

16.317: Microprocessor Systems Design I

Spring 2013

Homework 3

Due **Friday, 3/22/13**

1. (30 points) As noted in class, the SETcc instruction can be used to combine multiple conditions together to create a compound conditional test. For example, the code below tests the condition $((A < B) \ \&\& \ (C < D))$, storing the result in DL:

```
MOV    AX, A
CMP    AX, B
SETL   DL
MOV    AX, C
CMP    AX, D
SETL   DH
AND    DL, DH
```

For each part of this problem, assume A, B, C, D, E, and F refer to signed integers stored in memory.

What compound condition is tested by each of the code sequences below?

a.

```
MOV    AX, A
CMP    AX, B
SETLE  BL
CMP    AX, E
SETGE  BH
OR     BL, BH
```

b.

```
MOV    AX, C
CMP    AX, A
SETE   BL
MOV    AX, B
CMP    AX, A
SETNE  BH
AND    BL, BH
CMP    AX, C
SETL   BH
AND    BL, BH
CMP    AX, A
SETZ   BH
OR     BL, BH
```

c.

```
MOV    AX, A
SUB    AX, B
CMP    AX, C
SETGE  BL
MOV    AX, D
ADD    AX, E
SUB    AX, F
SETNZ  BH
OR     BL, BH
```

2. (15 points) The program that follows implements what is known as a *delay loop*.

```
        MOV    CX, 1000H
DLY:    DEC    CX
        NOP                    ; NOP instruction does nothing
        JNZ    DLY
NXT:    ---    ---
```

- How many times does the JNZ DLY instruction get executed?
 - Change the program so that JNZ DLY is executed just 17 times.
 - Change the program so that JNZ DLY is executed 2^{32} times.
3. (15 points) Write a program that compares the elements of two arrays, A(I) and B(I). Each array contains 100 16-bit signed numbers. The comparison is to be done by comparing the corresponding elements of the two arrays until either two elements are found to be unequal or all elements of the arrays have been compared and found to be equal. Assume that the arrays start in the current data segment at offset addresses $A000_{16}$ and $B000_{16}$, respectively. If the two arrays are found to be unequal, save the offset of the first unequal element of A(I) in the memory location with offset $C000_{16}$; otherwise, write all 0s into this location.

4. (40 points) Assume the 80386 is running in protected mode with the state given below. Note that each memory location shown contains a single segment descriptor.

GDTR = 001631A00037
LDTR = 0010
DS = 000E
ES = 001B
SS = 0015

EDI = 0000444A
EBX = 0000F000
EBP = 0000F010

Memory	Address
Base = 030010F0 Limit = 020F	00163170
Base = 12300020 Limit = 0007	00163178
Base = A0331010 Limit = 0027	00163180
Base = FE002200 Limit = FFFF	00163188
Base = 12340000 Limit = 00FF	00163190

Memory	Address
Base = AC000000 Limit = 0317	00163198
Base = 01610200 Limit = 03F7	001631A0
Base = 00163170 Limit = 0027	001631A8
Base = 00163180 Limit = 001F	001631B0
Base = 05000120 Limit = C00F	001631B8

What address does each of the following instructions access?

- MOV DX, [40H]
- XOR ES:[DI], CX
- BSF AX, WORD PTR [BX+100H]
- ADD SS:[BP-16], AX