Exercise 1.1

Convert the following binary numbers (base 2) to their decimal (base 10) equivalents. You should not need a calculator.

a. 1010	**b.** 10100	**c.** 10101	**d.** 10110
e. 11101110	**f.** 10101011	**g.** 11111	**h.** 10000
i. 11100111	**j.** 11111111	**k.** 10000001	**l.** 10111111

Exercise 1.2

Convert the following decimal numbers (base 10) to their binary (base 2) equivalents. You should not need a calculator.

a. 17	**b.** 19	**c.** 24	**d.** 29
e. 35	**f.** 42	**g.** 56	**h.** 61
i. 73	**j.** 99	**k.** 115	**l.** 143

Exercise 1.3

Use the Division Algorithm method 1.5 to convert these decimal number to binary.

a. 34092

b. 4997

c. 20507

Exercise 1.4

Convert each of the binary numbers in exercise 1.1 to

a. their octal equivalents.

b. their hexadecimal equivalents.

Exercise 1.5

Convert each of the following hexadecimal numbers to their binary equivalents.

a. 17	**b.** 19	**c.** 24	**d.** 29
e. 3A	**f.** B2	**g.** CF	**h.** 60
i. F3	**j.** 99	**k.** DD	**l.** A3

Multiplication

Exercise 1.6

Perform the following multiplications in binary. For each problem part, you must (1) convert each decimal number to binary, (2) perform the multiplication in binary, and (3) convert the binary result back to decimal. You must show your work.

Note: For consistency, place the binary representation of the left multiplicand in the top row of your multiplication and place the binary representation of the right multiplicand on the bottom row of your multiplication. Thus, "4 × 7" would be

$$\begin{array}{rrrr} & 1 & 0 & 0 \\ \times & 1 & 1 & 1 \\ \hline \end{array}$$

while "7 × 4" would be

$$\begin{array}{rrrr} & 1 & 1 & 1 \\ \times & 1 & 0 & 0 \\ \hline \end{array}$$

by this convention.

a. 27 × 6

b. 23 × 11

c. 11 × 23

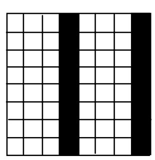
d. 46 × 7

Patterns

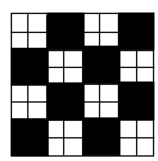
Exercise 1.7

Patterns, like the ones below, are available in most drawing programs for filling regions. A pattern is defined by an 8 × 8 array of bits. In each of the following two examples, the 8 × 8 array of bits on the left corresponds to the pattern on the right.

```
0 0 0 1 0 0 0 1
0 0 0 1 0 0 0 1
0 0 0 1 0 0 0 1
0 0 0 1 0 0 0 1
0 0 0 1 0 0 0 1
0 0 0 1 0 0 0 1
0 0 0 1 0 0 0 1
0 0 0 1 0 0 0 1
```

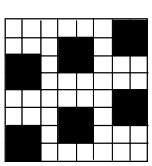


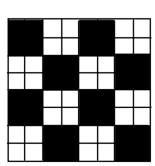
```
0 0 1 1 0 0 1 1
0 0 1 1 0 0 1 1
1 1 0 0 1 1 0 0
1 1 0 0 1 1 0 0
0 0 1 1 0 0 1 1
0 0 1 1 0 0 1 1
1 1 0 0 1 1 0 0
1 1 0 0 1 1 0 0
```

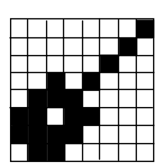


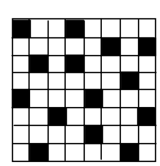
The 0s represent white, and the 1s represent black. Each row is an 8-bit binary number. As we know, a 4-bit binary number can be expressed as a single hex-digit, so an 8-bit binary number can be expressed with two hex-digits. Designers specify a pattern by giving eight 2-hex-digit numbers, one 2-hex-digit number per row. The two patterns given above are encoded as "11, 11, 11, 11, 11, 11, 11, 11" and "33, 33, CC, CC, 33, 33, CC, CC."

a. For each of the following patterns, give the eight 2-hex-digit encoding.









b. Use graph paper to show the pattern described by each of the following sequences of eight 2-hex-digit numbers. (See written Homework 01 for a link to printable graph paper.)

39, 7B, 42, 88, 88, 24, B7, 93 BD, A3, DB, 3A, BD, A3, DB, 3A

Two's Complement

Exercise 1.8

Negative numbers and two's complement. You *must* show your work to obtain full credit.

a. Give the 8-bit two's complement representations of the following integers: 34, 66, -71, -27.

b. Give the integer (in standard base-10 notation) which is represented by each of the following 8-bit two's complement numbers: 01100110, 10011001, 01010101, 11011101.

c. Compute the following sums and differences using 8-bit two's complement representations: $66 - 27$, $-71 - 27$. Verify that your answers are correct by converting the results back to standard base-10 notation.

Note: Use the two's complement representations from part **a** above.