2020 SCTF 部分WriteUp

原创

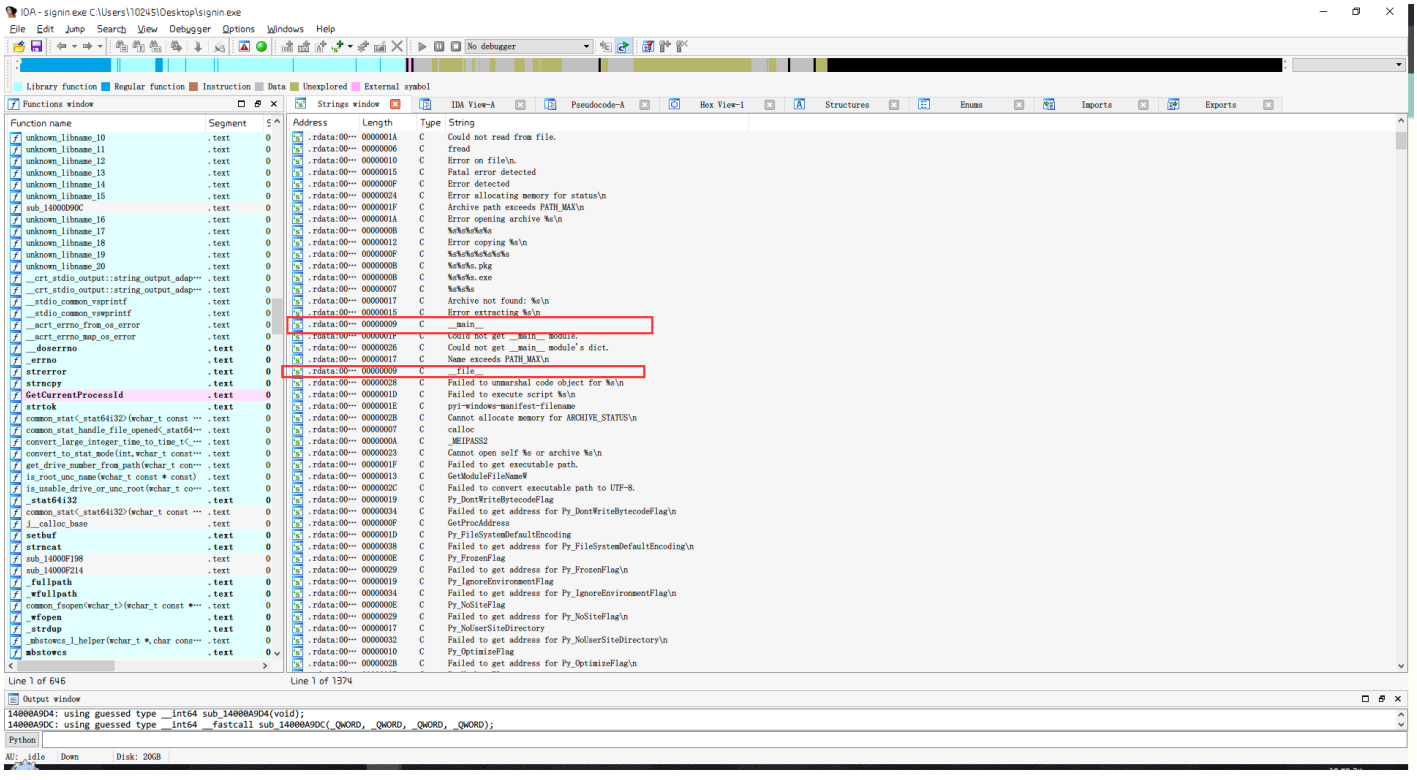
Hk_Mayfly 于 2020-07-06 09:31:00 发布 967 收藏 1

signin

准备

signin.exe：https://wwa.lanzous.com/inlQdec11zi

程序分析

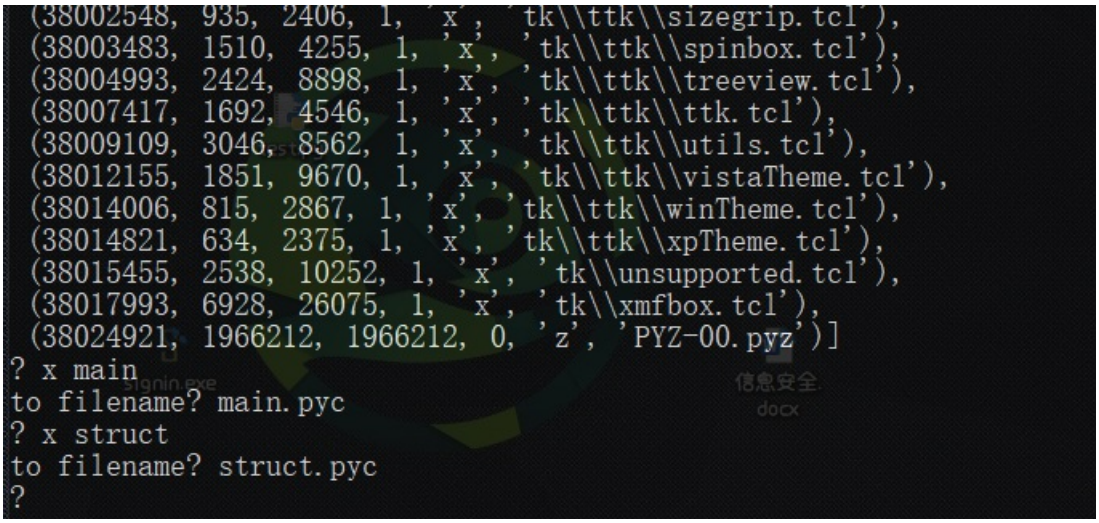


可以判断出，这个程序实际上是由Python打包成的可执行文件，且在运行这个程序时，在同目录下产生了一个tmp.dll文件，猜测是程序调用某些函数的接口。

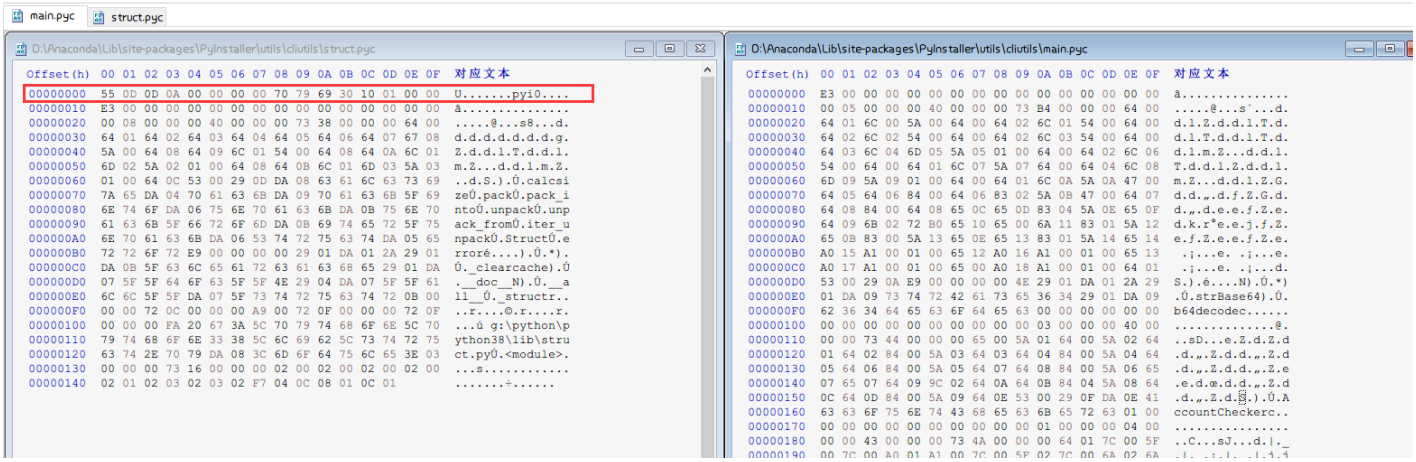
反编译

使用archive_viewer.py反编译为字节码文件

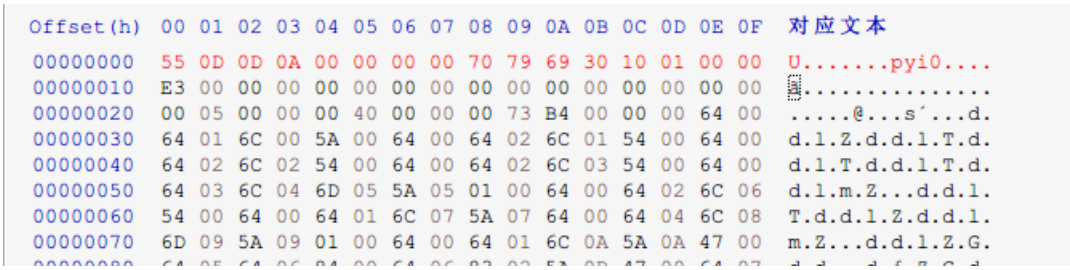
```
python archive_viewer.py signin.exe
```



修补文件



55 0D 0D 0A 00 00 00 00 70 79 69 30 10 01 00 00



程序是在Python3.8环境下打包，因此我们需要在Python3.8下使用uncompyle6

```
uncompyle6 main.pyc > main.py
```

得到py文件

```
# uncompyle6 version 3.7.2
# Python bytecode 3.8 (3413)
# Decompiled from: Python 3.8.0 (tags/v3.8.0:fa919fd, Oct 14 2019, 19:37:50) [MSC v.1916 64 bit (AMD64)]
# Embedded file name: main.py
# Compiled at: 1995-09-28 00:18:56
# Size of source mod 2**32: 272 bytes
import sys
from PyQt5.QtCore import *
from PyQt5.QtWidgets import *
from signin import *
from mydata import strBase64
from ctypes import *
import _ctypes
from base64 import b64decode
import os

class AccountChecker:

    def __init__(self):
        self.dllname = './tmp.dll'
        self.dll = self._AccountChecker__release_dll()
        self.enc = self.dll.enc
        self.enc.argtypes = (c_char_p, c_char_p, c_char_p, c_int)
        self.enc.restype = c_int
        self.accounts = {b'SCTFer': b64decode(b'PLHCu+fujfZmMOMLGHCyWWOq5H5HDN2R5nHnlV30Q0EA')}
        self.try_times = 0

    def __release_dll(self):
        with open(self.dllname, 'wb') as (f):
            f.write(b64decode(strBase64.encode('ascii')))
        return WinDLL(self.dllname)

    def clean(self):
        _ctypes.FreeLibrary(self.dll._handle)
        if os.path.exists(self.dllname):
            os.remove(self.dllname)

    def _error(self, error_code):
        errormsg = {0:'Unknown Error',
         1:'Memory Error'}
        QMessageBox.information(None, 'Error', errormsg[error_code], QMessageBox.Abort, QMessageBox.Abor
        sys.exit(1)

    def __safe(self, username: bytes, password: bytes):
        pwd_safe = b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x0
        status = self.enc(username, password, pwd_safe, len(pwd_safe))
        return (pwd_safe, status)

```

```
49      def check(self, username, password):
50          self.try_times += 1
51          if username not in self.accounts:
52              return False
53          encrypted_pwd, status = self._AccountChecker__safe(username, password)
54          if status == 1:
55              self._AccountChecker__error(1)
56          if encrypted_pwd != self.accounts[username]:
57              return False
58          self.try_times -= 1
59          return True
60
61
62  class SignInWnd(QMainWindow, Ui_QWidget):
63
64      def __init__(self, checker, parent=None):
65          super().__init__(parent)
66          self.checker = checker
67          self.setupUi(self)
68          self.PB_signin.clicked.connect(self.on_confirm_button_clicked)
69
70      @pyqtSlot()
71      def on_confirm_button_clicked(self):
72          username = bytes((self.LE_usrname.text()), encoding='ascii')
73          password = bytes((self.LE_pwd.text()), encoding='ascii')
74          if username == b'' or password == b'':
75              self.check_input_msgbox()
76          else:
77              self.msgbox(self.checker.check(username, password))
78
79      def check_input_msgbox(self):
80          QMessageBox.information(None, 'Error', 'Check Your Input!', QMessageBox.Ok, QMessageBox.Ok)
81
82      def msgbox(self, status):
83          msg_ex = {0:'',
84           1:'',
85           2:"It's no big deal, try again!",
86           3:'Useful information is in the binary, guess what?'}
87          msg = 'Succeeded! Flag is your password' if status else 'Failed to sign in\n' + msg_ex[(self.che
88          QMessageBox.information(None, 'SCTF2020', msg, QMessageBox.Ok, QMessageBox.Ok)
89
90
91  if __name__ == '__main__':
92      app = QApplication(sys.argv)
93      checker = AccountChecker()
94      sign_in_wnd = SignInWnd(checker)
95      sign_in_wnd.show()
96      app.exec()
97      checker.clean()
98      sys.exit()
99  # okay decompiling main.pyc
```

代码分析

通过代码我们能够了解到这些信息

1.

```
elf.dllname = './tmp.dll'
```

调用了tmp.dll文件作为接口。

2.

```
    def __safe(self, username: bytes, password: bytes):
        pwd_safe = b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
        status = self.enc(username, password, pwd_safe, len(pwd_safe))
        return (pwd_safe, status)

    def check(self, username, password):
        self.try_times += 1
        if username not in self.accounts:
            return False
        encrypted_pwd, status = self._AccountChecker__safe(username, password)
        if status == 1:
            self._AccountChecker__error(1)
        if encrypted_pwd != self.accounts[username]:
            return False
        self.try_times -= 1
        return True
```

```
self.accounts = {b'SCTFer': b64decode(b'PLHCu+fujfZmMOMLGHCyWWOq5H5HDN2R5nHnlV30Q0EA')}
```

调用tmp.dll文件中的enc函数，传入username, password, pwd_safe, len(pwd_safe)，实际就是将password加密后存储到pwd_safe字节码中。最后用pwd_safe与b64decode(b'PLHCu+fujfZmMOMLGHCyWWOq5H5HDN2R5nHnlV30Q0EA')比较，且我们能够了解到用户名应该是SCTFer，且最后返回的status一个为非1。

打开tmp.dll文件，找到enc函数

```
16  const char *Str; // [rsp+1D8h] [rbp+1B8h]
17  __int64 v19; // [rsp+1E0h] [rbp+1C0h]
18  int v20; // [rsp+1E8h] [rbp+1C8h]
19
20  v20 = a4;                                   // pwd_safe长度
21  v19 = a3;                                   // pwd_safe
22  Str = a2;                                   // password
23  v17 = a1;                                   // username
24  v4 = &v9;
25  for ( i = 110i64; i; --i )
26  {
27    *(_DWORD *)v4 = -858993460;
28    v4 += 4;
29  }
30  sub_180011078((__int64)&unk_180020003);
31  v10 = j_strlen(Str);                        // 密码长度
32  v11 = j_strlen(v17);                        // 用户名长度
33  if ( v10 <= v20 )
34  {
35    while ( v10 < 32 )
36      Str[v10++] = 0;
37    v12 = 0;
38    for ( j = 0; j < 4; ++j )                 // 循环4次
39    {
40      _mm_lfence();
41      memset(&Dst, 0, sizeof(Dst));
42      j_memcpy(&Dst, &Str[v12], 8ui64);       // 每次给Dst传入password的8字节数据
43      Dst = sub_180011311(Dst);               // 加密函数
44      j_memcpy((void *)(v12 + v19), &Dst, 8ui64);
45      v12 += 8;
46    }
47    for ( k = 0; k < 32; ++k )                // 数据异或
48    {
49      v16 = k;
50      *(_BYTE *)(v19 + k) ^= v17[k % v11];
51    }
52    *(_BYTE *)(v19 + 32) = 0;
53    v6 = 0i64;
54  }
55  else
56  {
57    v6 = 1i64;
58  }
59  v7 = v6;
60  sub_18001131B(&v9, &unk_18001A4A0);
61  return v7;
62}
```

观察代码，实际操作可以分为两部分，逆向分析

异或操作

第47~54行代码实际上就是将Dst与用户名循环异或，最后得到b64decode(b'PLHCu+fujfZmMOMLGHCyWWOq5H5HDN2R5nHnlV30Q0EA')，因此我们只需要逆向异或就能得到加密后的Dst

```
from base64 import *

username = "SCTFer"
pwd_safe = b64decode('PLHCu+fujfZmMOMLGHCyWWOq5H5HDN2R5nHnlV30Q0EA')
# print (len(pwd_safe))
num = ["%02x" % x for x in pwd_safe]
hex_num = [int(x, 16) for x in num]

print(num)
# print (len(num))
for i in range(32):
    hex_num[i] ^= ord(username[i % len(username)])
# print (hex_num)
hex_nums = bytes.fromhex(''.join([hex(x)[2:].rjust(2, '0') for x in hex_num]))

print (hex_nums)
```

得到

> **b'o\xf2\x96\xfd\x82\x9c\xde\xb52v\x86yK3\xe6\x1f\x06\xd8\xb7=\x13J\xb8\xe3\xb52\xb3\xd38\x86\x10\x02\x00'**

加密操作

每次传入了8字节数据进行加密（总共64字节），打开sub_180011311函数

```
__int64 __fastcall sub_180013CE0(__int64 a1)
{
  __int64 *v1; // rdi
  signed __int64 i; // rcx
  __int64 v4; // [rsp+0h] [rbp-20h]
  int j; // [rsp+24h] [rbp+4h]
  __int64 v6; // [rsp+120h] [rbp+100h]

  v6 = a1;
  v1 = &v4;
  for ( i = 66i64; i; --i )
  {
    *(_DWORD *)v1 = -858993460;
    v1 = (__int64 *)((char *)v1 + 4);
  }
  sub_180011078((__int64)&unk_180020003);
  for ( j = 0; j < 64; ++j )
  {
    if ( v6 >= 0 )
      v6 = sub_18001130C(2 * v6);
    else
      v6 = sub_18001130C(2 * v6 ^ 0xB0004B7679FA26B3ui64);
  }
  return v6;
}
```

仔细观察代码，实际上这部分代码是使用CRC32的查表法，对数据进行加密。

加密原理实际上就是CRC32算法---输入一组长度32的字符串，每8个字节分为1组，共4组。对每一组取首位，判断正负。正值，左移一位；负值，左移一位，再异或0xB0004B7679FA26B3。重复判断操作64次，得到查表法所用的表。

因此我们只需要将整个加密过程逆向操作得到查表法的表，再进行CRC32计算，就能得到输入。

```
secret = []

# for i in range(4):
#     secret.append(int(hex_nums[i*8:(i + 1) * 8][::-1].hex(),16))

for i in range(4):
    secret.append(int.from_bytes(hex_nums[i*8:(i + 1) * 8], byteorder="little"))

print (secret)

key = 0xB0004B7679FA26B3

flag = ""

for s in secret:
    for i in range(64):
        sign = s & 1
        if sign == 1:
            s ^= key
        s //= 2
        if sign == 1:
            s |= 0x8000000000000000
    print(hex(s))
    j = 0
    while j < 8:
        flag += chr(s&0xFF)
        s >>= 8
        j += 1
print(flag)
```

因为计算机中采用小端排序，因此需要注意分组倒序。得到

```
[13105084052108931695, 2298581059073635890, 16408946688824694790, 148766366331253429]
0x3165577b46544353
0x5f6f545f336d3063
0x3230325f66746353
0x7d21215f65725f30
SCTF{WelcOm3_To_Sctf_2020_re_!!}
```

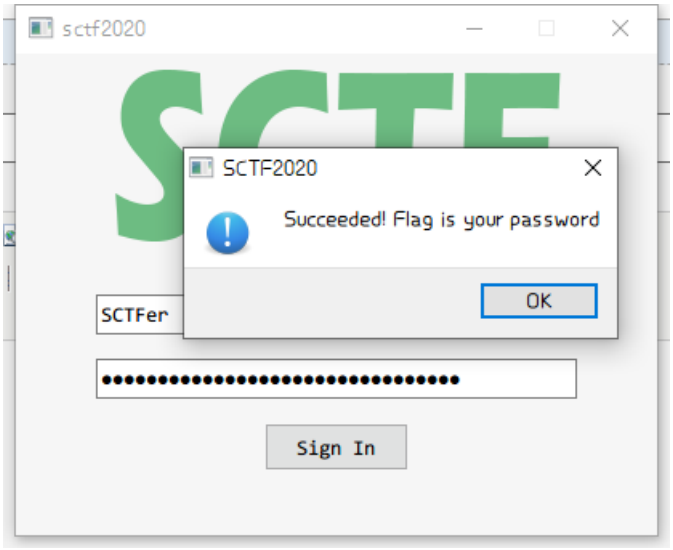
脚本

```
from base64 import *

username = "SCTFer"
pwd_safe = b64decode('PLHCu+fujfZmMOMLGHCyWWOq5H5HDN2R5nHnlV30Q0EA')
# print (len(pwd_safe))
num = ["%02x" % x for x in pwd_safe]
hex_num = [int(x, 16) for x in num]

print(num)
# print (len(num))
for i in range(32):
    hex_num[i] ^= ord(username[i % len(username)])
# print (hex_num)
hex_nums = bytes.fromhex(''.join([hex(x)[2:].rjust(2, '0') for x in hex_num]))

print (hex_nums)

secret = []

# for i in range(4):
#     secret.append(int(hex_nums[i*8:(i + 1) * 8][::-1].hex(),16))

for i in range(4):
    secret.append(int.from_bytes(hex_nums[i*8:(i + 1) * 8], byteorder="little"))

print (secret)

key = 0xB0004B7679FA26B3

flag = ""

for s in secret:
    for i in range(64):
        sign = s & 1
        if sign == 1:
            s ^= key
        s //= 2
        if sign == 1:
            s |= 0x8000000000000000
    print(hex(s))
    j = 0
    while j < 8:
        flag += chr(s&0xFF)
        s >>= 8
        j += 1
print(flag)
```

get flag!

username:SCTFer

password:SCTF{We1c0m3_To_Sctf_2020_re_!!}



get_up

```
1  void sub_402700()
2  {
3    char *v0; // ST14_4
4    HMODULE lpAddress; // ST18_4
5    DWORD flOldProtect; // [esp+Ch] [ebp-14h]
6    char Dst; // [esp+10h] [ebp-10h]
7
8    printf("you should give me a word:");
9    memset(&Dst, 0, 0xAu);
10   scanf_s("%s", &Dst, 10);
11   if ( strlen(&Dst) > 6 || !sub_401DF0(&Dst) )
12   {
13     sub_401080(std::cout, "try again");
14     exit(0);
15   }
16   v0 = sub_402B00(".reioc");
17   lpAddress = GetModuleHandleW(0) + (*((_DWORD *)v0 + 3) >> 2);
18   VirtualProtect(lpAddress, *((_DWORD *)v0 + 4), 0x40u, &flOldProtect);
19   sub_402610((int)lpAddress, &Dst);
20 }
```

这是实际就是在说明输入字符串长度不大于6，且通过sub_401DF0返回1

```
char __cdecl sub_401DF0(char *Str)
{
  char result; // al
  size_t Size; // [esp+Ch] [ebp-90h]
  signed int i; // [esp+14h] [ebp-88h]
  signed int j; // [esp+14h] [ebp-88h]
  char v5; // [esp+18h] [ebp-84h]
  char Str2; // [esp+30h] [ebp-6Ch]
  char Dst; // [esp+54h] [ebp-48h]
  char v8[39]; // [esp+55h] [ebp-47h]
  unsigned __int8 v9[16]; // [esp+7Ch] [ebp-20h]
  int v10; // [esp+98h] [ebp-4h]

  Size = strlen(Str);
  for ( i = 0; i < 1000000; ++i )
    sub_402C90(Str, Size, (int)v9);
  memset(&Dst, 0, 0x28u);
  sub_4015C0("0123456789abcdef");
  v10 = 0;
  for ( j = 0; j < 16; ++j )
  {
    *(&Dst + 2 * j) = *(_BYTE *)sub_4019A0((signed int)v9[j] >> 4);
    v8[2 * j] = *(_BYTE *)sub_4019A0(v9[j] % 16);
  }
  printf("\n");
  strcpy(&Str2, "32c1d123c193aecc4280a5d7925a2504");// sycsyc
  if ( !strcmp(&Dst, &Str2) )
  {
    v10 = -1;
    std::basic_string<char,std::char_traits<char>,std::allocator<char>>::~basic_string<char,std::char_traits<char>,std::allocator<char>>(&v5);
    result = 1;
```

返回1，实际就是满足加密后的Dst与32c1d123c193aecc4280a5d7925a2504相同，实际是MD5加密，得到输入为sycsyc

接下来，程序查找.reioc段，并将.reioc段数据与sycsyc循环异或，写出IDAPython脚本

```
beg_adr = 0x405000
dst = "sycsyc"
for i in range(0,0x200,16):
    for j in range(16):
        PatchByte(beg_adr+i+j,Byte(beg_adr+i+j)^ord(dst[j%6]))
```

然后跟去混淆方法类似，先转换为Data，再强制分析数据，转换为函数。

```
int sub_405000()
{
  sub_403120();                                 // flag plz!
  return sub_4027F0();
}
```

打开sub_4027F0函数

```
void sub_4027F0()
{
  char *v0; // ST18_4
  HMODULE lpAddress; // ST1C_4
  signed int i; // [esp+10h] [ebp-40h]
  DWORD flOldProtect; // [esp+14h] [ebp-3Ch]
  char Dst[40]; // [esp+18h] [ebp-38h]
  char Str[12]; // [esp+40h] [ebp-10h]

  memset(Dst, 0, 0x28u);
  memset(Str, 0, 0xAu);
  scanf_s("%s", Dst, 40);
  if ( strlen(Dst) != 30 )                    // flag长度为30
  {
    sub_401080(std::cout, "try again");
    exit(0);
  }
  for ( i = 0; i < 5; ++i )
    Str[i] = Dst[i];
  v0 = sub_402B00(".ebata");
  lpAddress = GetModuleHandleW(0) + (*((_DWORD *)v0 + 3) >> 2);
  VirtualProtect(lpAddress, *((_DWORD *)v0 + 4), 0x40u, &flOldProtect);
  sub_4025B0((int)lpAddress, Str);
  sub_404000();
}
```

这里实际和上面差不多，输入长度为30的flag，取前5个字符，与.ebata段的部分循环异或。（实际就是得到下面sub_404000函数的代码）。这里可以合理猜测flag的前五个字符为**SCTF{**,写出脚本

```
beg_adr = 0x404000
dst = "SCTF{"
for i in range(16,96):
    PatchByte(beg_adr+i,Byte(beg_adr+i)^ord(dst[i%5]))
```

跟上面一样将.ebata段转换为data，再分析代码，转换为函数，开头如果提示栈不平衡，重新单独分析一下就行。

```
13  char v12; // [esp+99Dh] [ebp-Fh]
14  char v13; // [esp+99Eh] [ebp-Eh]
15  char v14; // [esp+99Fh] [ebp-Dh]
16  char v15; // [esp+9A0h] [ebp-Ch]
17  char v16; // [esp+9A1h] [ebp-Bh]
18  char v17; // [esp+9A2h] [ebp-Ah]
19  char v18; // [esp+9A3h] [ebp-9h]
20  char v19; // [esp+9A4h] [ebp-8h]
21
22  v11 = 's';
23  v12 = 'y';
24  v13 = 'c';
25  v14 = 'l';
26  v15 = 'o';
27  v16 = 'v';
28  v17 = 'e';
29  v18 = 'r';
30  v19 = 0;
31  memset(Dst, 0, 0x28u);
32  for ( i = 0; i < strlen(Str); ++i )
33    Dst[i] = Str[i];
34  for ( j = 0; (signed int)j < 256; ++j )
35  {
36    v9[j] = j;
37    v1 = strlen(&v11);
38    v3[j] = *(&v11 + j % v1);
39  }
40  v5 = 0;
41  for ( k = 0; k < 256; ++k )
42  {
43    v5 = (v3[k] + v9[k] + v5) % 256;
44    v4 = v9[k];
45    v9[k] = v9[v5];
46    v9[v5] = v4;
47  }
48  return sub_401A70((int)v9, Dst);
49}
```

这里一个函数实际就是RC4生成S-BOX，另一个函数就是加密函数，key值为syclover

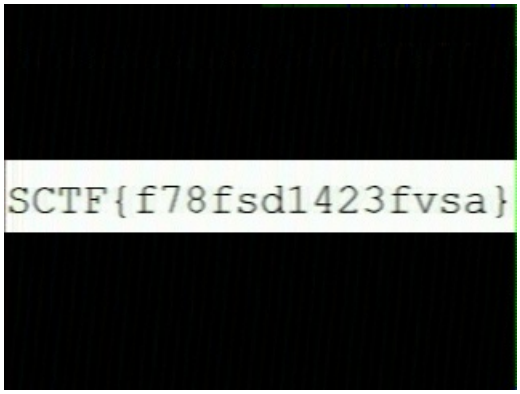
```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
typedef unsigned longULONG;

#pragma warning(disable:4996)

/*初始化函数*/
void rc4_init(unsigned char* s, unsigned char* key, unsigned long Len)
{
    int i = 0, j = 0;
    char k[256] = { 0 };
    unsigned char tmp = 0;
    for (i = 0; i < 256; i++)
    {
        s[i] = i;
        k[i] = key[i % Len];
    }
    for (i = 0; i < 256; i++)
    {
        j = (j + s[i] + k[i]) % 256;
        tmp = s[i];
        s[i] = s[j]; // 交换s[i]和s[j]
        s[j] = tmp;
    }
}

/*加解密*/
void rc4_crypt(unsigned char* s, unsigned char* Data, unsigned long Len)
```

```
{
    int i = 0, j = 0, t = 0;
    unsigned long k = 0;
    unsigned char tmp;
    for (k = 0; k < Len; k++)
    {
        i = (i + 1) % 256;
        j = (j + s[i]) % 256;
        tmp = s[i];
        s[i] = s[j]; // 交换s[x]和s[y]
        s[j] = tmp;
        t = (s[i] + s[j]) % 256;
        Data[k] ^= s[t];
    }
}

int main()
{
    unsigned char s[256] = { 0 }, s2[256] = { 0 }; // S-box
    char key[256] = { "syclover" };
    char pData[512] = { 0 };
    int v12[] = { 128,85,126,45,209,9,37,171,60,86,149,196,54,19,237,114,36,147,178,200,69,236,22,107,103,2
    int i;
    //char m[32] = { 0 };

    for (int i = 0; i < 30; ++i) {
        pData[i] = (char)v12[i];
    }

    unsigned long len = strlen(pData);

    printf("pData=%s\n", pData);
    printf("key=%s,length=%d\n\n", key, strlen(key));
    rc4_init(s, (unsigned char*)key, strlen(key)); // 已经完成了初始化
    printf("完成对S[i]的初始化，如下：\n\n");
    for (i = 0; i < 256; i++)
    {
        printf("%02X", s[i]);
        if (i && (i + 1) % 16 == 0)putchar('\n');
    }
    printf("\n\n");
    for (i = 0; i < 256; i++) // 用s2[i]暂时保留经过初始化的s[i]，很重要的！！！
    {
        s2[i] = s[i];
    }

    printf("已经初始化，现在解密:\n\n");
    printf("len = %d\n", len);
    rc4_crypt(s, (unsigned char*)pData, len);
    printf("pData=%s\n\n", pData);

    system("PAUSE");
    return 0;
}
```

> **SCTF{zzz~(|3[___]_rc4_5o_e4sy}**

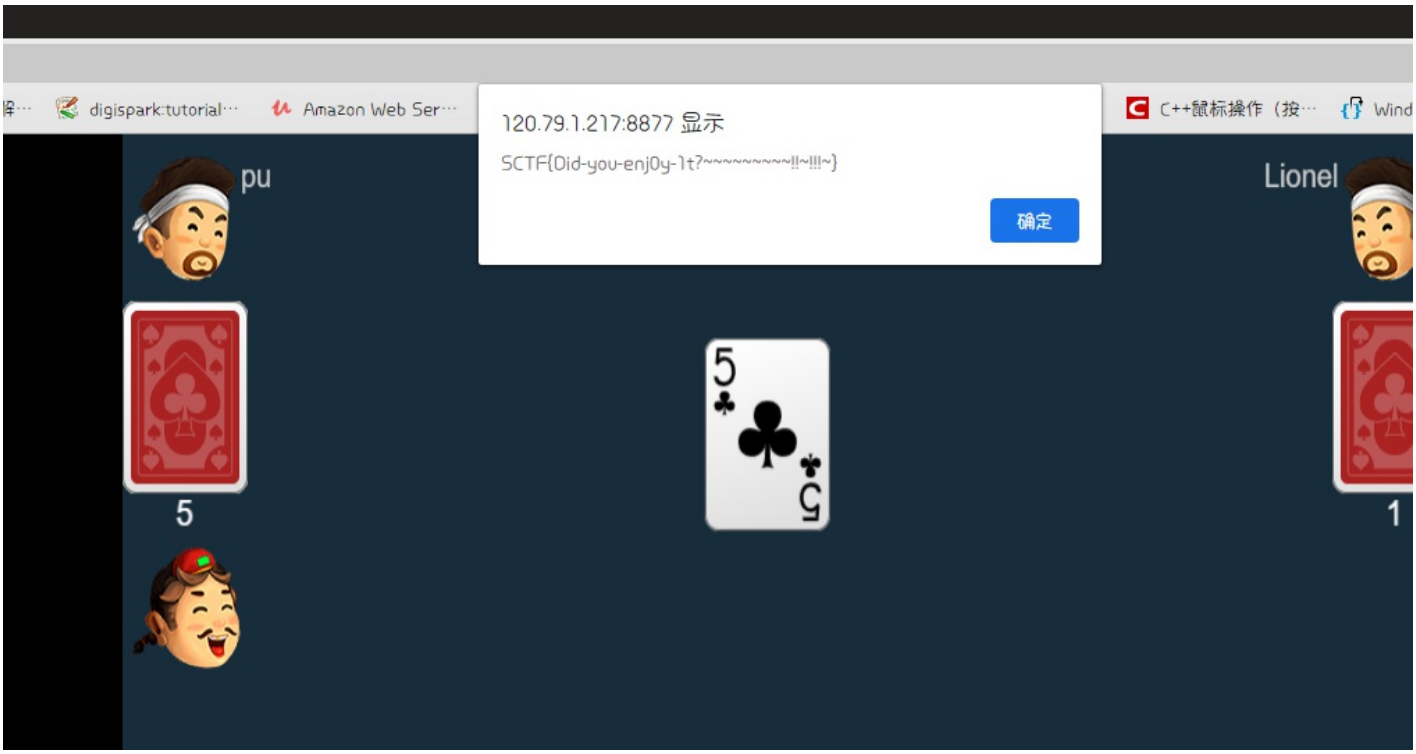
Can you hear

音频文件： https://wwa.lanzous.com/iMv4zecuw3g
音频是SSTV，用软件Robot36接受音频中的数据



doudizhu

只要将手里牌出完，就能获得flag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