CSE 232
Homework — 1
Süleyman Gölbol - 1801042656

1. Simplify the following function by using boolean algebra $F(x,y,z) = xy + x'z + yz$.

   Solution:

   $xy + x'z + yz = xy + x'z + yz(x + x')$
   $= xy + x'z + xyz + x'yz = xy(1+z) + x'z(1+y)$
   $xy + x'z$

2. Derive that $(x + y)(x' + z)(y + z) = (x + y)(x' + z)$ by using boolean algebra.

   Solution:

   $(x' + z)(y + z) = x'y + x'z + zy + \underbrace{zz}_{z}$

   $x'(y+z) + z\underbrace{(y + 1)}_{1}$

   $x'z + x'y + z = z\underbrace{(1 + x')}_{1} + x'y$

   $= z + x'y$

   So left side is $(x+y)(z + x'y) = xz + \underbrace{xx'}_{x}y + yz + \underbrace{yy}_{y}x')$

   $= xz + x'y + yz + yx'$

   so left side is $= xz + yz + x'y$

   And the right side is $\underbrace{xx'}_{0} + xz + yx' + yz = xz + x'y + yz$

   So left side and right side equals each other

3. (a) Express the following function in **sum of minterms** and **product of maxterms** by using truth table

   F(A, B, C, D) = B'D + A'D + BD.

   (b) Simplify the standard expression

   F(A, B, C, D) = B'D + A'D + BD.

   Solution (a)

A	B	C	D	MINTERM(SOP)	MAXTERMS(POS)
0	0	0	0	m0 = A'B'C'D'	M0 = A+B+C+D
0	0	0	1	m1 = A'B'C'D	M1 = A+B+C+D'
0	0	1	0	m2 = A'B'CD'	M2 = A+B+C'+D
0	0	1	1	m3 = A'B'CD	M3 = A+B+C'+D'
0	1	0	0	m4 = A'BC'D'	M4 = A+B'+C+D
0	1	0	1	m5 = A'BC'D	M5 = A+B'+C+D'
0	1	1	0	m6 = A'BCD'	M6 = A+B'+C'+D
0	1	1	1	m7 = A'BCD	M7 = A+B'+C'+D'
1	0	0	0	m8 = AB'C'D'	M8 = A'+B+C+D
1	0	0	1	m9 = AB'C'D	M9 = A'+B+C+D'
1	0	1	0	m10=AB'CD'	M10= A'+B+C'+D
1	0	1	1	m11=AB'CD	M11= A'+B+C'+D'
1	1	0	0	m12=ABC'D'	M12= A'+B'+C+D
1	1	0	1	m13=ABC'D	M13= A'+B'+C+D'
1	1	1	0	m14=ABCD'	M14= A'+B'+C'+D
1	1	1	1	m15=ABCD	M15= A'+B'+C'+D'

Table 1: Minterm and Maxterm Table

Solution: **For sum of minterms**

B'D + A'D + BD = D(B' + A' + B) = D($\underbrace{B' + B}_{1}$+A') = D($\underbrace{A' + 1}_{1}$) = D($\underbrace{A + A'}_{1}$)

= DA + DA' and since all (X+X')s are 1

= DA(B+B') + DA'(B+B')

= DAB + DAB' + DA'B + DA'B'

= DAB(C+C') + DAB'(C+C') + DA'B(C+C') + DA'B'(C+C')

= DABC + DABC' + DAB'C + DAB'C' + DA'BC + DA'BC' + DA'B'C + DA'B'C'

= $m_{15} + m_{13} + m_{11} + m_9 + m_7 + m_5 + m_3 + m_1$

= $\sum$ (15,13,11,9,7,5,3,1)

Solution: **For product of maxterms**

B'D + A'D + BD = D.(B' + A' + B) = D($\underbrace{B' + B}_{1}$+A') = D($\underbrace{1 + A'}_{1}$) = D

For D = (D+0) = D + AA' = (D+A)(D+A') since BB' = 0

(D+A+BB')(D+A'+BB') = (D+A+B)(D+A+B')(D+A'+B)(D+A'+B') since CC'= 0

=(D+A+B+CC')(D+A+B'+CC')(D+A'+B+CC')(D+A'+B'+CC')

=(D+A+B+C).(D+A+B+C').(D+A+B'+C).(D+A+B'+C').(D+A'+B+C).(D+A'+B+C').(D+A'+B'+C).(D+A'+B'+C')

= $m_0 + m_2 + m_4 + m_6 + m_8 + m_{10} + m_{12} + m_{14}$

= $\prod$ (0,2,4,6,8,10,12,14)

(b)

D(B' + A' + B)

Because of (B' + B) = 1

= D(1 + A')

Because of (1 + A') = 1

= D