UNCA CSCI 255
Exam 2 Fall 2009
20 November, 2009

This is a closed book and closed notes exam. It is to be turned in by 2:35 pm. Calculators, PDA's, cell phones, and any other electronic or communication devices may not be used during this exam.

Name:_____

If you want partial credit for imperfect answers, explain the reason for your answer!

Problem 1 (12 points) Adding
Add the following pairs of six-bit two's complement numbers **and indicate which additions result in an overflow**.

010011 + 000111	101100 + 101100
110000 + 110000	001110 + 011000

Problem 2 (13 points) Memory
A computer memory has 32-bit words stored in 8 M locations. What is the size of this memory in bits?

How many address bits are needed to address the 8 M words of this memory?

A computer memory has 32 M **bytes** stored in 16-bit words. How many words are stored in this memory?

Problem 3 (12 points) Decoding an LC-3 program
In the table below is an LC-3 binary program that is loaded into six memory locations starting at x3000. Complete the rightmost column by decoding the LC-3 binary instructions into LC-3 assembly instructions.

	0100000000000000	.ORIG x4000
x4000	1110001000000101	
x4001	0010010000000100	
x4002	0001001001000010	
x4003	0000100111111110	
x4004	0011001000000001	
x4005	1111000000100101	HALT ;TRAP x25
x4006	0100000000000100	

Problem 4 (13 points) Assignments Revisited
Write an LC-3 *subroutine* in assembler language that receives an argument in register `R1` and returns a value in register `R0`. If register `R1` contains a value greater than 255, a 1 should be returned. Otherwise, a 0 should be returned.

```
.ORIG    x3000
```

```
.END
```

Problem 5 (25 points) Hand assembled
Use the symbol table shown below in this question.

BUNCOMBE	**x3315**
HAYWOOD	**x3375**
MACON	**x33D5**
MADISON	**x3435**

Write the appropriate 16-bit LC-3 machine language word, in binary or hex, for each assembly language statement shown in the left column of the table below. Assume that the instruction is located at address x3311 in all cases. If the assembly language statement is illegal, state the reason why.

ADD R0,R2,#16	
ADD R7,R7,MACON	
AND R2,R3,#-3	
BR BUNCOMBE	
BRz HAYWOOD	
JSR MADISON	
LDI R7,MADISON	
LDR R2,R3,#20	
LEA R2,R3,x20	
ST R3,R5	
STI R3,MACON	
STR R3,R4,R5	

Problem 6 (25 points)

Assume that the eight LC/3 registers have the values shown on the left below and that the eight words of memory starting at memory location x3220 have the values shown on the right.

Register	*Value*
R0	x0000
R1	x0000
R2	x2222
R3	x3333
R4	x0000
R5	x0000
R6	x6666
R7	x0000

Address	*Value*
x3220	x0000
x3221	x1111
x3222	x2121
x3223	x0000
x3224	x0000
x3225	x5151
x3226	x0000
x3227	x0000

For the nine addresses shown below, write a single LC/3 instruction to load the value **stored in** the specified memory location into register 1. (For example, when x3222 is specified, x2121 should be stored in R4.) Assume that each instruction is located at memory address x3200. If this location cannot be loaded in one instruction, state why this is not possible.

x0000	
x1111	
x1112	
x2233	
x3101	
x3200	
x3201	
x3301	
x3344	
x6646	
x6666	
x6686	