Digital Systems

Representation and simplification of functions

proposed exercises[1]

1. Consider the function F defined by expression $F = A\overline{D}+B\overline{C}+\overline{A}BD+ABCD+\overline{A}BC\overline{D}$.
   (a) Draw the logic diagram of F.
   (b) Simplify the function and draw the corresponding logical diagram.
   (c) Compare the two implementations and comment the need for simplifying the functions.

2. Consider the function $f(A, B, C, D) = ABC + A\overline{B}C\overline{D} + A\overline{B}D + \overline{B}\ \overline{C}\ \overline{D}$.
   (a) Simplify the function using Karnaugh maps.
   (b) Implement the function using only `NOR` gates.
   (c) Draw the logic diagram of the function.

3. A project team is studying the selection of a new network server. Since it received many proposals, the team wants an automatic system to select the quality of each proposal. The team determined that there are 5 options in the equipment:

   - option A has the weight of 30%
   - options B and C have the weight of 20%
   - options D and E have the weight of 15%

   If the quality of the proposal is higher or equal than 70%, the recommendation is to buy it; if the quality of is lower than 70%, but higher than 50%, the decision is indifferent; if the quality is lower than 50%, the proposal is rejected.

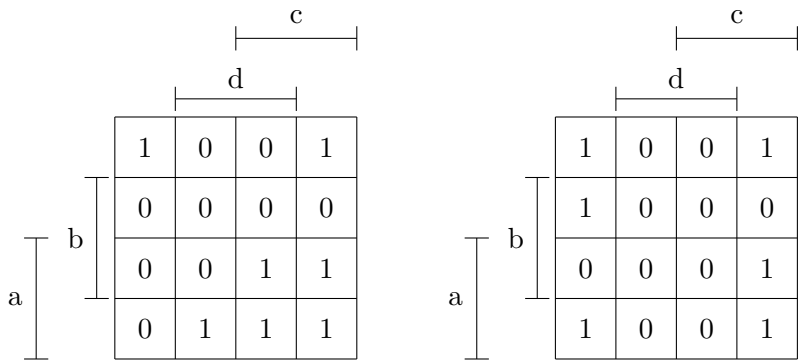
   (a) Using a truth table, represent the function that corresponds to the requirements of the team project.
   (b) Simplify the function.
   (c) Draw the logical diagram of the simplified functions

4. Consider the function $f(A, B, C, D) = \sum\ m(1, 3, 8, 10, 13, 14, 15) + i(0, 2)$, where $i()$ indicates the indifferences of the functions.
   (a) Indicate the maxterms.
   (b) Simplify the function.
   (c) Implement the simplified function using only `NAND` gates.

[1] Adapted from the book *Sistemas Digitais, princípios e prática.* Morgado Dias. FCA, 2010.

(d) Implement the simplified function using only `NOR` gates.

5. Consider the following Karnaugh map of function G and simplify it:



$E = 0$ $E = 1$