C335 Homework #2

Points:	: 40 points
Due Date:	: Feb. 10th (Before the start of the class)
Submissions:	: For F-2-F students, hardcopy (type or write your solution clearly) For online students, e-copy to Canvas

PART I (4 POINTS)

Do the addition and subtraction manually for the following two binary numbers:

```
    1 0 0 0 1 0 0 1 1 0 0 0          1 0 0 0 1 0 0 1 1 0 0 0
+   0 0 1 1 0 1 1 0 1 0 1 1      -   0 0 1 1 0 1 1 0 1 0 1 1
---------------------------------  ---------------------------------
```

PART II (4 POINTS) (SHOW YOUR STEPS!)

(1) What binary number does this hexadecimal number represent: 0x7ffffffa? What decimal number does it represent? (assume 32-bit 2's complement)
(2) What hexadecimal number does the binary number present: 0b11001010111111101111101011001110?

PART III (4 POINTS)

(1) Convert -103_{10} to binary (8 bits), and then to hexadecimal (assume 2's complement is used).
(2) Convert 0xAA to binary then to Decimal (assume 2's complement is used).

PART IV (TOTAL 12 POINTS, 3 POINTS EACH) (SHOW YOUR STEPS!)

(1) Convert 4096 into a 32-bit two's complement binary number.
(2) Convert -2047 into a 32-bit two's complement number.
(3) What decimal number does this two's complement binary number represent: 0b1111 1111 1111 1111 1111 1111 0000 0110?
(4) What decimal number does this two's complement binary number represent: 0b1111 1111 1111 1111 1111 1111 1110 1111?

PART V (5 POINTS) (DON'T FORGET TO ADD COMMENTS TO THE CODE!)

Add comments to this following MIPS code and describe in one sentence what it computes. Assume that $a0 and $a1 are used for the input and both initially contain the integers a and b, respectively. Assume that $v0 is used for the output:

```
            add  $t0, $zero, $zero
loop:       beq  $a1, $zero, finish
            add  $t0, $t0, $a0
            addi $a1, $a1, -1
            j    loop
finish:     addi $t0, $t0, 100
            add  $v0, $t0, $zero
```

PART VI (5 POINTS) (DON'T FORGET TO ADD COMMENTS TO THE CODE!)

The following code segment processes two arrays and products an important value in register $v0. Assume that each array consists of 2500 words indexed 0 through 2499, that the base addresses of the arrays are stored in $a0 and $a1, respectively, and their sizes (2500) are stored in $a2 and $a3, respectively. Add comments to the code and describe in one sentence what this code does. Specifically, what will be returned in $v0?

```
            sll  $a2, $a2, 2
            sll  $a3, $a3, 2
            add  $v0, $zero, $zero
            add  $t0, $zero, $zero
outer:      add  $t4, $a0, $t0
            lw   $t4, 0($t4)
            add  $t1, $zero, $zero
inner:      add  $t3, $a1, $t1
            lw   $t3, 0($t3)
            bne  $t3, $t4, skip
            addi $v0, $v0, 1
skip:       addi $t1, $t1, 4
            bne  $t1, $a3, inner
            addi $t0, $t0, 4
            bne  $t0, $a2, outer
```

PART VII (6 POINTS)

The following program tries to copy words from the address in register $a0 to the address in register $a1, counting the number of words copied in register $v0. The program stops copying when it finds a word equal to 0. You do not have to preserve the contents of register $v1, $a0, and $a1. This terminating word should be copied but not counted.

```
     addi $v0, $zero, 0  # Initialize count
loop:lw   $v1, 0($a0)    # Read next word from source
     sw   $v1, 0($a1)    # Write to destination
```

```
addi $a0, $a0, 4    # Advance pointer to next source
addi $a1, $a1, 4    # Advanced pointer to next destination
beq  $v1, $zero, loop    # Loop if word copied != zero
```

There are multiple bugs in this MIPS programs; fix them and turn in a bug-free version.

BONUS QUESTION (1 EXTRA POINT):

Find out how to represent **fractions** using binary number systems.

(1) Convert binary number 1.1011 to decimal number
(2) Convert decimal number 0.1 to binary number