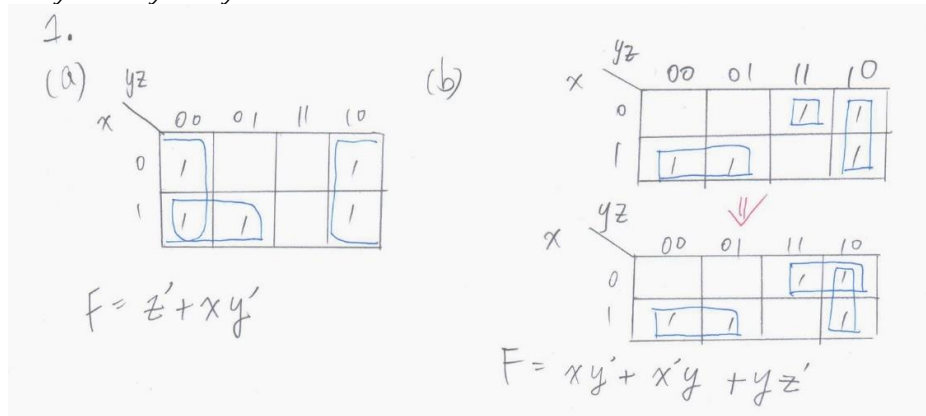


HW3

1. (10%) Simplify the following Boolean functions or expression, using three-variable maps:

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

(b) $F(x, y, z) = xy' + x'yz + yz'$

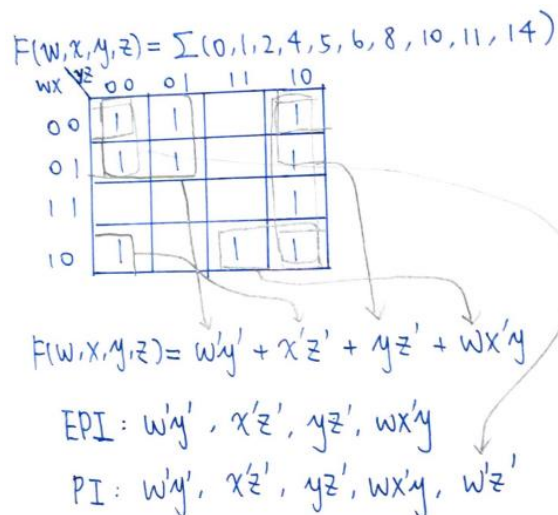


(b) 將題目的 Boolean function 轉成 Sum-of-minterms:

$$F = x'yz + x'yz' + xy'z' + xy'z + xyz'$$

2. (20%) Simplify the following Boolean functions by first finding the essential prime implicants (Please indicate the essential prime implicants and prime implicants):

(a) $F(w, x, y, z) = \sum(0, 1, 2, 4, 5, 6, 8, 10, 11, 14)$

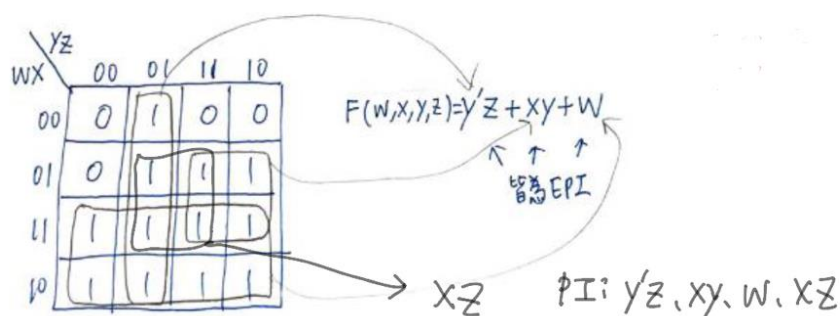


(b) $F(w, x, y, z) = wz' + xy + y'z + wx'z$

2(b) $F(w, x, y, z) = wz' + xy + y'z + wx'z$

$$= (wxy'z' + wxy'z + wx'y'z' + wx'y'z) + (wxy'z + wxy'z' + w'xy'z + w'xy'z') + (wxy'z + w'xy'z + w'x'y'z + w'x'y'z') + (wx'y'z + wx'y'z')$$

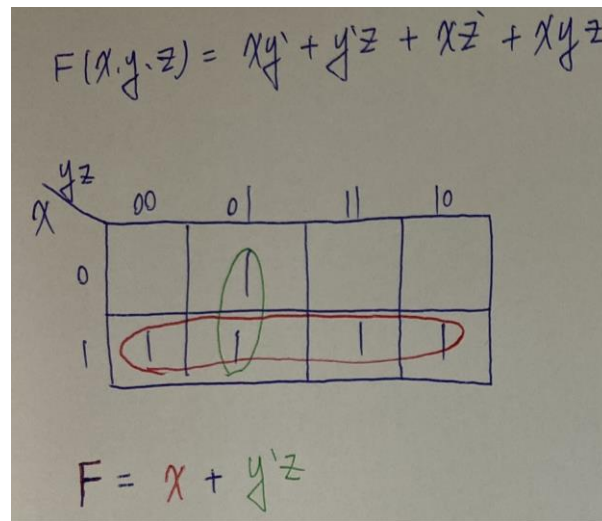
$$= \sum(1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15)$$



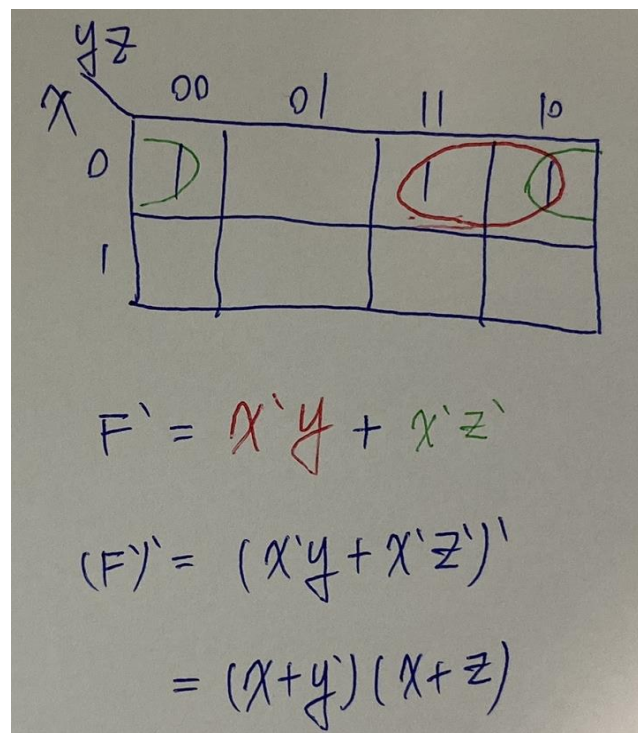
3. (10%) Simplify the following expressions in (a) sum of products and (b) product of sums:

$$F(x, y, z) = xy' + y'z + xz' + xzy$$

(a)

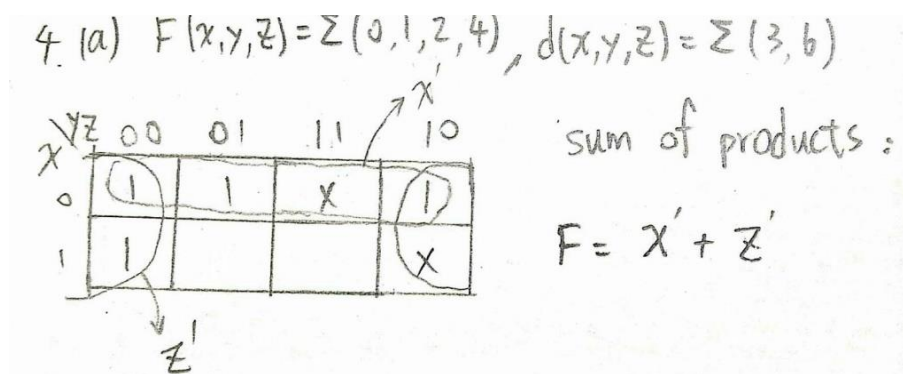


(b)



4. (20%) Simplify the following Boolean function F, together with the don't-care conditions d, and then express the simplified function in sum of products:

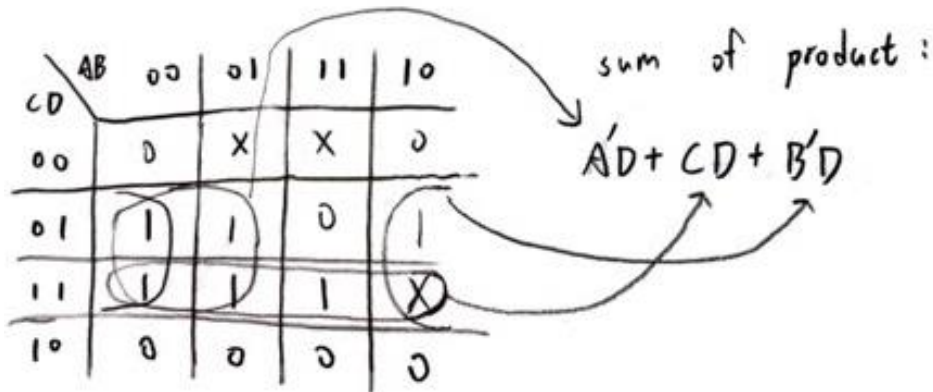
(a) $F(x, y, z) = \sum(0, 1, 2, 4), d(x, y, z) = \sum(3, 6)$



(b) $F(A, B, C, D) = \Sigma(1, 3, 5, 7, 9, 15)$, $d(A, B, C, D) = \Sigma(4, 11, 12)$

$$F(A, B, C, D) = \Sigma(1, 3, 5, 7, 9, 15)$$

$$d(A, B, C, D) = \Sigma(4, 11, 12)$$



5. (10%) Simplify the following expression, and implement it with two-level NAND gates:

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

5. $F = (A' + B' + C)(B + C')(A' + C)$

Use DeMorgan's theorem to derive F' :

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

$$= ABC' + (A+A')BC + (B+B')AC' \quad (\text{specify 0's})$$

So the K-map is as follows:

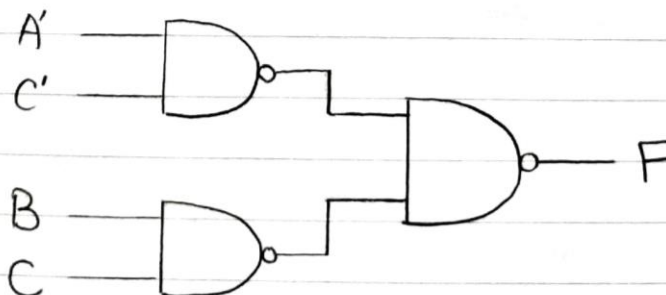
| ABC | 00 | 01 | 11 | 10 |
|-----|----|----|----|----|
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 |

Therefore,

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

$$= ((A'C')' \cdot (BC)')' \quad \text{DeMorgan's Theorem}$$

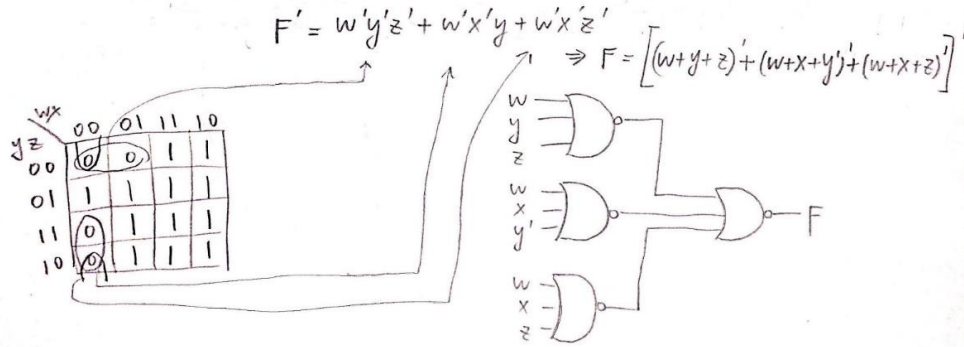
Logic Diagram:



6. (10%) Simplify the following expression, and implement it with two-level NOR gates:

$$F(w, x, y, z) = wz' + xy + y'z + wx'z$$

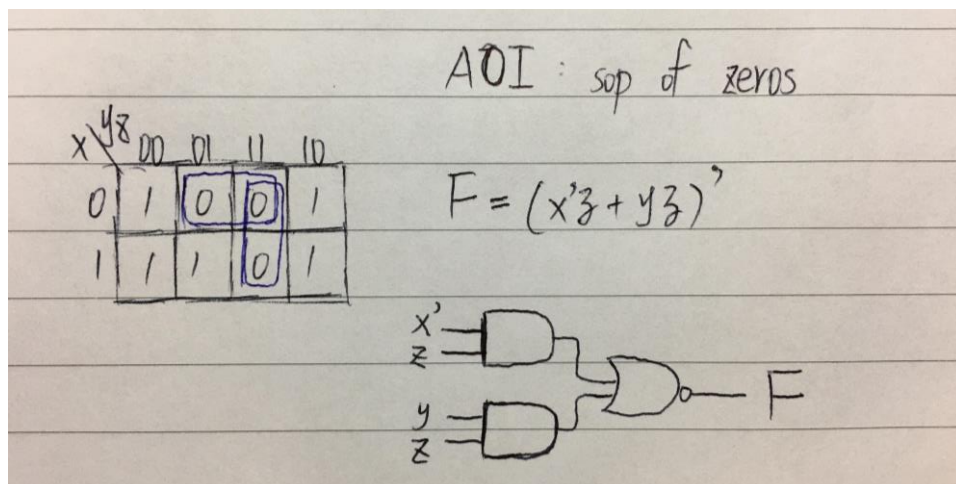
$$\begin{aligned} F(w, x, y, z) &= wz' + xy + y'z + wx'z \\ &= w(x+x')(y+y')z' + (w+w')xy(z+z') + (w+w')(x+x')y'z + wx'(y+y')z \\ &= wxyz' + wx'y'z' + wx'y'z + wx'y'z' + wxy'z + wxy'z' + w'xy'z + w'xy'z' \\ &\quad + wxy'z + wx'y'z + w'xy'z + w'xy'z' + wx'y'z + wx'y'z' \\ &= \Sigma(1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15) \end{aligned}$$



7. (20%) Simplify the following Boolean function F, using the two-level forms (a) AND-OR-Inverter, (b) OR-AND-Inverter logic diagrams

$$F(x, y, z) = \Sigma(0, 2, 4, 5, 6)$$

(a)



(b)

