SANTA CLARA UNIVERSITY
Electrical Engineering Department

Homework 2 solution

2.35. (a)

x_1	x_0	y_1	y_0	f
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

(b) The simplest POS expression is $f = (x_1 + \overline{y}_1)(\overline{x}_1 + y_1)(x_0 + \overline{y}_0)(\overline{x}_0 + y_0)$.

2.40. SOP form: $f = \bar{x}_2\bar{x}_3 + \bar{x}_2\bar{x}_4 + x_2x_3x_4$
POS form: $f = (\bar{x}_2 + x_3)(x_2 + \bar{x}_3 + \bar{x}_4)(\bar{x}_2 + x_4)$

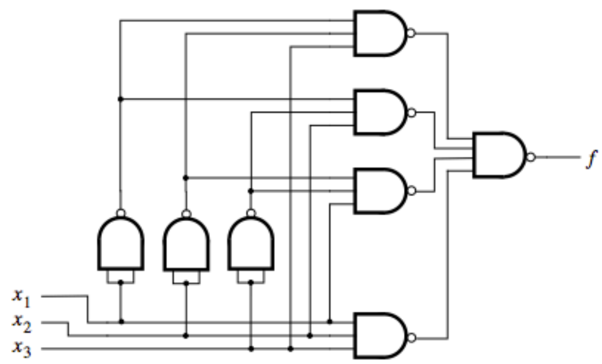
2.41. SOP form: $f = \bar{x}_3\bar{x}_5 + \bar{x}_3x_4 + x_2x_4\bar{x}_5 + \bar{x}_1x_3\bar{x}_4x_5 + x_1x_2\bar{x}_4x_5$
POS form: $f = (\bar{x}_3 + x_4 + x_5)(\bar{x}_3 + \bar{x}_4 + \bar{x}_5)(x_2 + \bar{x}_3 + \bar{x}_4)(x_1 + x_3 + x_4 + \bar{x}_5)(\bar{x}_1 + x_2 + x_4 + \bar{x}_5)$

2.42. SOP form: $f = \bar{x}_2x_3 + \bar{x}_1x_5 + \bar{x}_1x_3 + \bar{x}_3\bar{x}_4 + \bar{x}_2x_5$
POS form: $f = (\bar{x}_1 + \bar{x}_2 + \bar{x}_3)(\bar{x}_1 + \bar{x}_2 + \bar{x}_4)(x_3 + \bar{x}_4 + x_5)$

2.43. SOP form: $f = x_3\bar{x}_4\bar{x}_5 + \bar{x}_3\bar{x}_4x_5 + x_1x_4x_5 + x_1x_2x_4 + x_3x_4x_5 + \bar{x}_2x_3x_4 + x_2\bar{x}_3x_4\bar{x}_5$
POS form: $f = (x_3 + x_4 + x_5)(\bar{x}_3 + x_4 + \bar{x}_5)(x_1 + \bar{x}_2 + \bar{x}_3 + \bar{x}_4 + x_5)$

2.45. $f = x_1x_2x_3 + x_1x_2x_4 + x_1x_3x_4 + x_2x_3x_4$

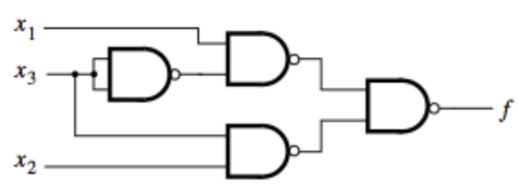
2.51 (etc). Using the ciruit in Figure 2.32*a* as a starting point, the function in Figure 2.31 can be implemented using NAND gates as follows:



2.54. The minimum-cost SOP expression for the function $f(x_1, x_2, x_3) = \sum m(3, 4, 6, 7)$ is

$$f = x_1\overline{x}_3 + x_2x_3$$

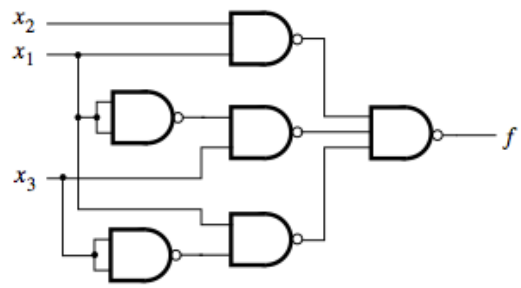
The corresponding circuit implemented using NAND gates is



2.55. A minimum-cost SOP expression for the function $f(x_1, x_2, x_3) = \sum m(1, 3, 4, 6, 7)$ is

$$f = x_1 x_2 + x_1 \overline{x}_3 + \overline{x}_1 x_3$$

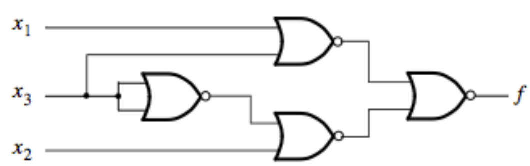
The corresponding circuit implemented using NAND gates is



2.56. The minimum-cost POS expression for the function $f(x_1, x_2, x_3) = \sum m(3, 4, 6, 7)$ is

$$f = (x_1 + x_3)(x_2 + \overline{x}_3)$$

The corresponding circuit implemented using NOR gates is



2.57. The minimum-cost POS expression for the function $f(x_1, x_2, x_3) = \sum m(1, 3, 4, 6, 7)$ is

$$f = (x_1 + x_3)(\overline{x}_1 + x_2 + \overline{x}_3)$$

The corresponding circuit implemented using NOR gates is