CMPUT 229: Computer Organization and Architecture I
Fall 2000–2001, Section A2
Midterm #1
Instructor: Paul Lu
(October 11, 2000)

Name: _____ SID: _____

Carefully read all of these instructions and the questions. Good luck!

1. Duration of the examination is 50 minutes.
2. Check that your exam package has 6 pages.
3. Answer all parts of all problems. There are 5 questions worth a total of 50 marks (i.e., one mark per minute of time).
4. No books, no notes, and no calculators.
5. You may use the provided MIPS Assembly Language reference pages taken from your textbook. Please return these pages to the instructor at the end of the exam.
6. Be concise and give clear answers.
7. Write all answers on the front of the exam pages and **within the space provided**. You may use the back of these pages for rough work, but it will **not** be marked.
8. If your answer is NOT legible, I cannot mark it.
9. **NOTE**: Here is a decimal, binary and hexadecimal conversion table.

Decimal	Binary	Hexadecimal	Decimal	Binary	Hexadecimal
0	0000	0	8	1000	8
1	0001	1	9	1001	9
2	0010	2	10	1010	A
3	0011	3	11	1011	B
4	0100	4	12	1100	C
5	0101	5	13	1101	D
6	0110	6	14	1110	E
7	0111	7	15	1111	F

Page 2		Page 3	Page 4–5	Page 6	
#1	#2	#3	#4	#5	Total
/8	/12	/10	/14	/6	50

Problem 1 (1 mark for each blank, 8 marks in total)
Fill in the blanks.

1. A 64-bit (not 32-bit) register can hold _____ hexadecimal digits, or _____ bytes.

2. Suppose the MIPS architecture is altered to use little-endian storage order. If the value `0xABCDEF01` is in register `$s0`, and a `sw $s0,0x10000000` is executed. Then

   (a) hexadecimal value _____ is stored at address `0x10000000`

   (b) hexadecimal value _____ is stored at address `0x10000001`

   (c) hexadecimal value _____ is stored at address `0x10000002`

   (d) hexadecimal value _____ is stored at address `0x10000003`.

3. According to standard MIPS subroutine calling convention, all of the registers must be saved by the subroutine before it does any computation. True or false? _____

4. Assuming two's complement representation, $00001110_2 + 11111011_2 =$ _____ (give answer in decimal).

Problem 2 (1 mark for each entry, 12 marks in total)
All of the rows in the following table contain different representations of the same number. Fill in the missing entries in the following table. As an example, the first row is complete.
Two's complement representation should be used. Sign extension should be used, where necessary.

Decimal	32-bit Hexadecimal	8-bit Binary
10	0000000A	0000 1010
	FFFFFFFD	
-1		
		0111 0001
160		
	00000011	
-12		

Problem 3 (5 marks for each question, 10 marks in total)

Short answers (2 or 3 sentences) are expected for the following questions. Keep your answers **brief** and to the point.

1. In the MIPS architecture, the stack grows from high memory to low memory (instead of growing from low to high memory). What is the advantage of this approach?

2. The Transwarp-1 CPU has an average clock cycles per instruction (CPI) of 1.0 and runs at 500 MHz. The newer Transwarp-2 CPU has a CPI of 1.2 and runs at 550 MHz.

   When running the same executable, which CPU is faster? Briefly explain your answer.

Problem 4 (2 marks for each blank, 14 marks in total)

The next 4 questions refer to the following MIPS assembly language code fragment.

Assume big-endian storage. Assume the label `buffer` corresponds to address `0x10010000`.

Use the addressing mode terminology of Chapter 2 of the textbook or the lecture notes.

```
        .text
start:
        la $t3,buffer
# Point A
        srl $t5,$t2,28
        sll $t2,$t2,4
        or $t2,$t2,$t5
# Point B
        andi $t1,$t2,0xf
# Point C
        addi $t1,$t1,7
# Point D
        sb $t1,2($t3)
# Point E

        li $v0,10
        syscall          # au revoir...

        .data
buffer:
        .word   5
```

1. In instruction `la $t3,buffer`, _____ is the addressing mode of operand `$t3`

2. In instruction `la $t3,buffer`, _____ is the addressing mode of operand `buffer`

3. In instruction `sb $t1,2($t3)`, _____ is the addressing mode of operand `2($t3)`

Problem 4 (continued)

4. Suppose `main` looks like this:

```
        .text
        .globl main
main:
        li $t2,0x1001ABCD
        j start
```

If we clear memory and registers, then single-step through the above program:

(a) At Point A, after executing `la $t3,buffer`, hexadecimal value _____ is in register `$t3`

(b) At Point B, after executing `or $t2,$t2,$t5`, hexadecimal value _____ is in register `$t2`

(c) At Point E, hexadecimal value _____ is stored at address `0x10010002`

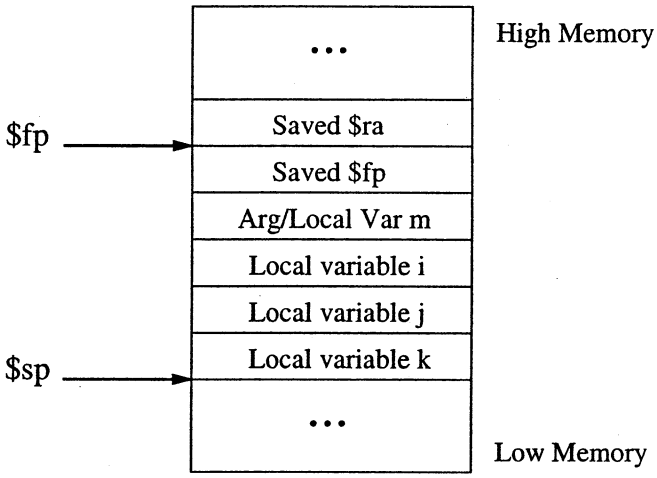
(d) At Point E, hexadecimal value _____ is stored at address `0x10010003`

Problem 5 (1 + 1 + 4 = 6 marks in total)

Suppose subroutine `mysub` has been called, the standard subroutine entry code has been executed (i.e., to set up the stack frame) and now `mysub` is about to start its computation.

Note that `mysub` takes an integer parameter `m` and has local integer variables `i`, `j`, `k`. All integers are 32-bit values.

Given the following stack frame inside `mysub`:



Write MIPS assembly code to:

1. Load the value of local variable `i` into register `$s0`

2. Store the value of register `$s1` into local variable `j`

3. Clean up the stack and return to the caller of `mysub` according to the subroutine calling conventions of the MIPS architecture.