

# 16.317: Microprocessor Systems Design I

Fall 2013

## Homework 4

Due **Wednesday, 10/16/13**

### Notes:

- While typed solutions are preferred, handwritten solutions to these problems are acceptable.
- Any handwritten solutions that are scanned and submitted electronically must be clearly legible and combined into a single file—simply sending a picture of each scanned page is not an acceptable form of submission.
- This assignment is worth a total of 50 points.

1. (20 points) Assume the state of the 80386DX's registers and memory are:

EAX: 00005555H	<b>Address</b>
EBX: 00000010H	ABD00H
ECX: 00000010H	0F F0 00 FF
EDX: 0000AAAAH	...
ESI: 000000F2H	45200H
EDI: 00000200H	30 00 19 91
DS: ABC0H	...
	45210H
	AA AA AB 0F
	...
	45220H
	55 55 7C EE
	...
	45300H
	AA 55 30 90

Also, assume all flags (ZF, CF, SF, PF, OF) are initialized to 0.

For the instruction sequence shown below, list all changed registers and/or memory locations and their new values, as well as all changed flags from the list above. Note that the registers and memory have the same starting values at the beginning of each sequence, but a value changed by one instruction in a sequence can affect the results of all other instructions in the same sequence.

```
BT      AX, 4
SETC    [100H]
BTS     AX, 5
SETC    [101H]
BTR     AX, 6
SETC    [102H]
BTC     AX, 7
SETC    [103H]
```

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

```
        MOV    CX, 2000H
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 25 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.