

1. a.

$$F(X,Y,Z) = \sum(0,2,5,6,7)$$

		Y			
		00	01	11	10
X	0	1			1
	1		1	1	1

F map

$$= \bar{X}\bar{Z} + XZ + XY + Y\bar{Z}$$

b.  $F(W,X,Y,Z) = \prod(1,3,5,7,12,13,14,15)$

$$F = \bar{W}\bar{Z} + WX$$

		Y			
		00	01	11	10
W	0	1	0	0	1
	1	1	0	0	1
X	0	0	0	0	0
	1	1	1	1	1

F map

c.  $F(A,B,C,D) = (\bar{A} + \bar{B} + D)(\bar{A} + \bar{D})(A + B + \bar{D})(A + \bar{B} + C + D)$

$$\bar{F}(A,B,C,D) = AB\bar{D} + AD + \bar{A}\bar{B}D + \bar{A}B\bar{C}\bar{D}$$

$$F = \bar{B}\bar{D} + \bar{A}BD + \bar{A}BC$$

$$+ \bar{A}C\bar{D}$$

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

F map

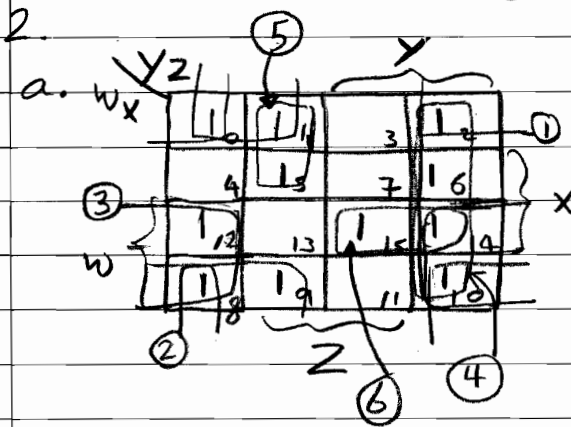
d.  $F(A,B,C,D) = A\bar{C} + \bar{B}D + \bar{A}CD + ABCD$

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

F map

H4-2

$$F(w, x, y, z) = \sum(0, 1, 2, 5, 6, 8, 9, 10, 12, 14, 15)$$



List of all possible PIs:

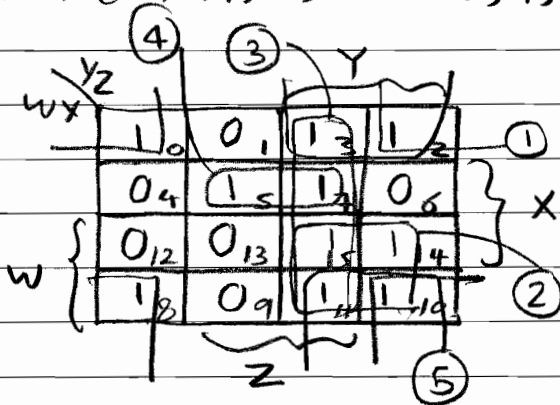
Essential?

- |                     |     |
|---------------------|-----|
| ① $\bar{x}\bar{z}$  |     |
| ② $\bar{x}\bar{y}$  | yes |
| ③ $w\bar{z}$        | yes |
| ④ $y\bar{z}$        | yes |
| ⑤ $\bar{w}\bar{y}z$ | yes |
| ⑥ $wyx$             | yes |

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

b.  $F(w, x, y, z) = \prod(1, 4, 6, 9, 12, 13)$

Essential?



- |                    |     |
|--------------------|-----|
| ① $\bar{x}\bar{z}$ | yes |
| ② $w y$            | yes |
| ③ $y z$            |     |
| ④ $\bar{w} x z$    | yes |
| ⑤ $y \bar{x}$      |     |

$$F(w, x, y, z) = x\bar{z} + yw + \bar{w}xz + y\bar{x}$$

$\bar{w} + yz$

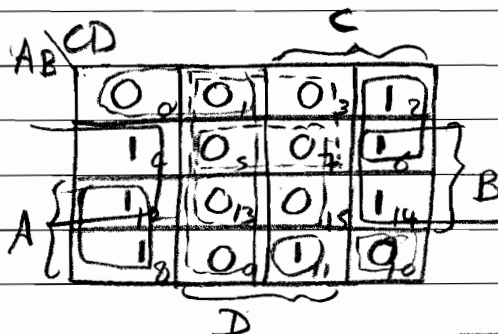
3. a.  $F(A, B, C, D) = \prod(0, 1, 3, 5, 7, 9, 10, 13, 15)$

SOP:

$$F = B\bar{D} + \bar{A}C\bar{D} + A\bar{C}\bar{D} + A\bar{B}CD$$

POS:

$$\bar{F} = \bar{C}D + \bar{A}D + BD + \bar{A}\bar{B}\bar{C} + A\bar{B}C\bar{D}$$



$$F = \bar{F} = \bar{C}D + \bar{A}D + BD + \bar{A}\bar{B}\bar{C} + A\bar{B}C\bar{D}$$

$$= (C + \bar{D}) \cdot (A + \bar{D}) \cdot (\bar{B} + \bar{D}) \cdot (A + B + C) \cdot (\bar{A} + B + \bar{C} + D)$$

3, contd.

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

	$yz$		$y$	
$x$	1 <sub>0</sub>	0 <sub>1</sub>	0 <sub>3</sub>	1 <sub>2</sub>
$x$	1 <sub>4</sub>	1 <sub>5</sub>	0 <sub>7</sub>	1 <sub>6</sub>
	$z$			

SOP

$$F = \bar{z} + x\bar{y} \quad \text{--- (1)}$$

POS

$$\bar{F} = \bar{x}z + yz$$

$$F = \bar{\bar{F}} = \overline{\bar{x}z + yz}$$

$$= (x + \bar{z})(\bar{y} + \bar{z}) \quad \text{--- (2)}$$

checking Equivalence of (1) & (2):

$$\begin{aligned} \text{From 2: } F &= (x + \bar{z})(\bar{y} + \bar{z}) \\ &= x\bar{y} + x\bar{z} + \bar{y}\bar{z} + \bar{z} \\ &= x\bar{y} + \bar{z}(1 + x + \bar{y}) \\ &= x\bar{y} + \bar{z} \quad \text{--- (1) } \checkmark \end{aligned}$$

4. a.

$$F(w, x, y, z) = \sum(2, 4, 7, 10, 12, 14),$$

$$d = (0, 3, 6, 8, 13)$$

	$yz$		$y$	
$w, x$	x <sub>0</sub>	0 <sub>1</sub>	x <sub>3</sub>	1 <sub>2</sub>
	1 <sub>4</sub>	0 <sub>5</sub>	1 <sub>7</sub>	x <sub>6</sub>
$w$	1 <sub>13</sub>	x <sub>12</sub>	0 <sub>15</sub>	1 <sub>14</sub>
	x <sub>8</sub>	0 <sub>9</sub>	0 <sub>11</sub>	1 <sub>10</sub>
	$z$			

$$F = \bar{z} + \bar{w}y$$

	$wxyz$	Implemented F
(13)	1101	0
(8)	1000	1

b.

$$F(x, y, z) = \sum(0, 1, 2, 4), \quad d(x, y, z) = y(z + x)$$

$$= yx + yz$$

	$yz$		$y$	
$x$	1 <sub>0</sub>	1 <sub>1</sub>	x <sub>3</sub>	1 <sub>2</sub>
	1 <sub>4</sub>	1 <sub>5</sub>	x <sub>7</sub>	x <sub>6</sub>
	$z$			

$$F = \bar{x} + \bar{z}$$

$$\begin{aligned}
 5. \quad F(A, B, C, D) &= (A + \bar{B} + C + \bar{D})(A + \bar{B} + \bar{C} + \bar{D}) \\
 &\quad (\bar{A} + \bar{B} + C + \bar{D})(\bar{A} + \bar{B} + \bar{C} + \bar{D}) \\
 &= M_{0101} \cdot M_{0111} \cdot M_{1101} \cdot M_{1111} \\
 &= \Pi(5, 7, 13, 15)
 \end{aligned}$$

		CD			
		00	01	11	10
AB	00	1	1	1	1
	01	1	0	0	1
	11	1	0	0	1
	10	1	1	1	1

$$F = \bar{B} + \bar{D}$$

$$\begin{aligned}
 6. \quad &\bar{w}x(\bar{z} + \bar{y}z) + x(w + \bar{w}yz) \\
 (i) \quad &= \bar{w}x[\bar{z} + z\bar{y}] + x[w + \bar{w}yz] \\
 &= \bar{w}x[(\bar{z} + z)(\bar{z} + \bar{y})] + x[(w + \bar{w})(w + yz)] \\
 &= \bar{w}x\bar{z} + \bar{w}x\bar{y} + xw + xyz \\
 &= \bar{w}x\bar{z} + x[w + \bar{w}\bar{y}] + xyz \\
 &= \bar{w}x\bar{z} + x[(w + \bar{w})(w + \bar{y})] + xyz \\
 &= \bar{w}x\bar{z} + xw + x\bar{y} + xyz \\
 &= xw + x\bar{w}\bar{z} + x\bar{y} + xyz \\
 &= x[w + \bar{w}\bar{z}] + x[\bar{y} + yz] \\
 &= x[(w + \bar{w})(w + \bar{z})] + x[(\bar{y} + y)(\bar{y} + z)] \\
 &= x[w + \bar{z}] + x[\bar{y} + z] \\
 &= x[w + \bar{y} + \bar{z} + z] \\
 &= x
 \end{aligned}$$

$$(ii) \quad \bar{w}x(\bar{z} + \bar{y}z) + x(w + \bar{w}yz) \\ = \bar{w}x\bar{z} + \bar{w}x\bar{y}z + wx + \bar{w}xyz$$

$w \backslash yz$   
 $x$

	0	1	3	2
1	4	5	7	6
1	12	13	15	14
8	9	11	10	

$w$  {  
 $z$

$x$

$$= x \checkmark$$