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## Assignment 1 CS2253 Fall 2021

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**Due Date: September 23, 2021 - 8:30 am**

**Purpose:** practice working with representations and operations on binary and hexadecimal numbers (textbook, Chapter 2).

**Problem 1.**

- a) Assume that 453 scientists have been invited to attend a conference. If every scientist is to be assigned a unique bit pattern, what is the minimum number of bits required to do this?
- b) How many more scientists can be invited to the conference, without requiring additional bits for each person's unique id?

**Problem 2.**

- a) What is the largest positive number one can represent in an 10-bit 2's complement code? Write your result in binary and decimal.
- b) What is the greatest magnitude negative number one can represent in an 10-bit 2's complement code? Write your result in binary and decimal.
- c) What is the largest positive number one can represent in n-bit 2's complement code?
- d) What is the greatest magnitude negative number one can represent in n-bit 2's complement code?

**Problem 3.** Convert the following 2's complement binary numbers to decimal.

- a) 11010
- b) 01100110011
- c) 11111111010
- d) 01110000010000

**Problem 4.** Perform the specified arithmetic operation for the following 2's complement binary numbers (Don't forget to sign-extend when required!). Show the results in 8-bit numbers. Verify your result by performing the operations with decimal numbers.

- a)  $11011 - 111$
- b)  $111 - 11011$

**Problem 5.** The following binary numbers are 5-bit 2's complement binary numbers. Which of the following operations generate overflow? Justify your answers by translating the operands and results into decimal.

- a)  $00111 + 00110$
- b)  $10111 - 11110$
- c)  $11000 - 00011$
- d)  $10110 + 10011$

**Problem 6.** Perform the following operation in 2's complement arithmetic, where both 8-bit operands are in hexadecimal:  $F6 + 49$ . First convert the numbers to binary, then add them. Does this operation cause overflow? Why or why not?

**Problem 7.** Perform the following logical operations. Express your answer in hexadecimal notation.

- a)  $x5478 \text{ AND } xFDEA$
- b)  $xABCD \text{ OR } x1234$
- c)  $\text{NOT}(\text{NOT}(xDEFA)) \text{ AND } (\text{NOT}(xFFFF))$
- d)  $x00FF \text{ XOR } x3232$

**Problem 8.** Write the decimal equivalents for the following IEEE floating point numbers.

a) 1 01111110 0100000000000000000000

b) 0 10000001 1010000000000000000000

**Problem 9.** Write the IEEE floating point representation of the decimal number 10.75.

**Problem 10.** Define a mathematical expression to convert the base ten digits 0-9 from their binary value to their ASCII value.

**To pass in the assignment:** Create a single pdf document and submit it via D2L. Name your document `LastName_FirstName A1.pdf` (LastName and FirstName are of course substituted with *your* last and first name).