first-fit(Use-After-Free)[Korean]

Unknown macro: 'html'

Excuse the ads! We need some help to keep our site up. Unknown macro: 'html'

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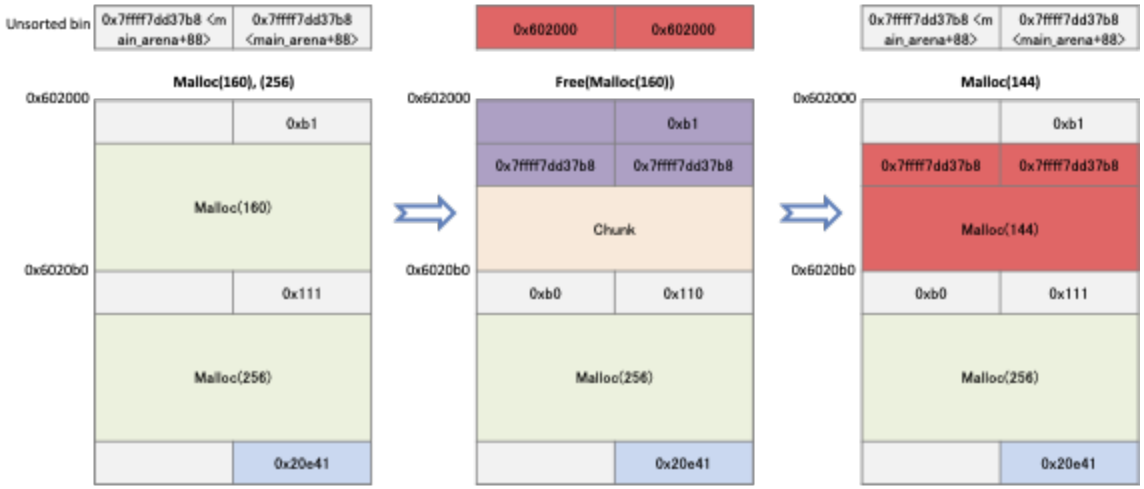
UAF(Use-After-Free)

- UAF .
- 2 , .
  - a , c .
  - , a .
  - .

UAF.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int main()
{
    char* a = malloc(160);
    char* b = malloc(256);
    char* c;

    free(a);

    c = malloc(144);

    strcpy(a, "Secret message");
}
```

UAF-1 flow



- .
  - , .
  - a .

UAF-2.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int main()
{
    char* a = malloc(160);
    strcpy(a, "Secret message");
    free(a);
    printf("%s\n",a);
}
```

Example

Example1

- 160byte, 256byte malloc() .
  - pointer a, b .
  - , 144byte pointer c .
  - , a .

UAF-1.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int main()
{
        char* a = malloc(160);
        char* b = malloc(256);
        char* c;

        free(a);

        c = malloc(144);

        strcpy(c, "Secret message");
        printf("%s\n",a);
}
```

- 0x4005c8 "a" , 0x4005e6 .
  - 0x4005f0 "c" , 0x400616 .
  - 0x40061d UAF .

Breakpoints

```
lazenca0x0@ubuntu:~/Book/4.UAF$ gcc -o UAF UAF.c
lazenca0x0@ubuntu:~/Book/4.UAF$ gdb -q UAF
Reading symbols from UAF...(no debugging symbols found)...done.
gdb-peda$ disassemble main
Dump of assembler code for function main:
   0x00000000004005b6 <+0>:        push   rbp
   0x00000000004005b7 <+1>:        mov    rbp,rsp
   0x00000000004005ba <+4>:        sub    rsp,0x20
   0x00000000004005be <+8>:        mov    edi,0xa0
   0x00000000004005c3 <+13>:        call   0x4004a0 <malloc@plt>
   0x00000000004005c8 <+18>:        mov    QWORD PTR [rbp-0x18],rax
   0x00000000004005cc <+22>:        mov    edi,0x100
   0x00000000004005d1 <+27>:        call   0x4004a0 <malloc@plt>
   0x00000000004005d6 <+32>:        mov    QWORD PTR [rbp-0x10],rax
   0x00000000004005da <+36>:        mov    rax,QWORD PTR [rbp-0x18]
   0x00000000004005de <+40>:        mov    rdi,rax
   0x00000000004005e1 <+43>:        call   0x400470 <free@plt>
   0x00000000004005e6 <+48>:        mov    edi,0x90
   0x00000000004005eb <+53>:        call   0x4004a0 <malloc@plt>
   0x00000000004005f0 <+58>:        mov    QWORD PTR [rbp-0x8],rax
   0x00000000004005f4 <+62>:        mov    rax,QWORD PTR [rbp-0x8]
   0x00000000004005f8 <+66>:        movabs rdx,0x6d20746572636553
   0x0000000000400602 <+76>:        mov    QWORD PTR [rax],rdx
   0x0000000000400605 <+79>:        mov    DWORD PTR [rax+0x8],0x61737365
   0x000000000040060c <+86>:        mov    WORD PTR [rax+0xc],0x6567
   0x0000000000400612 <+92>:        mov    BYTE PTR [rax+0xe],0x0
   0x0000000000400616 <+96>:        mov    rax,QWORD PTR [rbp-0x18]
   0x000000000040061a <+100>:        mov    rdi,rax
   0x000000000040061d <+103>:        call   0x400480 <puts@plt>
   0x0000000000400622 <+108>:        mov    eax,0x0
   0x0000000000400627 <+113>:        leave
   0x0000000000400628 <+114>:        ret
End of assembler dump.
gdb-peda$ b *0x00000000004005c8
Breakpoint 1 at 0x4005c8
gdb-peda$  b *0x00000000004005e6
Breakpoint 2 at 0x4005e6
gdb-peda$ b *0x00000000004005f0
Breakpoint 3 at 0x4005f0
gdb-peda$ b *0x0000000000400616
Breakpoint 4 at 0x400616
gdb-peda$ b *0x000000000040061d
Breakpoint 5 at 0x40061d
gdb-peda$
```

- 160byte malloc() 0x602010 , "a" .
    - Unsorted bin .

Free memory

```
gdb-peda$ r
Starting program: /home/lazenca0x0/Book/4.UAF/UAF

Breakpoint 1, 0x00000000004005c8 in main ()
gdb-peda$ i r rax
rax            0x602010        0x602010
gdb-peda$ c
Continuing.

Breakpoint 2, 0x00000000004005e6 in main ()
gdb-peda$ p main_arena.bins[0]
$1 = (mchunkptr) 0x602000
gdb-peda$ p main_arena.bins[1]
$2 = (mchunkptr) 0x602000
gdb-peda$ p/d main_arena.bins[0].size - 1
$3 = 176
gdb-peda$
```

- 144byte malloc() , Unsorted bin .
- Unsorted bin Unsorted bin .
  - Unsorted bin .
  - Unsorted bin , main_arena.last_remainder .
- Unsorted bin Unsorted bin (0x602010) .
  - 16byte.
  - malloc Unsorted bin (176) .
  - c .
  - "a" .

Reallocate memory

```
gdb-peda$ c
Continuing.

Breakpoint 3, 0x00000000004005f0 in main ()
gdb-peda$ i r rax
rax            0x602010        0x602010
gdb-peda$ p main_arena.last_remainder
$4 = (mchunkptr) 0x0
gdb-peda$ p/d 176 - 160
$5 = 16
gdb-peda$ x/4gx 0x602010 - 0x10
0x602000:        0x0000000000000000        0x00000000000000b1
0x602010:        0x00007ffff7dd1b78        0x00007ffff7dd1b78
gdb-peda$ p/d 0xb0
$7 = 176
gdb-peda$
```

- "Secret message" .
  - a(0x602010) .
- "a" "Secret message" .
  - "a" "a" .
  - , "a" (0x602010) .
  - "a" "c" .

Output the data stored in the pointer of 'a'

```
gdb-peda$ c
Continuing.

Breakpoint 4, 0x0000000000400616 in main ()
gdb-peda$ i r rax
rax            0x602010        0x602010
gdb-peda$ x/s 0x602010
0x602010:        "Secret message"
gdb-peda$ c
Continuing.

Breakpoint 5, 0x000000000040061d in main ()
gdb-peda$ i r rdi
rdi            0x602010        0x602010
gdb-peda$ ni
Secret message

gdb-peda$
```

Example2

- UAF-2.c .
  - 0x4005c8 pointer , 0x4005f5 .
  - 0x400601 .

Breakpoints

```
lazenca0x0@ubuntu:~/Book/4.UAF$ gdb -q ./UAF-2
Reading symbols from ./UAF-2...(no debugging symbols found)...done.
gdb-peda$ disassemble main
Dump of assembler code for function main:
   0x00000000004005b6 <+0>:        push   rbp
   0x00000000004005b7 <+1>:        mov    rbp,rsp
   0x00000000004005ba <+4>:        sub    rsp,0x10
   0x00000000004005be <+8>:        mov    edi,0xa0
   0x00000000004005c3 <+13>:        call   0x4004a0 <malloc@plt>
   0x00000000004005c8 <+18>:        mov    QWORD PTR [rbp-0x8],rax
   0x00000000004005cc <+22>:        mov    rax,QWORD PTR [rbp-0x8]
   0x00000000004005d0 <+26>:        movabs rdx,0x6d20746572636553
   0x00000000004005da <+36>:        mov    QWORD PTR [rax],rdx
   0x00000000004005dd <+39>:        mov    DWORD PTR [rax+0x8],0x61737365
   0x00000000004005e4 <+46>:        mov    WORD PTR [rax+0xc],0x6567
   0x00000000004005ea <+52>:        mov    BYTE PTR [rax+0xe],0x0
   0x00000000004005ee <+56>:        mov    rax,QWORD PTR [rbp-0x8]
   0x00000000004005f2 <+60>:        mov    rdi,rax
   0x00000000004005f5 <+63>:        call   0x400470 <free@plt>
   0x00000000004005fa <+68>:        mov    rax,QWORD PTR [rbp-0x8]
   0x00000000004005fe <+72>:        mov    rdi,rax
   0x0000000000400601 <+75>:        call   0x400480 <puts@plt>
   0x0000000000400606 <+80>:        mov    eax,0x0
   0x000000000040060b <+85>:        leave
   0x000000000040060c <+86>:        ret
End of assembler dump.
gdb-peda$ b *0x00000000004005c8
Breakpoint 1 at 0x4005c8
gdb-peda$ b *0x00000000004005f5
Breakpoint 2 at 0x4005f5
gdb-peda$ b *0x0000000000400601
Breakpoint 3 at 0x400601
gdb-peda$
```

- 0x602010, .
  - .

Allocate memory and Free the memory after stored data in memory.

```
gdb-peda$ r
Starting program: /home/lazenca0x0/Book/4.UAF/UAF-2

Breakpoint 1, 0x00000000004005c8 in main ()
gdb-peda$ i r rax
rax            0x602010        0x602010
gdb-peda$ c
Continuing.

Breakpoint 2, 0x00000000004005f5 in main ()
gdb-peda$ i r rdi
rdi            0x602010        0x602010
gdb-peda$ x/i $rip
=> 0x4005f5 <main+63>:        call   0x400470 <free@plt>
gdb-peda$ x/s 0x602010
0x602010:        "Secret message"
gdb-peda$ ni

0x00000000004005fa in main ()
gdb-peda$ x/30gx 0x602010 - 0x10
0x602000:        0x0000000000000000        0x0000000000021001
0x602010:        0x6d20746572636553        0x0000656761737365
0x602020:        0x0000000000000000        0x0000000000000000
0x602030:        0x0000000000000000        0x0000000000000000
0x602040:        0x0000000000000000        0x0000000000000000
0x602050:        0x0000000000000000        0x0000000000000000
0x602060:        0x0000000000000000        0x0000000000000000
0x602070:        0x0000000000000000        0x0000000000000000
0x602080:        0x0000000000000000        0x0000000000000000
0x602090:        0x0000000000000000        0x0000000000000000
0x6020a0:        0x0000000000000000        0x0000000000000000
0x6020b0:        0x0000000000000000        0x0000000000020f51
0x6020c0:        0x0000000000000000        0x0000000000000000
0x6020d0:        0x0000000000000000        0x0000000000000000
0x6020e0:        0x0000000000000000        0x0000000000000000
gdb-peda$ x/s 0x602010
0x602010:        "Secret message"
gdb-peda$ p main_arena.top
$1 = (mchunkptr) 0x602000
gdb-peda$
```

- "a" , .

Output the data stored in the freed memory.

```
gdb-peda$ c
Continuing.

Breakpoint 3, 0x0000000000400601 in main ()
gdb-peda$ i r rdi
rdi            0x602010        0x602010
gdb-peda$ x/i $rip
=> 0x400601 <main+75>:        call   0x400480 <puts@plt>
gdb-peda$ ni
Secret message
gdb-peda$
```

Related information

- https://github.com/shellphish/how2heap

Unknown macro: 'html'