General instructions:

- Hand in a paper copy of your solutions in class on the due date.
- Show your work! You are free to check your work with a calculator, but you should perform the calculations on paper, showing each step of the process.
- Discussion is encouraged, but you should ultimately be responsible for your own work.
- If you work with other students, please list them on your final submission.

Exercise 1. Flash memory

Suppose each cell of a flash memory device can be in one of four states.

(a) How many bits of information can each cell represent?
(b) How many cells does it take to represent one byte?
(c) Using the values 0, 1, 2, 3 to represent the four possible states of a single cell, give a sequence of cell states that can represent the number 177.

Exercise 2. Negative numbers

For this exercise, assume that bytes are the smallest addressable unit.

(a) Write the decimal number $-20,000$ as a 16-bit integer in binary two’s complement form.
(b) Convert the result to hexadecimal.
(c) Convert the hexadecimal representation to little-endian form.

Exercise 3. Binary arithmetic

For this exercise, assume that all numbers are signed 8-bit integers.

Compute the results of the following three arithmetic expressions by (1) converting the arguments to binary, (2) performing the arithmetic operation on the binary representations, then (3) converting back into hexadecimal. Finally, (4) check your work by converting all three numbers (the two arguments and the result) into decimal.

(a) 0x1E + 0x26
(b) 0xE5 + 0x46
(c) 0x0B × 0x09