Homework 2 - Due at Lecture on Wed, Feb 8th

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Instructions: You must do this homework **in groups of two**. Please hand in ONE copy of the homework that lists the **section number**, full **names** (as appear in Learn@UW) and **UW ID** numbers of all students. You must **staple** all pages of your homework together to receive full credit

Question 1. (3 points)

a. How many distinct decimal values (base-10) can be represented using 9 decimal digits?
b. How many distinct hexadecimal values (base-16) can be represented using 8 hexadecimal digits?
c. How many distinct binary values (base-2) can be represented using 32 binary digits (bits)?

Question 2. (2 points)

Find the 2's complement of the following binary numbers:

a. 0100 1010
b. 1001 0000

Question 3. (5 points)

a. Assume that there are exactly 200 students in your class. If every student is to be assigned a unique bit pattern, what is the minimum number of bits required to do this?
b. How many more students can be admitted to the class without requiring additional bits to represent each student's unique bit pattern?
c. How many students need to drop the course if we have only 7 bits to represent each student uniquely?

Question 4. (2 points)

Compute the following (All operations (AND, OR, NOT) are bitwise)

a. NOT(1101) AND NOT(1000)
b. NOT(1001 OR (1010 AND 1101))

Question 5. (4 points)

The binary number 1110 1000 is a string of 0s and 1s that can be interpreted differently depending on its data type. Please find the decimal value of the above number for the following data types:

a. An unsigned integer
b. A signed-magnitude integer
c. A 1's complement integer
d. A 2's complement integer

Question 6. (6 points)

The value "-64" can be represented by strings of 0s and 1s in many different ways depending on its data type. Please show its **hexadecimal** representation for the following data types.

a. An 8-bit unsigned integer
b. An 8-bit signed-magnitude integer
c. An 8-bit 1's complement integer
d. An 8-bit 2's complement integer
e. An ASCII string (Only represent the characters between the quotation marks and assume it as a null terminated string)
f. A 32-bit IEEE floating point number

Question 7. (6 points)

a. What is the largest positive value one can represent with a 7-bit 2's complement number? Write your result in binary and decimal.
b. What is the largest positive value one can represent with an n-bit 2's complement number?

c. What is the greatest magnitude negative value one can represent with a 7-bit 2's complement number? Write your result in binary and decimal.
d. What is the greatest magnitude negative value one can represent with a n-bit 2's complement number?

e. What is the largest positive value one can represent with a 7-bit 1's complement number? Write your result in binary and decimal.
f. What is the largest positive value one can represent with an n-bit 1's complement number?

g. What is the greatest magnitude negative value one can represent with a 7-bit 1's complement number? Write your result in binary and decimal.
h. What is the greatest magnitude negative value one can represent with an n-bit 1's complement number?

i. What is the maximum unsigned value one can represent with 7 quad digits? (quad number system is base-4 where only the digits 0, 1, 2 or 3 are legal)
j. What is the maximum unsigned value one can represent with n quad digits?

Question 8. (2 points)

Give an example of an *integer* that can be represented in floating point format (32-bit IEEE format), but cannot be represented as a 32-bit two's complement integer. Show its hexadecimal representation.

Question 9 (2 points)

a. What conditions indicate overflow has occurred when two 2's complement numbers are added?
b. Why does the sum of a negative 2's complement number and a positive 2's complement number never generate an overflow?