ENG2410 Assignment #3 Solutions
School of Engineering, University of Guelph, Fall 2025

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1. To find the complement of a function we either use DeMorgan's Theorem or use the Duals. Here we will first take the complement of both sides and then use DeMorgan's Theorem:

   (a) $\bar{F} = \overline{\bar{A}\bar{B} + \bar{A}B}$
   $\bar{F} = (A + B)(A + \bar{B})$

   (b) $\bar{F} = \overline{(\bar{V}W + \bar{X})Y + \bar{Z}}$
   $\bar{F} = ((V + \bar{W})X + \bar{Y})Z$

2. Simplification using Identities:

   (a) $ABC + \bar{A}BC$
   $BC(A + \overline{A})$
   BC

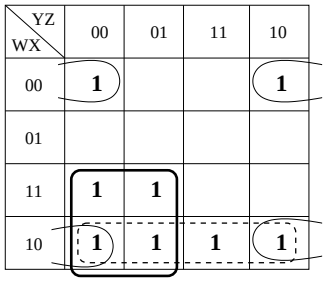
   (b) $\overline{(A + B)}(\overline{A} + \overline{B})$
   $(\overline{A} \cdot \overline{B})(\overline{A} + \overline{B})$
   $\overline{A} \cdot \overline{B} \cdot \overline{A} + \overline{A} \cdot \overline{B} \cdot \overline{B}$
   $(\overline{A} \cdot \overline{B})$

   (c) $\overline{A}BC + AC$
   $C(\overline{A}B + A)$
   $C(\overline{A} + A)(B + A)$ (Identity 15: Distibutive)
   $C(B + A)$

3. Simplification using maps:

(a)

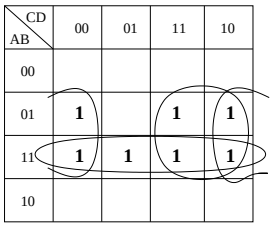
W	X	Y	Z	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0



$$F = W\bar{X} + W\bar{Y} + \bar{X}\bar{Z}$$

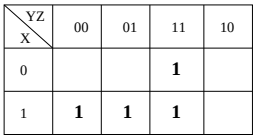
(b)

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

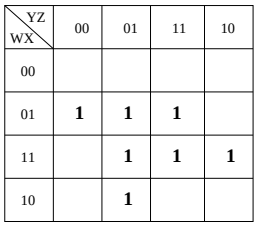


$F = B\overline{D} + AB + BC$

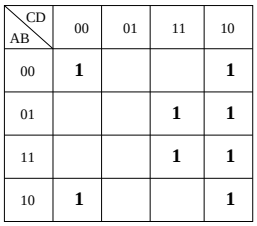
4. Minterms of the expressions:



$\sum m(3,4,5,7)$
$X\bar{Y} + YZ$
(a)



$\sum m(4,5,7,9,13,14,15)$
$XZ + \bar{W}X\bar{Y} + WXY + W\bar{Y}Z$
(b)



$\sum m(0,2,6,7,8,10,14,15)$
$BC + \bar{B}\bar{D}$
(c)

5. Prime implicants and essential prime implicants:
   (a) Prime = XZ, WX, $\overline{X}\ \overline{Z}$, $W\overline{Z}$
   Essential = XZ,$\overline{X}\ \overline{Z}$
   (b) Prime = CD, AC, $\overline{B}\ \overline{D}$, $\overline{A}BD$, $\overline{B}C$
   Essential = AC, $\overline{B}\ \overline{D}$, $\overline{A}BD$
   (c) Prime = AB, AC, AD, $B\overline{C}$, $\overline{B}D$, $\overline{C}D$
   Essential = AC,$B\overline{C}$, $\overline{B}D$