The University of Alabama in Huntsville
Electrical & Computer Engineering
CPE/EE 422/522
Spring 2004
Homework #1 Solution

1. (20 points) Prove the identity of each of the following Boolean equations using algebraic manipulation.

   a. $\overline{X}\overline{Y} + XY + \overline{X}Y = \overline{X} + Y$

   $\overline{X}\overline{Y} + XY + \overline{X}Y = \overline{X}\overline{Y} + \overline{X}Y + XY + \overline{X}Y = \overline{X}(\overline{Y} + Y) + Y(X + \overline{X}) = \overline{X} + Y$

   b. $\overline{X}Y + X\overline{Y} + XY + \overline{X}\overline{Y} = 1$

   $\overline{X}Y + X\overline{Y} + XY + \overline{X}\overline{Y} = \overline{X}Y + XY + X\overline{Y} + \overline{X}\overline{Y} = Y(\overline{X} + X) + C(X + \overline{X}) = Y + \overline{Y} = 1$c.

   $\overline{X} + XY + X\overline{Z} + X\overline{Y}\overline{Z} = \overline{X} + Y + \overline{Z}$

   $\overline{X} + XY + X\overline{Z} + X\overline{Y}\overline{Z} = \overline{X} + XY + X\overline{Z}(1 + \overline{Y}) = (\overline{X} + X)(\overline{X} + Y) + X\overline{Z} = \overline{X} + X\overline{Z} + Y =$

   $(\overline{X} + X)(\overline{X} + \overline{Z}) + Y = \overline{X} + \overline{Z} + Y$

   d. $X\overline{Y} + \overline{Y}\overline{Z} + \overline{X}\overline{Z} = X\overline{Y} + \overline{X}\overline{Z}$

   $X\overline{Y} + \overline{Y}\overline{Z} + \overline{X}\overline{Z} = X\overline{Y} + \overline{Y}\overline{Z}(X + \overline{X}) + \overline{X}\overline{Z} = X\overline{Y} + X\overline{Y}\overline{Z} + \overline{X}\overline{Y}\overline{Z} + \overline{X}\overline{Z}$

   $= X\overline{Y}(1 + \overline{Z}) + \overline{X}\overline{Z}(\overline{Y} + 1) = X\overline{Y} + \overline{X}\overline{Z}$

(15 points) Obtain the truth table of the following functions and express each function in sum of minterms and product of maxterms.

a. (XY + Z)(Y + XZ) =

Σm (3, 5, 6, 7)=ΠM (0, 1, 2, 4)

X	Y	Z	XY+Z	Y+XZ	F
0	0	0	0	0	0
0	0	1	1	0	0
0	1	0	0	1	0
0	1	1	1	1	1
1	0	0	0	0	0
1	0	1	1	1	1
1	1	0	1	1	1
1	1	1	1	1	1

b. $(\overline{A} + B)(\overline{B} + C)$=

Σm (0, 1, 3, 5, 7)=ΠM (2, 4, 6)

A	B	C	A′+B	B′+C	F
0	0	0	1	1	1
0	0	1	1	1	1
0	1	0	1	0	0
0	1	1	1	1	1
1	0	0	0	1	0
1	0	1	1	1	1
1	1	0	0	0	0
1	1	1	1	1	1

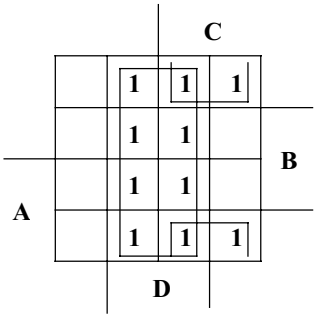
c. $\overline{Y}Z + WX\overline{Y} + WX\overline{Z} + \overline{W}\,\overline{X}Z$=Σm (1, 3, 5, 9, 12, 13, 14) =ΠM (0, 2, 4, 6, 7, 8, 10, 11, 15)

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	0
1	0	0	0	0
1	0	0	1	1
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	0

3. (20 points) Simplify the following expressions by means of a four-variable map.

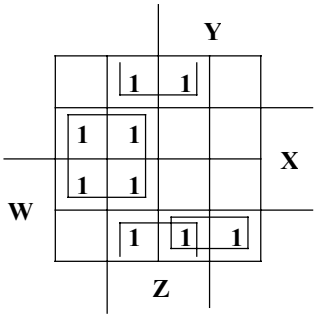
a. $\overline{A}D + BD + \overline{B}C + A\overline{B}D$

$= D + \overline{B}C$



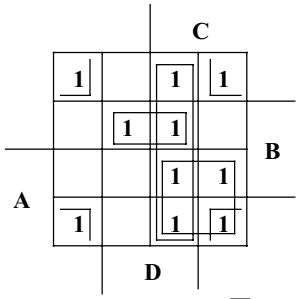
b. $\overline{X}Z + \overline{W}X\overline{Y} + W(\overline{X}Y + X\overline{Y})$

$= \overline{X}Z + \overline{W}\,\overline{Y} + W\,\overline{X}Y$



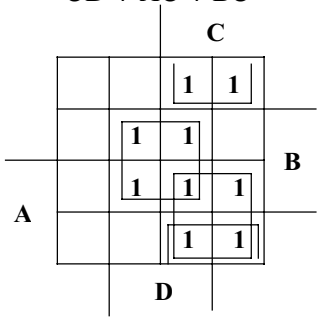
c. $A\overline{B}C + \overline{B}C\overline{D} + BCD + AC\overline{D} + \overline{A}\overline{B}C + \overline{A}B\overline{C}D$

$= AC + CD + \overline{B}\overline{D} + \overline{A}BD$



d, $ABC + CD + B\overline{C}D + \overline{B}C$

$= CD + AC + \overline{B}C$



4. (10 points) Implement the following expression with two-input NAND gates.

$(AB + \overline{A}\overline{B})(C\overline{D} + \overline{C}D)$