INF2270, exercise on combinational logic

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Abstract

In these exercises you can test your skills in simplifying combinational logic using the tools of Boolean logic, truth tables and Karnaugh maps.

Exercise 1:

(a) Analyse the combinational logic circuits in figure 1 and write down the corresponding Boolean function!

(b) Write down the functions as truth tables!

(c) Use the tables to write Karnaugh maps!

(d) Use the Karnaugh maps to derive minimal 'sum of products' Boolean functions!

(e) Draw the resulting combinational logic circuit!

Note that the resulting circuit might not always have a smaller gate count, but it will always be a standard format with only ANDs and ORs, which can be an advantage for implementation too.

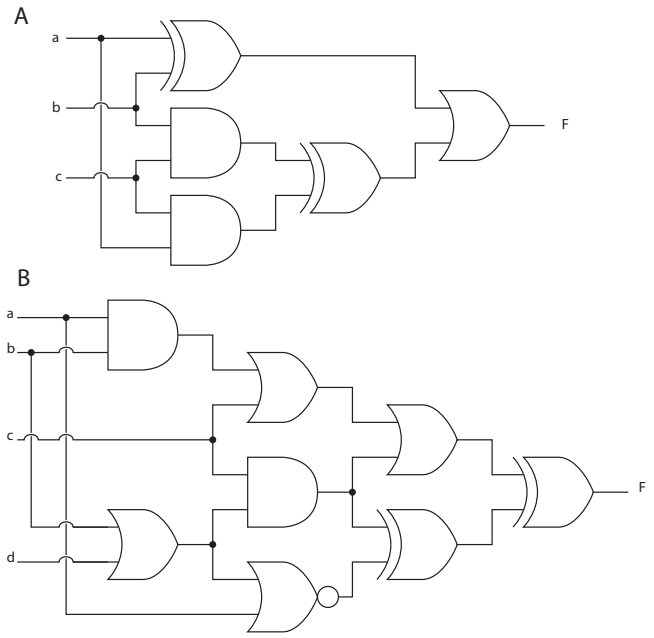

Figure 1: Two examples of (overly complicated) combinational circuits

Exercise 2: Adder

(a) Construct a one-bit adder. Draw the truthtable, simplify if possible using Karnaughmap and draw the circuit.

(b) Construct a two-bit adder.

Exercise 3: Gates

(a) List the truthtable for a 3-input AND-, OR-, NOR, NAND- and XOR-gates.

(b) Demonstrate how to build 3-input AND-, OR-, NOR-, NAND- and XOR gates with just using 2-input gates.

Exercise 4: Simplify Expressions

Simplify the following Boolean expressions to a minimum number of literals:

(a) xy + xy'

(b) (x+y)(x+y')

(c) xyz + x'y + xyz'

(d) (A+B)'(A'+B')'

(e) ABC + A'B + ABC'

(f) x'yz + xz

(g) (x+y)'(x'+y')

(h) xy + x(wz + wz')

(i) (BC' + A'D)(AB'+CD')

Reduce the following Boolean expressions to the indicated number of literals:

(a) A'C' + ABC + AC' *to three literals*

(b) (x'y' + z)' + z + xy + wz *to three literals*

(c) A'B(D'+C'D) + B(A+A'CD) *to one literal*

(d) (A'+C)(A'+C')(A+B+C'D) *to four literals*

Find the complement of F = x+yz then show that FF'=0 and F+F' = 1.

List the truthtable for the function: F = xy + xy' + y'z

Good Luck :)