CS 2110 — Quiz 1 (35 minutes)
September 5th, 2018

Full name: _____

GT username: _____

This quiz is worth a total of **100 points**.

In accordance with the Georgia Institute of Technology Honor Code, I have neither given nor received aid on this quiz.

Signature: _____

Binary Addition, Subtraction and Base Conversion

For questions 1, 2 and 3, let A and B be 8-bit binary integers such that $A = 0b01010111$ and $B = 0b10110100$. **Represent all binary results in 8 bits**, disregarding overflows and truncating down to 8 bits when necessary. **When asked to convert to decimal, convert the 8-bit value.** *Hint: The 0b prefix is used to denote a binary number. E.g.* $0b10 = 10_2 = 2$. **When writing a binary or hexadecimal number, do not use a negative sign (−) in any way. Hexadecimal and binary numbers should consist of valid characters of that base only.**

Do your calculations in the scrap areas on the bottom of the pages. Do NOT have anything other than answers outside these areas. Any non-answer text outside the scrap area affects autograder performance.

1. For the following calculations, interpret ***A*** and ***B*** as **unsigned integers**.
   (a) Calculate $\boldsymbol{A} + \boldsymbol{B}$ in binary, representing the result as an unsigned binary integer. [10]

   Answer: 0b 0000_1011

   (b) Express the result of $\boldsymbol{A} + \boldsymbol{B}$ as a decimal integer: 11 [5]

2. For the following calculations, interpret ***A*** and ***B*** as **signed magnitudes**.
   Hint: For signed magnitudes, the most significant bit is interpreted as the sign, and the rest of the binary value is interpreted as the magnitude much like an unsigned integer. Remember that the 7 least significant bits represent the absolute value of the number.
   (a) Express the value of ***A*** as a decimal integer: 87 [5]
   (b) Express the value of ***B*** as a decimal integer: -52 [5]

3. For the following calculations, interpret ***A*** and ***B*** as **2's complement integers**.
   (a) Calculate $\boldsymbol{B} + \boldsymbol{A}$ in binary, representing the result in 2's complement. [10]

   Answer: 0b 0000_1011

   (b) Express the result of $\boldsymbol{B} + \boldsymbol{A}$ as a decimal integer: 11 [5]
   (c) Calculate $\boldsymbol{A} - \boldsymbol{B}$ in binary, representing the result in 2's complement. [10]
   Hint: Convert the operation to addition first and then do the calculation.

   Answer: 0b 1010_0011

   (d) Express the result of $\boldsymbol{A} - \boldsymbol{B}$ as a decimal integer: -93 [5]

Scratch area:

4. Answer the following questions about **8-bit 2's complement integers**.
   (a) What is the negative number with the greatest absolute value? Hex: 0x__80__, Decimal: __-128__ [6]
   (b) What is the negative number with the smallest absolute value? Hex: 0x__FF__, Decimal: __-1__ [6]
   (c) What is the positive number with the greatest absolute value? Hex: 0x__7F__, Decimal: __127__ [6]

Bitwise Operations

5. Fill in the blanks with valid integers such that the equations are correct. Assume unsigned values.
   Hint: The 0x prefix is used to denote an hexadecimal number. E.g. 0x8 is equal to 8_{16}
   Hint: The $\wedge$ *operator means XOR*
   (a) $0b11101100\ \&\ \sim(0x5 << \underline{\quad 3 \quad}) = 0b11000100$ — *Express answer in decimal* [5]
   (b) $0b11011001 \wedge 0b\underline{\quad 0110\_1100 \quad} = 0b10110101$ — *Express answer in 8-bit binary* [5]

6. For this question, let C and D be **4-bit 2's complement integers** such that $C = 0b1100$ and $D = 0b0011$.
   (a) Extend C to be an 8-bit 2's complement integer, writing the result in binary: 0b__1111_1100__ [5]
   (b) Extend D to be an 8-bit 2's complement integer, writing the result in binary: 0b__0000_0011__ [5]

IEEE-754 Floating-Point Numbers

7. Answer the following question assuming that X and Y are IEEE-754 floating point numbers. [7]

Function	Sign	Exponent								Mantissa																					
Bit Index	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
X	1	1	1	0	0	0	1	1	0	1	1	1	1	1	0	0	1	1	0	0	1	1	1	0	0	1	1	0	0	0	1	0
Y	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	0	0	1	1	1	0	0	1	1	0	0	0	1	0

Which of the following is true for numbers X and Y?

● $X > Y$ ○ $X = Y$ ○ $X < Y$

Scratch area: