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problem 2-24 (page 72) Find the simplest SOP

* $f(x_1, x_2, x_3, x_4) = x_1\bar{x}_3\bar{x}_4 + x_2\bar{x}_3 x_4 + x_1\bar{x}_2\bar{x}_3$

$= x_1\bar{x}_3\bar{x}_4 + x_2\bar{x}_3 x_4 + x_1\bar{x}_2\bar{x}_3\bar{x}_4 + x_1\bar{x}_2\bar{x}_3 x_4$

$(\bar{x}_4 + x_4)$

$= (1+\bar{x}_2)x_1\bar{x}_3\bar{x}_4 + (x_2 + x_1\bar{x}_2)\bar{x}_3 x_4$

$= x_1\bar{x}_3\bar{x}_4 + (x_2 + x_1)\bar{x}_3 x_4$

$= x_1\bar{x}_3\bar{x}_4 + x_1\bar{x}_3 x_4 + x_2\bar{x}_3 x_4$

$= x_1\bar{x}_3 + x_2\bar{x}_3 x_4$

Another method, add $(\bar{x}_1 + x_1)$ to 2nd term

$f = x_1\bar{x}_3\bar{x}_4 + x_2\bar{x}_3 x_4(\bar{x}_1 + x_1) + x_1\bar{x}_2\bar{x}_3$

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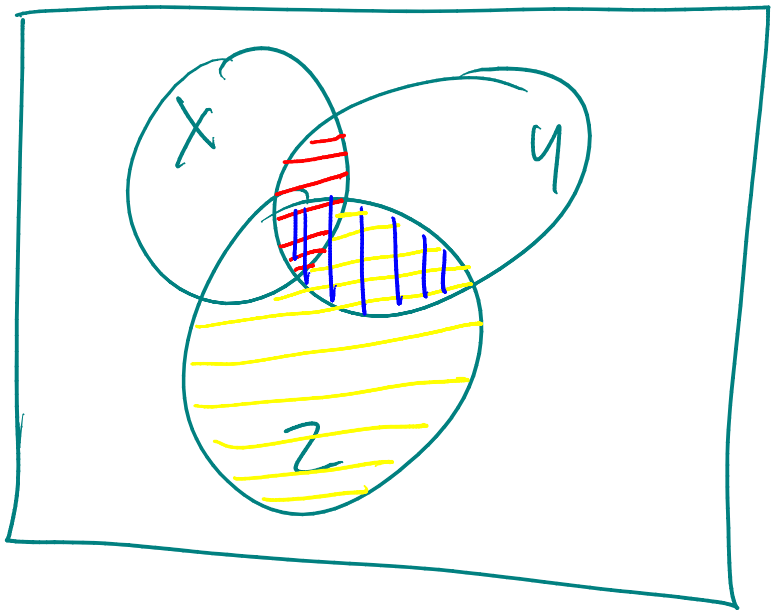
$$\underline{xy} + \underline{yz} + \underline{\bar{x}z} = xy + \bar{x}z$$



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x	y	f	minterm	maxterm
0	0	0	$\bar{x}\bar{y}$	$x+y$
0	1	1	$\bar{x}y$	$x+\bar{y}$
1	0	1	$x\bar{y}$	$\bar{x}+y$
1	1	0	xy	$\bar{x}+\bar{y}$

sop = Implement the 1s

$$f = \bar{x}y + x\bar{y}$$

pos = Implement the 0s

$$g = (x+y)(\bar{x}+\bar{y})$$

$$f = g \;!$$

Here is why

$$g = (x+y)(\bar{x}+\bar{y})$$
$$= \cancel{x\bar{x}} + x\bar{y} + \bar{x}y + \cancel{y\bar{y}}$$
$$= x\bar{y} + \bar{x}y \quad = f$$

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$$f = (x+y+z)(x+\bar{y}+z)(x+\bar{y}+\bar{z})(\bar{x}+\bar{y}+\bar{z})$$

$$= [(x+z)+y][(x+z)+\bar{y}][x+(\bar{y}+\bar{z})][\bar{x}+(\bar{y}+\bar{z})]$$

use 14b

$$= (x+z)(\bar{y}+\bar{z})$$

$$\bar{f} = \overline{(x+y+z)(x+\bar{y}+z)(x+\bar{y}+\bar{z})(\bar{x}+\bar{y}+\bar{z})}$$

$$= \overline{(x+y+z)} + \overline{(x+\bar{y}+z)} + \overline{(x+\bar{y}+\bar{z})} + \overline{(\bar{x}+\bar{y}+\bar{z})}$$

$$= \boxed{\bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z}} + \bar{x}yz + xyz$$

$$= \bar{x}\bar{z}(\bar{y}+y) + yz(\bar{x}+x)$$

$$\bar{f} = \bar{x}\bar{z} + yz$$

$$f = \overline{\bar{x}\bar{z} + yz} = (\overline{\bar{x}\bar{z}})(\overline{yz})$$

$$= (x+z)(\bar{y}+\bar{z})$$