University of Central Punjab

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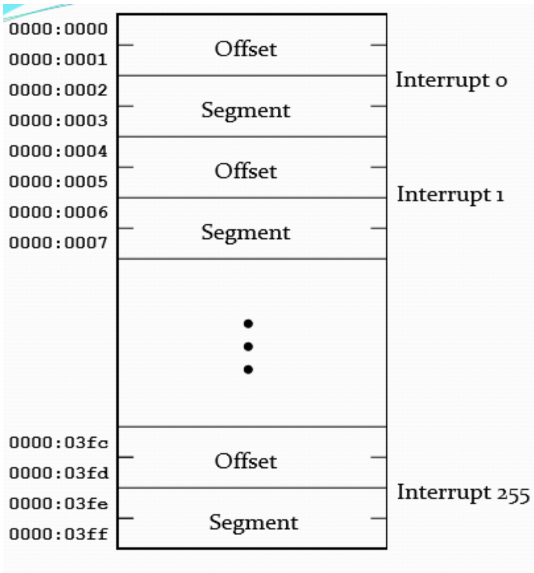
FACULTY OF INFORMATION TECHNOLOGY

Computer Organization and Assembly Language

Lab 14	
Topic	1. Interrupts 2. Interrupts hooking

Interrupt vector table-address mapping

- Offset: n*4 ; offset address of n^{th} interrupt
- Segment: n*4+2 ; base address of n^{th} interrupt



If N is the interrupt number then following operations are executed by the INT and IRET by the processor.

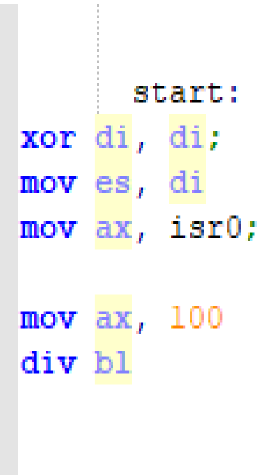
The operation of INT can be written as:

- sp ← sp-2
- [sp] ← flag
- sp ← sp-2
- if ← 0
- tf ← 0
- [sp] ← cs
- sp ← sp-2
- [sp] ← ip
- ip ← [0:N*4]
- cs ← [0:N*4+2]

The operation of IRET can be written as:

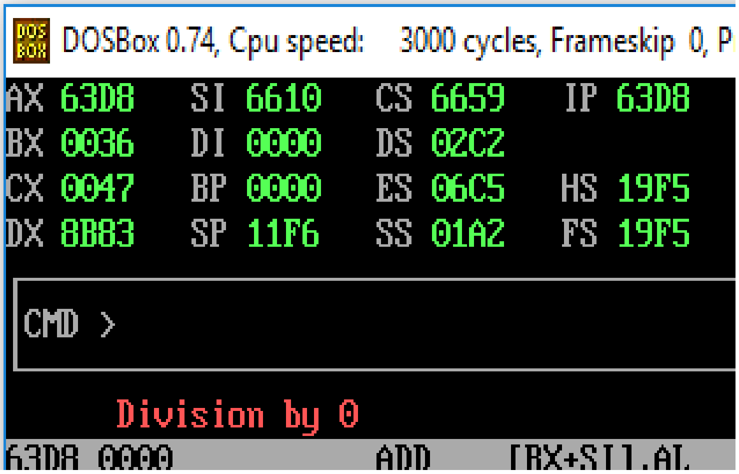
- ip ← [sp]
- sp ← sp+2
- cs ← [sp]
- sp ← sp+2
- flag ← [sp]
- sp ← sp+2

Interrupt zero: INT 0



```
     start:
xor di, di;
mov es, di
mov ax, isr0;

mov ax, 100
div bl
```



DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, P

```
AX 63D8    SI 6610    CS 6659    IP 63D8
BX 0036    DI 0000    DS 02C2
CX 0047    BP 0000    ES 06C5    HS 19F5
DX 8B83    SP 11F6    SS 01A2    FS 19F5

 CMD >

       Division by 0
63D8 0000             ADD     [BX+SI],AL
```

Example 3: ISR(Interrupt Service Routine) hooking-interrupt zero

```
[org 0x100]
jmp start
    message db 'Your message for divide overflow',0;



 isr0:

          pop ax                      ;pop the IP of div instruction
          push continue               ;push the IP of next instruction after "DIV"

   mov ax, 0xb800
   mov es, ax;
   mov si, message;
   mov ah,7
   nextchar:
   lodsb;
   cmp al, 0
   je skip
   stosw
   jmp nextchar
   skip:
iret

start:
xor di, di;
mov es, di
mov ax, isr0;
mov [es:0h*4],ax;
mov [es:0H*4+2], cs;
mov ax, 100

div bl                               ;when div interrupt is called it pushes the IP value of itself
                                     ;instead of the next instruction from where our code
                                     ; should continue after returning from interrupt.

continue:



mov ax,0x4c00
int 21h
```

Example 4: Another Interrupt hooking

```
[org 0x100]

jmp start


ISR0:

   MOV AX, 0XB800

   MOV ES, AX;

   MOV word [ES:0], 0X0741;

IRET


start:

XOR DI, DI;

MOV ES, DI

mov AX, ISR0;

MOV [ES:16h*4],AX;

MOV [ES:16h*4+2], CS;

mov ah,0;

int 0x16;


mov ax,0x4c00

int 21h
```

Note: After executing this interrupt, the contents of IVT against int 0x16 has been overwritten so the keyboard will not work properly.

Example 5: Interrupt hooking without using INT instruction

```
[org 0x100]
jmp start


ISR0:
   MOV AX, 0XB800
   MOV ES, AX;
   MOV word [ES:2], 0X0741;


IRET


start:
XOR DI, DI;
MOV ES, DI
mov AX, ISR0;
MOV [ES:17h*4],AX;
MOV [ES:17h*4+2], CS;
Pushf           ;push flag register
push cs         ;push code segment
push continue ;push IP (address of next instruction where to return)
jmp far [es:17h*4]      ;calling interrupt
continue:


mov ax,0x4c00
int 21h
```

Example 6: Interrupt unhooking.

```
[org 0x100]
jmp start

old_data: dd 0

ISR0:
   MOV AX, 0XB800
   MOV ES, AX;
   MOV word [ES:0], 0X0741;

          mov ax,0
          mov es,ax

          mov bx,[old_data]
          mov [ES:0x16*4],bx     ;saving the old values in a variable before overwritting.
          mov bx,[old_data+2]
          mov [ES:0x16*4+2],bx

          IRET

start:

XOR DI, DI;
MOV ES, DI
mov AX, ISR0;
mov bx,[ES:0x16*4]     ;saving the old values in a variable before overwriting.

mov [old_data],bx

mov bx,[ES:0x16*4+2]

mov [old_data+2],bx



MOV [ES:0x16*4],AX;              ;hooking the interrupt

MOV [ES:0x16*4+2], CS;


pushf

push cs

push continue

jmp far [es:0x16*4]

continue:


mov ax,0x4c00

int 21h
```

Note: Recover the old contents of IVT after executing your functionality via hooking.