Name: _____

Homework #6: Binary (13 points)

Due to Gradescope by 11:45 PM on Thursday, September 23rd

You need to submit a pdf to Gradescope; failure to assign questions to pages will result in a 10% deduction on your grade

Homework Goal: Practice binary conversions and operations;
learn more about ancient binary through reading and writing

Vocab

1. Practice your vocab from this chapter! (2 points)
    a. What does “bit” stand for? _____
    b. In sign magnitude notation, the leftmost bit represents _____
    c. _____ occurs when a computer tries to represent a number that exceeds the maximum value.
    d. Instead of using a decimal point, we use _____ for fractional numbers in binary.
    e. To represent text in binary, the computer assigns each printable letter or symbol a unique number called a _____.
    f. The number of bits used to store each sample is referred to as _____.
    g. _____ occurs at fixed time intervals, and is when the signal amplitude is measured/stored, while _____ is the process of converting an analog signal to a digital number.

Conversions

2. Perform the following conversions using simple, unsigned binary. (0.5 points)
    a. Convert 0010011101_2 to base ten

    b. Convert 322_{10} to unsigned binary

3. Perform the following conversions (easiest to go through binary for c and d!): (2 points)
    a. Convert the hex number $FAC3_{16}$ to binary

    b. Convert the octal number 567_8 to binary

    c. Convert the hex number CAB_{16} to octal

    d. Convert the octal number 436_8 to hex

4. Perform the following conversions, assuming **8 bits** for the representations: (1 point)
    a. Convert -29_{10} to binary using *two's complement* notation

    b. Convert -55_{10} to binary using *sign magnitude* notation

5. Convert the following fractional numbers between binary and decimal: (1 point)
    a. 110101.011_2 to decimal

    b. 2.1875_{10} to binary

Operations

6. Perform the following binary arithmetic operations, assuming that we are using *2's complement representation* and only have 6 bits available for representation. Leave your answer in binary and **state whether or not overflow occurs**. (1 point)
    a. $101011_2 + 000111_2$

        Overflow?

    b. $011101_2 + 001110_2$

        Overflow?

7. Would you be able to add numbers in sign magnitude notation the same way you did for problem 6? Explain why or why not. (0.5 points)

Data Representation - Numbers

8. What is the range of values (give numerical answers for minimum and maximum) that can be represented if 5 bits are available for these representations: (1.5 points)
    a. unsigned magnitude notation

    b. sign magnitude notation

    c. two's complement notation

9. How many bits would you need to represent -128_{10} in sign magnitude notation? What about in two's complement notation? (0.5 points)

Data Representation - ASCII

10. Using the ASCII code set at https://www.ascii-code.com (0.5 points)
    a. Show the internal binary representation of the following four-character string: {Hi}

    b. What character does 0111 1110 represent?

11. What is a problem you would face in trying to translate ASCII to other languages, such as Mandarin or Arabic? (0.5 points)

Data Representation - Sound & Color

12. True or False: A digital audio sample can be converted back to the EXACT analog sound wave it was created from. Explain your answer. (0.5 points)

13. Why does increasing the sampling rate improve the quality of an audio sample? (0.5 points)

14. For the following questions, write out an RGB value as (x,y,z) with decimal numbers, assuming a bit depth of 8 per color.
    (1 point)
    a. What is white in RGB?

    b. What is black in RGB?

    c. List two RGB values that are similar to each other, but not exactly the same.

    d. List two RGB values that are very different from each other.