Lesson 0: What is CTF and who is flagbot?

flagbot (CTF@VIS)

20. January 2024

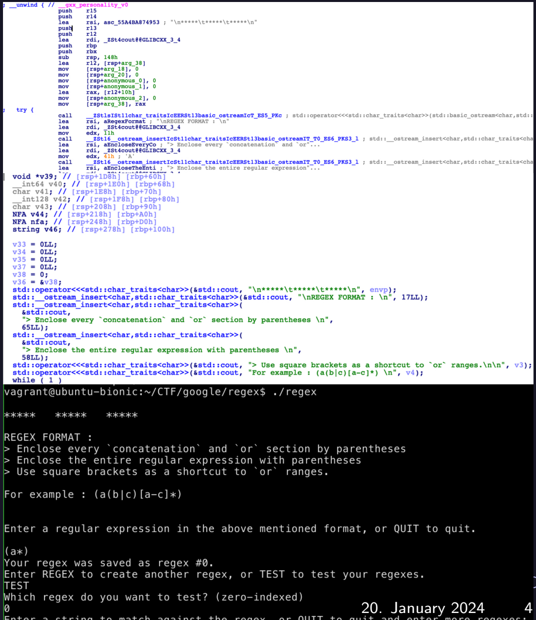
Table of Contents

What is CTF?

- Stands for Capture the Flag
- Sport consisting of solving hacking challenges
- Usually done in a team
- Flag as proof of solving a challenge
    - Example flag: `flagbot{sh0uld_h4ve_g0ne_f0r_the_he4d}`
- Challenges grouped into five major categories: pwn, reversing, web, crypto and misc

pwn challenges

- Usually a small application
- Get remote code execution by finding a vulnerability
- Often need to use a disassembler / decompiler



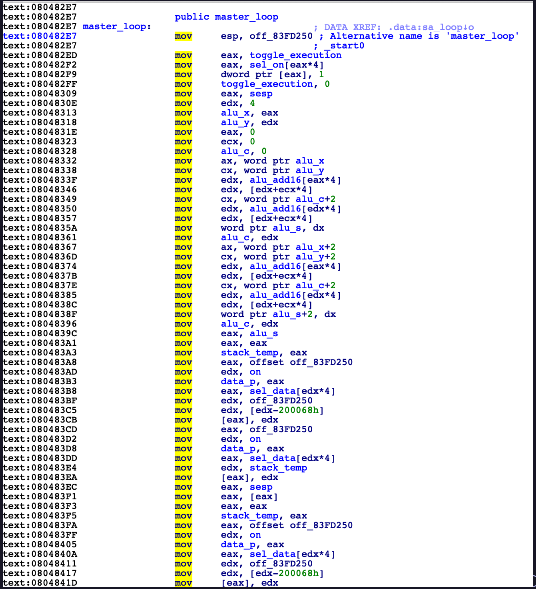
```
; __unwind { // __gxx_personality_v0
                push    r15
                push    r14
                lea     rsi, asc_55A4BA874953 ; "\n*****\t*****\t*****\n"
                push    r13
                push    r12
                lea     rdi, _ZSt4cout@@GLIBCXX_3_4
                push    rbp
                push    rbx
                sub     rsp, 148h
                lea     r12, [rsp+arg_38]
                mov     [rsp+arg_18], 0
                mov     [rsp+arg_20], 0
                mov     [rsp+anonymous_0], 0
                mov     [rsp+anonymous_1], 0
                lea     rax, [r12+10h]
                mov     [rsp+anonymous_2], 0
                mov     [rsp+arg_38], rax
;   try {
                call    __ZStlsISt11char_traitsIcEERSt13basic_ostreamIcT_ES5_PKc ; std::operator<<<std::char_traits<char>>(std::basic_ostream<char,std::
                lea     rsi, aRegexFormat ; "\nREGEX FORMAT : \n"
                lea     rdi, _ZSt4cout@@GLIBCXX_3_4
                mov     edx, 11h
                call    __ZSt16__ostream_insertIcSt11char_traitsIcEERSt13basic_ostreamIT_T0_ES6_PKS3_l ; std::__ostream_insert<char,std::char_traits<cha
                lea     rsi, aEncloseEveryCo ; "> Enclose every `concatenation` and `or"...
                lea     rdi, _ZSt4cout@@GLIBCXX_3_4
                mov     edx, 41h ; 'A'
                call    __ZSt16__ostream_insertIcSt11char_traitsIcEERSt13basic_ostreamIT_T0_ES6_PKS3_l ; std::__ostream_insert<char,std::char_traits<cha
                lea     rsi, aEncloseTheEnti ; "> Enclose the entire regular expression"...
```

```
  void *v39; // [rsp+1D8h] [rbp+60h]
  __int64 v40; // [rsp+1E0h] [rbp+68h]
  char v41; // [rsp+1E8h] [rbp+70h]
  __int128 v42; // [rsp+1F8h] [rbp+80h]
  char v43; // [rsp+208h] [rbp+90h]
  NFA v44; // [rsp+218h] [rbp+A0h]
  NFA nfa; // [rsp+248h] [rbp+D0h]
  string v46; // [rsp+278h] [rbp+100h]

  v33 = 0LL;
  v34 = 0LL;
  v35 = 0LL;
  v37 = 0LL;
  v38 = 0;
  v36 = &v38;
  std::operator<<<std::char_traits<char>>(&std::cout, "\n*****\t*****\t*****\n", envp);
  std::__ostream_insert<char,std::char_traits<char>>(&std::cout, "\nREGEX FORMAT : \n", 17LL);
  std::__ostream_insert<char,std::char_traits<char>>(
    &std::cout,
    "> Enclose every `concatenation` and `or` section by parentheses \n",
    65LL);
  std::__ostream_insert<char,std::char_traits<char>>(
    &std::cout,
    "> Enclose the entire regular expression with parentheses \n",
    58LL);
  std::operator<<<std::char_traits<char>>(&std::cout, "> Use square brackets as a shortcut to `or` ranges.\n\n", v3);
  std::operator<<<std::char_traits<char>>(&std::cout, "For example : (a(b|c)[a-c]*) \n", v4);
  while ( 1 )
```

```
vagrant@ubuntu-bionic:~/CTF/google/regex$ ./regex

*****    *****    *****

REGEX FORMAT :
> Enclose every `concatenation` and `or` section by parentheses
> Enclose the entire regular expression with parentheses
> Use square brackets as a shortcut to `or` ranges.

For example : (a(b|c)[a-c]*)


Enter a regular expression in the above mentioned format, or QUIT to quit.

(a*)
Your regex was saved as regex #0.
Enter REGEX to create another regex, or TEST to test your regexes.
TEST
Which regex do you want to test? (zero-indexed)
0
Enter a string to match against the regex, or QUIT to quit and enter more regexes.
```

reversing challenges

- Very similar to pwn challenges
- Figure out, what the program **exactly** does
- Examples are:
  - Key generator
  - Heavily obfuscated binary



```
text:080482E7
text:080482E7                 public master_loop
text:080482E7 master_loop:                            ; DATA XREF: .data:sa_loop↓o
text:080482E7                 mov     esp, off_83FD250 ; Alternative name is 'master_loop'
text:080482E7                                         ; _start0
text:080482ED                 mov     eax, toggle_execution
text:080482F2                 mov     eax, sel_on[eax*4]
text:080482F9                 mov     dword ptr [eax], 1
text:080482FF                 mov     toggle_execution, 0
text:08048309                 mov     eax, sesp
text:0804830E                 mov     edx, 4
text:08048313                 mov     alu_x, eax
text:08048318                 mov     alu_y, edx
text:0804831E                 mov     eax, 0
text:08048323                 mov     ecx, 0
text:08048328                 mov     alu_c, 0
text:08048332                 mov     ax, word ptr alu_x
text:08048338                 mov     cx, word ptr alu_y
text:0804833F                 mov     edx, alu_add16[eax*4]
text:08048346                 mov     edx, [edx+ecx*4]
text:08048349                 mov     cx, word ptr alu_c+2
text:08048350                 mov     edx, alu_add16[edx*4]
text:08048357                 mov     edx, [edx+ecx*4]
text:0804835A                 mov     word ptr alu_s, dx
text:08048361                 mov     alu_c, edx
text:08048367                 mov     ax, word ptr alu_x+2
text:0804836D                 mov     cx, word ptr alu_y+2
text:08048374                 mov     edx, alu_add16[eax*4]
text:0804837B                 mov     edx, [edx+ecx*4]
text:0804837E                 mov     cx, word ptr alu_c+2
text:08048385                 mov     edx, alu_add16[edx*4]
text:0804838C                 mov     edx, [edx+ecx*4]
text:0804838F                 mov     word ptr alu_s+2, dx
text:08048396                 mov     alu_c, edx
text:0804839C                 mov     eax, alu_s
text:080483A1                 mov     eax, eax
text:080483A3                 mov     stack_temp, eax
text:080483A8                 mov     eax, offset off_83FD250
text:080483AD                 mov     edx, on
text:080483B3                 mov     data_p, eax
text:080483B8                 mov     eax, sel_data[edx*4]
text:080483BF                 mov     edx, off_83FD250
text:080483C5                 mov     edx, [edx-200068h]
text:080483CB                 mov     [eax], edx
text:080483CD                 mov     eax, off_83FD250
text:080483D2                 mov     edx, on
text:080483D8                 mov     data_p, eax
text:080483DD                 mov     eax, sel_data[edx*4]
text:080483E4                 mov     edx, stack_temp
text:080483EA                 mov     [eax], edx
text:080483EC                 mov     eax, sesp
text:080483F1                 mov     eax, [eax]
text:080483F3                 mov     eax, eax
text:080483F5                 mov     stack_temp, eax
text:080483FA                 mov     eax, offset off_83FD250
text:080483FF                 mov     edx, on
text:08048405                 mov     data_p, eax
text:0804840A                 mov     eax, sel_data[edx*4]
text:08048411                 mov     edx, off_83FD250
text:08048417                 mov     edx, [edx-200068h]
text:0804841D                 mov     [eax], edx
```

web challenges

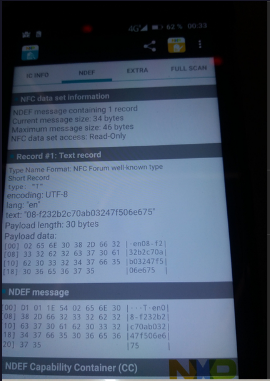
- Focuses on web services, languages and frameworks
- Often a “blackbox”
- Could even have to exploit language bugs
- Examples are:
  - SQL Injection
  - XSS
  - Badly implemented authentication

crypto challenges

- Short for cryptography
- Find weaknesses in specific implementation of existing cryptography protocol
- Analyze published research for specific cryptography protocol
- Examples are:
  - Using 3 as the exponent in RSA
  - Not initializing the IV

misc challenges

- No real focus
- Often includes steganography and some cryptography
- Examples are:
  - Hidden data inside an image
  - Scavenger hunt
  - Reading unknown symbols



NFC data set information

NDEF message containing 1 record
Current message size: 34 bytes
Maximum message size: 46 bytes
NFC data set access: Read-Only

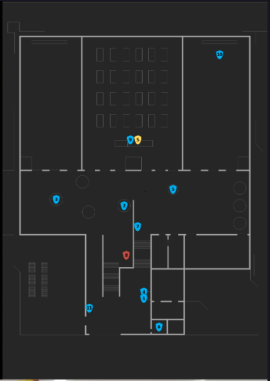
Record #1: Text record

```
Type Name Format: NFC Forum well-known type
Short Record
type: "T"
encoding: UTF-8
lang: "en"
text: "08-f232b2c70ab03247f506e675"
Payload length: 30 bytes
Payload data:
[00] 02 65 6E 30 38 2D 66 32 |·en08-f2|
[08] 33 32 62 32 63 37 30 61 |32b2c70a|
[10] 62 30 33 32 34 37 66 35 |b03247f5|
[18] 30 36 65 36 37 35       |06e675  |
```

NDEF message

```
[00] D1 01 1E 54 02 65 6E 30 |···T·en0|
[08] 38 2D 66 32 33 32 62 32 |8-f232b2|
[10] 63 37 30 61 62 30 33 32 |c70ab032|
[18] 34 37 66 35 30 36 65 36 |47f506e6|
[20] 37 35                   |75      |
```

NDEF Capability Container (CC)



Who is flagbot?

- We are a VIS committee
- Meet every Monday for Training
- Participate (sometimes) in cool CTF events over the Weekends
- Currently ranked decently in Switzerland

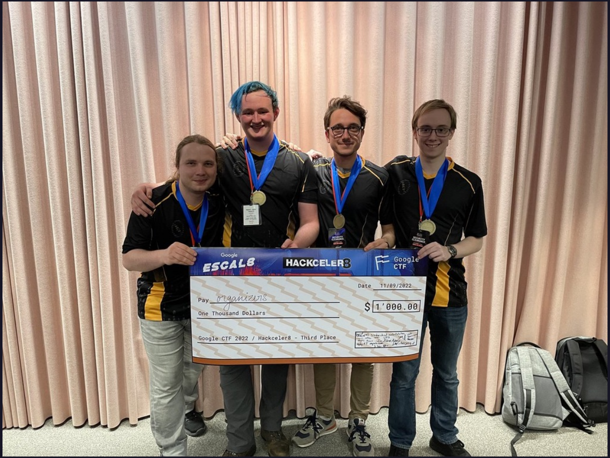
Who is organizers

- Joint team between polyglots (EPFL), cr0wn (UK) and secret.club
- Team up together for larger events
- Last year ranked #6 worldwide, 2022 we were #1
- Multiple big wins, such as best European team at DEFCON and #1 at Tencent CTF 2021

Some Impressions

DEFCON Finals in Las Vegas

Some Impressions



Google CTF Hackceler8

Some Impressions

Google CTF Hackceler8

Some Impressions

SECCON Finals

Some Impressions

Meetup for big events

Some Impressions

Meetup for big events

ctf@vis.ethz.ch Mailing list

- Subscribe at https://lists.vis.ethz.ch/postorius/lists/ctf.lists.vis.ethz.ch/
- We will send E-Mails there, whenever we participate in a CTF event
- Can be used to ask questions, but please keep them **spoiler free!**
- In general used for announcements

Some Practical Example - Hackceler8

- Hackceler8 == Google CTF Finale
- Special type of MISC challenge, mostly game-hacking
- We had to ”reverse engineer” a game and find ways to cheat or exploit bugs

picoCTF

- Beginner CTF
- Ideal way to introduce people to CTF
- Register here: play.picoctf.org