CS/ ECE 252 Introduction to Computer Engineering

Homework 2 – Due at Lecture on Wednesday, Feb 4th

Instructions: You should do this homework in a group of TWO or THREE students from the SAME 252 section. You should hand in ONE copy of the homework that lists the common section number and names and UW ID numbers of all students. You should staple multiple pages together.

Warning: Most homeworks will use questions from your textbook, Patt and Patel's *Introduction to Computing Systems*, which we abbreviate (*ItCS*). This homework explicitly includes all questions to aid those who are late in obtaining the textbook.

First contact for questions is TA Maheswaran Venkatachalam at: ***kvmakes@cs.wisc.edu***

Problem 1

a. What is the minimum number of bits that are required to uniquely represent the characters of English alphabet? (Consider upper case characters alone)

b. How many more characters can be uniquely represented without requiring additional bits?

Problem 2

Using 7 bits to represent each number, write the representations of 23 and -23 in signed magnitude and 2's complement integers

Problem 3

a. What is the largest positive number one can represent in a 12-bit 2's complement code? Write your result in binary and decimal.

b. What is the greatest magnitude negative number one can represent in a 12-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 4

What are the 8-bit patterns used to represent each of the characters in the string "CS/ECE 252"? (Only represent the characters between the quotation marks.)
Note: There is space between ECE and 252.

Problem 5

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

a. 0110
b. 1101
c. 01101111
d. 1101101100011100

Problem 6

Express the negative value -22 as a 2's complement integer, using eight bits. Repeat it for 16 bits and 32 bits. What does this illustrate with respect to the properties of sign extension as they pertain to 2's complement representation?

Problem 7

Write the decimal equivalents for these IEEE floating point numbers.

a. 0 01111111 00000000000000000000000
b. 1 01111110 10000000000000000000000

Problem 8

Describe what conditions indicate overflow has occurred when two 2's complement numbers are added.

Problem 9

De Morgan's Laws:

i. NOT (P AND Q) = (NOT P) OR (NOT Q)

ii. NOT (P OR Q) = (NOT P) AND (NOT Q)

Verify these for P = 1011 and Q = 1101

Problem 10

The following binary numbers are 4-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. 0011 + 1100
b. 0111 + 1111
c. 1110 + 1000
d. 0110 + 0010