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CMPE 240 Experiment 1 Lab Work

Truth Table

#	x2	x1	x0	y
0	0	0	0	0
1	0	0	1	1
2	0	1	0	1
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	0
7	1	1	1	1

Sum of Products (SOP)

$$y = x_2'x_1'x_0 + x_2'x_1x_0' + x_2'x_1x_0 + x_2x_1'x_0 + x_2x_1x_0$$

Minimized SOP

$$\begin{aligned} y &= x_2'(x_1'x_0 + x_1x_0) + x_2'x_1x_0' + x_2(x_1'x_0 + x_1x_0) && \text{[Distributivity]} \\ &= (x_2' + x_2)(x_1'x_0 + x_1x_0) + x_2'x_1x_0' && \text{[Distributivity]} \\ &= (x_2' + x_2)(x_0(x_1' + x_1)) + x_2'x_1x_0' && \text{[Distributivity]} \\ &= 1 \cdot (x_0 \cdot 1) + x_2'x_1x_0' && \text{[Complement]} \\ &= x_0 + x_2'x_1x_0' && \text{[Identity]} \\ &= (x_0 + x_2'x_1)(x_0 + x_0') && \text{[Distributivity]} \\ &= (x_0 + x_2'x_1) \cdot 1 && \text{[Complement]} \\ &= x_0 + x_2'x_1 && \text{[Identity]} \end{aligned}$$

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Product of Sums (POS)

$$y = (x_2 + x_1 + x_0)(x_2' + x_1 + x_0)(x_2' + x_1' + x_0)$$

Minimized POS

$$\begin{aligned} y &= (x_2x_2' + x_2x_1 + x_2x_0 + x_1x_2' + x_1x_1 + x_1x_0 + x_0x_2' + x_0x_1 \\ &\quad + x_0x_0)(x_2' + x_1' + x_0) \text{ [Distributive]} \\ &= (0 + x_2x_1 + x_2x_0 + x_1x_2' + x_1x_1 + x_1x_0 + x_0x_2' + x_0x_1 + x_0x_0) \cdot (x_2' \\ &\quad + x_1' + x_0) \text{ [Complement]} \\ &= (x_2x_1 + x_2x_0 + x_1x_2' + x_1x_1 + x_1x_0 + x_0x_2' + x_0x_1 + x_0x_0)(x_2' + x_1' \\ &\quad + x_0) \text{ [Identity]} \\ &= (x_2x_1 + x_2x_0 + x_1x_2' + x_1 + x_1x_0 + x_0x_2' + x_0x_1 + x_0)(x_2' + x_1' + \\ &\quad x_0) \text{ [Idempotent]} \\ &= x_2x_1x_2' + x_2x_0x_2' + x_1x_2'x_2' + x_1x_2' + x_1x_0x_2' + x_0x_2'x_2' + \\ &\quad x_0x_1x_2' + x_0x_2' + x_2x_1x_1' + x_2x_0x_1' + x_1x_2'x_1' + x_1x_1' + x_1x_0x_1' + x_0x_2'x_1' + \\ &\quad x_0x_1x_1' + x_0x_1' + x_2x_1x_0 + x_2x_0x_0 + x_1x_2'x_0 + x_1x_0 + x_1x_0x_0 + x_0x_2'x_0 + \\ &\quad x_0x_1x_0 + x_0x_0 \text{ [Distributive]} \\ &= 0.x_1 + 0.x_0 + x_1x_2'x_2' + x_1x_2' + x_1x_0x_2' + x_0x_2'x_2' + x_0x_1x_2' + \\ &\quad x_0x_2' + x_2.0 + x_2x_0x_1' + x_2'.0 + 0 + 0.x_0 + x_0x_2'x_1' + x_0.0 + x_0x_1' + x_2x_1x_0 + \\ &\quad x_2x_0x_0 + x_1x_2'x_0 + x_1x_0 + x_1x_0x_0 + x_0x_2'x_0 + x_0x_1x_0 + x_0x_0 \text{ [Complement]} \\ &= 0 + 0 + x_1x_2'x_2' + x_1x_2' + x_1x_0x_2' + x_0x_2'x_2' + x_0x_1x_2' + x_0x_2' + 0 \\ &\quad + x_2x_0x_1' + 0 + 0 + 0 + x_0x_2'x_1' + 0 + x_0x_1' + x_2x_1x_0 + x_2x_0x_0 + x_1x_2'x_0 + x_1x_0 \\ &\quad + x_1x_0x_0 + x_0x_2'x_0 + x_0x_1x_0 + x_0x_0 \text{ [Null element]} \\ &= x_1x_2'x_2' + x_1x_2' + x_1x_0x_2' + x_0x_2'x_2' + x_0x_1x_2' + x_0x_2' + x_2x_0x_1' \\ &\quad + x_0x_2'x_1' + x_0x_1' + x_2x_1x_0 + x_2x_0x_0 + x_1x_2'x_0 + x_1x_0 + x_1x_0x_0 + x_0x_2'x_0 + \\ &\quad x_0x_1x_0 + x_0x_0 \text{ [Identity]} \\ &= x_1x_2' + x_1x_2' + x_1x_0x_2' + x_0x_2' + x_0x_1x_2' + x_0x_2' + x_2x_0x_1' + \\ &\quad x_0x_2'x_1' + x_0x_1' + x_2x_1x_0 + x_2x_0 + x_1x_2'x_0 + x_1x_0 + x_1x_0 + x_0x_2' + x_0x_1 + x_0 \\ &\quad \text{[Idempotent]} \\ &= x_1x_2' + x_0x_2' + x_0x_1x_2' + x_2x_0x_1' + x_0x_2'x_1' + x_0x_1' + x_2x_1x_0 + \\ &\quad x_2x_0 + x_1x_0 + x_0 \text{ [Idempotent]} \\ &= x_2'(x_1 + x_0 + x_0x_1 + x_0x_1') + x_2(x_0x_1 + x_0x_1' + x_0) + x_0(x_1 + x_1' + \\ &\quad 1) \text{ [Distributive]} \\ &= x_2'(x_1 + x_0(1 + x_1 + x_1')) + x_2(x_0(x_1 + x_1' + 1)) + x_0(x_1 + x_1' + 1) \\ &\quad \text{[Distributive]} \\ &= x_2'(x_1 + x_0(1 + 1)) + x_2(x_0(1 + 1)) + x_0(1 + 1) \text{ [Complement]} \\ &= x_2'(x_1 + x_0.1) + x_2(x_0.1) + x_0.1 \text{ [Idempotent]} \\ &= x_2'(x_1 + x_0) + x_2x_0 + x_0 \text{ [Identity]} \\ &= x_2'x_1 + x_2'x_0 + x_2x_0 + x_0 \text{ [Distributive]} \\ &= x_2'x_1 + x_0(x_2' + x_2 + 1) \text{ [Distributive]} \\ &= x_2'x_1 + x_0(1 + 1) \text{ [Complement]} \\ &= x_2'x_1 + x_0.1 \text{ [Idempotent]} \end{aligned}$$

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$$\begin{aligned} &= x_2'x_1 + x_0 \text{ [Identity]} \\ &= (x_2' + x_0)(x_1 + x_0) \text{ [Distributive]} \end{aligned}$$

Circuit

