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# **ESD - Elettronica dei Sistemi Digitali**

Exercises on Graphical Minimization Methods

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## 1 Graphical minimization methods Exercises

### 1.1 Exercise 1

Design the following circuits by proceeding through these steps: define the truth table based on the textual description, construct the corresponding Karnaugh map, minimize the Boolean function, draw the circuit schematic, and finally verify the correctness of the truth table using Deeds.

#### 1.1.1 (a) Majority Detector

Design a circuit with three inputs A, B, C and one output Y, which is 1 whenever at least two inputs are 1.

#### 1.1.2 (b) Odd Parity Detector

Design a circuit with three inputs A, B, C and output  $Y = 1$  if the number of 1s is odd

#### 1.1.3 (c) Code Detector

Design a circuit with three inputs A, B, C. The output  $Y = 1$  only when the input pattern is 101.

#### 1.1.4 (d) Greater Than 9

Design a circuit that takes a 4-bit input  $A_3 A_2 A_1 A_0$  and outputs  $Y=1$  if the unsigned decimal number represented by the binary input is greater than 9 (decimal 10–15).

#### 1.1.5 (e) 2-bit Comparator

Design a circuit with two 2-bit binary numbers  $A_1 A_0$  and  $B_1 B_0$ . The output  $Y = 1$  if the unsigned decimal number represented by A is greater than the unsigned decimal number represented by B.

#### 1.1.6 (f) Binary-to-Gray Code Converter

Design a circuit that converts a 3-bit binary input ( $A_2 A_1 A_0$ ) to its Gray code ( $G_2 G_1 G_0$ )

## 1.2 Exercise 2

Simplify the following Boolean expressions using two different approaches: using Boolean algebra theorems and Karnaugh maps.

### 1.2.1 (a)

$$G = ABC + B\bar{C}$$

### 1.2.2 (b)

$$H = (A + \bar{B})(B + \bar{C})$$

### 1.2.3 (c)

$$Y = B\bar{C}\bar{D} + CD + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C$$

### 1.2.4 (d)

$$Y = AB + \bar{A}\bar{B}\bar{C}\bar{D}$$