

Unit 3. 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:

Explanation: in order to convert a decimal to binary that are base 2 as her name says, you have two way the first one is dividing by two until you can't anymore and take the remainders in above orders, or you can make a simple table of two to the power of the n position starting from right to left and subtract the number from the power of two, this is the method that I will be following for each exercise.

$2^{10}=1024$	$2^9=512$	$2^8=256$	$2^7=128$	$2^6=64$	$2^5=32$	$2^4=16$	$2^3=8$	$2^2=4$	$2^1=2$	$2^0=1$

- a. $234 = 11101010$

$$234-128=106 \rightarrow 1$$

$$234-128-64=42 \rightarrow 1$$

$$234-128-64-32=10 \rightarrow 1$$

$$(\text{this power exceeds the value}) \rightarrow 0$$

$$234-128-64-32-8=2 \rightarrow 1$$

$$(\text{this power exceeds the value}) \rightarrow 0$$

$$234-128-64-32-8-2=0 \rightarrow 1$$

$$(\text{this power exceeds the value}) \rightarrow 0$$

- b. $555 = 1000101011$

Explanation: in this case I choose the division method, we take module of the division from bottom to top in order to write the decimal number.

$$555 \% 2 = 1$$

$$277 \% 2 = 1$$

$$138 \% 2 = 0$$

$$69 \% 2 = 1$$

$$34 \% 2 = 0$$

$$17 \% 2 = 1$$

$$8 \% 2 = 0$$

$$4 \% 2 = 0$$

$$2 \% 2 = 0$$

$$1 \% 2 = 1$$

c. $12321 = 11000000100001$

$$12321 - 2^{13} = 4129 \rightarrow 1$$

$$4129 - 2^{12} = 33 \rightarrow 1$$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

$$33 - 32 = 1 \rightarrow 1$$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

$$1 - 1 = 0 \rightarrow 1$$

d. $152 = 10011000$

$$152 - 128 = 24 \rightarrow 1$$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

$$24 - 16 = 8 \rightarrow 1$$

$$8 - 8 = 0 \rightarrow 1$$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

(this power exceeds the value) $\rightarrow 0$

e. $32768 = 1000000000000000$

$$32768 - 2^{15} = 0 \rightarrow 1$$

The rest are zero as they exceed the value of zero.

2. Convert from binary to decimal:

Explanation: In order to convert from binary to decimal you have to multiply the n positioned number that could only be 0 or 1 for two elevated to n-1 and add each result $\rightarrow n \cdot 2^{(n-1)} + n \cdot 2^{(n-1)} \dots$

a. $100000000 = 128$

$$1 \cdot 2^8 + 0 \cdot 2^7 + 0 \cdot 2^6 + 0 \cdot 2^5 + 0 \cdot 2^4 + 0 \cdot 2^3 + 0 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0 = 128$$

b. 1011110100

$$1 \cdot 2^9 + 0 \cdot 2^8 + 1 \cdot 2^7 + 1 \cdot 2^6 + 1 \cdot 2^5 + 1 \cdot 2^4 + 0 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0 = 756$$

c. 10011101

$$1 \cdot 2^7 + 0 \cdot 2^6 + 0 \cdot 2^5 + 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0 = 157$$

d. $11111111111 = 2047$

This kind of binary number has a trick, you could count the quantity of number in this case is 11 so 2^{11} is 2048 but this is 100000000000 so now you can advise that the next minor binary number is 11111111111 so $2048 - 1 = 2047$

3. Convert from hexadecimal to binary:

Explanation: as hexadecimal has only 16 values (1-9 and A-F) has an associate binary number so is easy to made the conversion, for each number corresponds 4 binary numbers. So we use the upper table in order to make the conversion.

a. $45A0 = 0100010110100000$

$$4 = 0100$$

$$5 = 0101$$

$$A = 1010$$

$$0 = 0000$$

b. $CF = 11001111$

$$C = 1100$$

$$F = 1111$$

c. $AAB2 = 1010101010110010$

$$A = 1010$$

$$A = 1010$$

$$B = 1011$$

$$2 = 0010$$

d. $3020 = 001000000100000$

$$3 = 0011$$

$$0 = 0000$$

$$2 = 0010$$

$$0 = 0000$$

Decimal	Binary	Octal	Hexadecimal
0	0000	0	0
1	0001	1	1
2	0010	2	2
3	0011	3	3
4	0100	4	4
5	0101	5	5
6	0110	6	6
7	0111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F

4. Convert from binary to hexadecimal:

Explanation: in order to convert from binary to hexadecimal you have to group numbers by four from right to left and in the case there are number left in this ones have to add zeros at the left of this ones to complete the group of four numbers. Then we use the table to convert the digits.

- a. $110001000 = 188$
 $1000 = 8$
 $1000 = 8$
 $1 = 1$
- b. $100010110 = 116$
 $0110 = 6$
 $0001 = 1$
 $1 = 1$

Decimal	Binary	Octal	Hexadecimal
0	0000	0	0
1	0001	1	1
2	0010	2	2
3	0011	3	3
4	0100	4	4
5	0101	5	5
6	0110	6	6
7	0111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F

5. Complete the following conversions related to octal numeral system:

Explanation: the conversion to octal from binary are made straight of the table of values grouping by three from right to left.

- a. Convert the numbers from exercise 4 to octal.
 $110001000 = 610$
 $000 = 0$
 $001 = 1$
 $110 = 6$
- b. Convert the octal 3020 to binary.
 $3020 = 011000010000$
 $0 = 000$
 $2 = 010$
 $0 = 000$
 $3 = 011$

Decimal	Binary	Octal	Hexadecimal
0	0000	0	0
1	0001	1	1
2	0010	2	2
3	0011	3	3
4	0100	4	4
5	0101	5	5
6	0110	6	6
7	0111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F

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

Explanation: For the first row I converted from decimal to binary using the table of exercise 1, from here I take the binary in order to make the hexadecimal and octal conversion grouping digits by four for the hexadecimal and by three for the octal, then I use the table of exercise 3. For second and third row I converted well the hexadecimal or the octal to binary with the table of exercise 3 and then to decimal using the table of exercise number 1. For the last row I use the table of the exercise 1 to convert in to decimal and the table of exercise 3 to convert the binary in to hexadecimal and octal.

BINARY	DECIMAL	HEXADECIMAL	OCTAL
10 0001	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?

Explanation: In order to know the bits we need to know the binary number so we need to make the conversion as usual and then if there's any zero on the left we can omit then because that not count like a bit.

(The 0 that in bold letter doesn't count as a bit)

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

4B = **0**100 1011 = 7bits

4 = 0100

B = 1011

4AA = **0**100 1010 1010 = 11bits

4 = 0100

A = 1010

A = 1010

FF4FA = 20bits

345F = 15bits

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

100 = **0**110 0100 = 7bits

$1 \cdot 2^6 + 1 \cdot 2^5 + 0 \cdot 2^4 + 0 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0 = 1100100$

256 = 9bits

255 = 8bits

32 = 6bits

31 = 5bits

3 = 2bits

4350 = 13bits

1024 = 11bits

45 = 6bits

$2^{30} = 31$ bits

63 = 6bits

8. Solve the following parts using ASCII extended (8 bits).
- a. Write a random text, which contains letters, numbers and other alphanumeric characters.
L0*,4r
 - b. Encode to hexadecimal, according ASCII table.
4C302A2C3472
 - c. Convert to binary.
100 1100 0011 0000 0010 1010 0010 1100 0011 0100 0111 0010