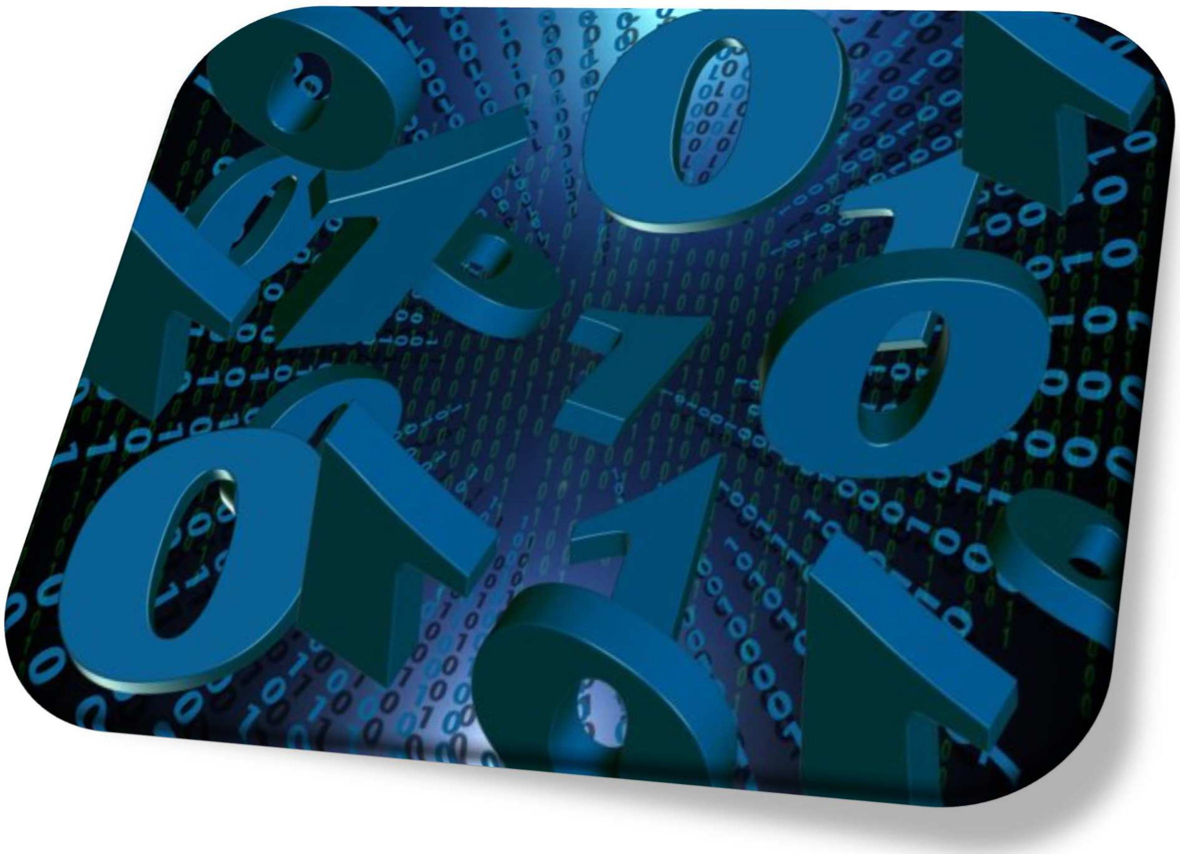

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Exercises about representation of information

Add a few explanations to demonstrate how to perform each conversion. For example, from decimal to binary we use powers and then explain the corresponding operations.

1. Convert from decimal to binary:

Make a table. Write the powers of two in a "base table of 2" from right to left. Start with 2^0, assigning it a value of "1". Increase the exponent by one for each power. Continue with the table until you reach the number closest to the decimal number you want to convert and if the result is less than the outpu, you put 1, if exceeds 234 you will put 0:

2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
256	128	64	32	16	8	4	2	1
	1	1	1	0	1	0	1	0

Then, find the highest power of 2. Choose the largest number that fits in the number you are going to convert with sums:

128 + 64 = 192
192 + 32 = 224
224 + 16 = 240 (it is exceeding so you put a 0).
224 + 8 = 232
232 + 4 = 236 (it is exceeding so you put a 0).
232 + 2 = 234
In this case, for even decimal numbers, don’t forget to add as many zeros on the right as needed to complete the binary result.

a. 234 = 11101010
b. 555 = 1000101011
c. 12321 = 11000000100001
d. 152 = 10011000
e. 32768 = 1000000000000000 This is a power of two -> 2^{15}

2. Convert from binary to decimal:

Write the binary number and list the powers of 2 from right to left. First, write the binary number. Then, write the powers of two from right to left. Start at 2^0, giving it a value of "1". Increase the exponent by one on each power.

$$1*2^9 + 0*2^8 + 1*2^7 + 1*2^6 + 1*2^5 + 1*2^4 + 0*2^3 + 1*2^2 + 0*2^1 + 0*2^0$$

Write the digits of the binary number below their corresponding powers. Now, type **1011110100** below the numbers **512, 256, 128, 64, 32, 16, 8, 4, 2 and 1**, so that each binary digit corresponds to its power of two. The "1" to the right of the binary number should correspond to the "1" to the right of the powers of two and so on.

a. 100000000 = 256 it is a power of two -> 2^9
b. 1011110100 = 756
c. 10011101 = 157
d. 11111111111 = 2047 it is a power of two subtracting 1 -> 2^{11}-1

NOTE: to do the next three exercises (3, 4 and 5), you need to use the corresponding table group of three (0 and 1) in octal and four in hexadecimal numbers.

0	0	0	0	**0**
0	0	0	1	**1**
0	0	1	0	**2**
0	0	1	1	**3**
0	1	0	0	**4**
0	1	0	1	**5**
0	1	1	0	**6**
0	1	1	1	**7**
1	0	0	0	**8**
1	0	0	1	**9**
1	0	1	0	**A**
1	0	1	1	**B**
1	1	0	0	**C**
1	1	0	1	**D**
1	1	1	0	**E**
1	1	1	1	**F**

3. Convert from hexadecimal to binary:

   a. 45A0 = 100 0101 1010 0000
   b. CF = 1100 1111
   c. AAB2 = 1010 1010 1011 0010
   d. 3020 = 11 0000 0010 0000

4. Convert from binary to hexadecimal:
   a. 110001000 = 188
   b. 100010110 = 116

5. Complete the following conversions related to octal numeral system:
   a. Convert the numbers from exercise 4 to octal.

      $\underline{110}\ \underline{001}\ \underline{000}_2$ = 610,
      $\underline{100}\ \underline{010}\ \underline{110}_2$ = 426

   b. Convert the octal 3020 to binary = 11000010000

6. Fill in the gaps, using all the conversions you need. You must write the steps to transform each number.

   To do this exercise, you have to follow the same steps as the previous exercises:

BINARY	DECIMAL	HEXADECIMAL	OCTAL
100001	**33**	**21**	**41**
1111 1111	**255**	**FF**	**377**
1111 1111	**255**	**FF**	**377**
10 0001	**33**	**21**	**41**

7. How many bits do you need to represent the following numbers in binary?

In this exercise, you need to convert the numbers and delete ceros on the left, especially for hexadecimal numbers. For example, **4B = 0100 1011**, but you have to pad ceros to get the minimum digits: **100 1011**

   a. hexadecimal: 4B, 4AA, FF4FA, 345F

   4B: 100 1011 **= 7 bits**
   4AA: 100 1010 1010 = **11 bits**
   FF4FA: 1111 1111 0100 1111 1010 = **20 bits**
   345F: 0011 0100 0101 1111 = **14 bits**

   b. decimal: 100, 256, 255, 32, 31, 3, 4350, 1024, 45, 2^{30} , 63

   100: 1100100 = **7 bits**
   256: 1 1111 1111 = **9 bits**
   255: 1111 1111 = **8 bits**
   32: 11 1111 = **6 bits**
   31: 11111 = **5 bits**

3: 011 = **2 bits**
4350: 0001 0000 1111 1110 = **13 bits**
1024: 1111 1111 111 = **11 bits**
45: 101101 = **6 bits**
2^{30}: (1.073.741.824) = **31 (1+thirty ceros)**
63: 111111 = **6 bits**

8. Solve the following parts using ASCII extended (8 bits).
   a. Write a random text, which contains letters, numbers and other alphanumeric characters.
   b. Encode to hexadecimal, according ASCII table.
   c. Convert to binary.

a) **MEMENTO-60:**

b) M = **4D**
E = **45**
M = **4D**
E = **45**
N = **4E**
T = **54**
O = **4F**
- = **2D**
6 = **36**
0 = **30**

c) 4D = **0100 1101**
45 = **0100 0101**
4D = **0100 1101**
45 = **0100 0101**
4E = **0100 1110**
54 = **0101 0100**
2D = **0010 1101**
36 = **0011 0110**
30 = **0011 0000**

MEMENTO-60 in binary:

01001101 01000101 01001101 01000101 01001110 01010100 00101101 00110110 00110000