Marta Muñoz San Román

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:**
   a. 234 = 11101010
   b. 555 = 10 0010 1011
   c. 12321 = 11 0000 0010 0001
   d. 152 = 1001 1000
   e. 32768 = 1000 0000 0000 0000

I have divided the input decimal number by 2, then I repeat this process till quotient becomes zero. The equivalent binary number will be the remainders in above process in reverse order.

2. **Convert from binary to decimal:**

1024	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
-	1	0	1	1	1	1	0	1	0	0
	512 +	256 +	128 +	64 +	32 +	16 +		4 = 756		

   a. 100000000 = 256
   b. 10 1111 0100 = 512 + 128 + 64 + 32 + 16 + 4 = 756
   c. 10011101 = 128 + 16 + 8 + 4 + 1 = 157
   d. 11111111111 = 1024 + 512 + 256 + 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 2047 (it´s equal to the power of 11)

To convert a binary number to decimal, I just add the final value of each power of two.

3. **Convert from hexadecimal to binary:**
   a. 45A0 = 0100 0101 1010 0000
   b. CF = 1100 1111
   c. AAB2 = 1010 1010 1011 0010
   d. 3020 = 0011 0000 0010 0000

Dec	Hex	Oct	Bin
0	0	000	0000
1	1	001	0001
2	2	002	0010
3	3	003	0011
4	4	004	0100
5	5	005	0101
6	6	006	0110
7	7	007	0111
8	8	010	1000
9	9	011	1001
10	A	012	1010
11	B	013	1011
12	C	014	1100
13	D	015	1101
14	E	016	1110
15	F	017	1111

Taking into account this reference table and that hexadecimal numbers have four digits, I simply compare them with the references.

4. **Convert from binary to hexadecimal:**
    a. 1 1000 1000 = 0001 1000 1000 = 188
    b. 1 0001 0110 = 0001 0001 0110 = 116

Firstly, I have divided the digits in groups of four, from the right to the left. The last group that only has one digit should be completed with three zeros.

5. **Complete the following conversions related to octal numeral system:**
    a. Convert the numbers from exercise 4 to octal.
    To do this operation, I divided the binary numbers in groups of three digits to have the conversion.
        i. 110 001 000 = 006 001 000 = 610
        ii. 100 010 110 = 004 002 006 = 426
    b. Convert the octal 3020 to binary.
    To convert an octal into binary, I just simply use the table as reference and commit the operation. Also, I will divide the numbers in groups of 1 digit:
        i. 3 0 2 0 = 0011 0000 0010 0000

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

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

As I have done in exercises before, from binary to decimal I have divided 33 by 2, till quotient becomes zero. Then, the equivalent binary number will be the reminders in reverse order = 10 0001.
From decimal to hexadecimal, taking into account that each four numbers are equivalent to an hexadecimal digit, I have divide the binary digits intro groups of four (starting from the right). Then, each our numbers are equivalent to an hexadecimal digit = 21.
Finally, to convert from binary to octal (the easiest way), I divide the binary digits into groups of three (starting from the right) and then convert each group of three binary digits to one octal digit.
I have done the same with the rest of the table, converting each hexadecimal and octal number to binary and then converting the binary number to each left number type.

7. **How many bits do you need to represent the following numbers in binary?**
    a. hexadecimal: 4B, 4AA, FF4FA, 345F

- 4B = 0100 1011 = 7 bits / 1Byte
  4AA = 0100 1010 1010 = 11 bits / 2 bytes
  FF4FA = 1111 1111 0100 1111 1010 = 20 bits / 3 bytes
  345F = 0011 0100 0101 1111 = 14 bits / 2 bytes

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

- 100 = 0110 0100 = 7 bits / 1 byte
  256 = 0001 0000 0000 = 9 bits / 2 bytes
  255 = 1111 1111 = 8 bits / 1 byte
  32 = 0010 0000 = 6 bits / 1 byte
  31 = 0001 1111 = 5 bits / 1 byte
  3 = 0011 = 2 bits / 1 byte
  4350 = 0001 0000 1111 1110 = 13 bits / 2 bytes
  1024 = 0100 0000 0000 = 11 bits / 2 bytes
  45 = 0010 1101 = 6 bits / 1 byte
  2^{30} = 100 0000 0000 0000 0000 0000 0000 0000 = 31 bits / 4 bytes
  63 = 0011 1111 = 6 bits / 1 byte

8. Solve the following parts using ASCII extended (8 bits).

a. Write a random text, which contains letters, numbers and other alphanumeric characters.

- Hello universe, my surname is Muñoz San Román and I was born in 1999.

b. Encode to hexadecimal, according ASCII table.

- Decimal code:
  72 101 108 108 111 | 117 110 105 118 101 114 115 101 | 44 | 109 121 | 115 117 114 110 97 109 101 | 105 115 | 77 117 241 111 122 | 83 97 110 | 82 111 109 225 110 | 97 110 100 | 73 | 119 97 115 | 98 111 114 110 | 105 110 | 49 57 57 57 | 46
- Hexadecimal code:
  48 65 6C 6C 6F 20 75 6E 69 76 65 72 73 65 2C 20 6D 79 20 73 75 72 6E 61 6D 65 20 69 73 20 4D 75 F1 6F 7A 20 53 61 6E 20 52 6F 6D E1 6E 20 61 6E 64 20 49 20 77 61 73 20 62 6F 72 6E 20 69 6E 20 31 39 39 39 2E

c. Convert to binary.

- 01001000 01100101 01101100 01101100 01101111 00100000 01110101 01101110 01101001 01110110 01100101 01110010 01110011 01100101 00101100 00100000 01101101 01111001 00100000 01110011 01110101 01110010 01101110 01100001 01101101 01100101 00100000 01101001 01110011 00100000 01001101 01110101 11000011 10110001 01101111 01111010 00100000 01010011 01100001 01101110 00100000 01010010 01101111 01101101 11000011 10100001 01101110 00100000 01100001 01101110 01100100 00100000 01001001 00100000 01110111 01100001 01110011 00100000 01100010 01101111 01110010 01101110 00100000 01101001 01101110 00100000 00110001 00111001 00111001 00111001 00101110