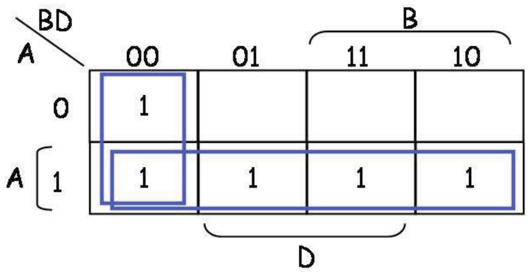
INF1400- Uke 03- FASIT

Folkens, her kommer det en del oppgaver som skal gi dere god trening innen det å bruke Karnaugh-diagram til forkortning av uttrykk. Løs også alle oppgave som står i boka i slutten av kapittel 3. Lykke til ☺

1. Simplify the following boolean expressions using a Karnaugh-diagram:

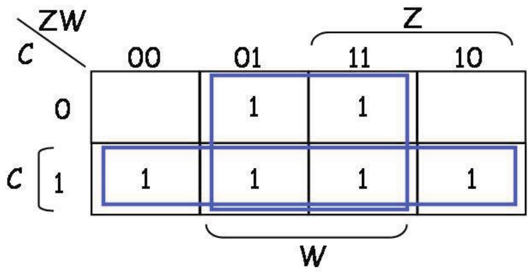
a): BA + D'B' + DB'A

F = D´B´+ A



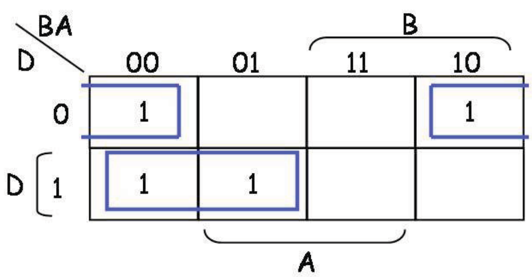
b): CZ + Z'W + CW' + C'ZW

F = C + W



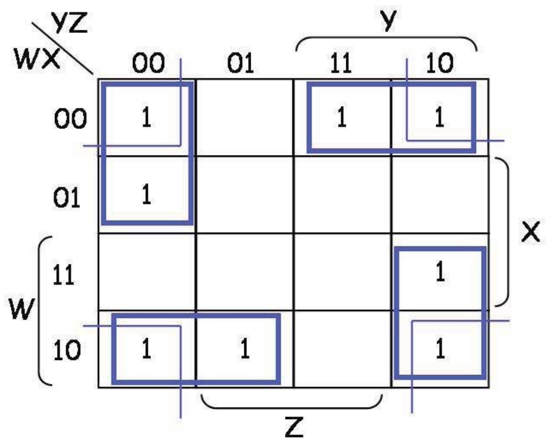
c): B'A' + D'A' + DB'A

F = D´A´+ DB



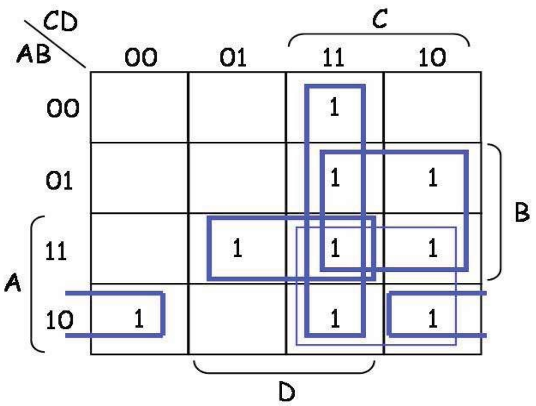
2. Simplify the following Boolean functions F

a): F(W,X,Y,Z) = Sum m(0, 2, 3, 4, 8, 9, 10, 14)



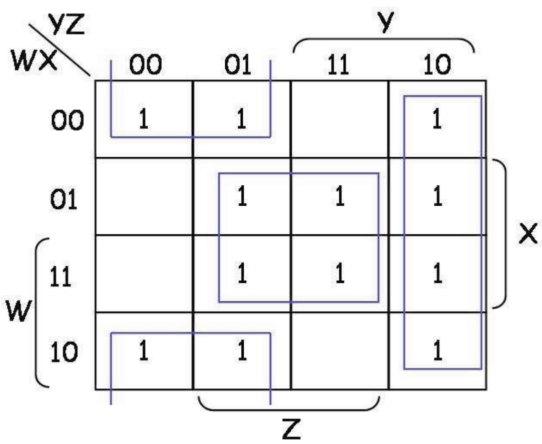
$$F = \bar{W}\bar{Y}\bar{Z} + \bar{W}\bar{X}Y + W\bar{X}\bar{Y} + WY\bar{Z}$$

b): F(A,B,C,D) = Sum m(3, 6, 7, 8, 10, 11, 13, 14, 15)



$$F = CD + BC + ABD + A\bar{B}\bar{D}$$

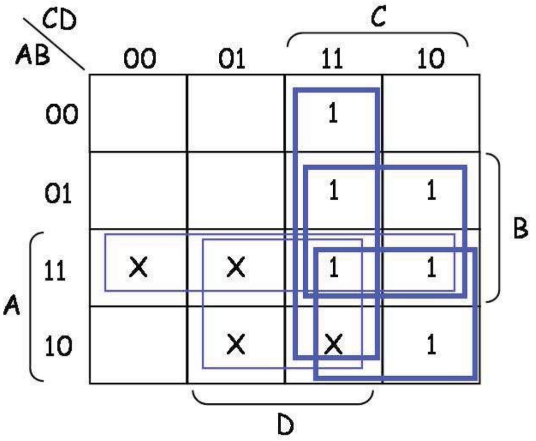
c): F(W,X,Y,Z) = Sum m(0, 1, 2, 5, 6, 7, 8, 9, 10, 13, 14, 15)



$$F = \bar{X}\bar{Y} + XZ + Y\bar{Z}.$$

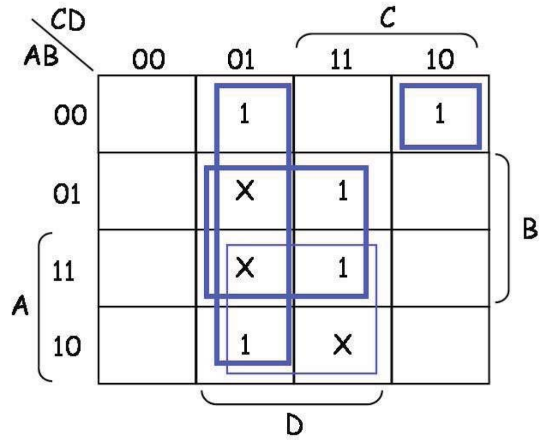
3. Simplify the following Boolean functions F together with the don't-care conditions

a): F(A,B,C,D) = Sum m(3, 6, 7, 10, 14, 15), don't-care conditions: d(A,B,C,D) = Sum m(9, 11, 12, 13)



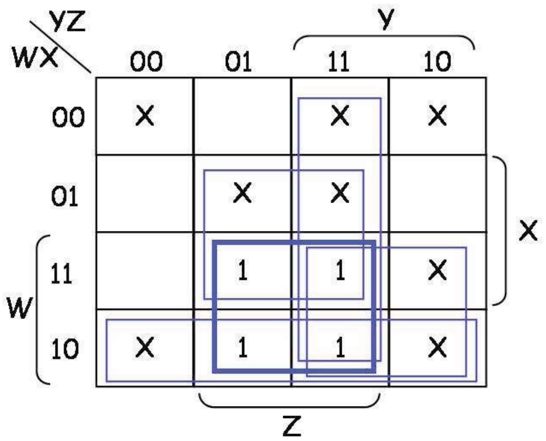
$F = CD + BC + AC$

b): F(A,B,C,D) = Sum m(1, 2, 7, 9, 15), don't-care conditions: d(A,B,C,D) = Sum m(5, 11, 13)



$F = \bar{C}D + BD + \bar{A}\bar{B}C\bar{D}$

c): F(W,X,Y,Z) = Sum m(9, 11, 13, 15), don't-care conditions: d(W,X,Y,Z) = Sum m(0, 2, 3, 5, 7, 8, 10, 14)



$F = WZ$

4. Simplify the following Boolean expressions, using four-variable maps:

F = wxy + yz + xy’z + x’y

wx \ yz	00	01	11	10
00			1	1
01		1	1	
11		1	1	1
10			1	1

F = xz + x’y + wy

5. Simplify the following Boolean function by first finding the essential prime implicants:

F(A, B, C, D) = Σ (0, 2, 3, 5, 7, 8, 10, 11, 14, 15).

AB \ CD	00	01	11	10
00	1		1	1
01		1	1	
11			1	1
10	1		1	1

All Essential prime implicates: B’D’ , CD , AC , A’BD

F(A, B, C, D) = B’D’ + CD + AC + A’BD

6. Simplify the following Boolean function, using five-variable maps:

F(A, B, C, D, E) = Σ (0, 1, 4, 5, 16, 17, 21, 25, 29)

BC \ DE	00	01	11	10
00	1	1		
01	1	1		
11				
10				

DE / BC	00	01	11	10
00	1	1		
01		1		
11		1		
10		1		

F(A, B, C, D, E) = A’B’D’ + AD’E + B’C’D’

7. Simplify the following Boolean function *F*, together with the don't-care conditions *d,* and then express the simplified function in sum of minterms:

F(x, y, z) = Σ (0, 1, 2, 4, 5)
d(x, y, z) = Σ (3, 6, 7).

x \ yz	00	01	11	10
0	1	1	X	1
1	1	1	X	X

F(x, y,z) = Σ (0, 1, 2, 3, 4, 5, 6) = 1.

8. Given

F(A, B, C, D) = Σ(0, 4, 5, 7, 8, 12, 13, 15)
G(A, B, C, D) = Π(0, 1, 7, 8, 9, 10, 11, 12, 15)

Use 4-variable maps to find

a) Simplified F•G
b) Simplified F+G

F(A, B, C, D) = Σ(0, 4, 5, 7, 8, 12, 13, 15)

AB \ CD	00	01	11	10
00	1	0	0	0
01	1	1	1	0
11	1	1	1	0
10	1	0	0	0

G(A, B, C, D) = Π(0, 1, 7, 8, 9, 10, 11, 12, 15)

AB \ CD	00	01	11	10
00	0	0	1	1
01	1	1	0	1
11	0	1	0	1
10	0	0	0	0

(a) Simplified F•G

AB \ CD	00	01	11	10
00	0	0	0	0
01	1	1	0	0
11	0	1	0	0
10	0	0	0	0

F•G = A'BC' + BC'D

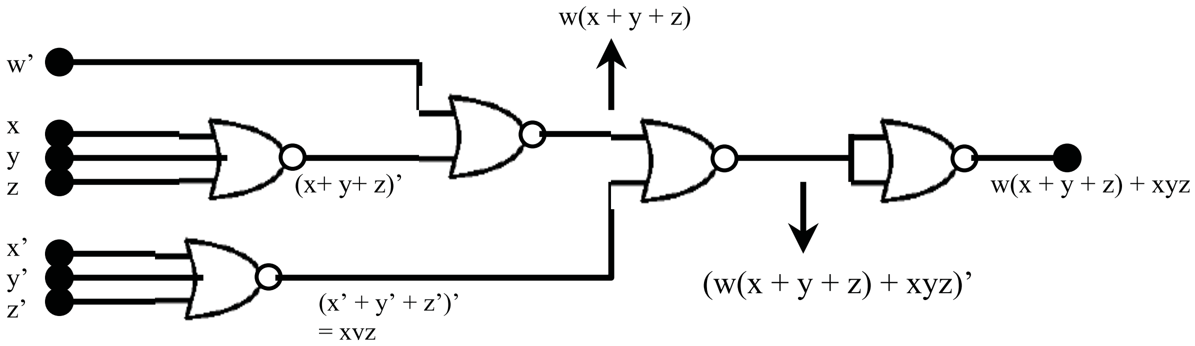
(b) Simplified F+G

AB \ CD	00	01	11	10
00	1	0	1	1
01	1	1	1	1
11	1	1	1	1
10	1	0	0	0

F+G = B + C'D' + A'C

9. Draw the multiple-level NOR circuit for the following expression:

F = w(x + y + z) + xyz.



10. Design a combinational circuit with three inputs x, y and z, and three outputs A, B and C. When the binary input is 0, 1, 2 and 3, the binary output is one greater than the input. When the binary input is 4, 5, 6 and 7, the binary output is one less than the input.

Ans. → First, we need to find the truth table for the circuit:

x	y	z	**A**	**B**	**C**
0	0	0	**0**	**0**	**1**
0	0	1	**0**	**1**	**0**
0	1	0	**0**	**1**	**1**
0	1	1	**1**	**0**	**0**
1	0	0	**0**	**1**	**1**
1	0	1	**1**	**0**	**0**
1	1	0	**1**	**0**	**1**
1	1	1	**1**	**1**	**0**

Now Find the Boolean Function for output A, B and C.

For Output A::

x \ yz	00	01	11	10
0	0	0	1	0
1	0	1	1	1

So, Output A = yz + xz + xy

For Output B::

x \ yz	00	01	11	10
0	0	1	0	1
1	1	0	1	0

So, Output B = x'y'z + x'yz' + xy'z' + xyz = x'(y'z + yz') + x(y'z' + yz)
= x'(y⊕z) + x(y⊕z)' = x⊕y⊕z

For Output C::

x	00	01	11	10
0	1	0	0	1
1	1	0	0	1

So, Output C = z’

Designing Circuit from Boolean Equations::