

THE UNIVERSITY OF AUCKLAND

SECOND SEMESTER, 2010
Campus: City

Computer Science

TEST

Computer Systems 1

(Time Allowed: 50 MINUTES)

Note:

- The use of calculators is NOT permitted.
- Compare the exam version number on the Teleform sheet supplied with the version number above. If they do not match, ask the exam supervisor for a new sheet.
- Enter your name and student ID on the Teleform sheet. Your name should be entered left aligned. If your name is longer than the number of boxes provided, truncate it.
- Answer ALL **Multiple-choice** questions on the Teleform answer sheet provided.
- Use a dark pencil to mark your answers in the multiple choice answer boxes on the Teleform sheet. Check that the question number on the sheet corresponds to the question number in this question/answer book. If you spoil your sheet, ask the supervisor for a replacement.
- An appendix is included on the last page. You may detach this appendix.

CONTINUED

Question 1

[2 marks] If the radix is 15, each digit can have an integer value in the range:

- (a) 1 to 15
- (b) 0 to 9
- (c) 1 to 14
- (d) 0 to 14

Question 2

[3 marks] Using 8 bits, the 2's complement integer representation of **-39** is:

- (a) 11011001
- (b) 11100111
- (c) 00100111
- (d) 11011000

Question 3

[2 marks] Using 8 bits, the Signed Magnitude representation of **-29** is:

- (a) 00011101
- (b) 11100011
- (c) 10011101
- (d) 11111101

Question 4

[2 marks] Using 8 bits, the unsigned integer representation of **160** is:

- (a) 00100000
- (b) 01100000
- (c) 10100000
- (d) Unknown

Question 5

[3 marks] Convert the unsigned integer **Hexadecimal** representation of **4C** to **Octal**:

- (a) 214
- (b) 23
- (c) 114
- (d) 230

CONTINUED

Question 6

[3 marks] Convert the unsigned integer **Octal** representation of 342 to **Hexadecimal**:

- (a) 648
- (b) F2
- (c) E2
- (d) E1

Question 7

[3 marks] Two values $A = 00101010$ and $B = 00010010$ are representations of 8-bit, **2's complement** integers.

Evaluate $A + B$

- (a) 10111100
- (b) 11000011
- (c) 00011000
- (d) 00111100

Question 8

[3 marks] Two values $A = 00111010$ and $B = 01000110$ are representations of 8-bit, **2's complement** integers.

Evaluate $A - B$

- (a) 10000000
- (b) 11110011
- (c) 01111110
- (d) 11110100

Question 9

[3 marks] Two values $A = 10110110$ and $B = 00000101$ are representations of 8-bit, **unsigned** integers.

Evaluate $A \text{ XOR } B$

- (a) 10110111
- (b) 01001100
- (c) 10110011
- (d) 10111011

Question 10

[3 marks] Two values $A = 01101010$ and $B = 00001111$ are representations of 8-bit, **unsigned** integers.

Evaluate $A \text{ AND } B$

- (a) 00001010
- (b) 01100000
- (c) 01101010
- (d) 11110101

CONTINUED

Question 11

[3 marks] Two values $A = 01101010$ and $B = 00000100$ are representations of 8-bit, **2's complement** integers.

Evaluate $A \ll B$

- (a) 01101110
- (b) 10100000
- (c) 00000110
- (d) 01010000

Question 12

[3 marks] Two values $A = 10001010$ and $B = 00000100$ are representations of 8-bit, **2's complement** integers.

Evaluate $A \gg B$

- (a) 11111000
- (b) 00000001
- (c) 00001000
- (d) 11110001

Question 13

[3 marks] Two values $A = 0010.1000$ and $B = 0101.1100$ are representations of **unsigned binary** fractions.

Evaluate $A + B$

- (a) 0111.0100
- (b) 1000.0100
- (c) 1101.0100
- (d) 1000.0010

Question 14

[3 marks] Convert the unsigned fraction **Octal** representations of 14.20 to **Hexadecimal**:

- (a) 12.20
- (b) C.4
- (c) 14.40
- (d) A.2

Question 15

[3 marks] Two values $A = 1.01$ and $B = 10.01$ are representations of **unsigned binary** fractions.

Evaluate $A * B$.

- (a) 10.1101
- (b) 10.1011
- (c) 11.011
- (d) 101.101

CONTINUED

A 32-bit IEEE-754 floating point number consists of 1 sign bit, 8 exponent bits and 23 mantissa/significand bits.

Questions 16-18 are based on the following 32-bit IEEE floating point number:

A = 0xF9D00000

Question 16

[3 marks] What is the decimal value of the mantissa bits stored in the above floating point number?

- (a) 0.5
- (b) 0.875
- (c) 0.625
- (d) 0.75

Question 17

[3 marks] What are the decimal value of the exponent bits and exponent stored in the above floating point number?

- (a) -13, 114
- (b) 13, 140
- (c) 249, 122
- (d) 243, 116

Question 18

[3 marks] What is the answer to the above floating point number multiplied by 2? (i.e. $A * 2$)

- (a) 0xFDD00000
- (b) 0xFA900000
- (c) 0xFA700000
- (d) 0xFA500000

CONTINUED

Questions 19-20 are based on the following 32-bit IEEE floating point numbers:

A = 0x42100000 and **B = 0x41400000**

Question 19

[3 marks] What are the exponent Field and the binary value of the significand/mantissa of the above two IEEE floating point numbers?

- (a) [A: exponent field = 10000100, mantissa = 0 .001], [B: exponent field = 10000010, mantissa = 0.10]
- (b) [A: exponent field = 01000010, mantissa = 1 .001], [B: exponent field = 01000001, mantissa = 1.10]
- (c) [A: exponent field = 10000100, mantissa = 1 .001], [B: exponent field = 10000010, mantissa = 1.10]
- (d) [A: exponent field = 01000010, mantissa = 0 .001], [B: exponent field = 01000001, mantissa = 0.10]

Question 20

[3 marks] What is the answer to the **mantissa of A** multiplied by the **mantissa of B**? (i.e. the mantissa of $A * \text{the mantissa of B}$)

- (a) 1.0011
- (b) 1.1011
- (c) 0.001
- (d) 0.0011

CONTINUED

Read the program below before answering the following TEN questions.

```

      .ORIG x3500
L     LEA     R0, A
      LD      R1, B
      LDI     R2, C
      BRn    D
      LD      R3, E
      ADD     R4, R1, R3
      JSR     G
D     HALT

G     ST      R4, F
      STR     R4, R0, 0
      RET

A     .FILL 6
B     .FILL 7
C     .FILL x350B
E     .FILL 8
F     .FILL x350C
      .END

```

Question 21

[2 marks] What is the address of label L?

- (a) x3000
- (b) x3500
- (c) x3501
- (d) x0000
- (e) x5000

Question 22

[3 marks] What is the value stored in register 0 after instruction "LEA R0, A" is executed?

- (a) x350B
- (b) x350C
- (c) x350A
- (d) x400B
- (e) x300B

Question 23

[3 marks] What is the value stored in register 1 after instruction "LD R1, B" is executed?

- (a) 6
- (b) x350B
- (c) 7
- (d) x1234
- (e) 0

CONTINUED

Question 24

[3 marks] What is the value stored in register 2 after instruction "LDI R2, C" is executed?

- (a) 9
- (b) 0
- (c) 6
- (d) 7
- (e) x350B

Question 25

[3 marks] What are the values of the condition codes after instruction "LDI R2, C" is executed?

- (a) N is set and the others are cleared.
- (b) All the condition codes are cleared.
- (c) N, Z and P are set while S is cleared.
- (d) N and P are both set while Z is cleared.
- (e) P is set and the others are cleared.

Question 26

[2 marks] What is the value stored in register 3 after instruction "LD R3, E" is executed?

- (a) 9
- (b) 7
- (c) 8
- (d) x350B
- (e) x3508

Question 27

[3 marks] What is the value stored in register 4 after instruction "ADD R4, R1, R3" is executed?

- (a) x000E
- (b) 15
- (c) x3513
- (d) x3515
- (e) x3514

Question 28

[3 marks] What is the value stored in register 7 after instruction "JSR G" is executed?

- (a) x3506
- (b) cannot be determined
- (c) x3507
- (d) x350A
- (e) 0

CONTINUED

Question 29

[3 marks] Which one of the following statements is correct?

- (a) Instruction “ST R4, F” stores a value at memory location with label F.
- (b) Instruction “ST R4, F” stores a value at memory location x350C.
- (c) Instruction “ST R4, F” stores 4 at memory location x350C.
- (d) The execution of instruction “ST R4, F” changes the values of the condition codes.
- (e) Instruction “ST R4, F” adds the value in register 4 to the value stored at memory location with label F.

Question 30

[3 marks] Which one of the following statements is correct?

- (a) Instruction “STR R4, R0, 0” moves the value in register 0 to register 4.
- (b) Instruction “STR R4, R0, 0” stores the value in register 4 at the memory location whose address is held in register 0.
- (c) Instruction “STR R4, R0, 0” moves the value in register 4 to register 0 and sets the value in register 4 to 0.
- (d) Instruction “STR R4, R0, 0” changes the value in register 0.
- (e) Instruction “STR R4, R0, 0” sets the value in register 0 to 0.

Read the following description before answering the following TWO questions.

A fragment of an assembly program is shown below. The memory location with label H is at address x4000.

```
H      .BLKW 2
K      .STRINGZ    "abc"
J      .FILL 5
```

Question 31

[3 marks] What is the address of the memory location with label K?

- (a) x4001
- (b) x4010
- (c) 2
- (d) x4002
- (e) 0

Question 32

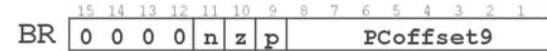
[3 marks] What is the address of the memory location with label J?

- (a) x4000
- (b) x4005
- (c) x4007
- (d) x4006
- (e) x4004

CONTINUED

Question 33

[3 marks] Assume the LC-3 assembly language instruction “BRn x” is stored at memory address x4000 and label x refers to the memory location at address x4009. The format of the BR instruction is as below:



What is the machine language code of instruction “BRn x”?

- (a) 0000011000001001
- (b) 0000010000001001
- (c) 0000100000001000
- (d) 0000100000001001
- (e) 0000011000001000

Question 34

[3 marks] Which one of the following statements is correct?

- (a) In the von Neumann model, the processing unit is responsible for interpreting the instruction.
- (b) In the von Neumann model, the memory unit can only be used to store instructions.
- (c) In the von Neumann model, the processing unit carries out arithmetic and logical operations.
- (d) In the von Neumann model, the input/output unit is responsible for moving instructions from memory to the processing unit.
- (e) In the von Neumann model, the instruction register in the processing unit holds the instruction that is being executed.

Question 35

[3 marks] Which one of the following statements is correct?

- (a) The program counter is incremented after an instruction is fetched from the memory.
- (b) The program counter holds the address of the instruction that is being executed.
- (c) Control instructions are used to move data from memory to registers.
- (d) Operate instructions are used to communicate with users.
- (e) During the execution of an instruction, the data movement instructions are used to fetch instructions from the memory unit.

CONTINUED

A.3 The Instruction Set

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ADD ⁺	0001			DR			SR1			0	00		SR2			
ADD ⁺	0001			DR			SR1			1	imm5					
AND ⁺	0101			DR			SR1			0	00		SR2			
AND ⁺	0101			DR			SR1			1	imm5					
BR	0000			n	z	p		PCOffset9								
JMP	1100			000			BaseR			000000						
JSR	0100			1	PCOffset11											
JSRR	0100			0	00		BaseR			000000						
LD ⁺	0010			DR			PCOffset9									
LDI ⁺	1010			DR			PCOffset9									
LDR ⁺	0110			DR			BaseR			offset6						
LEA ⁺	1110			DR			PCOffset9									
NOT ⁺	1001			DR			SR			111111						
RET	1100			000			111			000000						
RTI	1000			000000000000												
ST	0011			SR			PCOffset9									
STI	1011			SR			PCOffset9									
STR	0111			SR			BaseR			offset6						
TRAP	1111			0000			trapvect8									
reserved	1101															

Figure A.2 Format of the entire LC-3 instruction set. Note: + indicates instructions that modify condition codes

Source: Data Abstraction and Problem Solving with Java, Frank M Carrano & Janet J Pritchard