Name: _____ **Date:** _____

CS270 Homework Assignment 1
"Number Crunching"

Due Thursday, January 26 (start of class)
Homework assignments are to be done individually.

Goals

To understand data representation in a computer, including Boolean, integer, floating point, and character values, and the associated logical and arithmetic operations.

Please write the answers clearly in the space provided. In some cases there is room to show your work. If needed, do your work on a separate sheet, clearly labeled with the problem number, attach it to your submission.

The Problems

Question 1 (5 points): There are 130 keys in a newly designed keyboard. If each key is to be represented by a single, unique combination of bits, what is the minimum number of bits needed to represent them? How many more keys can you add to the keyboard with those bits?

Minimum number of bits: _____

Number of keys that can be added: _____

You need to assign a unique binary number (tag) to a set of 25 objects. How many bits do you need?

_____ With this many bits, how many additional objects can still be given a unique tag? _____

Question 2 (10 points): By using repeated division by the radix, determine the representations of the decimal number 18012011 in the following bases: 4, 16 (hexadecimal), 11 and 15? Show the remainder and quotient at each step. Do not use a calculator.

Base 4 Base 16 (hex) Base 11 Base 15

Question 3 (15 points): What decimal numbers are the represented by the following sequence of digits in the radix indicated (use Horner's rule and show your work; you don't really need it, but you may use a calculator for the second one)?

$(BB904)_{12}$ $(B8D.503)_{15}$ $(552143)_{6}$

Question 4 (5 points): What is the range of unsigned integers that can be stored using 10 bits? What is the range for signed integers stored represented in 1's and 2's complement, with the same number of bits?

Range of unsigned integers: _____ to _____

Range of signed integers: _____ to _____ (1's complement)

Range of signed integers: _____ to _____ (2's complement)

Question 5 (5 points): Show the 2's complement addition of +62 plus -23, with both numbers in binary using 8 bits. Hint: make sure that the resulting binary number corresponds to the correct answer.

_____ (+62)

\+ _____ (-23)

= _____ (+??)

Question 6 (5 points): Show the 2's complement subtraction of -18 – (-8), with both numbers in binary using 8 bits. Hint: make sure that the resulting binary number corresponds to the correct answer.

_____ (-18)

\- _____ (-8)

= _____ (-10)

Question 7 (5 points): Show the results of the following bitwise operations (using the same number of bits as shown in each problem):

NOT(10101111100011) = _____

10110111 OR 01010011 = _____

1110111010 AND 0101110111 = _____

1101001001 XOR 1100001111 = _____

NOT (10101101 XOR 11101110) = _____

Question 8 (5 points): Show the results of the following bitwise operations:

~(0xFDEE & 0x1234) = 0x_____

(0xABCD ^ 0x1234) | 0xCDEF = 0x_____

Question 9 (7 points): Find the floating-point numbers from the following values (assuming IEEE 16-bit floating-point representation – look up "IEEE half precision floating point format" on Wikipedia):

0xABD5 = _____f

0 10101 10 0110 0000 = _____f (the spaces are for your convenience)

Question 10 (8 points): Find the binary and hexadecimal numbers for the following floating-point values (assuming IEEE 16-bit floating-point representation):

0.78125f = 0x_____ (hexadecimal)

0.78125f = _____ (binary)

Question 11 (5 points): Translate the following strings into ASCII values and vice versa:

"Document" = 0x_____

0x45485154 = "_____"

Question 12 (25 points): Perform the following additions and subtractions within the radix indicated (i.e., without converting to decimal and back)

Additions:

$(32145)_9$	$(325)_9$	$(2165)_7$	$(2130)_4$
$+(42730)_9$	$+(674)_9$	$+(1163)_7$	$+(3333)_4$

Subtractions:

$(4268)_9$	$(674)_9$	$(2163)_7$	$(2032)_4$
$-(4122)_9$	$-(375)_9$	$-(1664)_7$	$-(1311)_4$

By the time you have solved all these problems, you should have spent about three hours on this homework. You still owe us 7 hours. We're going to take a rain check on this (don't worry, there will be later assignments that will ask for a lot of time/effort) but we'll give you the opportunity to earn extra credit.

Question 13 (for luck) [15 points]: Your young cousin just learnt about significant digits and numbers in scientific notation (remember the convention: only one digit to the left of the decimal point, and rounding off to the given number of significant digits). We are going to review some of the basics, and also work on it.

1. Review the scientific notation (see http://en.wikipedia.org/wiki/Scientific_notation). This should take you 15 minutes. Review the rules for addition and answer the following questions [5 points]:
    a. What is 3.621E6 + 4.7E5?
    b. What is the previous answer rounded to 3 significant digits?
    c. What is 7.52E2+3.12E5 (rounded to 3 significant digits)?
2. [10 points] For this part, we will always use numbers rounded off to 4 significant digits and we will only use 2 digits for the exponent.

Jane has a younger brother Joe who is also very interested in this stuff, so you and Jane have to teach him the rules of doing addition in scientific notation. The problem is that Joe is working with a narrow strip of paper, on which he can only write down 4 digits (possibly with a decimal point and a sign).

You are to provide him with specific, step-by-step instructions on how to add two numbers. The numbers all have up to 2-digit exponents (after the E) but the numbers may be positive or negative. At no point can an intermediate result be more than 4 digits.

Submission Instructions

All written homework assignments are due at the beginning of class on the due date.

Late Policy

Late assignments will be accepted up to 48 hours past the due date and time for a deduction of 10% per 24-hour delay, and will not be accepted past this period. Late submissions should be made via email (.txt or .pdf files only), or by delivering the paper copy to Sanjay Rajopadhye's office (room 340 in the Computer Science building.)