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Group ID: 2

Session ID: 2

CMPE 240 2019 Experiment 2 Preliminary Work

Truth Table

| # | r | c | g | p | b |
|----|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 1 | 0 | 0 |
| 3 | 0 | 0 | 1 | 1 | 0 |
| 4 | 0 | 1 | 0 | 0 | 0 |
| 5 | 0 | 1 | 0 | 1 | 0 |
| 6 | 0 | 1 | 1 | 0 | 1 |
| 7 | 0 | 1 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 | 0 |
| 9 | 1 | 0 | 0 | 1 | 0 |
| 10 | 1 | 0 | 1 | 0 | 1 |
| 11 | 1 | 0 | 1 | 1 | 0 |
| 12 | 1 | 1 | 0 | 0 | 1 |
| 13 | 1 | 1 | 0 | 1 | 0 |
| 14 | 1 | 1 | 1 | 0 | 1 |
| 15 | 1 | 1 | 1 | 1 | 1 |

Sum of Products (SOP)

$$b = r'cgp' + r'cgp + rc'gp' + rcg'p' + rcgp' + rcgp$$

Minimized SOP

$$\begin{aligned} b &= r'cgp' + r'cgp + rp'c'g + rp'cg' + rcgp' + rcgp && \text{(commutativity)} \\ &= r'cg(p' + p) + rp'(c'g + cg') + rcg(p' + p) && \text{(distributivity)} \\ &= r'cg(1) + rp'(c'g + cg') + rcg(1) && \text{(complement)} \end{aligned}$$

| | |
|-----------------------------------|------------------|
| $=r'cg + rp'(c'g + cg') + rcg$ | (identity) |
| $=r'cg + rcg + rp'(c'g + cg')$ | (commutativity) |
| $=(r+r')cg + rp'(c'g + cg')$ | (distributivity) |
| $=(1)cg + rp'(c'g + cg')$ | (complement) |
| $=cg + rp'(c'g + cg')$ | (identity) |
| $=cg + rp'c'g + rp'cg'$ | (distributivity) |
| $=(c+rp'c')g + rp'cg'$ | (distributivity) |
| $=((c+r)(c+p'))(c+c'))g + rp'cg'$ | (distributivity) |
| $=((c+r)(c+p'))(1))g + rp'cg'$ | (complement) |
| $=((c+r)(c+p'))g + rp'cg'$ | (identity) |
| $=(c+rp')g + rp'cg'$ | (distributivity) |
| $=cg + rp'g + rp'cg'$ | (distributivity) |
| $=cg + rp'(g + cg')$ | (distributivity) |
| $=cg + rp'((g+c)(g+g'))$ | (distributivity) |
| $=cg + rp'((g+c)(1))$ | (complement) |
| $=cg + rp'(g+c)$ | (identity) |
| $=cg + rp'g + rp'c$ | (distributivity) |
| $=cg + rgp' + rcp'$ | (commutativity) |

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Product of Sums (POS)

$$b = (r+c+g+p)(r+c+g+p')(r+c+g'+p)(r+c+g'+p')(r+c'+g+p)(r+c'+g+p')(r'+c+g+p)(r'+c+g+p')(r'+c+g'+p)(r'+c'+g+p')$$

Minimized POS

$$\begin{aligned}
 b &= (r+c+g+p)(r+c+g+p')(r+c+g+p')(r+c+g+p')(r+c+g'+p)(r+c+g'+p') \\
 &\quad (r+c+g'+p')(r+c'+g+p)(r+c'+g+p')(r+c'+g+p')(r'+c+g+p)(r'+c+g+p')(r'+c+g+p') \\
 &\quad (r'+c+g+p')(r'+c+g'+p')(r'+c'+g+p') \quad (\text{idempotent}) \\
 &= (r+c+g+p)(r+c+g+p')(r+c+g'+p)(r+c+g'+p')(r+c+g+p')(r+c+g'+p') \\
 &\quad (r+c'+g+p)(r+c'+g+p') (r+c+g+p')(r+c'+g+p')(r'+c+g+p)(r'+c+g+p')(r'+c+g+p') \\
 &\quad (r'+c+g'+p')(r'+c+g+p')(r'+c'+g+p') \quad (\text{commutativity}) \\
 &= (r+c+g+pp')(r+c+g'+pp')(r+c+gg'+p')(r+c'+g+pp')(r+cc'+g+p') \\
 &\quad (r'+c+g+pp')(r'+c+gg'+p')(r'+cc'+g+p') \quad (\text{distributivity}) \\
 &= (r+c+g+0)(r+c+g'+0)(r+c+0+p')(r+c'+g+0)(r+0+g+p')(r'+c+g+0) \\
 &\quad (r'+c+0+p')(r'+0+g+p') \quad (\text{complement}) \\
 &= (r+c+g)(r+c+g')(r+c+p')(r+c'+g)(r+g+p')(r'+c+g)(r'+c+p')(r'+g+p') \\
 &\quad (\text{identity}) \\
 &= (r+c+g)(r+c+g)(r+c+g)(r+c+g')(r+c+p')(r+c'+g)(r+g+p')(r'+c+g) \\
 &\quad (r'+c+p')(r'+g+p') \quad (\text{idempotent}) \\
 &= (r+c+g)(r+c+g')(r+c+g)(r+c'+g)(r+c+g)(r'+c+g)(r+c+p')(r'+c+p') \\
 &\quad (r+g+p')(r'+g+p') \quad (\text{commutativity}) \\
 &= (r+c+gg')(r+cc'+g)(rr'+c+g)(rr'+c+p')(rr'+g+p') \\
 &\quad (\text{distributivity}) \\
 &= (r+c+0)(r+0+g)(0+c+g)(0+c+p')(0+g+p') \\
 &\quad (\text{complement}) \\
 &= (r+c)(r+g)(c+g)(c+p')(g+p') \\
 &\quad (\text{identity})
 \end{aligned}$$

Circuit

