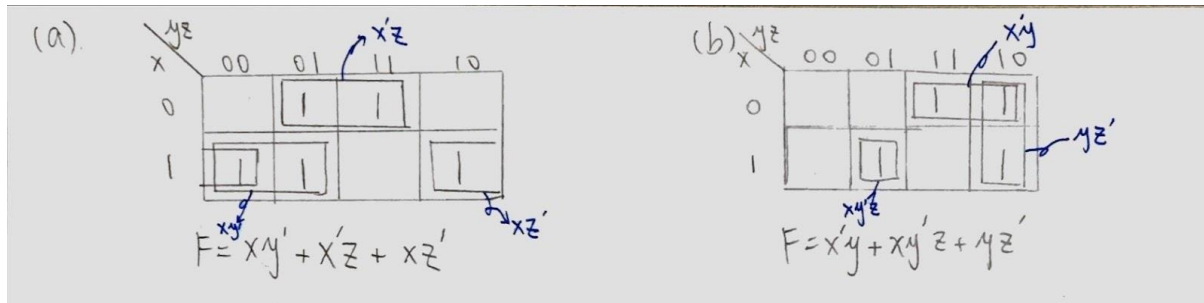


HW3 solution

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

(a) $F(x, y, z) = S(1, 3, 4, 5, 6)$

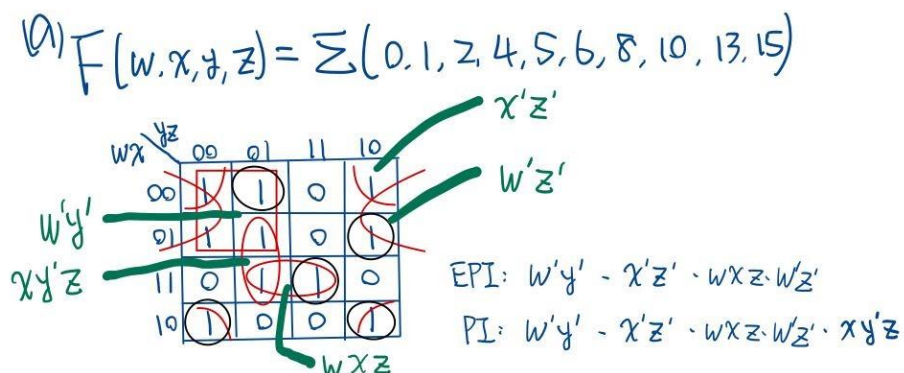
(b) $F(x, y, z) = x'y + xy'z + yz'$



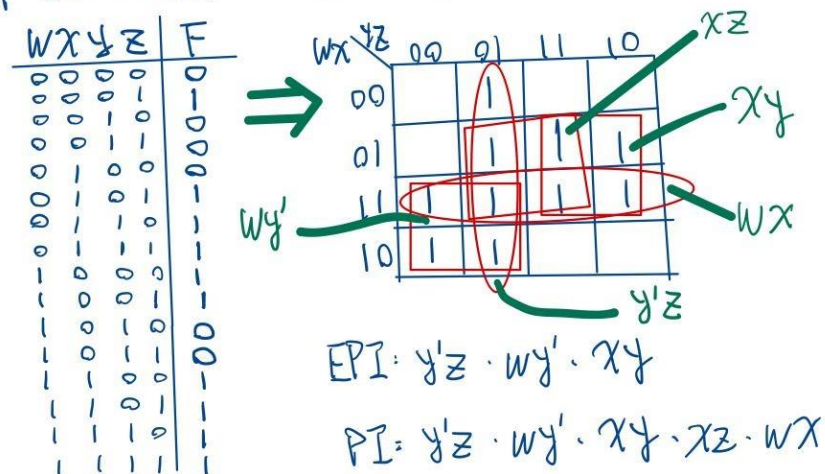
2. (20%) Simplify the following Boolean functions by first finding the essential prime implicants (Please indicate the essential prime implicants and prime implicants):

(a) $F(w, x, y, z) = S(0, 1, 2, 4, 5, 6, 8, 10, 13, 15)$

(b) $F(w, x, y, z) = wy' + xy + y'z + w'xz$



(b) $F(w, x, y, z) = wy' + xy + y'z + w'xz$

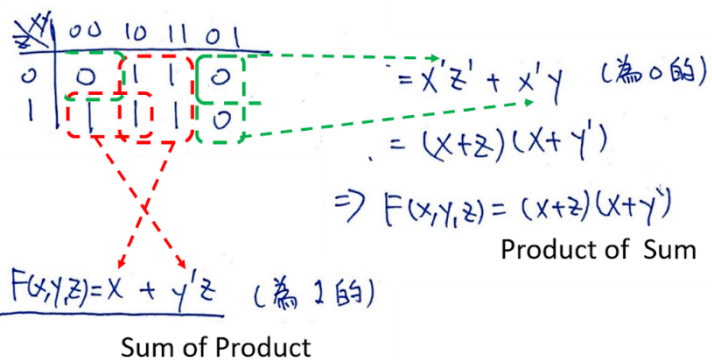


3. (10%) Simplify the following expressions in (a) sum of products and (b) product of sums:

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

x	y	z	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

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

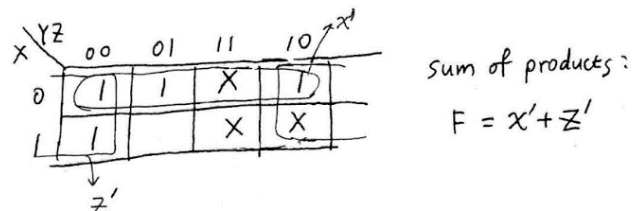


4. (20%) Simplify the following Boolean function F , together with the don't-care conditions d , and then express the simplified function in sum of products:

(a) $F(x, y, z) = S(0, 1, 2, 4)$, $D(x, y, z) = S(3, 6, 7)$

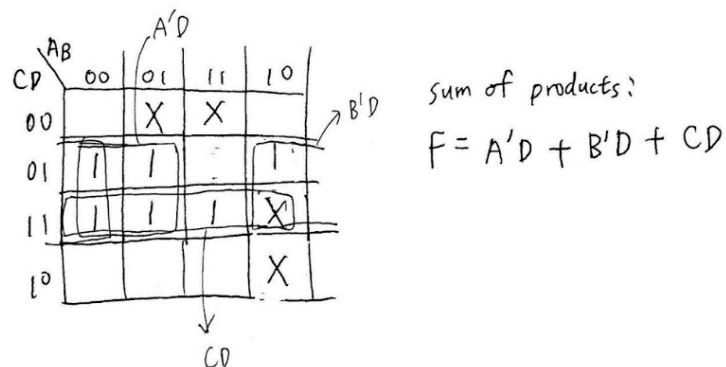
(b) $F(A, B, C, D) = S(1, 3, 5, 7, 9, 15)$, $D(A, B, C, D) = S(4, 10, 11, 12)$

(a) $F(x, y, z) = \Sigma(0, 1, 2, 4)$, $D(x, y, z) = \Sigma(3, 6, 7)$



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

$D(A, B, C, D) = \Sigma(4, 10, 11, 12)$



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

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

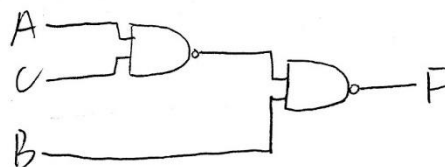
$$S. F(A, B, C) = (A + B' + C)(A + B')(B' + C)$$

A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

A \ B	00	01	11	10
0	1	1	0	0
1	1	1	1	0

Groupings: B' (covering 00, 01, 10, 11) and AC (covering 01, 11).

$$\Rightarrow F = B' + AC = (B \cdot (AC)')'$$



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

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

(b)

w	x	y	z	F
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

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

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

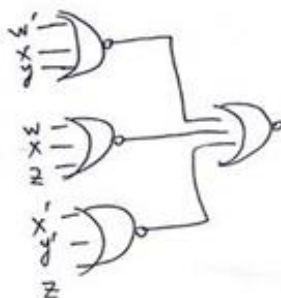
$$F = (F')' = (w'x'y' + w'x'z' + xy'z')'$$

$$= (w'x'y')'(w'x'z')'(xy'z')'$$

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

$$= [(w' + x + y)']' [(w' + x' + z)']' [(x' + y' + z)']'$$

$$= [(w' + x + y) + (w' + x' + z) + (x' + y' + z)']'$$



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

$$F(x, y, z) = \Sigma(0, 1, 2, 4, 5, 6)$$

7.

$$F(x, y, z) = \Sigma(0, 1, 2, 4, 5, 6)$$

(a)

	yz	00	01	11	10
x	0	1	1	0	1
	1	1	1	0	1

yz

(AOI)

$$F' = yz \text{ (F' in sum of product)}$$

$$\Rightarrow F = (yz)' \#$$

因退化成一級，所以無法呈現 AOI。

(b)

	yz	00	01	11	10
x	0	1	1	0	1
	1	1	1	0	1

z' y'

(OAI)

$$F = y' + z' \text{ (F in sum of product)}$$

$$\Rightarrow F' = yz \text{ (F' in product of sum)}$$

$$\Rightarrow F = (yz)' \#$$

因退化成一級，所以無法呈現 OAI。