

Jazyk symbolických instrukcií (assembler)

Bezpečnost informacných systémov z pohľadu praxe

Peter Svec

>motivacia

>zaklady su potrebne pre exploitaciu

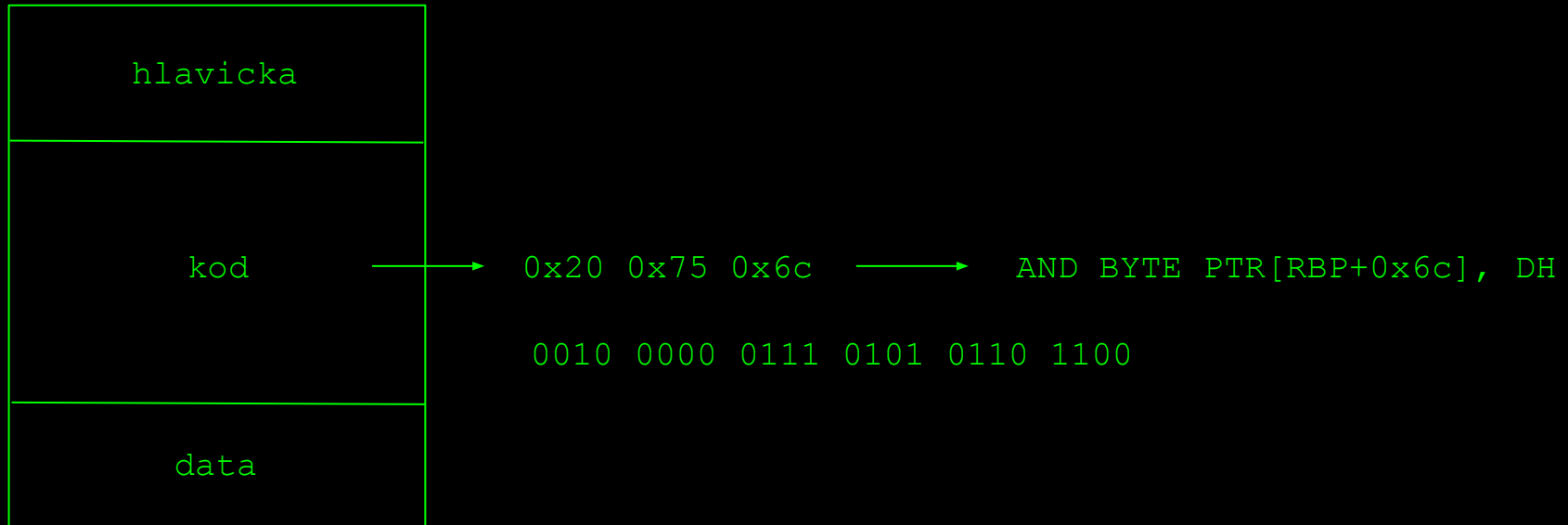
>je vsade

>znalost zakladov pomaha aj pri programovanie v jazykoch
vyssej urovne

>samozrejme programovanie zariadeni, ovladacov,
optimalizacie, atd..

>spustitelny subor

>ELF format (**E**xecutable and **L**inkable **F**ormat)



>jazyk symbolických instrukcii

>tri zakladne koncepty

>instrukcie:

>manipulacia s datami (matematicke operacie,...)

>kontrola toku programu

>systemove volanie

>registre:

>ukladanie docasnych dat

>pamat:

>samotne instrukcie

>zasobnik

>registre

>maly a rychly ulozny priestor (8 bajtov na x86_64)

>vseobecne registre:

>8086: AX, BX, CX, DX, **SP**, **BP**, SI, DI

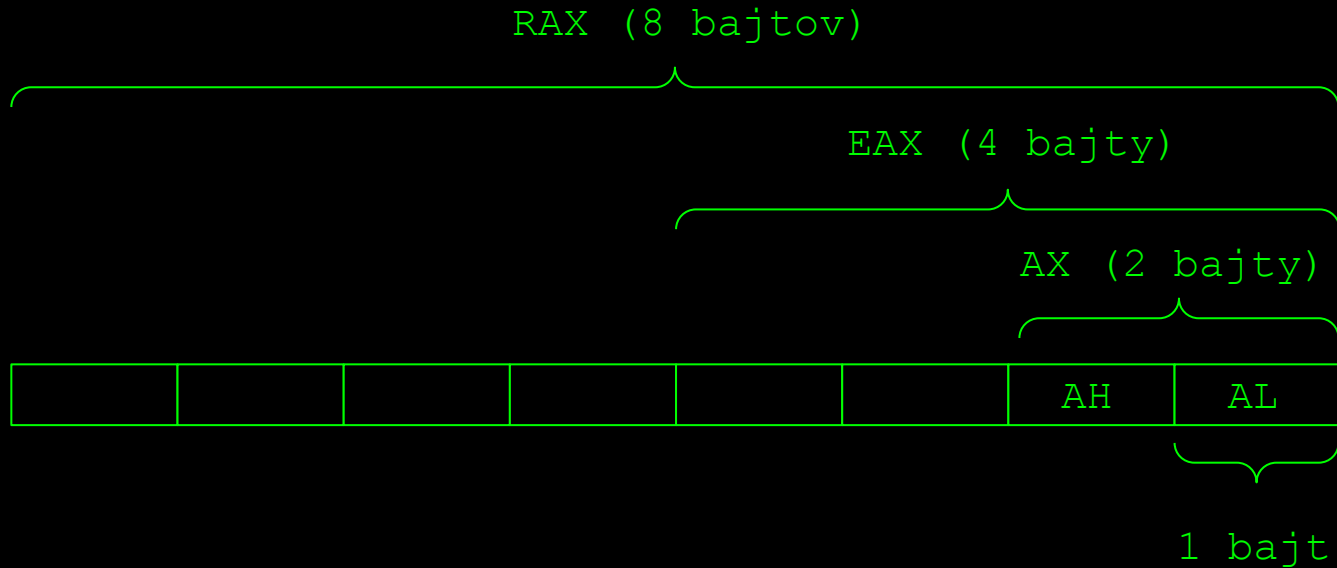
>x86: EAX, EBX, ECX, EDX, **ESP**, **EBP**, ESI, EDI

>x86_64: RAX, RBX, RCX, RDX, **RSP**, **RBP**, RSI, RDI, R8,
R9, R10, R11, R12, R13, R14, R15

>adresa nasledujucej instrukcie:

> **IP**(8086), **EIP**(x86), **RIP**(x86_64)

>registre



>RAX = 0xff 0xff 0xff 0xff 0xff 0xff 0xff 0xff

>AH = 0xcc

>RAX = 0xff 0xff 0xff 0xff 0xff 0xff **0xcc** 0xff

>EAX = 0xaa 0xaa 0xaa 0xaa

>RAX = 0x00 0x00 0x00 0x00 **0xaa 0xaa 0xaa 0xaa**

>instrukcie

>vseobecna forma (typicky 0-2 operandy):

INSTRUKCIA OPERAND, OPERAND,...

>instrukcia -> co sa ma vykonat (scitanie? nasobenie? skok?)

>operand -> nad akymi datami sa ma vykonat instrukcia

```
mov rcx, rax          mov rax, rbx
add rcx, 5            mov rax, [rbx+4]
cmp rcx, rbx         add rax, rbx
je navestie          mul rsi
navestie:            inc rax
inc rcx              inc [rax]
```

intel syntax

>sposoby adresovania

>priame

```
MOV RAX, 0x45
```

>register

```
MOV RAX, RBX
```

>pamat

```
MOV RAX, [RBX]
```


>pomocne direktivy

```
mov [0x1337000], 1
```

```
>0x01?
```

```
>0x00 0x01?
```

```
>0x00 0x00 0x00 0x01??
```

mov BYTE PTR [0x1337000], 1	BYTE: 8 bitov (1 bajt)
mov WORD PTR [0x1337000], 1	WORD: 16 bitov (2 bajty)
mov DWORD PTR [0x1337000], 1	DWORD: 32 bitov (4 bajty)
mov QWORD PTR [0x1337000], 1	QWORD: 64 bitov (8 bajtov)

>tok programu

>skoky prebiehaju na zaklade registra RFLAGS

>register sa nastavuje pri:

>aritmeticke operacie (add, mul, div, sub,...)

>instrukcia `cmp rax, rbx` (`rax - rbx`)

>instrukcia `test rax, rbx` (`rax & rbx`)

>RFLAGS priklady bitov:

>ZF - Zero Flag

`cmp rax, rbx`

`cmp rax, rbx`

>OF - Overflow Flag

`je navestie`

`jb navestie`

>SF - Signed Flag

`// ZF = 1`

`// CF = 1`

>CF - Carry Flag

>dalsie mozne skoky: `jmp, jne, jg, jl, jle, jge,...`

>systemove volania

>interakcia s OS

>open, read, write, fork, exec,...

>instrukcia **syscall** (iba na x86_64)

>priklad:

>chceme zavolat systemove volanie exit s hodnotou 42

>cislo systemoveho volania je 60¹

```
mov rax, 60
mov rdi, 42
syscall      // navratova hodnota v RAX
```

¹https://blog.rchapman.org/posts/Linux_System_Call_Table_for_x86_64

>zasobnik

>zasobnikovy ramec pre volanie funkcii

>obsahuje:

>kde zacina zasobnikovy ramec predchadzajuceho volania

>lokálne premenne pre funkciu

>navratova adresa (navrat z funkcie - instrukcia RET)

>registre ovladajuce zasobnik:

>RSP -> vrch zasobnika (**S**tack **P**ointer)

>RBP -> spodok zasobnika (**B**ase **P**ointer)

>praca so zasobnikom: PUSH, POP

```
push rax
```

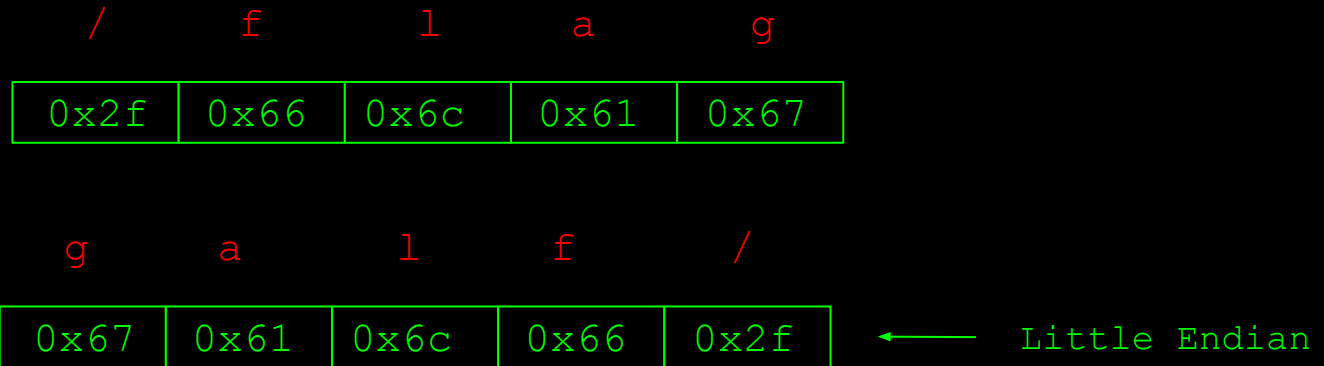
```
pop rax
```

```
push 0xff
```

```
pop [rcx]
```

>endianita

>data na x86 architekturah su ulozene v opacnom poradi
>Little Endian



>dalsie instrukcie

>logicke operacie:

>XOR, AND, OR, NEG, ...

>bitove posuny:

>SHR, SHL, ROL, ROR, ...

>volanie funkcie:

>CALL, RET

>nacitanie adresy:

>LEA (Load Effective Address) -> LEA, [EAX + EBX]

>ziadna operacia:

>NOP (No Operation)

```
>hello world
```

```
> hello.s
```

```
    .global _start
_start:
    .intel_syntax noprefix
    mov rax, 1
    mov rdi, 1
    lea rsi, [rip+hello]
    mov rdx, 1000
    syscall
hello:
    .string "Hello World!"
```

```
> gcc -nostdlib main.s -o hello
```

>dalsie zdroje

>rappel

> <https://github.com/yyp604/rappel>

>dokumentacia instrukcii

> <https://www.felixcloutier.com/x86/>

