CSE320 Boolean Logic Practice Problems

Boolean Algebra

1. Prove the following Boolean expression using algebra.

   A. X'Y' + X'Y + XY = X' + Y

   B. A'B + B'C' + AB + B'C = 1

   C. Y + X'Z + XY' = X + Y + Z

   D. X'Y' + Y'Z + XZ + XY + YZ' = X'Y' + XZ + YZ'

   E. AB' + A'C'D'+ A'B'D + A'B'CD' = B' + A'C'D'

   F. XZ + WY'Z'+W'YZ'+WX'Z' = XZ + WY'Z' + WXY' + W'XY + X'YZ'

   G. CD + AB' + AC + A'C' + A'B + C'D' = (A' + B' + C + D')(A + B + C' + D)

2. Simplify the following Boolean expressions to the minimum number of literals (total number of appearances of all variables).

   A. ABC + ABC' + A'B
   B. (A + B)'(A' + B')
   C. A'BC + AC
   D. BC + B(AD + AD')
   E. (A + B' + AB')(AB + A'C +BC)

3. Reduce the following expressions to the indicated number of literals (total number of appearances of all variables).

   A. X'Y' + XYZ + X'Y to 3 literals
   B. X + Y(Z + (X + Z)') to 2 literals
   C. W'X(Z' + Y'Z) + X(W + W'YZ) to 1 literals
   D. ((A + B) + A'B')(C'D' + CD) + A'C' to 4 literals

4. Find the complement of the following expressions

   A. AB' + A'B
   B. (V'W +X)Y +Z'
   C. WX(Y'Z+YZ') + W'X'(Y' + Z)(Y +Z')
   D. (A +B' + C)(A'B' + C)(A + B'C')

5. Obtain the truth tables for the following expressions

   A. (XY + Z)(Y + XZ)
   B. (A' + B)(B' + C)
   C. WXY' + WXZ' + WXZ +YZ'

6. Convert the following truth table to switching expression (Boolean Algebra), and simplify the expression as much as possible

X	Y	Z	**E**
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

X	Y	Z	**G**
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

7. Using DeMorgan's theorem, express the function
   F = ABC + A'C' + A'B'
   B. with only OR and complement operators
   C. with only AND and complement operators

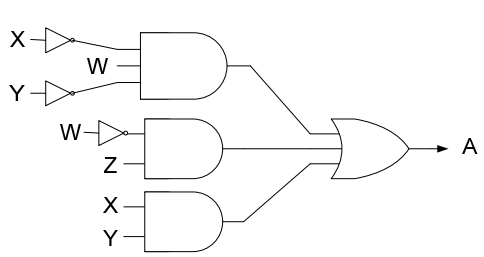
Minterms & Maxterms

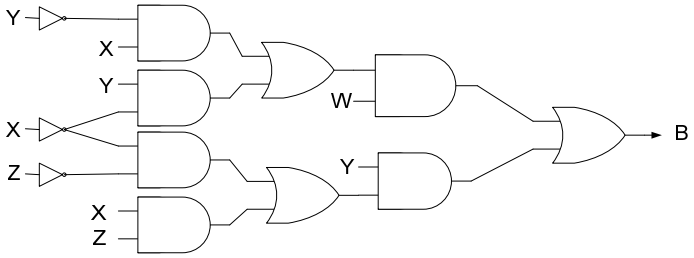
8. Write the truth table for the following functions, and express the functions as sum-of-minterms and product-of-maxterms
   A. (XY + Z)(Y + XZ)
   B. (A' + B)(B' + C)
   C. WXY' + WXZ' + WXZ + YZ'

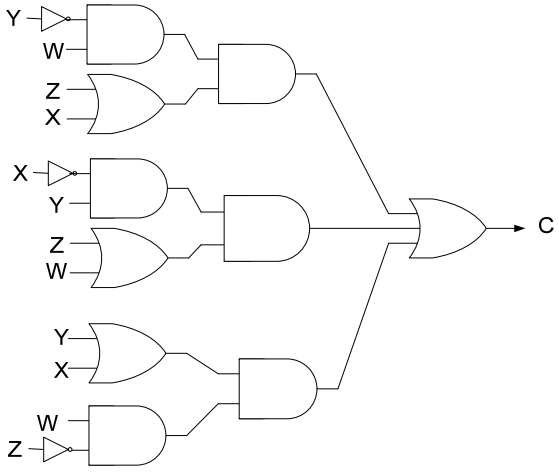
9. Convert the following expressions into sum-of-products (minterms) and product-of-sums (maxterms)

A. (AB +C)(B + C'D)
B. X' + X(X + Y')(Y + Z')
C. (A + BC' + CD)(B' + EF)

10. Convert the following gate diagrams into (1) switching expression, (2) truth table, (3) minterms, and (4) maxterms







11. Simplify the following expressions in (1) sum-of-products and (2) product-of-sums forms
    A. AC' + B'D + A'CD + ABCD
    B. (A' + B + D')(A + B' + C')(A' + B + D')(B + C' + D')
    C. (A' + B' + D)(A' + D')(A + B + D')(A + B' + C + D))
    D. $F(A,B,C,D) = \sum m(2,3,5,7,8,10,12,13)$
    E. $F(X,W,Y,Z) = \prod M(2,10,13)$

12. For the Boolean functions given in the following truth table:

X	Y	Z	E	F	G
0	0	0	1	0	1
0	0	1	1	0	1
0	1	0	1	1	1
0	1	1	0	1	0
1	0	0	0	0	1
1	0	1	1	0	0
1	1	0	0	1	1
1	1	1	0	1	0

    A. List the minterms and maxterms of each function
    B. List the maxterms of E', F', and G'
    C. Write the truth tables for E + F and EF
    D. List the minterms of E + F and EF
    E. Express E, F and G in sum-of-products
    F. Simplify E, F and G to expressions with a minimum number of literals (either sum-of-products or products-of-sums)