

CSE 231

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H.W# 3.1 - 3.16 (Chapter 3)

3.1

a) $f(x, y, z) = \sum(0, 2, 4, 5)$

x'	$y'z'$	$y'z$	yz	yz'
x	1	0	0	1
y	1	1	0	0

$$F = x'y' + x'z'$$

b)

$f(x, y, z) = \sum(0, 2, 4, 5, 6)$

x'	$y'z'$	$y'z$	yz	yz'
x	1	0	0	1
y	1	1	0	1

$$F = z' + x'y'$$

c)

$f(x, y, z) = \sum(0, 1, 2, 3, 5)$

x'	$y'z'$	$y'z$	yz	yz'
x	1	0	1	1
y	0	1	0	0

$$F = x' + y'z$$

$$\textcircled{2} \quad f(x, y, z) = \Sigma(1, 2, 3, 7)$$

	$y'z'$	$y'z$	yz	yz'
x'	0	1	1	1
x	0	0	1	0

$$f = x'z + yz + x'y$$

$$\textcircled{3.2} \quad f(x, y, z) = \Sigma(0, 1, 5, 7)$$

	$y'z'$	$y'z$	yz	yz'
x'	1	1	0	0
x	0	1	1	0

$$f = x'y' + xz$$

$$\textcircled{6} \quad f(x, y, z) = \Sigma(1, 2, 3, 6, 7)$$

	$y'z'$	$y'z$	yz	yz'
x'	0	1	1	1
x	0	0	1	1

$$f = x'z + y$$

$$\textcircled{c} \quad f(x, y, z) = \Sigma(2, 3, 4, 5)$$

	$y'z'$	$y'z$	yz	yz'
x'	0	0	1	1
x	1	1	0	0

$$f = x'y + xy'$$

$$\textcircled{d} \quad f(x, y, z) = \Sigma(1, 2, 3, 5, 6, 7)$$

	$y'z'$	$y'z$	yz	yz'
x'	0	1	1	1
x	0	1	1	1

$$f = z + y$$

$$\textcircled{e} \quad F(x, y, z) = \Sigma(3, 4, 5, 6, 7)$$

	$y'z'$	$y'z$	yz	yz'
x'	0	0	1	0
x	1	1	1	1

$$F = x + yz$$



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3.3

④

$$\pi y + \pi' y' z' + \pi' y z'$$

$$= \pi y(z+z') + \pi' y' z' + \pi' y z'$$

$$= \pi yz + \pi yz' + \pi' y' z' + \pi' y z'$$

	$y' z'$	$y' z$	yz	yz'
π'	1	0	0	1
π	0	0	1	1

$$f = \pi' z' + \pi y$$

⑥ $\pi' y' + yz + \pi' y z'$

$$= \pi' y' (z+z') + yz(\pi+\pi') + \pi' y z'$$

$$= \pi' y' z + \pi' y' z' + \pi yz + \pi' y z + \pi' y z'$$

	$y' z'$	$y' z$	yz	yz'
π'	1	0	1	1
π	1	0	0	1

$$f = z' + \pi y$$

$$\textcircled{d} \quad f(x_1, y, z) = x_1'yz + (xy'z' + x'y'z)$$

	$y'z'$	$y'z$	yz	yz'
x'	0	0	1	0
x	1	1	0	0

$$f = x_1y' + x_1'y_2$$

$$\textcircled{3.4} \quad @ \quad f(x_1, y, z) = \Sigma(2, 3, 6, 7)$$

	$y'z'$	$y'z$	yz	yz'
x'	0	0	1	1
x	0	0	1	1

$$f = y_1'z_1' + y_1'z_2' + y_2'z_1' + y_2'z_2'$$

0	1	1	1
1	0	0	0
1	0	0	0
1	0	0	0

$$(y_1'z_1' + y_1'z_2') + (y_2'z_1' + y_2'z_2')$$



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$$\textcircled{6}, F(A, B, C, D) = \Sigma(4, 6, 7, 15)$$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	0	0	0	0
$A'B$	1	0	1	1
AB	0	0	1	0
AB'	0	0	0	0

$$F = BCD + A'BD'$$

$$\textcircled{7}, F(A, B, C, D) = \Sigma(3, 7, 11, 13, 14, 15)$$

	$C'D'$	$C'D$	CD	CD'
AB	0	0	1	0
$A'B$	0	0	1	0
AB	0	1	1	1
AB'	0	0	1	0

$$F = ABD + AB'C + CD$$

$$\textcircled{2} \quad f(w, x, y, z) = \Sigma(2, 3, 12, 13, 19, 75)$$

	$y'z'$	$y'z$	yz	yz'
$w'x'$	0	0	1	1
$w'x$	0	0	0	0
wx	1	1	1	1
wx'	0	0	0	0

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

$$\textcircled{3} \quad f(w, x, y, z) = \Sigma(8, 10, 12, 13, 14)$$

	$y'z'$	$y'z$	yz	yz'
$w'x'$	0	0	0	0
$w'x$	0	0	0	0
wx	1	1	0	1
wx'	1	0	0	1

$$f = w\bar{x}y' + w\bar{z}'$$



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3.5) ① $F(w, x, y, z) = \Sigma(1, 4, 5, 6, 12, 14, 15)$

	$y'z'$	$y'z$	yz	yz'
$w'x'$	0	1	0	0
$w'x$	1	1	0	1
wx	1	0	1	1
wx'	0	0	0	0

$$F = \cancel{w'x'yz'} + wxy + w'y'z$$

⑥ $F(A, B, C, D) = \Sigma(2, 3, 6, 7, 12, 13, 14)$

	CD'	CD	$C'D$	$C'D'$
00	A'B'	0	0	1 1
01	A'B	0	0	1 1
11	AB	1 1	0	1
10	AB'	0	0	0

$$F = A'C + ABD' + \cancel{ABC}$$

④ $F(A, B, C, D) \Rightarrow \{0, 2, 4, 5, 6, 7, 8, 10, 13, 15\}$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	1)	0	0	(1)
$A'B$	1)	1	1	1
AB	0	1	1	0
AB'	1)	0	0	(1)

$$F = A'B + BD + B'D'$$

3.6 @ $A'B'C'D' + AC'D' + B'C'D' + A'BCD + BC'D$
 $\Rightarrow A'B'C'D' + AC'D'(B+B') + B'C'D'(A+A') + A'BCD$
 $\Rightarrow A'B'C'D' + A'BC'D' + AB'C'D' + AB'C'D + AB'CD + A'BCD$
 $+ BC'D(A+A')$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	1)	0	0	(1)
$A'B$	0	1	1	0
AB	1)	1	0	0
AB'	1)	0	0	(1)

$$F = B'D' + A'BD + ABC'$$

$$\begin{aligned}
 ⑥ & \quad \bar{x}'z + w'xy' + w(\bar{x}'y + \bar{y}x') \\
 \Rightarrow & \quad \bar{x}'z + w'xy' + w\bar{x}'y + w\bar{y}x' \\
 \Rightarrow & \quad \bar{x}'z(w + w) (y + y') + w'xy'(z + z') \\
 & \quad + w\bar{x}'y(z + z') + w\bar{y}x'(z + z') \\
 \Rightarrow & \quad \bar{x}'z w(y + y') + \bar{x}'z w'(y + y') + w'xy'z + \\
 & \quad w'xy'z' + w\bar{x}'yz + w\bar{x}'yz' + w\bar{y}xz + w\bar{y}xz' \\
 \Rightarrow & \quad w\bar{x}'yz + w\bar{x}'yz' + w'xy'z + \\
 & \quad w'xy'z' + w\bar{x}'yz + w\bar{x}'yz' + w\bar{y}xz + w\bar{y}xz' + w\bar{y}xz' + w\bar{y}xz
 \end{aligned}$$

	$y'z'$	$y'z$	yz'	yz
$w\bar{x}'$	0	1	1	0
$w'\bar{x}$	1	1	0	0
$w\bar{x}$	1	1	0	0
$w\bar{x}'$	0	1	1	1

$$F = y'z + \bar{y}x' \rightarrow$$

$$F = xy' + \bar{x}'z + w\bar{x}'y$$

$$\begin{aligned}
 & \textcircled{B.2} @ w'z + wz + z'y + wz'z \\
 \Rightarrow & w'z (x_1 + x_1') (y + y') + wz (w + w') (y + y') + \\
 & z'y (w + w') (z + z') + wz'z (y + y') \\
 \Rightarrow & w'z x_1 (y + y') + w'z x_1' (y + y') + wz w (y + y') \\
 & + wz w' (y + y') + x_1' y w (z + z') + x_1' y w' (z + z') \\
 \Rightarrow & w'z x_1 y + w'z x_1' y' + w'z x_1' y + w'z x_1' y' + wz w y \\
 & + wz w' y + wz w' y + wz w' y' + x_1' y w z + \\
 & x_1' y w z' + x_1' y w' z + x_1' y w' z' + wz'z y + w y' z
 \end{aligned}$$

	$y'z'$	$y'z$	yz	yz'
$w'z'$	0	1	1	1
$w'z$	0	1	1	0
wz	0	1	1	0
wz'	0	1	1	1

$$\begin{aligned}
 f = & w'z + wz + z'y \\
 = & z + z'y
 \end{aligned}$$

$$\begin{aligned}
 & \textcircled{6} \quad AD' + B'C'D + BCD' + BC'D \\
 \Rightarrow & AD'(B+B') (C+C') + B'C'D(A+A') + \\
 & BCD'(A+A') + BC'D(A+A') \\
 \Rightarrow & AD'B(C+C') + AD'B'(C+C') + B'C'DA + \\
 & A'B'C'D + ABCD' + A'BCD' + ABC'D + A'BC'D \\
 \Rightarrow & ABCD' + ABC'D' + AB'D'C + AB'C'D' \\
 & + AB'C'D + A'B'C'D + ABCD' + A'BCD' + \\
 & ABC'D + A'BC'D
 \end{aligned}$$

$A'B'$	$C'D'$	CD'	CD
$A'B$	0	1	1
AB	0	1	0
AB'	0	1	1

$$F = C'D + B'C + ABC'$$

$$\textcircled{2} \quad AB'C + B'C'D' + BCD + ACD + A'B'C \\ + A'BC'D$$

$$\begin{aligned} &= AB'C(D+D') + B'C'D'(A+A') + BCD(A+A') \\ &\quad + ACD'(B+B') + A'B'C(D+D') + A'B'C'D \\ &= AB'CD + AB'C'D' + AB'C'D + A'B'C'D + ABCD \\ &\quad + A'BCD + ABCD' + AB'C'D' + A'B'CD + A'B'C'D' \end{aligned}$$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	1	0	1	1
$A'B$	0	1	1	0
AB	0	0	1	0
AB'	1	0	1	1

$$f = B'D' + CD + AC + A'B'D$$



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3.8 ④ $xy + yz + xy'z$
 $\Rightarrow xy(z+z') + yz(x+x') + xy'z$
 $= xyz + xyz' + xyz + x'y'z + xy'z$
 $\Rightarrow xyz + xyz' + x'y'z + xy'z$

	$y'z'$	$y'z$	yz	yz'
x'	0	0	1	0
x	0	1	1	1

$$F = yz + xy + xz$$

⑥ $C'D + ABC' + ABD' + A'B'D'$
 $= C'D(A+A')(B+B') + ABC'(D+D') + ABD'(C+C')$
 $+ A'B'D'(C+C')$
 $= AC'D(B+B') + A'C'D(B+B') + ABC'D +$
 $ABC'D' + ABCD' + ABC'D' + A'B'C'D' +$
 $A'B'C'D'$
 $= ABC'D + AB'C'D + ABC'D + ABC'D' + ABCD'$
 $+ ABC'D' + A'B'C'D' + A'B'C'D'$

	$C'D'$	$C'D$	CD	CD'
$A'D'$	1	0	0	1
$A'D$	0	0	0	0
AB	1	1	0	1
AB'	0	1	0	0

$$F = AC'D + ABD' + A'B'D'$$

Q) $A'B + A'CD + B'CD + BC'D'$

$$= A'B(C+C')(D+D') + A'CD(B+B') + B'CD(A+A')$$

$$+ BC'D'(A+A')$$

$$= A'BC(D+D') + A'BC'(D+D') + A'BCD + A'B'CD$$

$$AB'CD + A'B'CD + ABC'D' + A'BC'D'$$

$$= A'BCD + A'BCD' + A'BC'D + A'BC'D' + A'BCD$$

$$+ A'B'CD + AB'CD + A'B'CD + ABC'D' + A'BC'D'$$

0	0	1	0
1	1	1	1
1	0	0	0
0	0	1	0

$$F = A'B + B'CD + BC'D'$$

$$3.11 \quad F(x, y, z) = \sum(0, 1, 2, 5, 8, 10, 13)$$

1	1	0	1
0	1	0	0
0	1	0	0
1	0	0	1

$$F = \bar{x}z' + \bar{x}y' + \bar{w}xy' + w'y'z$$

$$(wz)'x'z + (\bar{w}x)'z + (\bar{w}x)y' + (\bar{w}x)y'z$$

$$\bar{w}z'x' + \bar{w}z'x + \bar{w}z'y + \bar{w}z'y'z$$

$$\bar{w}z'x' + \bar{w}z'x + \bar{w}z'y + \bar{w}z'y'z + \bar{w}z'y' + \bar{w}z'y'z$$

$$\bar{w}z'x' + \bar{w}z'x + \bar{w}z'y + \bar{w}z'y'z + \bar{w}z'y' + \bar{w}z'y'z$$

$$\bar{w}z'x' + \bar{w}z'x + \bar{w}z'y + \bar{w}z'y'z + \bar{w}z'y' + \bar{w}z'y'z$$

$$\bar{w}z'x' + \bar{w}z'x + \bar{w}z'y + \bar{w}z'y'z + \bar{w}z'y' + \bar{w}z'y'z$$

$$\bar{w}z'x' + \bar{w}z'x + \bar{w}z'y + \bar{w}z'y'z + \bar{w}z'y' + \bar{w}z'y'z$$

$$\bar{w}z'x' + \bar{w}z'x + \bar{w}z'y + \bar{w}z'y'z + \bar{w}z'y' + \bar{w}z'y'z$$

3.12

$$\textcircled{a} \quad F(A, B, C, D) = \prod (1, 3, 5, 7, 13, 15)$$

	$A'D'$	$C'D'$	CD	CD'
$A'B'$	1	0	0	1
$A'B$	1	0	0	1
AB	1	0	0	1
AB'	1	1	1	1

$$BD + A'D$$

$$F = (B' + D') (A + D')$$

$$\textcircled{b} \quad F(A, B, C, D) = \prod (1, 3, 6, 7, 11, 12)$$

	$C'D'$	CD'	CD	CD'
$A'B$	1	0	0	1
$A'B$	1	1	1	0
AB	0	1	1	0
AB'	1	0	0	1

$$B'D + ABD' + BCD'$$

$$F = (B + D') (A + B' + D) (B' + C + D)$$



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$$\begin{aligned}
 & \textcircled{3.13} \textcircled{a} \quad x'z' + y'z' + yz' + xyz \\
 & \Rightarrow x'z'(y+y') + y'z'(x+x') + yz'(x+x') + \\
 & \quad xyz(z+z') \\
 & \Leftrightarrow x'z'y + x'z'y' + xy'z' + x'y'z' + xyz' + \\
 & \quad x'yz' + xyz + xyz
 \end{aligned}$$

SOP:

	$y'z'$	$y'z$	yz	yz'
x'	1	0	0	1
x	1	0	1	1

POS :

	$y'z'$	$y'z$	yz	yz'
x'	1	0	0	1
x	1	0	1	1

$$y'z + x'z$$

$$F_2 = (y+z')(x+z')$$

$$\begin{aligned}
 & \textcircled{b} \quad ACD' + C'D + AB' + ABCD \\
 \Rightarrow & ACD'(B+B') + C'D(A+A') (B+B') + AB'(C+C')(D+D') \\
 & + ABCD \\
 = & ABCD' + AB'C'D' + AC'D(B+B') + A'C'D(B+B') \\
 & AB'C(D+D') + AB'C'(D+D') + ABCD \\
 = & ABCD' + AB'C'D' + ABC'D + AB'C'D + A'B'C'D + \\
 & A'B'C'D + AB'CD + AB'C'D' + \textcircled{AB'C'D} + \textcircled{A'B'C'D} + AB'C'D' \\
 & + ABCD
 \end{aligned}$$

Sop:

	$C'D'$	$C'D$	CD	CD'
$A'B'$	0	1	0	0
$A'B$	0	1	0	0
AB	0	1	1	1
AB'	1	1	1	1

$$F = C'D + AB' + AC$$

Pos:

	$C'D'$	$C'D$	CD	CD'
$A'D'$	0	1	0	0
$A'B$	0	1	0	0
AB	0	1	1	1
AB'	1	1	1	1

$$A'D' + A'C + BC'D'$$

$$F_2 = (A+D)(A+C')(B'+C+D)$$

$$\textcircled{C} \quad (A'+B+D')(A'+B'+C')(A'+B'+C)(B'+C+D')$$

SOP:

$$F = AB'D + ABC + ABC' + BC'D$$

$$\Rightarrow AB'D(C+C') + ABC(D+D') + ABC'(D+D')$$

$$BC'D(A+A')$$

$$\Rightarrow AB'CD + AB'C'D + ABCD + ABCD' + ABC'D + ABC'D' + ABC'D + A'BC'D$$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	0	0	0	0
$A'B$	0	1	0	0
AB	1	1	1	1
AB'	0	1	1	0

$$f = AB + AD + BD$$

$$\text{POS: } (A'+B+D')(A'+B'+C')(A'+B'+C)(B'+C+D')$$

$$\Rightarrow (A'+B+C.C'+D')(A'+B'+C'+D.D') + (A'+B'+C+D.D')$$

$$\cancel{(B.A)} \cancel{(C.D)} (A.A' + B' + C + D')$$

$$= (A'+B+C+D')(A'+B+C'+D')(A'+B'+C+D)(A'+B'+C+D')$$

$$(A'+B'+C+D)(A'+B'+C+D')(A+B+C+D)(A'+B'+C+D')$$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	0	0	0	0
$A'B$	0	1	1	0
AB	1	1	1	0
AB'	1	1	1	0

$$A'B' + CD' \rightarrow A'D'$$

$$F = (A+B) - (C+D) + (A+D)$$

② $BCD' + ABC' \neq ACD$

$$\Rightarrow BCD'(A+A') + ABC'(D+D') + ACD(B+B')$$

$$\Rightarrow ABCD' + A'B'CD' + ABC'D + ABC'D' + ABCD + A'B'CD$$

SOP:

	CD'	$C'D$	CD	CD'
AB'	0	0	0	0
$A'B$	0	0	0	1
AB	1	1	1	1
AB'	0	0	1	0

$$F = AB + BCD' + ACD$$

Pos:

	$c'D'$	$c'D$	cD	cD'
$A'B'$	0	0	0	0
$A'B$	0	0	0	1
AB	1	1	1	1
AB'	0	0	1	0

$$A'C' + A'D + B'C' + B'D'$$

$$F = (A+C)(A+D') + (B+C)(B+D)$$



00	00	01	01
00	01	11	11
01	01	10	10
01	11	11	11

$$A'C' + A'D + B'C' + B'D' = A'C' + B'D'$$

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$$\begin{aligned}
 3.14 \quad F &= A'B'C'D' + AB'CD + A'B'C' + ACD' \\
 &\Rightarrow A'B'C'D' + AB'CD + A'B'C'(D+D') + \\
 &\quad ACD'(B+B') \oplus \\
 &= A'B'C'D' + AB'CD + A'B'C'D + A'B'C'D' \\
 &\quad + \cancel{A'CD'} AB'CD + AB'C'D'
 \end{aligned}$$

	$B'C'D'$	$C'D$	CD	CD'
$A'B'$	1	1	0	0
$A'B$	0	1	0	0
AB	0	0	0	1
AB'	0	0	1	1

SOP $F = A'B'C' + A'C'D + ACD' + AB'C$

	$c'd'$	$c'd$	cd	cd'
$A'B'$	1	1	0	0
$A'B$	0	1	0	0
AB	0	0	0	1
AB'	0	0	1	1

POS: $A'C' + AC' + BC'D' + BCD$

$$F = (A+C') (A'+C) (B'+C+D) (B+C+D)$$

(3.15) @ $f(x,y,z) = \Sigma(0,1,4,5,6)$

$$d(x, y, z) = d(2, 3, x)$$

20	1	1	x	10
0	1	1	x	1
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

y_1	y_2'	y_2	y_2	y_2'
y_1	1	1	x	x
y_1	1	1	x	1

$$(f_2 \circ g) + g$$

100



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$$\textcircled{6} \quad f(A,B,C,D) = \Sigma(0,6,8,13,14)$$

$$d(A,B,C,D) = \Sigma(2,4,10)$$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	1	0	0	(X)
$A'B$	(X)	0	0	1
AB	0	(1)	0	1
AB'	1	0	0	(X)

$$F = CD' + B'D' + A'BCD$$

$$\textcircled{7} \quad f(A,B,C,D) = \Sigma(4,12,7,2,10)$$

$$d(A,B,C,D) = \Sigma(0,6,8)$$

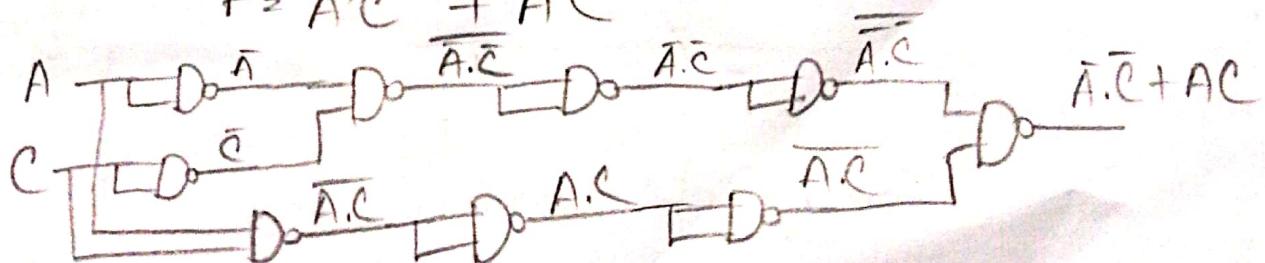
	$C'D'$	CD	CD'	CD
$A'B'$	(X)	0	0	1
$A'B$	1	0	(1)	(X)
AB	1	0	0	0
AB'	(X)	0	0	(1)

$$F = B'D' + C'D' + A'BC$$

$$\begin{aligned}
 3.16 @ F(A, B, C, D) &= AC'D' + A'C + ABC + AB'C + A'C'D \\
 &= A'C'D'(B+B') + A'C(B+B')(D+D') \\
 &\quad + ABC(D+D') + AB'C(D+D') + A'C'D(B+B') \\
 &= A'C'D'B + A'C'D'B' + ABC(D+D') + \\
 &\quad AB'C(D+D') + ABCD + ABCD' + AB'CD + AB'CD' \\
 &\quad + A'BC'D + A'B'C'D \\
 &= A'BC'D' + A'B'C'D' + ABCD + ABCD' + AB'CD + AB'CD' + A'BC'D \\
 &\quad + A'B'C'D
 \end{aligned}$$

	CD'	$C'D$	CD	CD'
$A'B'$	1	1	0	0
$A'B$	1	1	0	0
AB	0	0	1	1
AB'	0	0	1	1

$$f = A'C' + AC$$

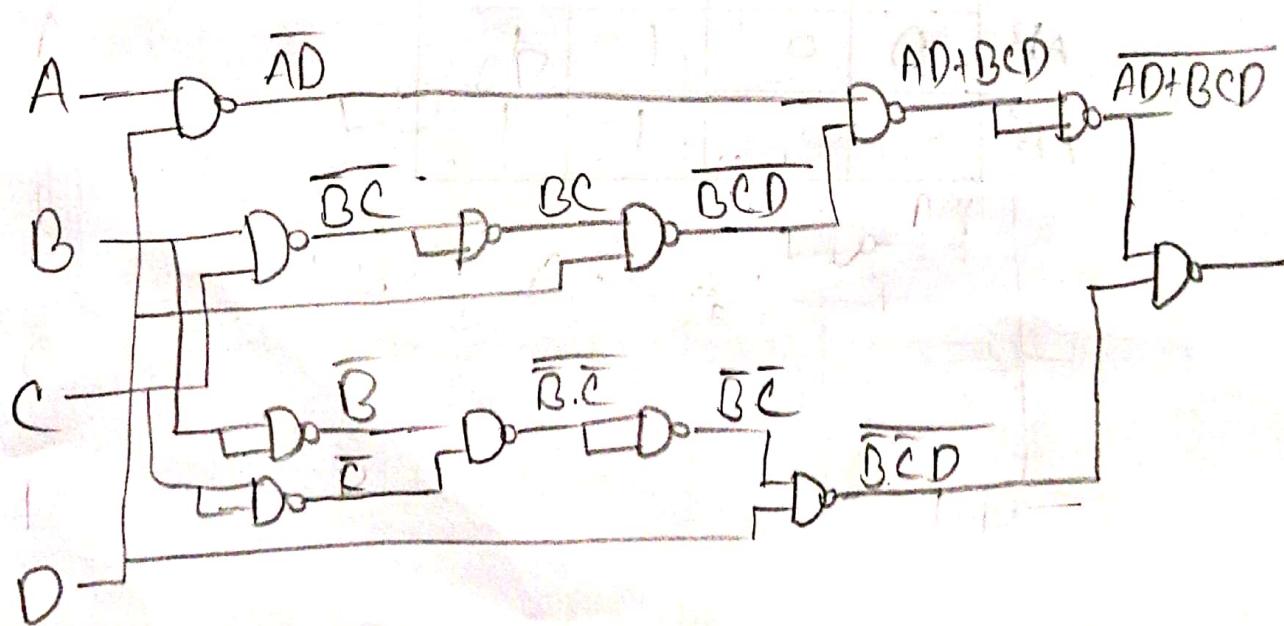


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$$\begin{aligned}
 ⑥ F(A, B, C, D) &= A'B'C'D + CD + AC'D \\
 &\equiv A'B'C'D + CD(A+A')(B+B') + AC'D(B+B') \\
 &\Rightarrow A'B'C'D + ACD + (B+B') + A'CD(B+B') \\
 &\quad + \cancel{A'CD} + ABC'D + ABC'D \\
 &= A'B'C'D + ABCD + AB'C'D + A'BCD + ABCD \\
 &\quad + ABC'D + AB'C'D
 \end{aligned}$$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	0	1	0	0
$A'B$	0	0	1	0
AB	0	1	1	0
AB'	0	1	1	0

$$F = AD + BCD + B'C'D$$



$$\begin{aligned}
 \textcircled{O} \quad f(A, B, C) &= (A' + C' + D')(A'C') (C'D') \\
 &\Rightarrow (A' + B \cdot B' + C' + D') (A' + \cancel{B \cdot B'} + C' + D') \\
 &\quad (A \cdot A' + B \cdot B' + C' + D') \\
 &= (A' + B + C' + D') (A' + B' + C' + D') (A' + B + C' + D \cdot D') \\
 &\quad (A' + B' + C' + D \cdot D') (A + B \cdot B' + C' + D') \\
 &\quad (A' + B \cdot B' + C' + D') \\
 &= (A' + B + C' + D') (A' + B' + C' + D') (A' + B + C' + D) (A' + B + C' + D') \\
 &\quad (A' + B' + C' + D) (A' + B' + C' + D') (A + B + C' + D') \\
 &\quad (A + B' + C' + D') (A' + B + C' + D') (A' + B' + C' + D')
 \end{aligned}$$

$A'B'$	$A'B$	AB	AB'	$C'D'$	$C'D$	CD	CD'
0	0	1	1	0	0	1	1
0	0	1	1	0	0	1	1
0	1	1	1	0	1	1	1
0	1	1	1	1	1	1	1

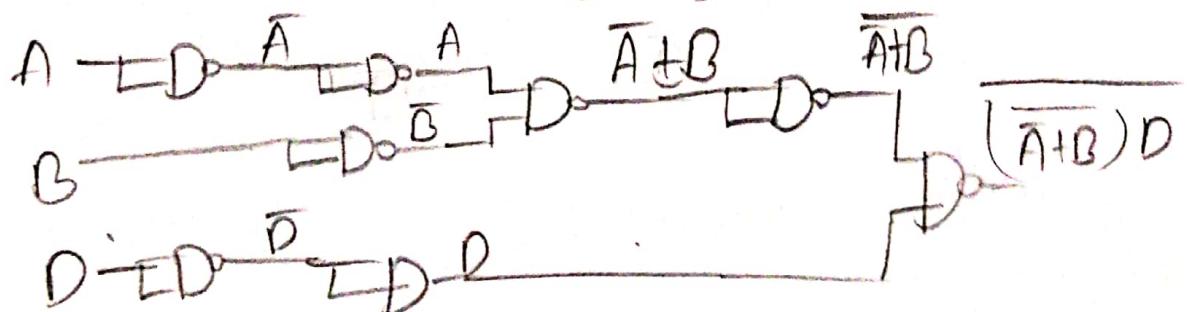
$$\begin{aligned}
 ② F(A, B, C, D) &= A' + B + D' + B'C \\
 &= A'(B+B')(C+C')(D+D') + B(A+A')(C+C')(D+D') \\
 &\quad D'(A+A')(B+B')(C+C') + B'C(A+A')(D+D') \\
 &= A'B(C+C')(D+D') + A'B'(C+C')(D+D') \\
 &\quad + AB(C+C')(D+D') + A'B(C+C')(D+D') + \\
 &\quad A'D'(B+B')(C+C') + A'D'(B+B')(C+C') + \\
 &\quad AB'C(D+D') + \cancel{A'B'C}(D+D') \\
 &= A'BC(D+D') + A'BC'(D+D') + A'B'C(D+D') \\
 &\quad + A'B'C'(D+D') + ABC(D+D') + ABC'(D+D') \\
 &\quad + A'BC(D+D') + A'BC'(D+D') + ABD'(C+C') + \\
 &\quad AB'D'(C+C') + A'D'B(C+C') + A'D'B'(C+C')
 \end{aligned}$$

$$AB'CD + AB'CD' + A'B'C'D + A'B'C'D'$$

$$\begin{aligned}
 &= A'BCD + A'BCD' + A'BC'D + A'BC'D' + A'B'C'D + A'B'C'D' \\
 &\quad + A'B'C'D + A'B'C'D' + ABCD + ABCD' + ABC'D + ABCD' \\
 &\quad + A'BCD + A'BCD' + A'BC'D + A'BC'D' + ABCD' + \\
 &\quad ABCD' + AB'CD + AB'C'D + A'B'C'D + A'B'C'D' \\
 &\quad + A'B'C'D + A'B'C'D' \\
 &= A'BCD + A'BCD' + A'BC'D + A'BC'D' + A'B'C'D + A'B'C'D' \\
 &\quad + A'B'C'D + A'B'C'D' + ABCD + ABCD' + ABC'D + ABCD' \\
 &\quad + AB'CD + AB'C'D'
 \end{aligned}$$

	$C'D'$	$C'D$	CD	CD'
$A'B'$	1	1	1	1
$A'B$	1	1	1	1
AB	1	1	1	1
AB'	1	0	0	1

$$F = A' + B + D'$$



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