16.317: Microprocessor Systems Design I

Spring 2014

Homework 3

Due **Wednesday, 3/5/14**

Notes:

- While typed solutions are preferred, handwritten solutions are acceptable.
- Electronic submissions should be e-mailed to Dr. Geiger at Michael_Geiger@uml.edu.
- All electronic submissions must be contained in a single file (Word document or PDF). Archived submissions (e.g., zipped folders sent as a .zip file) are not acceptable.
- This assignment is worth 50 points.

1. (20 points) Assume the state of an x86 processor's registers and memory are:

EAX: 00005555H
EBX: 00000010H
ECX: 00000010H
EDX: 0000AAAAH
ESI: 000000F2H
EDI: 00000200H
DS: 4500H

Address				
45100H	0F	F0	00	FF
	…			
45200H	30	00	19	91
	…			
45210H	AA	AA	AB	0F
	…			
45220H	55	55	7C	EE
	…			
45300H	AA	55	30	90

What is the result produced in the destination operand by each of the instructions listed below? Assume that the instructions execute in sequence.

```
AND BYTE PTR [0300H], 0FH
SAR DX, 8
OR [BX+DI], AX
ROL AX, 2
XOR AX, [SI+BX]
NOT BYTE PTR [0300H]
RCR AX, 4
```

2. (10 points) Assume the state of an x86 processor's registers and memory are:

EAX: 00005555H
EBX: 00000010H
ECX: 00000010H
EDX: 0000AAAAH
ESI: 000000F2H
EDI: 00000200H
DS: ABC0H

Address				
ABD00H	0F	F0	00	FF
	…			
45200H	30	00	19	91
	…			
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]
```

3. (20 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
```