

Assignment #4

CPEN 442

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Github Repository (*with solutions*):
https://github.com/EmilMaric/CPEN_442/tree/master/Assignment_4

I. QUESTION #1

Student #:

33657115

Hash:

LTF6A2CBE86F0354722C9B377E9E187885D1DE6B5D

Bits of entropy

$\sim 13 \text{ bits} = \ln(10^4)/\ln(2)$

Password found:

1531

CPU/GPU time spent:

Less than a second

I started off by examining the number of characters in the hashed password. The count came out to 42 characters (168 bits), which didn't match any of the common hashing algorithms. Next, I observed that the first two characters of my hash were non-hex, while the other 40 characters were hex characters.

This led me believe that the first two characters of the hash were stored as the salt, and the following 40 characters were the result of hashing the password using **SHA1**, since **SHA1** produces a 20-character hash (40-character hex-representation).

To crack the password, I ran **oclHashcat** [2], a password cracker that runs on the GPU. It took less than a second for **oclHashcat** to crack the password.

II. QUESTION #2

Student #:

33657115

Hash:

CS0DF2939D499DCC46A693653DB281FDBB016B502B

Bits of entropy

$\sim 37 \text{ bits} = \ln(76^6)/\ln(2)$

Password found:

y%jtqf

CPU/GPU time spent:

3 mins, 30 secs
(70,748,995,584 combinations tried)

Since the format of the hash is the same as Question #1, I made the same assumption as before. Namely, that the hash function used to hash the password was **SHA1**.

Again, I ran **oclHashcat** in order to crack the password. It took the program about three and a half minutes to find the password.

III. QUESTION #3

Student #:

33657115

Found Password:

#l!Je*iDiHBbB50#_Bm

In order to begin, I disassembled the binary using **IDAPro** [1]. This allowed me to step through the assembly code in order to find the password.

The first thing I noticed was that the program was denying access if the length of the string was not nineteen characters (0x13) long. Next, I inputted a nineteen-character long password, which allowed me to progress further through the code.

```
push offset ar1easeEnterPass ; "Please enter password:"
push offset unk_41A550 ; int
call sub_403000
add esp, 8
lea eax, [ebp+var_28]
push eax
push offset dword_41A490
call sub_403470
add esp, 8
lea ecx, [ebp+var_28]
call unknown_libname_1 ; Microsoft VisualC 2-11/net runtime
mov [ebp+var_2C], eax
mov [ebp+var_2D], 1
mov ecx, [ebp+var_2C]
push ecx ; char *
call _strlen
add esp, 4
cmp eax, 13h
jnz short loc_401084
```

Fig. 1. Result of `strlen()` being compared with 0x13

At this point, I noticed that the program was fetching one character at a time from my inputted password string and offset 0x419051, and comparing these two values. I assumed that this was the password that the program was looking for. I extracted 19 characters from this offset location, and inputted this result on the next program iteration. This password finally granted me access.

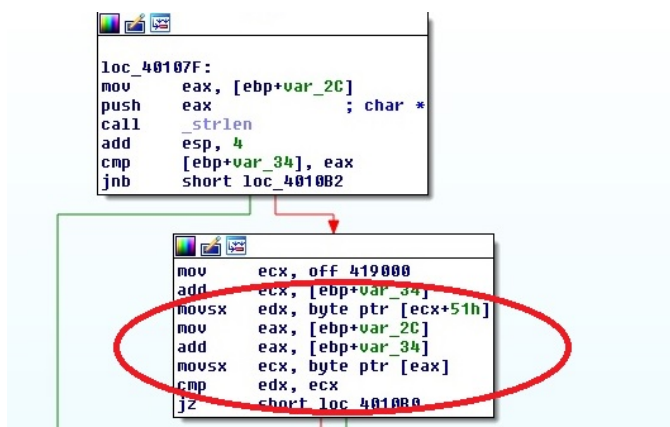


Fig. 2. My input string being compared with the stored password

In order to patch the program, I changed the value of `%ebp + var_2D` to always be 1, indicating that the correct password was entered. When the value of `%ebp + var_2D` was tested (or compared to 0), it would always pass through, and grant me access.

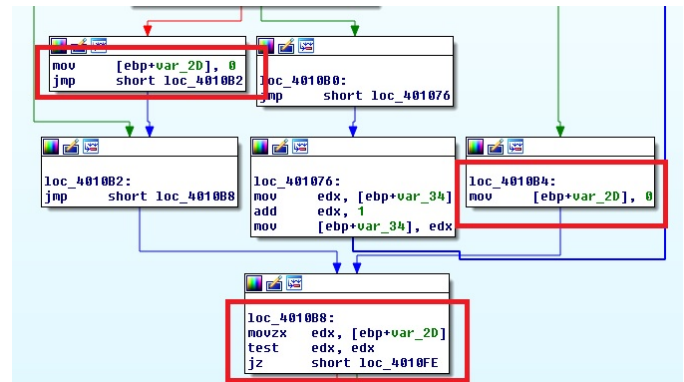


Fig. 3. Assigning `%ebp + var_2D` to 1 prevents the program from jumping to the "Access Denied" block

IV. QUESTION #4

Student #:

33657115

Hash:

929a2e98651FD2DDE3629F8DB8F0BDC32B673BE4

Found Password:

M7rUAV

CPU/GPU time spent:

2 mins, 53 secs

The process to find the required password for this problem was very similar to Question #3. Once again I used **IDAPro**. The presence of a **SHA1** function led me to believe that password was stored as a hash. The only parameter to the **SHA1** function was the input password itself, which led me to assume that no salt was used to hash the password.

```
call    unknown_libname_2 ; Microsoft VisualC 2
push    eax
lea     ecx, [ebp+var_28]
call    unknown_libname_1 ; Microsoft VisualC 2
push    eax
call    SHA1
add     esp, 0Ch
mov     [ebp+var_29], 1
mov     [ebp+var_44], 0
jmp     short loc_40109F
```

Fig. 4. SHA1 function shown with parameters (notice no salt passed)

I noticed that my hashed input string was being compared with a string located at 0x4141F3. I extracted 20 characters from this location and took it to be the password hash. Next, I entered the hash into **oclHashcat** and it generated the corresponding plaintext password.

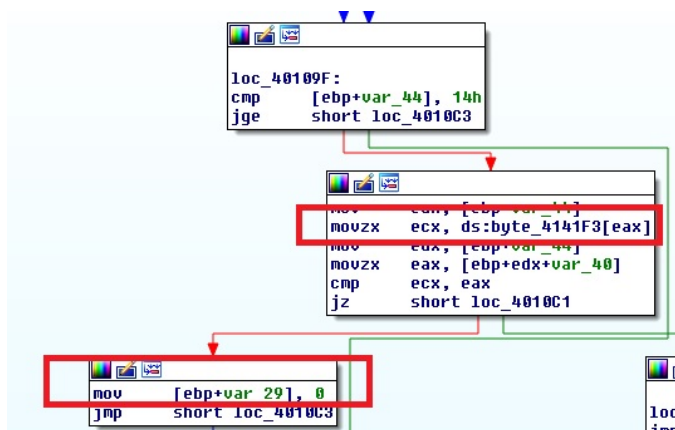


Fig. 5. My hashed input being compared with the hashed password. Also shows the instruction that I patched

To patch the program, I changed the value of `%ebp + var_29` to always be 1. **Fig. 5** highlights where I changed the value of this variable from 0 to 1. This allowed the program to always grant access, regardless of whether the password was correct or not.

In order to allow the user to change the password of the program, I created a Python program that asked the user for the new password, hashed it, and then overwrote the old hashed password, which was stored in static memory in the binary, with the new hashed password. The next time the user ran the program, they would need to enter the new password in order to gain access.

REFERENCES

- [1] *IDAPro*. 2015. URL: <https://www.hex-rays.com/products/ida/> (visited on 10/29/2015).
- [2] Jens 'atom' Steube. *oclHashcat*. 2015. URL: <http://hashcat.net/oclhashcat/> (visited on 10/29/2015).