MATH 5: HANDOUT 11
BINARY NUMBERS II

Today we talked more about binary numbers. We discussed arithmetic operations with binary numbers.

We also touched on Roman numerals and other bases.

The topic we didn't discuss (but also an interesting topic) if the base is larger than 10, then in addition to digits $0 \dots 9$ we use letters A, B, etc. For example, in base 16, we use digits $1, \dots, 9$ and letters $A = 10, B = 11, C = 12, D = 13, E = 14, F = 15$. The digits correspond to powers of 16:

$$D4B_{16} = D \cdot 256 + 4 \cdot 16 + B \cdot 1 = 13 \cdot 256 + 4 \cdot 16 + 11 \cdot 1 = 3403_{10}$$

HOMEWORK

1. What is the largest number that can be written as a 5-digit binary number? (Hint: what is the smallest 6-digit binary number?)

2. Letters and other symbols are written in computers as sequences of 0 and 1 (bits). The correspondence between actual letters and their codes, i.e. sequences of 0 and 1, is called *encoding*. Is it possible to encode every letter of English alphabet by a 4-digit binary numbers? You can choose any way you like — for example encoding A as 0000, B as 0001, or by any other method.

Would it be possible if we used 5-digit binary numbers?

3. Write numbers 45 and 165 in binary system

4. A car has traveled 125 miles during some period. During the same period, another car, which is faster by 10 mph, has traveled 150 miles. What is the speed of the faster car?

5. Do the following arithmetic operations with binary numbers. Try doing them without converting the numbers to decimal form.

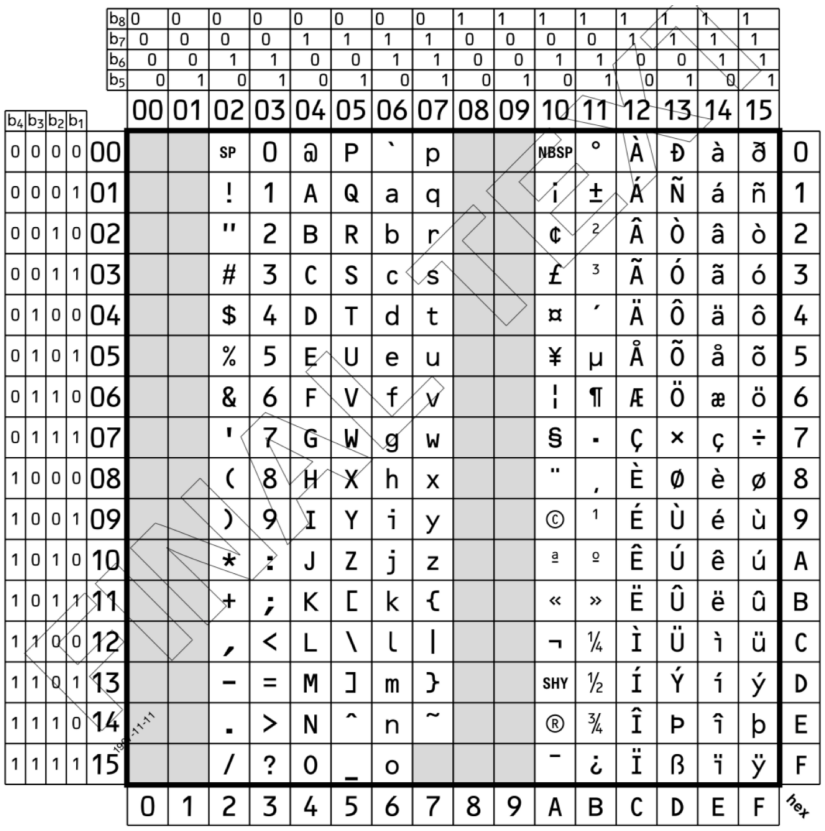
(a) $110101_b + 111011_b$ (b) $10101_b \times 1011_b$ (c) $(10101_b + 1101_b) \times 10110_b$

6. There are five heads and fourteen legs in a family. How many people and dogs are in the family?

7. Fish head weighs as much as the tail and half of the body together. The body weighs as much head and tail together, and the tail weighs 1 kg. How heavy is the fish?

8. In real life, people use a 8-digits sequence of 0 and 1 to encode a single letter.

The most common encoding is called Latin 1(or ISO 8859-1). It is shown in the table below. In this table, rows correspond to the last 4 bits, and columns, to the first four bits. For example, lower case letter "a" has code 01100001.



The following is a beginning of a computer file. Can you decode it (assuming it is written in the standard, Latin 1, encoding)?

01010100 01101111 01110000 00100000 01110011 01100101 01100011 01110010 01100101 01110100 00001010