Wednesday, October 2, 2019

The minimal SOP form

SOP form simplified as far as possible. For function F

- no other SOP expression has fewer product terms
- further, no SOP expression has fewer literals

The expression for C_{out} determined on Monday is minimal (with 3 product terms, 6 literals).

Another example: comparing 3 equivalent SOP expressions.

(1) $F = A\bar{B}\bar{C} + A\bar{B}C + ABC$ ⟵ (2) and (3) have 1 fewer product term

(2) $F = A\bar{B} + ABC$ ⟵ (3) has one fewer literal

(3) $F = A\bar{B} + AC$ ⟵ minimal

(1) $F = A\bar{B}\bar{C} + A\bar{B}C + ABC = A\bar{B}(\bar{C}+C) + ABC$

(2) $F = A\bar{B} + ABC = A(\underbrace{\bar{B} + BC})$

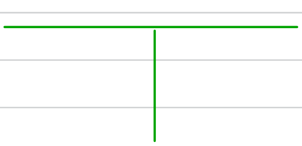
"add out" $\bar{B} + BC = (\bar{B}+B)(\bar{B}+C)$
$= \bar{B} + C$

(3) $F = A\bar{B} + AC$

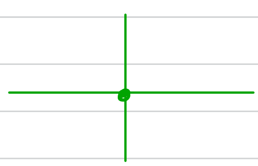
We don't yet have an easy way to prove that we have a minimal form.

Drawing schematic diagrams

Following the conventions in the text, we draw wires this way:



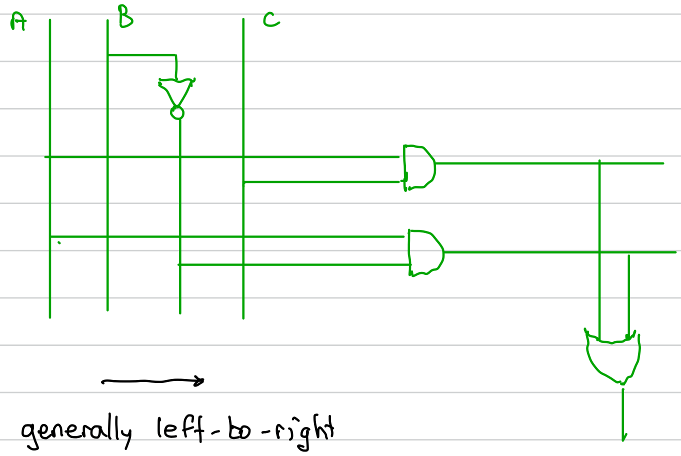
Connection at a "tee" junction



Connecting crossing wires

crossing wires, no connection

One easy way to draw a circuit

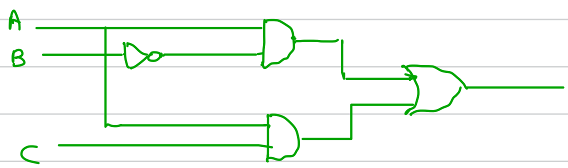


top-to-bottom

Programmed Logic Array (PLA) style

generally left-to-right flow

or simply,



In-line style

Multilevel combinational circuits

The two circuits above are 2-level circuits

- the NOT gates do not count as a level
- the AND gates here are the first-level gates
- the OR gate is the second-level gate

  - naturally suited for any SOP expression

However, 3-or-higher level circuits can reduce hardware requirements

Hardware reduction

For example, following Section 2.5.1 (p. 70), the sum bit for a 1-bit full adder ....