Homework 2

Computer Architecture
CSCI 361, Fall 2014

Due: October 6, 2014 in class

Instructions: Complete the problems enumerated below. No collaboration is permitted on this or any assignment. Correct answers without work shown will not receive credit. Answers must typed and neatly formatted. You will submit a printed hardcopy of your work at the beginning class on the specified due date. Include your name and email address on each page of your submission. Please include a header containing your name on every page. Late assignments will not be accepted.

Problem 1 **[20 pts]**

Complete the following problems as instructed. Show the your work to receive credit.

(a) Convert the following 8-bit unsigned binary numbers to decimal.

Binary
0 0 0 0 1 0 0 1 1
0 1 0 1 0 1 0 1 0

(b) Convert the following decimal numbers to both 8-bit Sign Magnitude and Two's Complement Notation.

	Sign Magnitude	**Two's Complement**
37		
−37		
−121		

(c) Convert the following two hexidecimal numbers to decimal.

Hex
8 c e
a b c d e f 1 2

Problem 2 [10 pts]

What are the largest and the smallest integers respresentable in:

(a) 4-bit unsigned binary representation

(b) 4-bit sign-magnitude representation

(c) 4-bit two's complement representation

(d) 8-bit unsigned binary representation

(e) 8-bit sign-magnitude representation

(f) 8-bit two's complement representation

(g) 16-bit unsigned binary representation

(h) 16-bit sign-magnitude representation

(i) 16-bit two's complement representation

(j) Explain why your answers differ between (h) and (i).

Problem 3 [10 pts]

X	$0000\ 0001\ 0011\ 0010\ 0110\ 1000\ 0010\ 0010_{two}$
Y	$1000\ 1101\ 0001\ 0010\ 0000\ 0000\ 0000\ 1100_{two}$

(a) Convert X into MIPS assembly.

(b) Which type (I-type, R-type, J-type) is instruction X?

(c) Convert Y into MIPS assembly.

(d) Which type (I-type, R-type, J-type) is instruction Y?

Problem 4 [20 pts]

(a) Consider the following MIPS assembly instructions. What is a corresponding C statement?

```
add f, h, g
sub f, i, f
```

(b) If the variables `f, g, h`, and `i` have the values 1, 2, 3, and 5 respectively, what is the end value of `f`?

(c) Now consider the following C statement. What is the corresponding MIPS assembly code?

```
B[8] = A[i-j];
```

Assume `i` and `j` are assigned to registers `$s3` and `$s4` respectively. Assume the base address of the arrays `A` and `B` are in registers `$s6` and `$s7` respectively.

Problem 5 [10 pts]

```
addi $t0, $s6, 4
add $t1, $s6, $0
sw $t1, 0($t0)
lw $t0, 0($t0)
add $s0, $t1, $t0
```

For the MIPS assembly above, assume the registers `$s0` and `$s1` contain the values 0x0000 0014 and 0x0000 0028, respectively. Also assume register `$s6` contains the value 0x0000 0200, and that memory contains the following values:

Address	Value
0x0000 0200	0x0000 00c8
0x0000 0204	0x0000 012c
0x0000 0208	0x0000 0190

Find the value of `$s0` at the end of the assembly code.

Problem 6 [10 pts]

Assume the following register contents:

```
$t0 = 0x5ca1ab1e
```

(a) What is the value of `$t2` for the following sequence of instructions?

```
sll  $t2, $t0, 4
andi $t2, $t2, -1
```

(b) What is the value of `$t2` for the following sequence of instructions?

```
srl $t2, $t0, 3
andi $t2, $t2, 0xf00d
```

Problem 7 [10 pts]

Assume `$t0` contains the following:

```
0x8000 8000
```

What is the value of `$t1` after the following instructions?
Show a trace of `$t1` throughout the iteration.

```
        slt $t1, $0, $t0
        bne $t1, $0, ELSE
        j DONE
ELSE:   addi $t1, $t1, 4
DONE:
```

Problem 8 **[10 pts]**

```
for (i = 0; i < x; i++)
    x += y;
```

Assume that the values of `x, y` and `i` are in registers `$s5, $s6, $t1,` respectively.

(a) Translate the above C code to MIPS assembly code. Use a minimum number of instructions.

(b) How many MIPS instructions does it take to implement the C code?

(c) If the variables `x` and `y` are both initialized to 1, what is the total number of MIPS instructions that is executed to complete the loop?