

Assignment 02

01. $F = (x' + y + z')(x' + y') (x + z')$

$$= x'y'z' + x'y' + xz' \quad (\text{dual})$$

$$= x''y'z'' + x''y'' + x'z'' \quad (\text{complement})$$

$$= xy'z + xy + x'z$$

02. (a) $f(A, B, C, D) = A + B'CD'$

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

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

$$= ABCD + ABCD' + ABC'D + ABC'D' + AB'CD + \underline{AB'CD'} + AB'C'D + AB'C'D' + \underline{AB'CD'} + A'B'CD'$$

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$$= ABCD + ABCD' + ABC'D + ABC'D' + AB'CD + AB'CD' + AB'C'D + AB'C'D' + A'B'CD'$$

$$= 1111, 1110, 1101, 1100, 1011, 1010, 1001, 1000, 0010$$

$$= \sum (15, 14, 13, 12, 11, 10, 9, 8, 2)$$

(a) $f(A, B, C, D) = A + B'CD'$

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

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

$$= (A + B' + CC' + DD')(A + BB' + C + DD')(A + BB' + CC' + D')$$

$$= \underline{(A + B' + C + D)} \underline{(A + B' + C + D')} \underline{(A + B' + c + D)} \underline{(A + B' + C' + D')} \underline{(A + B + C + D)} \underline{(A + B + C + D')} \underline{(A + B' + C + D)}$$

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

PO5

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

$$= 0100, 0101, 0110, 0111, 0000, 0001, 0011$$

$$= \Pi (4, 5, 6, 7, 0, 1, 3)$$

$$\begin{aligned}
 \text{Q2. (b)} \quad F(A, B, C, D, E) &= AB + CDE \\
 &= AB(C+C')(D+D')(E+E') + (A+A')(B+B')(CDE) \\
 &= (ABC + ABC')(DE + DE' + D'E + D'E') + (AB + AB' + A'B + A'B')CDE \\
 &= \underline{\underline{ABCDE}} + \underline{\underline{ABCDE'}} + \underline{\underline{ABCD'E}} + \underline{\underline{ABCD'E'}} + \underline{\underline{ABC'DE}} + \underline{\underline{ABC'D'E'}} + \underline{\underline{ABC'D'E'}} + \\
 &\quad \underline{\underline{ABCDE}} + \underline{\underline{AB'CDE}} + \underline{\underline{A'B'CDE}} + \underline{\underline{A'B'CDE}} \\
 &= ABCDE + ABCDE' + ABCD'E + ABCD'E' + ABC'DE + ABC'DE' + ABC'D'E + ABC'D'E' + \\
 &\quad AB'CDE + A'B'CDE + A'B'CDE \\
 &= 11111, 11110, 11101, 11100, 11011, 11010, 11001, 11000, 10111, 01111, 00111 \\
 &= \sum (31, 30, 29, 28, 27, 26, 25, 24, 23, 15, 7)
 \end{aligned}$$

$$\begin{aligned}
 \text{(b)} \quad F(A, B, C, D, E) &= AB + CDE \\
 &= (AB + CD)(AB + E) \quad \checkmark \\
 &= (AB + C)(AB + D)(A + E)(B + E) \quad \checkmark \\
 &= (A + C)(B + C)(A + D)(B + D)(A + E)(B + E) \quad \checkmark \\
 &= (A + BB' + C + DD' + EE')(AA' + B + C + DD' + EE')(A + BB' + CC' + D + EE') \\
 &\quad (AA' + B + CC' + D + EE')(A + BB' + CC' + DD' + E)(AA' + B + CC' + DD' + E) \quad \checkmark \\
 &= (A + BB' + C + DD' + E)(A + BB' + C + DD' + E')(AA' + B + C + DD' + E) \quad (AA' + B + C + DD' + E') \\
 &\quad (A + BB' + CC' + D + E)(A + BB' + CC' + D + E')(AA' + B + CC' + D + E) \quad (AA' + B + CC' + D + E') \\
 &\quad (A + BB' + CC' + D + E)(A + BB' + CC' + D + E)(AA' + B + CC' + D + E)(AA' + B + CC' + D + E) \\
 &= (A + BB' + C + D + E)(A + BB' + C + D + E')(A + BB' + C + D + E') \quad (A + BB' + C + D + E') \\
 &\quad (AA' + B + C + D + E)(AA' + B + C + D + E')(AA' + B + C + D + E') \quad (AA' + B + C + D + E') \\
 &\quad (A + BB' + C + D + E)(A + BB' + C' + D + E)(A + BB' + C + D + E') \quad (A + BB' + C' + D + E') \\
 &\quad (AA' + B + C + D + E)(AA' + B + C' + D + E)(AA' + B + C + D + E') \quad (AA' + B + C' + D + E') \\
 &\quad (A + BB' + C + D + E)(A + BB' + C' + D + E)(A + BB' + C + D' + E) \quad (A + BB' + C' + D' + E) \\
 &\quad (AA' + B + C + D + E)(AA' + B + C' + D + E)(AA' + B + C + D' + E) \quad (AA' + B + C' + D' + E) \\
 &= (A + BB' + C + D + E)(A + BB' + C + D + E)(A + BB' + C + D + E') \quad (A + BB' + C + D + E') \\
 &\quad (AA' + B + C + D + E)(AA' + B + C + D + E')(AA' + B + C + D + E') \quad (AA' + B + C + D + E') \\
 &\quad (A + BB' + C' + D + E)(A + BB' + C' + D + E')(AA' + B + C' + D + E) \quad (AA' + B + C' + D + E') \\
 &\quad (A + BB' + C' + D + E)(AA' + B + C' + D + E)(AA' + B + C' + D' + E) \quad (AA' + B + C' + D' + E)
 \end{aligned}$$

$$\begin{aligned}
&= (\underline{A+B+C+D+E}) (\underline{A+B'+C+D+E}) (\underline{A+B+C+D'+E}) (\underline{A+B'+C+D'+E}) \\
&\quad (\underline{A+B+C+D+E'}) (\underline{A+B'+C+D+E'}) (\underline{A+B+C+D'+E'}) (\underline{A+B'+C+D'+E'}) \\
&\quad (\underline{A+B+C+D+E}) (\underline{A'+B+C+D+E}) (\underline{A+B+C+D'+E}) (\underline{A'+B+C+D'+E}) \\
&\quad (\underline{A+B+C+D+E'}) (\underline{A'+B+C+D+E'}) (\underline{A+B+C+D'+E'}) (\underline{A'+B+C+D'+E'}) \\
&\quad (\underline{A+B+C'+D+E}) (\underline{A+B'+C'+D+E}) (\underline{A+B+C'+D+E'}) (\underline{A+B'+C'+D+E'}) \\
&\quad (\underline{A+B+C'+D+E}) (\underline{A'+B+C'+D+E}) (\underline{A+B+C'+D+E'}) (\underline{A'+B+C'+D+E'}) \\
&\quad (\underline{A+B+C'+D+E}) (\underline{A+B'+C'+D+E}) (\underline{A+B+C'+D+E}) (\underline{A'+B+C'+D+E}) \\
&\quad (\underline{A+B+C'+D+E}) (\underline{A'+B+C'+D+E})
\end{aligned}$$

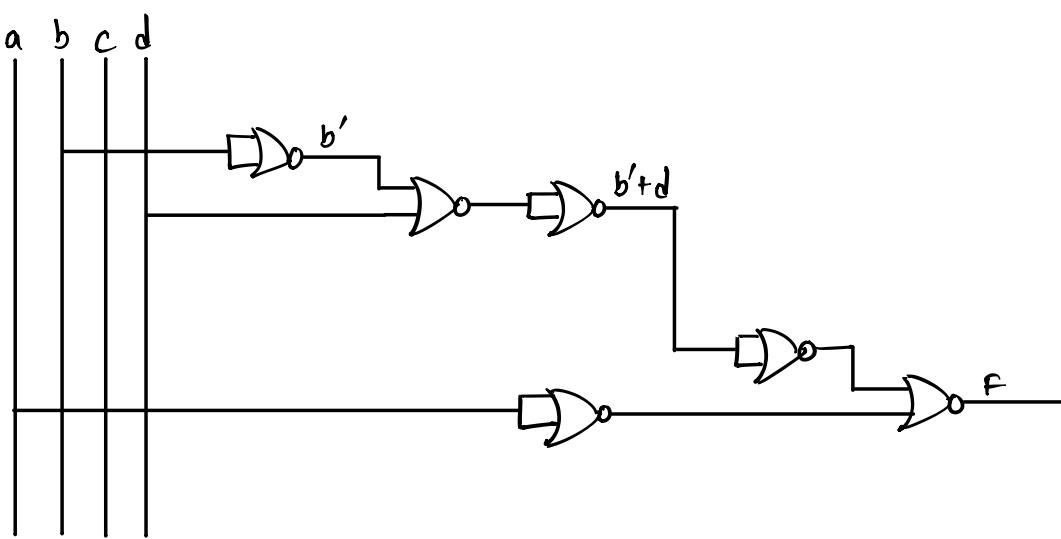
$$\begin{aligned}
&= (\underline{A+B+C+D+E}) (\underline{A+B'+C+D+E}) (\underline{A+B+C+D'+E}) (\underline{A+B'+C+D'+E}) \\
&\quad (\underline{A+B+C+D+E'}) (\underline{A+B'+C+D+E'}) (\underline{A+B+C+D'+E'}) (\underline{A+B'+C+D'+E'}) \\
&\quad (\underline{A'+B+C+D+E}) (\underline{A'+B+C+D'+E}) (\underline{A'+B+C+D+E'}) (\underline{A'+B+C+D'+E'}) \\
&\quad (\underline{A+B+C'+D+E}) (\underline{A+B'+C'+D+E}) (\underline{A'+B+C'+D+E}) (\underline{A+B+C'+D+E'}) \\
&\quad (\underline{A'+B+C'+D+E'}) (\underline{A+B+C'+D+E}) (\underline{A+B'+C'+D+E}) (\underline{A'+B+C'+D+E'}) \\
&\quad (\underline{A+B'+C'+D+E})
\end{aligned}$$

$$\begin{aligned}
&= 00000, 01000, 00010, 01010, 00001, 01001, 00011, 01011, \\
&\quad 10000, 10010, 10001, 10011, 00100, 01100, 10100, 00101, \\
&\quad 10101, 00110, 01110, 10110, 01101
\end{aligned}$$

$$= \pi(0, 8, 2, 10, 1, 9, 3, 11, 16, 18, 17, 19, 4, 12, 20, 5, 21, 6, 14, 22, 13)$$

$$03. F(a, b, c, d) = \sum(8, 9, 10, 11, 13, 15)$$

$$\begin{aligned}
&= 1000 + 1001 + 1010 + 1011 + 1101 + 1111 \\
&= ab'c'd' + ab'c'd + ab'cd' + ab'cd + abc'd + abcd \\
&= ab'c'(d'+d) + ab'c(d'+d) + abd(c'+c) \\
&= ab'c' + ab'c + abd \\
&= ab'(c'+c) + abd \\
&= ab' + abd \\
&= a(b' + bd) \\
&= a(b' + b)(b' + d) \\
&= a(b' + d)
\end{aligned}$$



$$04. \quad f(a, b, c, d) = \sum(5, 8, 9, 12, 15)$$

$$\begin{aligned}
 &= 0101, 1000, 1001, 1100, 1111 \\
 &= a'b'c'd + ab'c'd' + ab'c'd + abc'd' + abcd \\
 &= a'b'c'd + ab'c'(d' + d) + abc'd' + abcd \\
 &= a'b'c'd + ab'c' + abc'd' + abcd \\
 &= a'b'c'd + ac'(b' + bd') + abcd \\
 &= a'b'c'd + ac'(b' + b)(b' + d') + abcd \\
 &= a'b'c'd + ac'(b' + d') + abcd \\
 &= bd(a'c' + ac) + ac'(b' + d')
 \end{aligned}$$

