**CS270 Recitation 1**  
**“Number Crunching”**

This recitation will help you prepare for the quiz next section. Some answers can be checked on the website referenced at the bottom of the assignment.

**Question 1:** What is the minimum number of bits required to represent the 54 fourteeners in the Colorado mountains? If you have exactly the minimum number of bits, how many bit patterns are unused?

Minimum number of bits: ____________

Number of unused bit patterns: ____________

**Question 2:** What is the range of unsigned integers that can be stored using 7 bits? What is the range for signed integers represented in 1’s and 2's complement, with the same number of bits?

Range of unsigned integers: ___ to ___

Range of signed integers: ___ to ___ (1’s complement)

Range of signed integers: ___ to ___ (2’s complement)

**Question 3:** Show the 2’s complement addition of -32 plus 12, with both numbers in binary using 8 bits. Hint: make sure that the resulting binary number corresponds to the correct answer.

_____________ (-32) + _______________ (12) = _______________ (-20)

**Question 4:** Show the 2’s complement subtraction of 10 minus 8, with both numbers in binary using 8 bits. Hint: make sure that the resulting binary number corresponds to the correct answer.

_____________ (10) + _______________ (-8) = _______________ (2)

**Question 5:** Show the results of the following bitwise operations (using the same number of bits as shown in each problem):

```
NOT(0b10101100) = ____________
0b10000010 OR 0b01110110 = ____________
0b1000111 AND 0b10111010 = ____________
0b10001000 XOR 0b01011111 = ____________
NOT(0b11011110 XOR 0b01100000) = ____________
```

**Question 6:** Show the results of the following bitwise operations:

```
~(0x3456& 0xDCBA) = 0x________
(0xFF00 ^ 0x2244) | 0x1357= 0x________
```
**Question 7: (OPTIONAL)** Given a string of digits representing a number in an arbitrary radix r, you must be able to convert it to a decimal integer. To help you practice, we have provided you with a program that generates a random 5-digit number and a random radix between 2 and 16 and asks you to convert this number into a decimal number step by step. To run it, enter the following command in a terminal:

```
~cs270/a2i
```

**Question 8: (OPTIONAL)** Now we do the opposite. Given a number in decimal, you must be able to convert it to an arbitrary radix r. To help you practice, we have provided you with a program that generates a random 5-digit number and a random radix between 2 and 16 and asks you to convert this number into the given radix. To run it, enter the following command in a terminal:

```
~cs270/i2a <mode>
```

You must replace `<mode>` with one of easy, medium, or hard. In the easy mode, you will only have to enter the least significant digit of the given number in the radix-r representation. In the medium mode, you will convert the entire number, but the program will help you a bit. In the hard mode, you will have to do everything.

Website for two’s complement math: [www.planetcalc.com/747](http://www.planetcalc.com/747)