CSCI 200: Elements of Computing **Spring 2011**

LAB 1

name:_____

INTRODUCTION: This lab is practice with *binary* and *two's complement* arithmetic. Do your work with a pencil. We will work a few of each type during today's lab. Work in pairs where possible.

TURN IN:

1. **This document with the answers for each problem. Show your work. Answers without showing calculations will not receive credit.**

Task 1: Convert the following 2's complement binary numbers to their decimal (base 10) equivalent. Those with a 1 in the leftmost bit are negative: *first* complement the bits, *then* add 1.

0 0 1 0 1 0 0 1	1 1 0 1 1 1 0 0
0 1 1 1 0 1 1 0	1 1 1 0 1 1 0 1
0 0 1 1 0 0 1 0	1 1 0 1 1 0 1 0
0 0 0 0 1 1 1 0	1 0 0 0 1 1 1 0
0 1 0 0 1 0 1 1	1 1 0 0 1 0 1 1

Task 2: What are the binary results of the following arithmetic operations? For subtraction, first convert the *subtrahend* to its two's complement representation, then add it to the *minuend*. Retain only the rightmost *eight* bits.

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

Task 3: What is the result of the following arithmetic operations? Use repeated subtraction for division and take advantage of shifts for multiplication. Products must be eight bits. Show calculations.

$$\begin{array}{r} 0\ 1\ 0\ 1\ 1\ 0\ 1\ 0 \\ \times\quad\quad\quad\quad 1\ 0\ 1\ 1 \\ \hline \end{array}$$	$$\begin{array}{r} 1\ 0\ 1\ 0 \\ \div\ 0\ 1\ 0\ 1 \\ \hline \end{array}$$
$$\begin{array}{r} 0\ 1\ 1\ 1\ 1\ 1\ 1\ 1 \\ \times\quad\quad\quad\quad 1\ 1\ 1\ 1 \\ \hline \end{array}$$	$$\begin{array}{r} 1\ 0\ 0\ 1\ 0\ 1\ 1\ 0 \\ \div\quad\quad\quad\quad 1\ 1\ 1\ 1 \\ \hline \end{array}$$
$$\begin{array}{r} 0\ 1\ 0\ 1\ 0\ 1\ 0\ 1 \\ \times\quad\quad\quad\quad 1\ 0\ 1\ 0 \\ \hline \end{array}$$	$$\begin{array}{r} 0\ 0\ 1\ 1\ 1\ 1\ 0\ 0 \\ \div\quad\quad\quad\quad 0\ 1\ 0\ 1 \\ \hline \end{array}$$

Task 4: Convert the following decimal (base ten) values to the binary (base two equivalent). Use exactly eight bits for the result. If the decimal value is negative, first convert the positive value, then perform the 2's complement operation.

12	-15
33	-63