

## Exercises on the topics of class 7

### Exercises with solutions

**Ex. 1.** Consider the binary string 100110 and give the codeword with (even) parity, where the parity bit is the last one. Is the resulting string a Hamming 4-to-3 codeword? If no, assume that one single error occurred, identify it and correct it.

SOLUTION:

We have to add a 1 (even parity bit). Hence, the resulting codeword is 1001101 that is NOT a Hamming codeword. Indeed:

- 1011 has an odd number of 1s
- 1010 has an even number of 1s
- 1001 has an even number of 1s

So, the error is in position 1-3-5-7. The only position that occurs only in this string is 1. Hence, the correct Hamming codeword is 1001100.

**Ex. 2.** Consider 0100.

- Give its parity bit.
- Write the string as a 2x2 matrix and calculate the longitudinal and vertical parity bits.
- Write the Hamming 4-to-3 codeword associated to the given string.

SOLUTION:

- The (even) parity bit is 1.
- The matrix representation and the parity bits (in bold) are:

0	1	<b>1</b>
0	0	<b>0</b>
<b>0</b>	<b>1</b>	

- The Hamming codeword is  $010c_30c_2c_1$ , whose first control bit that check parity of 1-3-5-7, the second one that of 2-3-6-7, and the third one that of 4-5-6-7. Hence, the result is **0101010**

### Exercises without solutions

**Ex. 1.** Write the Hamming 4-to-3 codeword for 0110.

**Ex. 2.** Consider the binary string 110010 and build its (even) parity codeword, where the parity bit is the last one. Is the resulting string a Hamming 4-to-3 codeword? If no, assume there was one single error, detect and correct it.