ITI1100

Homework#1
Solutions

1.10 **(a)** $1.10010_2 = 0001.1001_2 = 1.9_{16} = 1 + 9/16 = 1.563_{10}$

(b) $110.010_2 = 0110.0100_2 = 6.4_{16} = 6 + 4/16 = 6.25_{10}$

Reason: 110.010_2 is the same as 1.10010_2 shifted to the left by two places.

1.18 Note: Consider sign extension with 2s complement arithmetic.

(a)

	10001
1s comp:	01110
2s comp:	01111
	10011
Diff:	00010

(b)

	100011	
1s comp:	1011100	with sign extension
2s comp:	1011101	
	0100010	
	1111111	sign bit indicates that the result is negative
	0000001	2s complement
	-000001	result

(c)

	101000	
1s comp:	1010111	
2s comp:	1011000	
	001001	
Diff:	1100001	(negative)
	0011111	(2s comp)
	-011111	(diff is -31)

(d)

	10101	
1s comp:	1101010	with sign extension
2s comp:	1101011	
	110000	
	0011011	sign bit indicates that the result is positive
	Check: 48 -21 = 27	

1.35 **(a)**

Perform subtraction on the given unsigned binary numbers using the 2's complement of the subtrahend. If the result is negative, find its 2's complement and affix a minus sign:
(a) 10011 – 10001 = 10011 + (-10001) = 10011 + 01111 = 00010

(b) 100010 – 100011 = 100010 + (-100011) = 100010 + 011101 = 111111 = - 000001

Find the complement of the following 2 expressions:

(A'B + CD)E' + E and (x' +y + z')(x + y')(x + z)

$F' = [(A'B + CD)E' + E]' = [(A'B + CD) + E]' = (A'B + CD)'E' = (A'B)'(CD)'E'$
$F' = (A + B')(C' + D')E' = AC'E' + A D'E' + B'C'E' + B'D'E'$

$F' = [(x' + y + z')(x + y')(x + z)]' = (x' + y + z')' + (x + y')' + (x + z)' =$
$F' = xy'z + x'y + x'z'$

2.15 (a) $T_1 = A'B'C' + A'B'C + A'BC' = A'B'(C' + C) + A'C'(B' + B) = A'B' + A'C' = A'(B' + C')$

(b) $T_2 = T_1' = A'BC + AB'C' + AB'C + ABC' + ABC$
$= BC(A' + A) + AB'(C' + C) + AB(C' + C)$
$= BC + AB' + AB = BC + A(B' + B) = A + BC$

$\Sigma(3, 5, 6, 7) = \Pi(0, 1, 2, 4)$

$T_1 = A'B'C' + A'B'C + A'BC'$

$A'B'$ $A'C'$

$T_1 = A'B'\ A'C' = A'(B' + C')$

$T_2 = A'BC + AB'C' + AB'C + ABC' + ABC$

AC' AC BC

$T_2 = AC' + BC + AC = A + BC$

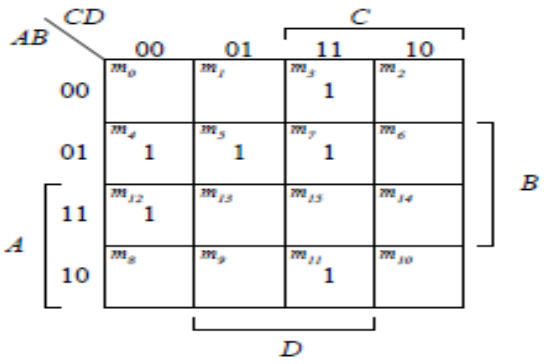
2.19 $F = B'D + A'D + BD$

ABCD	ABCD	ABCD
-B'-D	A'--D	-B-D
0001 = 1	0001 = 1	0101 = 5
0011 = 3	0011 = 3	0111 = 7
1001 = 9	0101 = 5	1101 = 13
1011 = 11	0111 = 7	1111 = 15

$F = \Sigma(1, 3, 5, 7, 9, 11, 13, 15) = \Pi(0, 2, 4, 6, 8, 10, 12, 14)$

3.8 :

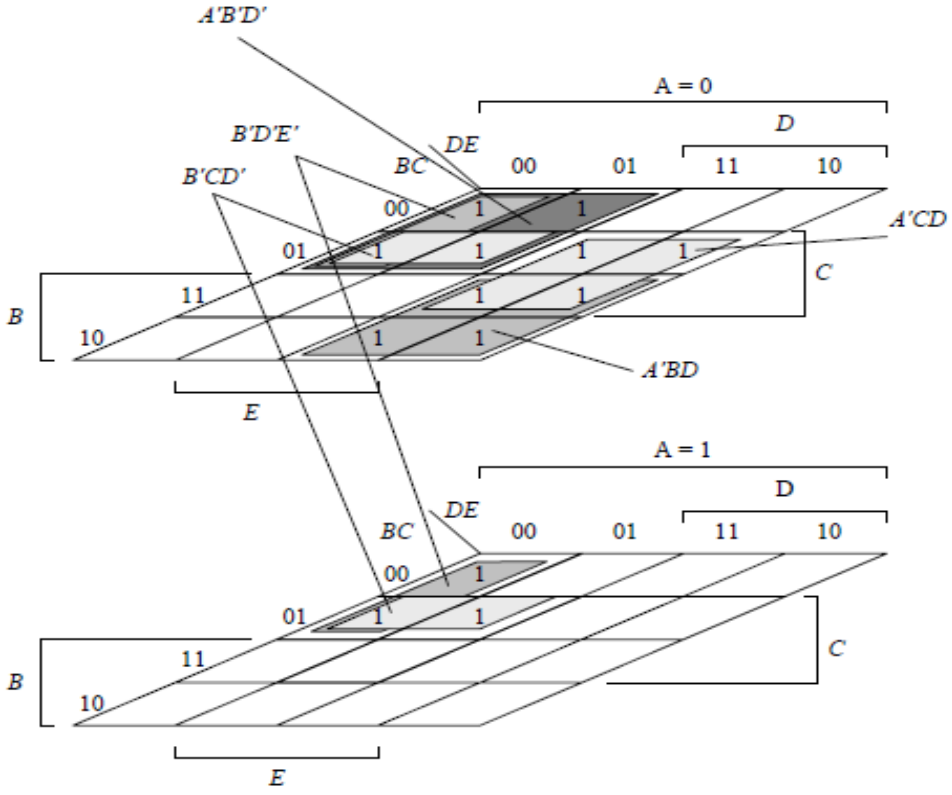
(d) $F = \Sigma(3, 4, 5, 7, 11, 12)$



Simplify the following Boolean function using 5-variable maps:
F(A,B,C,D,E) = A'B'CE' + B'C'D'E' + A'B'D' + B'CD' + A'CD + A'BD

(b) $F(A, B, C, D, E) = A'B'CE' + B'C'D'E' + A'B'D' + B'CD' + A'CD + A'BD$
$F(A, B, C, D, E) = A'B'D' + B'D'E' + B'CD' + A'CD + A'BD$

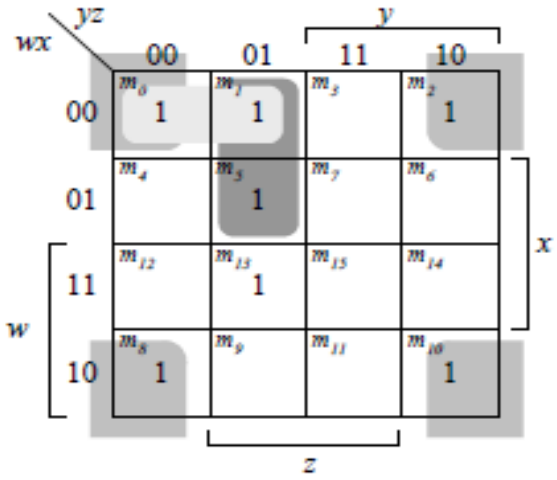
$A'B'CE'$: $AB'CDE' + A'B'CD'E'$
$B'C'D'E'$: $AB'C'D'E' + A'B'C'D'E'$
$A'B'D'$: $A'B'CD'E + A'B'CD'E' + A'B'C'D'E + A'B'C'D'E'$
$B'CD'$: $AB'CD'E + AB'CD'E' + A'B'CD'E + A'B'CD'E'$
$A'CD$: $A'BCDE + A'BCDE' + A'B'CDE + A'B'CDE'$
$A'BD$: $A'BCDE + A'BCDE' + A'BC'DE + A'BC'DE'$



Simplify the following Boolean function into a sum of products (SOP) form:

F(w,x,y,z) = ∑(0,1,2,5,8,10,13)

(a)



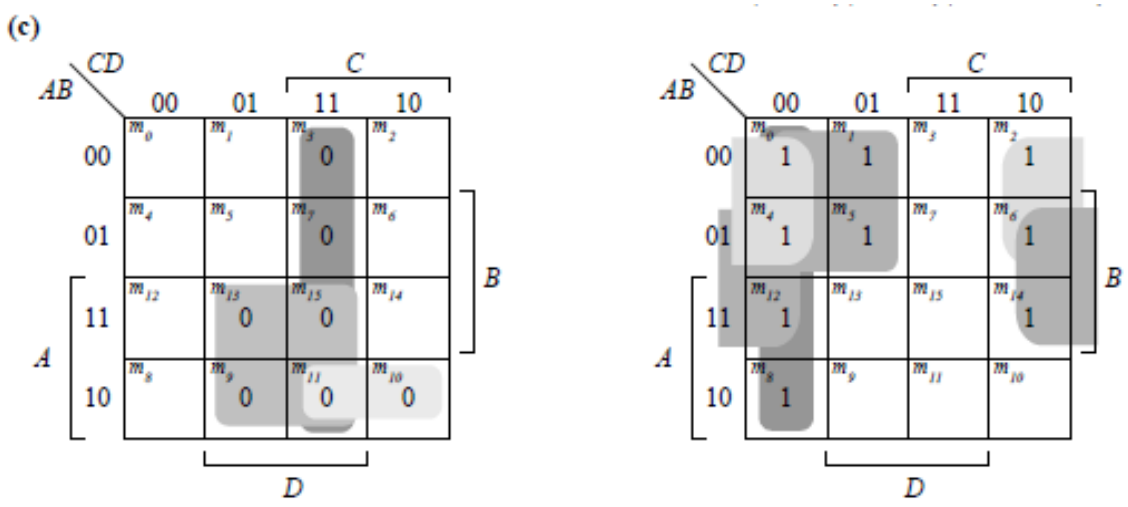
$F = \Sigma(0, 1, 2, 5, 8, 10, 13)$

$F = x'z' + w'x'y' + w'y'z$

Simplify the following Boolean function into a SOP and a POS form:

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

(c)



$F = (A + C' + D')(A' + B' + D')(A' + B + D')(A' + B + C')$

$F' = A'CD + ABD + AB'D + AB'C$

$F = A'C + A'D' + BD' + C'D'$

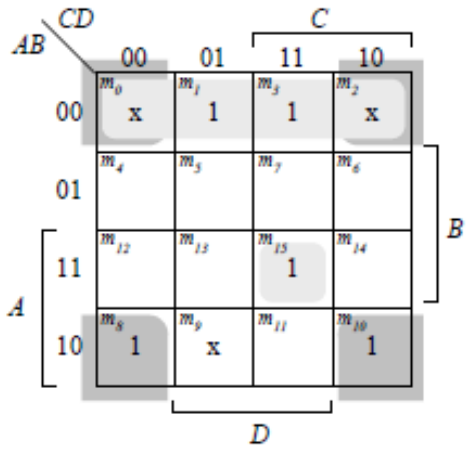
$F' = AD + CD + AB'C$

$F = (A' + D')(C + D')(A' + B + C')$

Simplify the following Boolean function and express the result in sum of minterms form:

$F(A,B,C,D) = \sum_m(1,3,8,10,15) + \sum_d(0,2,5,9)$

(d)



$F = B'D' + A'B' + ABCD$

$F = \quad F = \Sigma(0, 1, 2, 3, 8, 10, 15)$

3.20 :

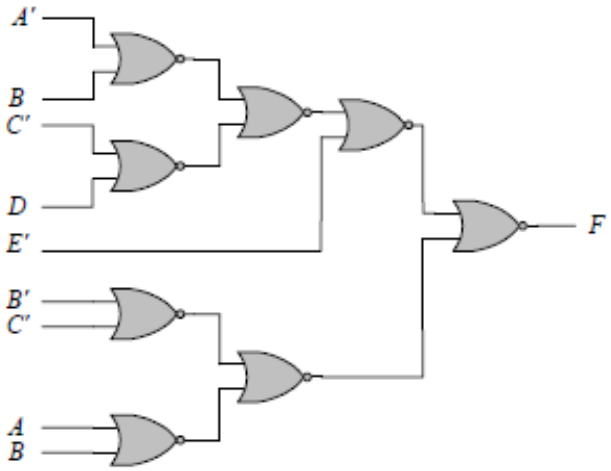
Multi-level NOR:

$F = (AB' + CD')E + BC(A + B)$

$F' = [(AB' + CD')E + BC(A + B)]'$

$F' = [\,[(AB' + CD')' + E']' + [\,(BC)' + (A + B)']'\,]'$

$F' = [\,[((A' + B)' + (C' + D)')' + E']' + [\,(B' + C')' + (A + B)']'\,]'$



Multi-level NAND:

$F = (AB' + CD')E + BC(A + B)$

$F' = [\,(AB' + CD')E]'\,[BC(A + B)]'$

$F' = [\,(\,(AB')'(\,CD')'\,)'E]'\,[BC(A'B')']'$