

Group Homework 6

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$$\begin{aligned} 1. \quad & f(X, Y, Z) = Y + X'Y'Z' \\ &= Y + (X + Y + Z)' \\ &= ((Y')(X + Y + Z))' \\ &= (Y'X + Y'Y + Y'Z)' \\ &= (Y'X + Y'Z)' \\ &= (Y'X)'(Y'Z)' \\ &= (Y + X')(Y + Z') \\ &= YY + YZ' + X'Y + X'Z' \\ &= Y(1 + Z' + X') + X'Z' \\ &= Y + X'Z' \end{aligned}$$

$$\begin{aligned}
2. \quad f(X, Y, Z) &= (X + Y)(X + Z)(Z + Y) \\
&= (XX + XZ + XY + YZ)(Z + Y) \\
&= XZ + XY + XZY + YZ \\
&= XZ + XY(1 + Z) + YZ \\
&= XZ + XY + YZ
\end{aligned}$$

$$\begin{aligned}
3. \quad f(X, Y, Z) &= X'Y' + X'Y + YZ' + XZ' \\
&= X'(Y' + Y) + YZ' + XZ' \\
&= X' + YZ' + XZ' \\
&= ((X)(XZ')'(YZ')')' \\
&= ((X)(X' + Z)(Y' + Z))' \\
&= ((X)(X'Y' + X'Z + Y'Z + ZZ))' \\
&= (XX'Y' + XX'Z + XY'Z + XZ)' \\
&= (XZ(Y' + 1))' \\
&= (XZ)' \\
&= X' + Z'
\end{aligned}$$

$$\begin{aligned}
4. \quad & f(W, X, Y, Z) = YW + X'YZ' + XZ'W + XYZ + X'ZW \\
&= YW + Y(X'Z' + XZ) + W(XZ' + X'Z) \\
&= YW + Y(X'Z + XZ')' + W(XZ' + X'Z) \\
&= Y(X'Z + XZ')' + W(XZ' + X'Z) \quad \text{Theorem 3} \\
&= X'YZ' + XZ'W + XYZ + X'ZW
\end{aligned}$$

$$\begin{aligned}
5. \quad f(X, Y, Z) &= (X + Z)(X + Y')(Y + Z) \\
&= (X + XY' + ZX + ZY')(Y + Z) \\
&= XY + XZ + XY'Y + XY'Z + ZXY + ZXZ + ZY'Y + ZY'Z \\
&= XY + XZ + XY'Z + XYZ + ZY' \\
&= XY + XZ + XZ(Y' + Y) + ZY' \\
&= XY + XZ + ZY'
\end{aligned}$$

$$\begin{aligned}
6. \quad f(W, X, Y, Z) &= (W' + X')(Y + Z)' \\
&= WX(Y + Z)' \\
&= WX(Y'Z') \\
&= WXY'Z'
\end{aligned}$$

$$\begin{aligned}
7. \quad f(X, Y, Z) &= (X + Y)(X' + Y)(X + Y')(X' + Y') \\
&= (XX' + XY + X'Y + YY)(XX' + XY' + X'Y' + Y'Y') \\
&= (XY + X'Y + Y)(XY' + X'Y' + Y') \\
&= Y(X + X' + 1)Y'(X + X' + 1) \\
&= YY' \\
&= 0
\end{aligned}$$

$$8. f(A, B, C, D) = AB + A'C + B'CD$$

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

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

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

$$= BD + ABC' + BC + A'B'C$$

$$= BD + ABC' + BC(A + A') + A'B'C$$

$$= BC + ABC' + ABC + A'BC + A'B'C$$

$$= BD + AB + A'C$$

$$9. f(A, B, C, D) = AB + A'C + B'D + CD$$

$$=$$

$$=$$

$$=$$

$$=$$

$$=$$

$$\begin{aligned}
10. \quad f(X, Y, Z) &= (X'(XY'Z'))'Z \\
&= Z(X'(X' + Y + Z))' \\
&= Z(X'X' + X'Y + X'Z)' \\
&= Z(X'(1 + Y + Z))' \\
&= Z(X')' \\
&= ZX
\end{aligned}$$