:   74 1e                   je     401fb6 <init_timeout+0x25>
  401f98:   be 60 16 40 00          mov    $0x401660,%esi
  401f9d:   bf 0e 00 00 00          mov    $0xe,%edi
  401fa2:   e8 e9 eb ff ff          callq  400b90 <signal@plt>
  401fa7:   85 db                   test   %ebx,%ebx
  401fa9:   bf 00 00 00 00          mov    $0x0,%edi
  401fae:   0f 49 fb                cmovns %ebx,%edi
  401fb1:   e8 8a eb ff ff          callq  400b40 <alarm@plt>
  401fb6:   5b                      pop    %rbx
  401fb7:   c3                      retq

0000000000401fb8 <init_driver>:
  401fb8:   55                      push   %rbp
  401fb9:   53                      push   %rbx
  401fba:   48 83 ec 28             sub    $0x28,%rsp
  401fbe:   48 89 fd                mov    %rdi,%rbp
  401fc1:   64 48 8b 04 25 28 00    mov    %fs:0x28,%rax
  401fc8:   00 00
  401fca:   48 89 44 24 18          mov    %rax,0x18(%rsp)
  401fcf:   31 c0                   xor    %eax,%eax
  401fd1:   be 01 00 00 00          mov    $0x1,%esi
  401fd6:   bf 0d 00 00 00          mov    $0xd,%edi
  401fdb:   e8 b0 eb ff ff          callq  400b90 <signal@plt>
  401fe0:   be 01 00 00 00          mov    $0x1,%esi
  401fe5:   bf 1d 00 00 00          mov    $0x1d,%edi
  401fea:   e8 a1 eb ff ff          callq  400b90 <signal@plt>
  401fef:   be 01 00 00 00          mov    $0x1,%esi
  401ff4:   bf 1d 00 00 00          mov    $0x1d,%edi
  401ff9:   e8 92 eb ff ff          callq  400b90 <signal@plt>
  401ffe:   ba 00 00 00 00          mov    $0x0,%edx
  402003:   be 01 00 00 00          mov    $0x1,%esi
  402008:   bf 02 00 00 00          mov    $0x2,%edi
  40200d:   e8 6e ec ff ff          callq  400c80 <socket@plt>
  402012:   89 c3                   mov    %eax,%ebx
  402014:   85 c0                   test   %eax,%eax
  402016:   79 4f                   jns    402067 <init_driver+0xaf>
  402018:   48 b8 45 72 72 6f 72    movabs $0x43203a726f727245,%rax
  40201f:   3a 20 43
  402022:   48 89 45 00             mov    %rax,0x0(%rbp)
  402026:   48 b8 6c 69 65 6e 74    movabs $0x6e7520746e65696c,%rax
  40202d:   20 75 6e
  402030:   48 89 45 08             mov    %rax,0x8(%rbp)
  402034:   48 b8 61 62 6c 65 20    movabs $0x206f7420656c6261,%rax
  40203b:   74 6f 20
  40203e:   48 89 45 10             mov    %rax,0x10(%rbp)
  402042:   48 b8 63 72 65 61 74    movabs $0x7320657461657263,%rax
  402049:   65 20 73
  40204c:   48 89 45 18             mov    %rax,0x18(%rbp)
  402050:   c7 45 20 6f 63 6b 65    movl   $0x656b636f,0x20(%rbp)
  402057:   66 c7 45 24 74 00       movw   $0x74,0x24(%rbp)
  40205d:   b8 ff ff ff ff          mov    $0xffffffff,%eax
  402062:   e9 0a 01 00 00          jmpq   402171 <init_driver+0x1b9>
  402067:   bf 60 27 40 00          mov    $0x402760,%edi
  40206c:   e8 2f eb ff ff          callq  400ba0 <gethostbyname@plt>
  402071:   48 85 c0                test   %rax,%rax
  402074:   75 68                   jne    4020de <init_driver+0x126>
  402076:   48 b8 45 72 72 6f 72    movabs $0x44203a726f727245,%rax
  40207d:   3a 20 44
  402080:   48 89 45 00             mov    %rax,0x0(%rbp)
  402084:   48 b8 4e 53 20 69 73    movabs $0x6e7520736920534e,%rax
  40208b:   20 75 6e
  40208e:	48 89 45 08          	mov    %rax,0x8(%rbp)
  402092:	48 b8 61 62 6c 65 20 	movabs $0x206f7420656c6261,%rax
  402099:	74 6f 20 
  40209c:	48 89 45 10          	mov    %rax,0x10(%rbp)
  4020a0:	48 b8 72 65 73 6f 6c 	movabs $0x2065766c6f736572,%rax
  4020a7:	76 65 20 
  4020aa:	48 89 45 18          	mov    %rax,0x18(%rbp)
  4020ae:	48 b8 73 65 72 76 65 	movabs $0x6120726576726573,%rax
  4020b5:	72 20 61 
  4020b8:	48 89 45 20          	mov    %rax,0x20(%rbp)
  4020bc:	c7 45 28 64 64 72 65 	movl   $0x65726464,0x28(%rbp)
  4020c3:	66 c7 45 2c 73 73    	movw   $0x7373,0x2c(%rbp)
  4020c9:	c6 45 2e 00          	movb   $0x0,0x2e(%rbp)
  4020cd:	89 df                	mov    %ebx,%edi
  4020cf:	e8 7c ea ff ff       	callq  400b50 <close@plt>
  4020d4:	b8 ff ff ff ff       	mov    $0xffffffff,%eax
  4020d9:	e9 93 00 00 00       	jmpq   402171 <init_driver+0x1b9>
  4020de:	48 c7 04 24 00 00 00 	movq   $0x0,(%rsp)
  4020e5:	00 
  4020e6:	48 c7 44 24 08 00 00 	movq   $0x0,0x8(%rsp)
  4020ed:	00 00 
  4020ef:	66 c7 04 24 02 00    	movw   $0x2,(%rsp)
  4020f5:	48 63 50 14          	movslq 0x14(%rax),%rdx
  4020f9:	48 8b 40 18          	mov    0x18(%rax),%rax
  4020fd:	48 8d 7c 24 04       	lea    0x4(%rsp),%rdi
  402102:	b9 0c 00 00 00       	mov    $0xc,%ecx
  402107:	48 8b 30             	mov    (%rax),%rsi
  40210a:	e8 a1 ea ff ff       	callq  400bb0 <__memmove_chk@plt>
  40210f:	66 c7 44 24 02 3b 6e 	movw   $0x6e3b,0x2(%rsp)
  402116:	ba 10 00 00 00       	mov    $0x10,%edx
  40211b:	48 89 e6             	mov    %rsp,%rsi
  40211e:	89 df                	mov    %ebx,%edi
  402120:	e8 0b eb ff ff       	callq  400c30 <connect@plt>
  402125:	85 c0                	test   %eax,%eax
  402127:	79 32                	jns    40215b <init_driver+0x1a3>
  402129:	41 b8 60 27 40 00    	mov    $0x402760,%r8d
  40212f:	b9 20 27 40 00       	mov    $0x402720,%ecx
  402134:	48 c7 c2 ff ff ff ff 	mov    $0xffffffffffffffff,%rdx
  40213b:	be 01 00 00 00       	mov    $0x1,%esi
  402140:	48 89 ef             	mov    %rbp,%rdi
  402143:	b8 00 00 00 00       	mov    $0x0,%eax
  402148:	e8 23 eb ff ff       	callq  400c70 <__sprintf_chk@plt>
  40214d:	89 df                	mov    %ebx,%edi
  40214f:	e8 fc e9 ff ff       	callq  400b50 <close@plt>
  402154:	b8 ff ff ff ff       	mov    $0xffffffff,%eax
  402159:	eb 16                	jmp    402171 <init_driver+0x1b9>
  40215b:	89 df                	mov    %ebx,%edi
  40215d:	e8 ee e9 ff ff       	callq  400b50 <close@plt>
  402162:	66 c7 45 00 4f 4b    	movw   $0x4b4f,0x0(%rbp)
  402168:	c6 45 02 00          	movb   $0x0,0x2(%rbp)
  40216c:	b8 00 00 00 00       	mov    $0x0,%eax
  402171:	48 8b 4c 24 18       	mov    0x18(%rsp),%rcx
  402176:	64 48 33 0c 25 28 00 	xor    %fs:0x28,%rcx
  40217d:	00 00 
  40217f:	74 05                	je     402186 <init_driver+0x1ce>
  402181:	e8 aa e9 ff ff       	callq  400b30 <__stack_chk_fail@plt>
  402186:	48 83 c4 28          	add    $0x28,%rsp
  40218a:	5b                   	pop    %rbx
  40218b:	5d                   	pop    %rbp
  40218c:	c3                   	retq   

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000000000040218d <driver_post>:
  40218d:	53                   	push   %rbx
  40218e:	48 83 ec 10          	sub    $0x10,%rsp
  402192:	48 89 cb             	mov    %rcx,%rbx
  402195:	85 d2                	test   %edx,%edx
  402197:	74 27                	je     4021c0 <driver_post+0x33>
  402199:	48 89 f2             	mov    %rsi,%rdx
  40219c:	be 78 27 40 00       	mov    $0x402778,%esi
  4021a1:	bf 01 00 00 00       	mov    $0x1,%edi
  4021a6:	b8 00 00 00 00       	mov    $0x0,%eax
  4021ab:	e8 50 ea ff ff       	callq  400c00 <__printf_chk@plt>
  4021b0:	66 c7 03 4f 4b       	movw   $0x4b4f,(%rbx)
  4021b5:	c6 43 02 00          	movb   $0x0,0x2(%rbx)
  4021b9:	b8 00 00 00 00       	mov    $0x0,%eax
  4021be:	eb 3e                	jmp    4021fe <driver_post+0x71>
  4021c0:	48 85 ff             	test   %rdi,%rdi
  4021c3:	74 2b                	je     4021f0 <driver_post+0x63>
  4021c5:	80 3f 00             	cmpb   $0x0,(%rdi)
  4021c8:	74 26                	je     4021f0 <driver_post+0x63>
  4021ca:	48 89 0c 24          	mov    %rcx,(%rsp)
  4021ce:	49 89 f1             	mov    %rsi,%r9
  4021d1:	41 b8 ec 22 40 00    	mov    $0x4022ec,%r8d
  4021d7:	48 89 f9             	mov    %rdi,%rcx
  4021da:	ba 8f 27 40 00       	mov    $0x40278f,%edx
  4021df:	be 6e 3b 00 00       	mov    $0x3b6e,%esi
  4021e4:	bf 60 27 40 00       	mov    $0x402760,%edi
  4021e9:	e8 be f5 ff ff       	callq  4017ac <submitr>
  4021ee:	eb 0e                	jmp    4021fe <driver_post+0x71>
  4021f0:	66 c7 03 4f 4b       	movw   $0x4b4f,(%rbx)
  4021f5:	c6 43 02 00          	movb   $0x0,0x2(%rbx)
  4021f9:	b8 00 00 00 00       	mov    $0x0,%eax
  4021fe:	48 83 c4 10          	add    $0x10,%rsp
  402202:	5b                   	pop    %rbx
  402203:	c3                   	retq
  402204:	90                   	nop
  402205:	90                   	nop
  402206:	90                   	nop
  402207:	90                   	nop
  402208:	90                   	nop
  402209:	90                   	nop
  40220a:	90                   	nop
  40220b:	90                   	nop
  40220c:	90                   	nop
  40220d:	90                   	nop
  40220e:	90                   	nop
  40220f:	90                   	nop

0000000000402210 <__libc_csu_init>:
  402210:	48 89 6c 24 d8       	mov    %rbp,-0x28(%rsp)
  402215:	4c 89 64 24 e0       	mov    %r12,-0x20(%rsp)
  40221a:	48 8d 2d df 0b 20 00 	lea    0x200bdf(%rip),%rbp        # 602e00 <__do_global_dtors_aux_fini_array_entry>
  402221:	4c 8d 25 d0 0b 20 00 	lea    0x200bd0(%rip),%r12        # 602df8 <__frame_dummy_init_array_entry>
  402228:	4c 89 6c 24 e8       	mov    %r13,-0x18(%rsp)
  40222d:	4c 89 74 24 f0       	mov    %r14,-0x10(%rsp)
  402232:	4c 89 7c 24 f8       	mov    %r15,-0x8(%rsp)
  402237:	48 89 5c 24 d0       	mov    %rbx,-0x30(%rsp)
  40223c:	48 83 ec 38          	sub    $0x38,%rsp
  402240:	4c 29 e5             	sub    %r12,%rbp
  402243:	41 89 fd             	mov    %edi,%r13d
  402246:	49 89 f6             	mov    %rsi,%r14
  402249:	48 c1 fd 03          	sar    $0x3,%rbp
  40224d:	49 89 d7             	mov    %rdx,%r15
  402250:	e8 6b e8 ff ff       	callq  400ac0 <_init>
  402255:	48 85 ed             	test   %rbp,%rbp
  402258:	74 1c                	je     402276 <__libc_csu_init+0x66>
  40225a:	31 db                	xor    %ebx,%ebx
  40225c:	0f 1f 40 00          	nopl   0x0(%rax)
  402260:	4c 89 fa             	mov    %r15,%rdx
  402263:	4c 89 f6             	mov    %r14,%rsi
  402266:	44 89 ef             	mov    %r13d,%edi
  402269:	41 ff 14 dc          	callq  *(%r12,%rbx,8)
  40226d:	48 83 c3 01          	add    $0x1,%rbx
  402271:	48 39 eb             	cmp    %rbp,%rbx
  402274:	75 ea                	jne    402260 <__libc_csu_init+0x50>
  402276:	48 8b 5c 24 08       	mov    0x8(%rsp),%rbx
  40227b:	48 8b 6c 24 10       	mov    0x10(%rsp),%rbp
  402280:	4c 8b 64 24 18       	mov    0x18(%rsp),%r12
  402285:	4c 8b 6c 24 20       	mov    0x20(%rsp),%r13
  40228a:	4c 8b 74 24 28       	mov    0x28(%rsp),%r14
  40228f:	4c 8b 7c 24 30       	mov    0x30(%rsp),%r15
  402294:	48 83 c4 38          	add    $0x38,%rsp
  402298:	c3                   	retq
  402299:	0f 1f 80 00 00 00 00 	nopl   0x0(%rax)

00000000004022a0 <__libc_csu_fini>:
  4022a0:	f3 c3                	repz retq
  4022a2:	90                   	nop
  4022a3:	90                   	nop

Disassembly of section .fini:

00000000004022a4 <_fini>:
  4022a4:	48 83 ec 08          	sub    $0x8,%rsp
  4022a8:	48 83 c4 08          	add    $0x8,%rsp
  4022ac:	c3                   	retq
```