CS-150 Worksheet 2 — Release date: 11/10/2019

This worksheet is about getting familiar with representation methods for different number types, including the use of negative numbers, real numbers, and calculations on them.

☐ Task 2.1

This task is about conversion of numbers to Two's Complement binary representation.

1. Convert the following numbers to an 8-bit Two's Complement binary representation:
   - 34 = **00100010**
   - -50 = **11001110**
   - -120 = **10001000**
   - 109 = **01101101**
2. Convert the following numbers from an 8-bit Two's Complement binary representation to decimal:
   - 10111011 = **-69**
   - 00100101 = **37**
   - 11110111 = **-9**
   - 01111111 = **127**

☐ Task 2.2

This task is about performing calculations on Two's Complement binary representations.

1. Perform the following additions on numbers which are in 8-bit Two's Complement binary representation:
   - 00010101 + 00101110 = **01000011**
   - 10010110 + 00010111 = **10101101**
2. Perform the following subtractions on numbers which are in 8-bit Two's Complement binary representation:
   - 00110111 - 00001101 = **00110111 + 11110011 = 00101010**
   - 01011010 - 11101111 = **01011010 + 00010001 = 01101011**

☐ Task 2.3

This task is about converting floating point numbers from base x to base y.

1. Convert the following from decimal to binary
   - 10.125 = **1010.001**
   - 223.25 = **11011111.01**
2. Convert the following from binary to hexadecimal:
   - 10010111100.0111 = **4BC.7**
   - 1100.0010101 = **C.2A**

☐ Task 2.4

This task is about representation of real numbers using the $\texttt{sign} \times \texttt{mantissa} \times \texttt{base}^{\texttt{exp}}$ scheme.

1. Convert each of the following decimal real numbers, identifying the `sign`, `mantissa`, `base` and `exp`. For example: 3.14 would be Sign: +1, Mantissa: 314, Base: 10, Exponent: -2.
   - 4138.12 = **Sign: +1, Mantissa: 413812, Base: 10, Exponent: -2**
   - 141402.1112 = **Sign: +1, Mantissa: 1414021112, Base: 10, Exponent: -4**
   - 0.002323 = **Sign: +1, Mantissa: 2323, Base: 10, Exponent: -6**
2. Convert each of the following decimal real numbers, identifying the `sign`, `mantissa`, `base` and `exp`, however this time we can only store 5 significant digits. For example: 3.141592 would be Sign: +1, Mantissa: 31415, Base: 10, Exponent: -4. Note that we can't store the "92".
   - 23.451 = **Sign: +1, Mantissa: 23451, Base: 10, Exponent: -3**
   - 0.123141 = **Sign: +1, Mantissa: 12314, Base: 10, Exponent: -5**
   - 12000.23222 = **Sign: +1, Mantissa: 12000, Base: 10, Exponent: 0**
3. Convert each of the following to their true decimal value.
   - Sign: -1, Mantissa: 57231, Base: 10, Exponent: 5 = **-5723100000**
   - Sign: +1, Mantissa: 29320, Base: 10, Exponent: -2 = **293.20**
   - Sign: +1, Mantissa: 13123, Base: 10, Exponent: -7 = **0.0013123**

☐ Task 2.5

This task is about representation of real numbers using Scientific Notation.

1. Convert each of the following decimal real numbers into Scientific Notation. For example: 11102019 would be 1.1102019E7.
   - 5240.82 = **5.24082E3**
   - 249232.23 = **2.4923223E5**
   - 0.0014210 = **1.4210E-3**