

EE2000 - Tutorial 1

1. Simplify the following expressions using boolean algebra

$$\begin{aligned} \text{(i)} \quad f(x, y, z) &= \bar{x}z + y\bar{z} + \bar{x}yz + xy \\ &= x'z(1+y') + yz' + xy \\ &= x'z + xyz' + x'yz' + xy \\ &= x'(z + yz') + xy(1 + z') \\ &= x'(z + y) + xy \\ &= x'z + x'y + xy \\ &= x'z + y(x + x') \\ &= x'z + y \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad F(A, B, C) &= \bar{A}\bar{B}(\bar{B} + \bar{C})(A + C) \\ &= \bar{A}\bar{B}'(\bar{A}\bar{B}' + \bar{A}\bar{C}' + \bar{B}'\bar{C} + \bar{C}\bar{C}') \\ &= \bar{A}\bar{B}' + \bar{A}\bar{B}'\bar{C}' + \bar{A}\bar{B}'\bar{C} \\ &= \bar{A}\bar{B}' \end{aligned}$$

2. Plot the following functions on the K-map and simplify the function

$$\text{(a)} \quad F(A, B, C, D) = A'C'D' + AB'D' + ACD + B'CD' + A'BD + ABC'D$$

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

$$F(A, B, C, D) = BD + B'D' + \left\{ \begin{array}{c} A'C'D' \\ \text{or} \\ A'BC' \end{array} \right\} + \left\{ \begin{array}{c} AB'C \\ \text{or} \\ ACD \end{array} \right\}$$

$$\text{(b)} \quad F(W, X, Y, Z) = WY'Z' + WZ + XZ + X'YZ' + W'X'Z'$$

	WX			
YZ	00	01	11	10
00	1		1	1
01			1	1
11		1	1	1
10	1	1	1	1

$$F(W, X, Y, Z) = W + XY + X'Z'$$

- (c) $f(a,b,c,d) = \Sigma m(0,1,3,5,7,9,10,11,14,15)$ in SOP form

	ab			
cd	00	01	11	10
00	1			
01	1	1		1
11	1	1	1	1
10			1	1

$$f(a,b,c,d) = a'd + ac + b'd + a'b'c'$$

- (d) $f(a,b,c,d) = \prod M(0,1,5,6,7,8,9,11,13)$ in POS form

	ab			
cd	00	01	11	10
00	0			0
01	0	0	0	0
11		0		0
10		0		

$$f(a,b,c,d) = (c + d')(b + c)(a + b' + c')(a' + b + d')$$

- (e) $f(a,b,c,d) = \Sigma m(1,3,10,13,14,15) + \Sigma d(7,8,9,12)$ in SOP form

	ab			
cd	00	01	11	10
00			d	d
01	1		1	d
11	1	d	1	
10			1	1

$$f(a,b,c,d) = ab + ad' + a'b'd$$

- (f) $f(a,b,c,d) = \prod M(2,5,7,8,10,13) \cdot \prod d(1,3,12,14)$ in POS form

	ab			
cd	00	01	11	10
00			d	0
01	d	0	0	
11	d	0		
10	0		d	0

$$f(a,b,c,d) = (a + d')(a' + d) \left\{ \begin{array}{c} (a + b + c') \\ or \\ (b + c' + d) \end{array} \right\} \left\{ \begin{array}{c} (a' + b' + c) \\ or \\ (b' + c + d') \end{array} \right\}$$

3. Use a K-map to convert the following canonical SOP expression into a minimum POS expression.
 $f(a,b,c,d) = \sum m(0,1,2,5,7,8,10,13,14,15)$

	<i>ab</i>			
<i>cd</i>	00	01	11	10
00		0	0	
01				0
11	0			0
10		0		

$$f(a,b,c,d) = (b' + c + d)(a' + b + d')(a + b' + d)(b + c' + d')$$

4. Use a K-map to convert the following canonical POS expression into a minimum SOP expression.
 $f(a,b,c,d) = \prod M(0,2,5,7,8,9,13)$

	<i>ab</i>			
<i>cd</i>	00	01	11	10
00		1	1	
01	1			
11	1		1	1
10		1	1	1

$$f(a,b,c,d) = ac + bd' + a'b'd$$