UNCA CSCI 255
Exam 1 Fall 2014
17 September, 2014

This is a closed book and closed notes exam. It is to be turned in by 3:00 PM.

Communication with anyone other than the instructor is not allowed during the exam. Furthermore, calculators, cell phones, and any other electronic or communication devices may not be used during this exam. Anyone needing a break during exams must leave their exam with the instructor. Cell phones or computers may not be used during breaks.

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

Name:________________________________

Problem 1 (8 points) Decimal to two's complement conversion
Convert the following four signed decimal numbers into seven-bit *two's complement* representation. Some of these numbers may be outside the range of representation for seven-bit two's complement numbers. Write "out-of-range" for those cases.

-32	-31
23	107

Problem 2 (8 points) Two's complement to decimal conversion
Convert the following four seven-bit *two's complement* numbers into signed decimal representation.

0110110	0000111
1101000	1111111

Problem 3 (8 points) Unsigned to decimal conversion
Convert the following four seven-bit *unsigned* numbers into decimal representation.

0010001	1110100
1100110	1100000

Problem 4 (4 points) Binary arithmetic
Perform the following operations and express the result as it should be for CSCI 255. (Remember Problem 2 of homework 4. Keep it simple!)

4k * 32
16M / 256

Problem 5 (8 points) Adding signed numbers
Add the following pairs of seven-bit *two's complement* numbers **and indicate which additions result in an overflow by writing one of "overflow" or "no overflow" in each box**. You must write either "overflow" or "no overflow" in each box in addition to the result of the addition.

0101001 + 1101001	0110110 + 0110110
1001101 + 1010101	1101011 + 0110100

Problem 6 (8 points) Adding unsigned numbers
Add the following pairs of seven-bit *unsigned* numbers **and indicate which additions result in an overflow by writing one of "overflow" or "no overflow" in each box**. You must write either "overflow" or "no overflow" in each box in addition to the result of the addition.

0101001 + <u>1101001</u>	0110110 + <u>0110110</u>
1001101 + <u>1010101</u>	1101011 + <u>0110100</u>

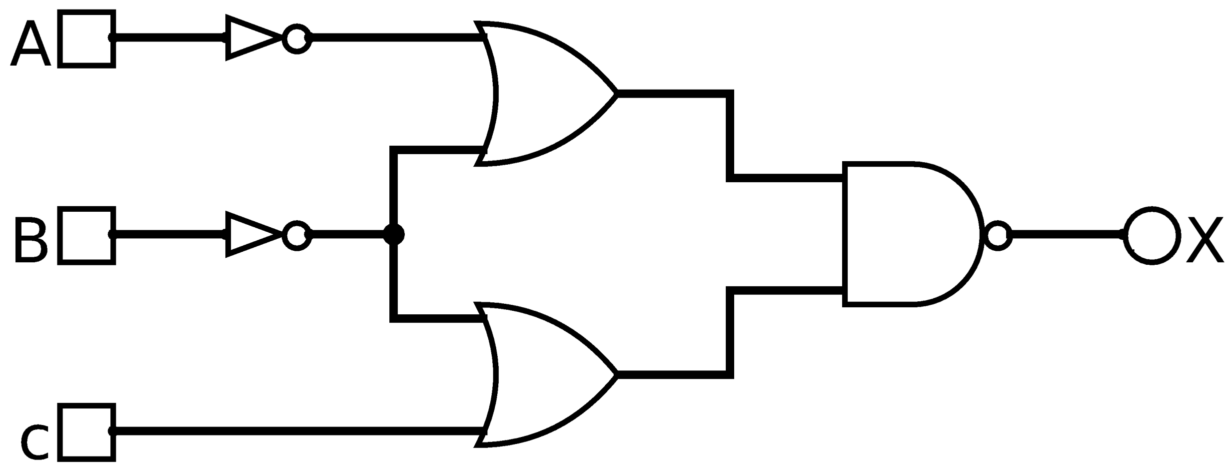
Problem 7 (6 points) Memories
Consider a memory with 256 M words where each word is 16 bits.

How many bits are contained in this memory?

How many bits are required to address the words of this memory?

Remember to express your answers in the CSCI 255 way.

Problem 8 (13 points) Digital logic to truth table
A gate-level circuit is shown below with three inputs on the left and a single output on the right. Complete the truth table so that it corresponds to this digital logic circuit.



A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Problem 9 (5 points) Digital logic to Boolean expression
Write a Boolean expression that corresponds to the logic circuit shown in Problem 8. You can build on your Problem 8 answer if that seems appropriate.

Problem 10 (13 points) Truth table to digital logic
Draw a logic circuit at the gate level that will implement the following truth table, where A, B, and C are inputs and X is the single output.

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

Problem 11 (5 points) Truth table to Boolean expression
Write a Boolean expression that corresponds to the truth table shown in Problem 10. You can build on your Problem 10 answer if that seems appropriate.

Problem 11 (9 points) Boolean expression to truth table
Complete the truth table on the left below so that it corresponds to the following Boolean equation

$$X = \overline{A + C} + \overline{A}\,B\,C$$

If you prefer that your inversions be primes, you can think of the equation as

$$X = (A + C)' + A'\,B\,C$$

Or, if you really like Java and C expressions, you can go with

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X = !(A || C) || !A && B && C
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Problem 12 (6 points) Boolean expression to digital logic
On the remainder of this page, draw a logic circuit at the gate level that will implement the Boolean equation given in Problem 11. You can build on your Problem 11 answer if that seems appropriate.

A	B	C	Z
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	