Example: Practice 11, p. 645

PRACTICE 11

a. Find the canonical sum-of-products form for the truth function of Table 8.5.
b. Draw the network for the expression of part (a).

TABLE 8.5

x_1	x_2	x_3	$f(x_1, x_2, x_3)$
1	1	1	1
1	1	0	0
1	0	1	1
1	0	0	1
0	1	1	0
0	1	0	0
0	0	1	1
0	0	0	1

Example: Exercise 15, p. 657 Find the canonical sum-of-products form for the truth function:

15.

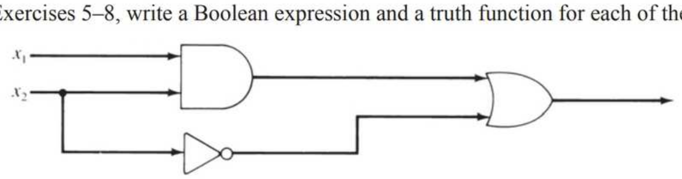
x_1	x_2	x_3	$f(x_1, x_2, x_3)$
1	1	1	0
1	1	0	0
1	0	1	1
1	0	0	1
0	1	1	0
0	1	0	1
0	0	1	0
0	0	0	0

Example: Exercise 2, p. 655 Write a truth function and construct a logic network using AND gates, OR gates, and inverters for the Boolean expression $(x_1 + x_2') + x_1' x_3$

Example: Exercise 5, p. 655

For Exercises 5–8, write a Boolean expression and a truth function for each of the logic networks shown.

5.



0.1 An example: Adding Binary numbers

Half-Adder: Adds two binary digits.

$$\begin{aligned} s &= x_1'x_2 + x_1x_2' \\ c &= x_1x_2 \end{aligned}$$

Full-Adder: Adds two digits plus the carry digit from the preceding step (which we can create out of two half-adders!).

- Given the preceding carry digit c_{i-1}, and binary digits x_i and y_i.
- We'll use a half-adder to add x_i to y_i, obtaining write digit σ and carry digit γ.
- Then use a half-adder to add the carry digit c_{i-1} to σ; the write digit is s_i, and call the carry digit c.
- To get the carry digit c_i, compare the carry digits c and γ: if either gives a 1, then $c_i = 1$ (so it's an "or").

Let's derive all that from the truth functions, representing the sum from the full-adder:

c_{i-1}	x_i	y_i	c_i	s_i
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

So the canonical sum of products forms of each function are

$$\begin{aligned} s_i(c_{i-1}, x_i, y_i) &= c_{i-1}'x_i'y_i \\ &+ c_{i-1}'x_iy_i' \\ &+ c_{i-1}x_i'y_i' \\ &+ c_{i-1}x_iy_i \\ &= c_{i-1}'(x_i'y_i + x_iy_i') + c_{i-1}(x_i'y_i + x_iy_i')' \end{aligned}$$

and

$$\begin{aligned} c_i(c_{i-1}, x_i, y_i) &= c_{i-1}'x_iy_i \\ &+ c_{i-1}x_i'y_i \\ &+ c_{i-1}x_iy_i' \\ &+ c_{i-1}x_iy_i \\ &= x_iy_i + c_{i-1}(x_i'y_i + x_iy_i') \end{aligned}$$

We recognize these quantities in terms of half-adders.