Workshop 9 - Exercises

Consider the exercises below. Some tasks require simple calculations, for which relevant examples are given. Ask your workshop tutor if you need help.

1) Memory Address Decoding

Example:

The starting address of a memory segment is FF800h, where h stands for hexadecimal notation and each address points to 1 byte of data. What is the size of available memory if the last address of the segment is FFFFFh?

FFFFFh – FF800h = 7FFh

$=111\ 1111\ 1111_2$

$=2047_{10}$

There are 2048 addresses in the given range (including FF800h).
Each address contains one byte of data.
Therefore, the memory size is 2048Bytes = $2*2^{10}$ Bytes = **2KB**

Keeping in mind the above examples, answer the following questions:

a) What will be the last address of 512KB of RAM if the first address is 00000h?

b) 32KB of EPROM has the last address FFFFFh. What is its initial address?

2) Data representation in memory

Write down the first 12 entries of a code table that shows the correspondences between bit patterns and upper-case characters. You need to choose which specific 6-bit pattern corresponds to each letter. Make sure to arrange them in a logical order so that your system fits around the mapping given below:

`001001` maps to "`J`"

3) Two's Complement Notation (Challenge)

The concept is this:
Consider the binary numbers from 0000 to 1111 (i.e., 0 to 15 in base ten).
0001 →0111 will represent the positive numbers 1 → 7 respectively
and, 1001→1111 will represent the negative numbers –7 → –1, respectively.

It is easy to change a negative integer in base ten into binary form using the method of two's complement. The method is given below:

Step 1: Write the absolute value of the given number in binary form. Prefix this number with 0 to indicate it has a positive sign.
Step 2: Take the complement of each bit by changing zeroes to ones and ones to zero.
Step 3: Add 1 to your result. This is the two's complement representation of the negative integer.
Example:
Find the two's complement of –17 represented by 8 bits.
Step 1: $+17_{10} = 0001\ 0001_2$
Step 2: Create the complement: 1110 1110
Step 3: Add 1:
1110 1110 + 1 = 1110 1111.

Here is the task for you:

Subtract 29 from 23, as a computer would. (Using two's complement notation)

Hint: 23 – 29 = 23 + (-29)