Jade Yu Cheng

ICS 312

Homework #3

Feb 23, 2009

Exercise #2: Overflow [20 pts]

For each of the following hex operation say whether the carry bit is set and whether the overflow bit is set. Also, for each operation, if the result were sign-extended into the EAX register, say what print_int would print? (Remember that this macro prints signed numbers in decimal representation).

a. The calculations are expressed as below

1. 2-byte quantities: 8FF0 + A026
2. 2-byte quantities: 6043 + 7ABC
3. 1-byte quantities: F3 + 0D
4. 1-byte quantities: E5 + 03

Answer:

----- 8FF0 + A026 -----

```
      c     8c    Fc    F     0
            A     0     2     6
     ---------------------------------------
            3     0     1     6
```

The carry bit is set, CF = 1.

The overflow bit is set, OF = 1.

Both 8FF0 and A026 are negative numbers, the summation of them should be a big negative number, while 3016 is a positive number. The overflow bit is therefore set.

signed-extend: 3016 ⇒ 0000 3016

$00003016_h = 3 \times 16^3 + 0 \times 16^2 + 1 \times 16^1 + 6 \times 16^0$
$= 12288 + 0 + 16 + 6$
$= 12310$

```
movsz       eax,        3016        ; eax: 0000 3016
call        print_int               ; prints 12310 to the screen
```

----- 6043 + 7ABC -----

```
    6    0    4    3
    7    A    B    C
  ------------------------------
    D    A    F    F
```

The carry bit is not set, CF = 0.
The overflow bit is set, OF = 1.
Both 6043 and 7ABC are positive numbers, the summation of them should be a big positive number, while DAFF is a negative number. The overflow bit is, therefore, set.

signed-extend: DAFF ⇒ FFFF DAFF
flip: FFFF DAFF ⇒ 0000 2500
plus one: 0000 2500 ⇒ 0000 2501

$FFFFDAFF_h = -(2 \times 16^3 + 5 \times 16^2 + 0 \times 16^1 + 1 \times 16^0)$

$= -(8192 + 1280 + 0 + 1)$

$= -9473$

```
movsz       eax,        DAFF        ; eax: FFFF DAFF
call        print_int               ; prints -9473 to the screen
```

----- F3 + 0D -----

```
            c       Fc      3
                    0       D
          --------------------------
                    0       0
```

The carry bit is set, CF = 1.
The overflow bit is not set, OF = 0.
F3 is a small negative number, 0D is a small positive number. The summation of these two should be in the range. The overflow bit is, therefore, not set.

signed-extend: 00 ⇒ 0000 0000

```
movsz       eax,        00          ; eax: 0000 0000
call        print_int               ; prints 0 to the screen
```

----- E5 + 03 -----

```
              E       5
              0       3
            ---------------
              E       8
```

The carry bit is not set, CF = 0.
The overflow bit is not set, OF = 0.
E5 is a negative number, 03 is a very small positive number. The summation of these two should be in the range. The overflow bit is therefore, not set.

signed-extend:	E8	⇒	FFFF FFE8
flip:	FFFF FFE8	⇒	0000 0017
plus one:	0000 0017	⇒	0000 0018

$FFFFFE8_h = -(1 \times 16^1 + 8 \times 16^0)$
$= -(16 + 8)$
$= -24$

```
movsz       eax,        E8      ; eax: FFFF FFE8
call        print_int           ; prints -24 to the screen
```