CIS 240: **MICROCOMPUTER ARCHITECTURE & PROGRAMMING**

HW2: 2's complement and building with gates

1. 2's complement
   Fill in this table. Do row by row like we did in class. All answers need to be 8-bits.

Row #	Base-10	Positive binary	Hexadecimal	2's complement
①	-12_{10}			
②		00010101_2		
③			0x84	
④				11110001_2
⑤				00001001_2

2. If you need more practice, find an on-line calculator for any of these representations and test yourself. Be careful with the 2's complement calculators. Some of them flip any number you put into the calculator. Look for one that's decimal to 2's complement like: https://www.exploringbinary.com/twos-complement-converter/

3. SOP (sum of product) from truth table. Find the logic for the digital circuit described by the following truth tables.
   a.

Inputs		Output
A	B	Out
0	0	0
0	1	1
1	0	0
1	1	1

b.

Inputs			Output
A	B	C	Out
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

c. Make a truth table that converts 3-bit thermometer code to binary. Thermometer code counts up:

$000_2 \rightarrow 001_2 \rightarrow 011_2 \rightarrow 111_2$

In thermometer code, $000_2=0_{10}$, $001_2=1_{10}$, $011_2=2_{10}$, and $111_2=3_{10}$. Also note that if you count up from 111_2 in this particular problem, let's say you go back to zero. **HINT:** In the truth table, any row not used can have an output of X (for don't care).

d. Find the logic for your thermometer code truth table.

4. KMaps: Find the minimal logic (biggest circles).

a.

Inputs			Output
A	B	C	Out
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

b.

	Inputs			Output
A	B	C	D	Out
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

c. Use KMaps to find minimal logic for the truth table for the thermometer code counter in question 3c.