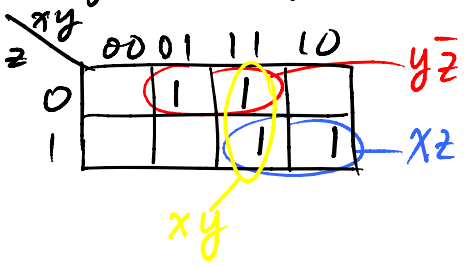
example of using K-map

Q. Is this a minimum-cost SOP expression?

$f = xz + y\bar{z} + xy$ (Note: each of the prod. term represents 2 minterms (i.e. two "1" entries)



minimum-cost SOP: $f = y\bar{z} + xz$

(Consensus rule)

use Boolean algebra. $f = xz + y\bar{z} + xy$

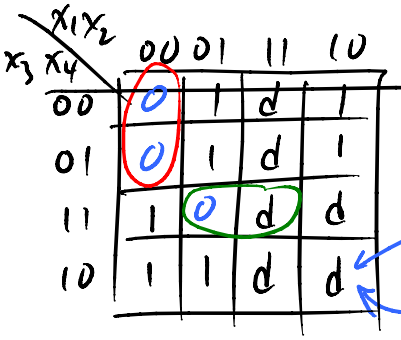
$= xz + y\bar{z} + xy(z + \bar{z})$

$= xz + y\bar{z} + xyz + xy\bar{z}$

$xz(1+y)$ $(1+x)y\bar{z}$ absorption rule.

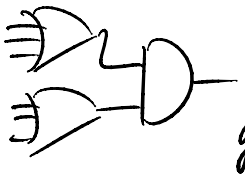
$= xz + y\bar{z}$

K-map POS $f = \sum m(2,3,4,5,6,8,9) + \sum d(10-15)$

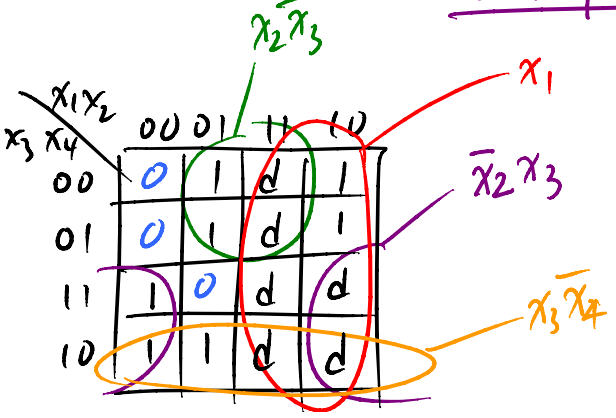


$f = (x_1 + x_2 + x_3)(\bar{x}_2 + \bar{x}_3 + \bar{x}_4)$

cost. ignore inverter.

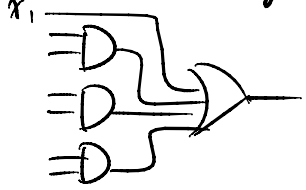


SOP form:



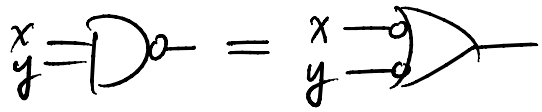
$f = x_1 + x_2\bar{x}_3 + \bar{x}_2x_3 + x_3\bar{x}_4$

cost. $= 4$ gates $+ 10 = 14$

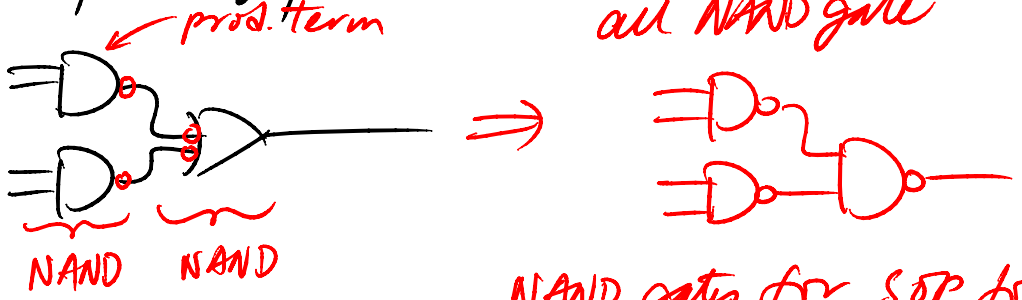


NAND and NOR (cheaper)

Recall DeMorgan's $\overline{xy} = \overline{x} + \overline{y}$

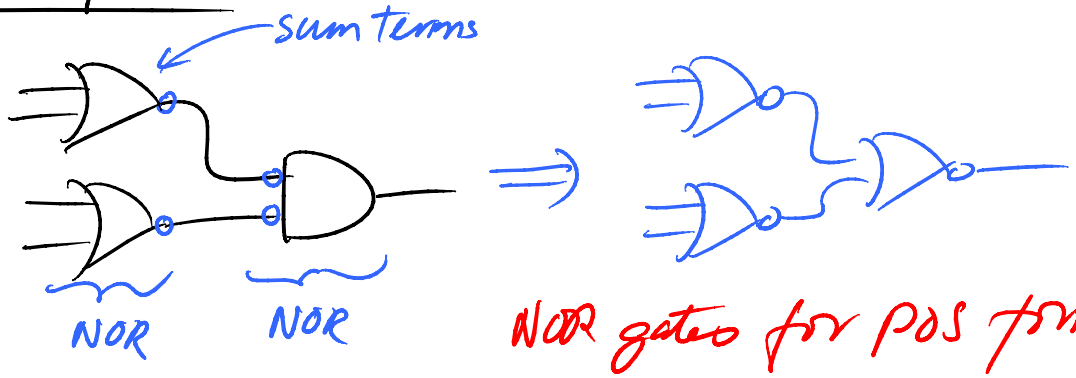


eg. SOP form of function



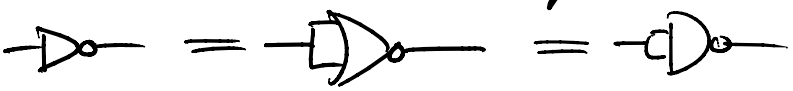
NAND gates for SOP forms !

POS form



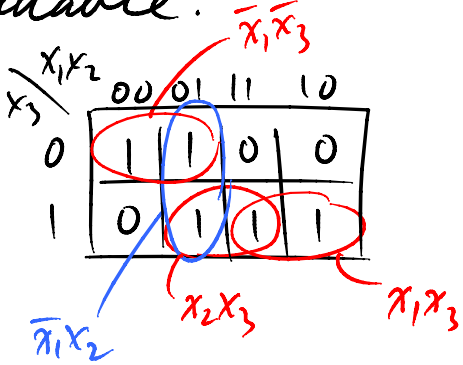
NOR gates for POS forms !

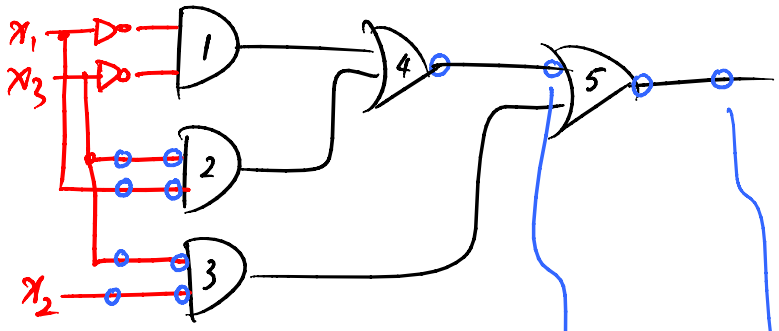
example draw cct. diagram using only 2-input NOR gates.
for $f = \overline{x}_1 x_2 + x_1 x_3 + x_1 \overline{x}_3$ (as few gates as possible)
assume any non-comp. inputs are available.



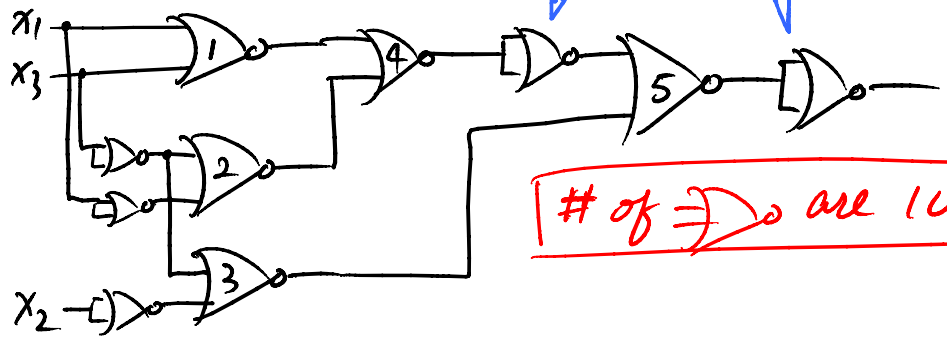
Option 1 SOP form — one of the two possible SOPs.

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





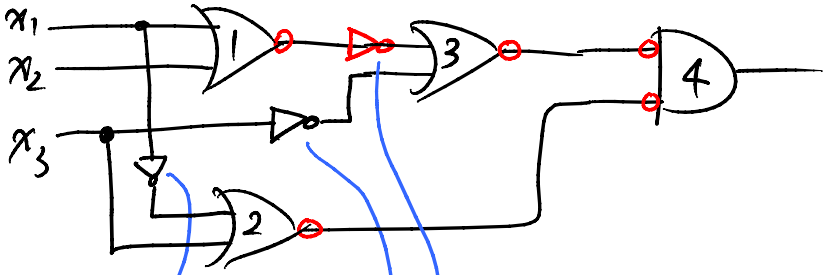
We are trying to create either ⊐○ or 

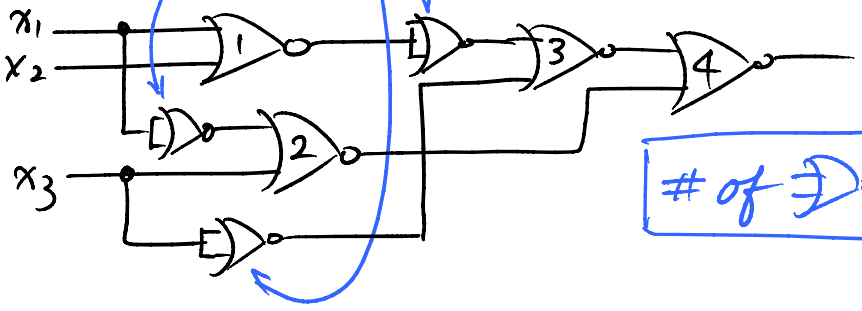


of ⊐○ are 10

x_3 \ x_1x_2	00	01	11	10
0	1	1	0	0
1	0	1	1	1

Option 2 POS form $f = (x_1 + x_2 + \bar{x}_3)(\bar{x}_1 + x_3)$





of ⊐○ gates are 7

Option 3 (Clever thinking!)

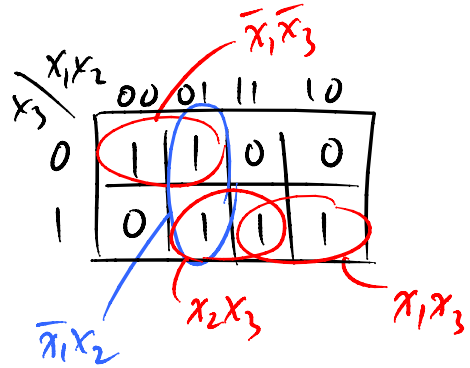
function in SOP form

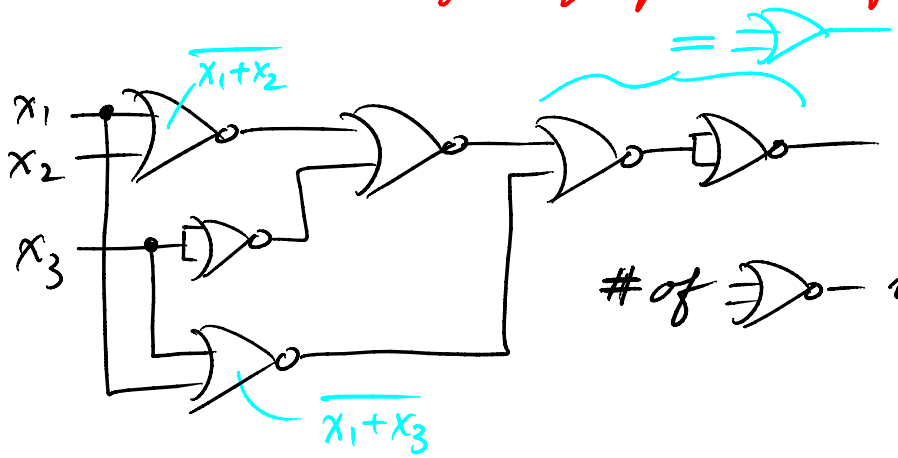
$$f = x_1x_3 + x_2x_3 + \bar{x}_1\bar{x}_3$$

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

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

this form of expression represents a $\Rightarrow$o—





of $\Rightarrow$o— used = 6