

16.317: Microprocessor Systems Design I

Spring 2013

Exam 1
February 20, 2013

Name: _____ ID #: _____

For this exam, you may use a calculator and one 8.5" x 11" double-sided page of notes. All other electronic devices (e.g., cellular phones, laptops, PDAs) are prohibited. If you have a cellular phone, please turn it off prior to the start of the exam to avoid distracting other students.

The exam contains 4 questions for a total of 100 points. Please answer the questions in the spaces provided. If you need additional space, use the back of the page on which the question is written and clearly indicate that you have done so.

You will be provided with four pages (2 double-sided sheets) of reference material for the exam: a list of the 80386 instructions and condition codes we have covered thus far. You do not have to submit these pages when you turn in your exam.

You will have 50 minutes to complete this exam.

Q1: Multiple choice	/ 20
Q2: Data transfers and memory addressing	/ 30
Q3: Arithmetic instructions	/ 25
Q4: Logical instructions	/ 25
TOTAL SCORE	/ 100

1. (20 points, 5 points per part) **Multiple choice**

For each of the multiple choice questions below, clearly indicate your response by circling or underlining the single choice you think best answers the question.

a. If the carry flag (CF) is set to 0, which of the following instructions will always set $CF = 1$?

- A. STC
- B. CLC
- C. CMC
- D. LAHF
- E. SAHF

- i. A and C
- ii. B and C
- iii. A, C, and D
- iv. A, C, and E
- v. B, C, and E

b. If $AH = 0FH$, what is the result of the instruction `BTC AH, 7`?

- i. $CF = 0$, AH is unchanged
- ii. $CF = 1$, AH is unchanged
- iii. $CF = 0$, $AH = 4FH$
- iv. $CF = 0$, $AH = 8FH$
- v. $CF = 1$, $AH = 8FH$

1 (cont.)

c. Which of the following statements the compare instruction `CMP AX, BX` are true?

- A. The instruction subtracts $AX - BX$ and stores the result in `AX`.
- B. The instruction subtracts $AX - BX$ but does not store the result anywhere.
- C. If `AX` and `BX` are equal, the zero flag (`ZF`) is set to 1.
- D. If `AX` is less than `BX`, then the sign flag (`SF`) will always be 1.
- E. If `AX` is less than `BX`, then the sign flag (`SF`) will always be 0.

- i. Only A
- ii. Only B
- iii. B and C
- iv. B, C, and D
- v. A, C, and E

d. If `AX = 0FF0H`, which of the following choices correctly shows the results of performing the two bit scan instructions (`BSF` and `BSR`) on this register?

- i. `BSF DX, AX` $\rightarrow ZF = 0, DX$ unchanged
 `BSR DX, AX` $\rightarrow ZF = 0, DX$ unchanged
- ii. `BSF DX, AX` $\rightarrow ZF = 1, DX$ unchanged
 `BSR DX, AX` $\rightarrow ZF = 1, DX$ unchanged
- iii. `BSF DX, AX` $\rightarrow ZF = 0, DX = 0004H$
 `BSR DX, AX` $\rightarrow ZF = 0, DX = 000BH$
- iv. `BSF DX, AX` $\rightarrow ZF = 1, DX = 0004H$
 `BSR DX, AX` $\rightarrow ZF = 1, DX = 000BH$
- v. `BSF DX, AX` $\rightarrow ZF = 1, DX = 000BH$
 `BSR DX, AX` $\rightarrow ZF = 1, DX = 0004H$

2. (30 points) ***Data transfers and memory addressing***

For each data transfer instruction shown below, list all changed registers and their final values. Also, indicate if each instruction performs an aligned memory access, an unaligned memory access, or no memory access at all.

Initial state:

EAX: 00000000H
EBX: 00000008H
ECX: 0000021EH
EDX: 0000FF00H
ESI: 0000F000H
EDI: 00001010H
DS: 2201H
ES: 2000H

Address	Lo		Hi	
22000H	20	13	80	40
22004H	FF	AF	BC	13
22008H	99	88	77	66
2200CH	A8	B1	F0	43
22010H	78	D6	32	33
22014H	34	35	12	16
22018H	93	03	7C	EF

Instructions:

MOV AX, [BX+01H] Aligned? Yes No Not a memory access

MOVSX EBX, BYTE PTR [0001H] Aligned? Yes No Not a memory access

MOVZX ECX, WORD PTR ES:[SI+3004H] Aligned? Yes No Not a memory access

LEA DI, [SI+1A2BH] Aligned? Yes No Not a memory access

LDS EDX, ES:[2006H] Aligned? Yes No Not a memory access

3. (25 points) Arithmetic instructions

For each instruction in the sequence shown below, list all changed registers and/or memory locations and their new values. If memory is changed, be sure to explicitly list **all changed bytes**. Where appropriate, you should also list the state of the carry flag (CF).

Initial state:

EAX: 00000047H
EBX: 000000C5H
ECX: 0000021EH
EDX: 0000FFFEH
CF: 1
ESI: 00000004H
DS: 3170H

Address	Lo			Hi
31700H	04	00	08	00
31704H	83	00	01	01
31708H	05	01	71	31
3170CH	20	40	60	80
31710H	02	00	AB	0F
31714H	00	16	11	55

Instructions:

ADC AX, [SI]

SUB AX, BX

NEG BX

IMUL DL

INC AH

4. (25 points) **Logical instructions**

For each instruction in the sequence shown below, list all changed registers and/or memory locations and their new values. If memory is changed, be sure to explicitly list **all changed bytes**. Where appropriate, you should also list the state of the carry flag (CF).

Initial state:

EAX: 00000F0H
EBX: 00001000H
ECX: 00000003H
EDX: 0000F63CH
CF: 0
DS: 1000H

Address	Lo			Hi
10000H	C0	00	02	10
10004H	10	10	15	5A
10008H	89	01	05	B1
1000CH	20	40	AC	DC
10010H	04	08	05	83

Instructions:

AND AL, [07H]

XOR AL, DH

SAR AL, 3

ROL AL, 4

RCR AL, 2