CS 31: Lab 2 part 1 (due Feb 3, 2023 at the start of lab)

Names and Lab Section:

Instructions

1. Write legibly and show your work.
2. When writing number of different representations, use the following prefixes:
   - `0b` for binary numbers, e.g. `0b101010` is the binary value `101010`
   - `0x` for hexadecimal numbers, e.g. `0x123a` is the hexadecimal value `123a`
   - no prefix for decimal numbers

Questions

1. What is the largest positive value that can be represented with an *unsigned* 8-bit number? Briefly explain.

2. What is the largest positive value that can be represented with a *signed* (two's complement) 8-bit number? Briefly explain.

3. Convert the *unsigned* 8-bit binary value 10100110 to decimal. Show your work.

4. Convert the *signed* 8-bit binary value 10100110 to decimal. Show your work.

5. Be sure to show your work for each question. Given the following 8-bit binary values:

```
value1:  0b01011101
value2:  0b01100101
```

(a) What is the decimal representation of the resulting addition if the two values are interpreted as 8-bit *unsigned* values?

(b) What is the decimal representation of the resulting addition if the two values are interpreted as 8-bit *signed* values?

(c) What is the binary representation of the result of adding the two values together? Does this operation result in overflow when the values are intepreted as *unsigned*, *signed*, both, or neither? Justify your answer.

(d) What is the binary representation of the result of subtracting the second from the first (`value1 - value2`)? Does this operation result in overflow when the values are intepreted as *unsigned*, *signed*, both, or neither? Justify your answer.

6. Convert the following 2-byte binary numbers directly to hexadecimal, without converting to decimal first. Recall that one hexadecimal digit corresponds to 4 bits. (The binary values have spaces between each set of 4 bits to make them more readable.)

   (a) `0000 0110 0001 1111`

   (b) `1100 0101 1110 0101`

   (c) `1010 0111 1101 0110`

7. Convert the following hexadecimal numbers to **2-byte** binary, without converting to decimal first. Recall that one hexadecimal digit corresponds to 4 bits.

   (a) `0x23`

   (b) `0x852`

   (c) `0xc1a6`

   (d) `0xefab`

8. Convert the following decimal values to 8-bit *signed* (two's complement) **binary** and then convert your binary result into **hexadecimal**. Show your work.

   (a) `12`

   (b) `-36`

(c) `123`

(d) `-123`

9. Given the following 4-bit binary values, show the results of each bit-wise operation, showing both the binary and decimal result value for each (list the unsigned decimal value):

   (a) `0110 | ~(1010)`

   (b) `~(0110 | 1010)`

   (c) `0111 & ~(1001)`

   (d) `(1010 | 0000) & 1111`

   (e) `0011 ^ 1110`

   (f) `0111 << 2`

   (g) `0111 >> 2`