Bits (part 2) Homework #6 (8 points)
Due to Gradescope by 11:45 PM on Thursday, February 6th
You need to submit a pdf to Gradescope; failure to mark which pages your questions are on will result in a 10% deduction on your grade

Homework Goal: Work with binary in its usage for different types of data representation.

Binary Conversions

1. Convert the following fractional numbers between binary and decimal: (0.5 points)
   a. $110110.011_2$ to decimal
   b. $27.625_{10}$ to binary

2. Normalize the following numbers, writing your answers for (a) and (c) as $M \times B^E$, where $M$ is the significand (Mantissa), $B$ is the Base, and $E$ is the Exponent. (1 point)
   a. $15.125_{10}$ to binary
   b. $(1.011011 \times 2^2)_2$ to decimal
   c. $0.75_{10}$ to binary
Data Representation - ASCII

3. Using the ASCII code set at [http://www.asciitable.com/](http://www.asciitable.com/), (0.5 points)
   a. Show the internal binary representation of the following character string:
      \{Hi\}
   
   b. What character does 0101 1110 represent?

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

Data Representation - Sound

5. 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)

6. Why does increasing the sampling rate improve the quality of an audio sample? (0.5 points)
Data Representation - Color & Images

7. For the following questions, write out an RGB value as (x,y,z) with decimal numbers. (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.

8. How many bytes does it take to store 10 seconds of color video, if the video is 25 frames per second and each frame is 1280x720 pixels? (Think about how many bytes are in a pixel to represent all RGB values.) Show your work. (0.5 points)

9. Discuss the trade-offs of increasing pixel bit depth. Give at least one reason why you might want to increase pixel bit depth and one reason why you might not want to do this. (0.5 points)
Written Component

10. Practice your vocab from this chapter! (1 point)
   a. Instead of using a decimal point, we use a ____________________________ for fractional numbers in binary.
   b. To represent text in binary, the computer assigns each printable letter or symbol a unique number called a _____________________________.
   c. The number of bits used to store each sample is referred to as _____________________________.
   d. ____________________________ 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.

11. Read through the linked article on representing colors and images in binary and then answer the following questions. Feel free to explore the interactive activities! (1.5 points) https://csfieldguide.org.nz/en/chapters/data-representation/images-and-colours/
   a. Explain the difference between additive and subtractive mixing and where each is used.
   b. Why does the article suggest using less bits to represent blue? Do you agree with this? Why or why not?
   c. Does 24 bits allow you to represent every color? If yes, explain why. If no, give a counterexample (a color that isn’t represented).