Karnaugh Maps

ELEC 311

Digital Logic and Circuits

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THE CITADEL
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Minimum Switching Functions

Find a minimum sum-of-products expression for

$$F(a, b, c) = \Sigma m\,(0, 1, 2, 5, 6, 7)$$

$$F = a'b'c' + a'b'c + a'bc' + ab'c + abc' + abc$$

$$= a'b' + b'c + bc' + ab$$

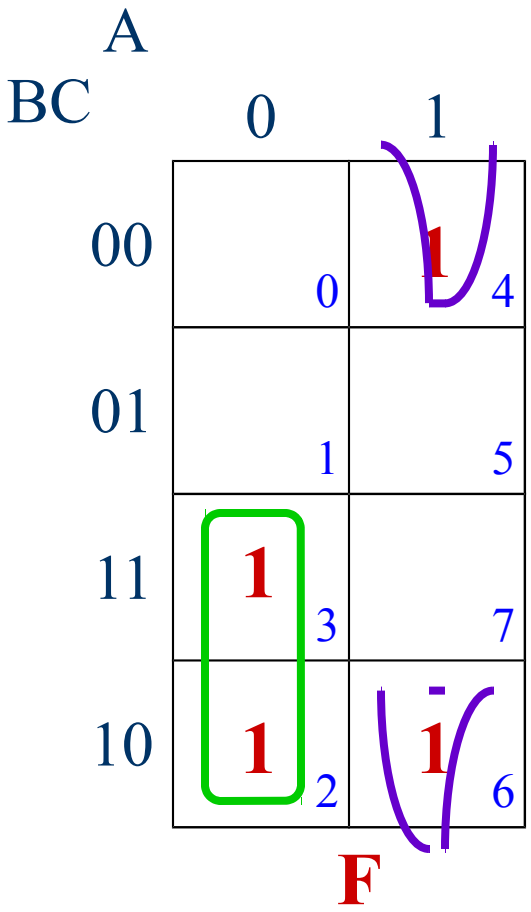
None of the terms in the above expression can be eliminated by consensus. However, combining terms in a different way leads directly to a minimum sum of products:

$$F = a'b'c' + a'b'c + a'bc' + ab'c + abc' + abc$$

$$= a'b' + bc' + ac$$

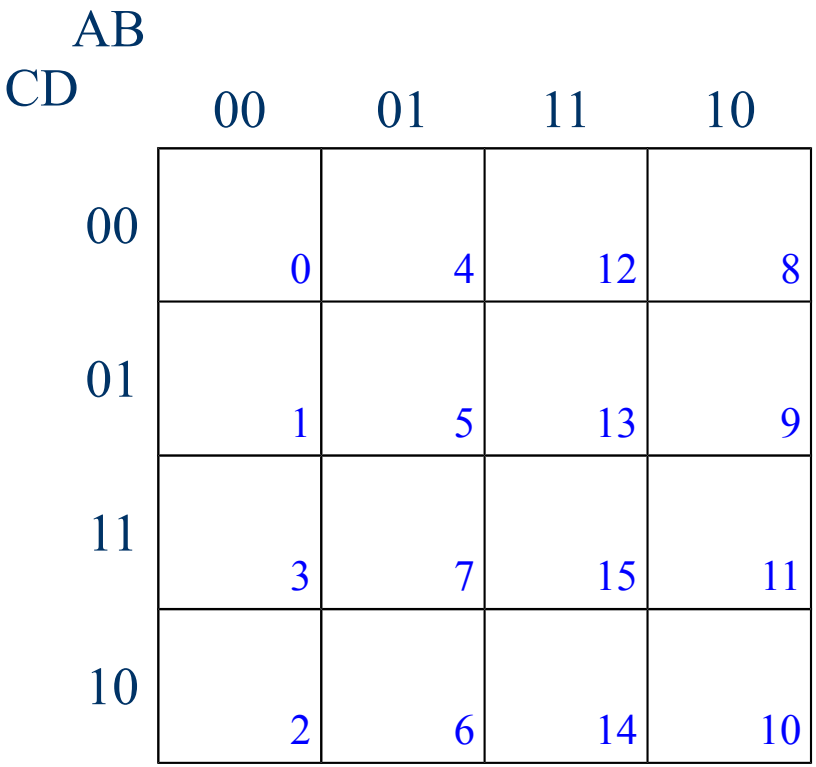
Karnaugh Map

A B C	F
0 0 0	0
0 0 1	0
0 1 0	1
0 1 1	1
1 0 0	1
1 0 1	0
1 1 0	1
1 1 1	0



$F(A,B,C) = \Sigma m(2,3,4,6)$

Four-Variable Karnaugh Map



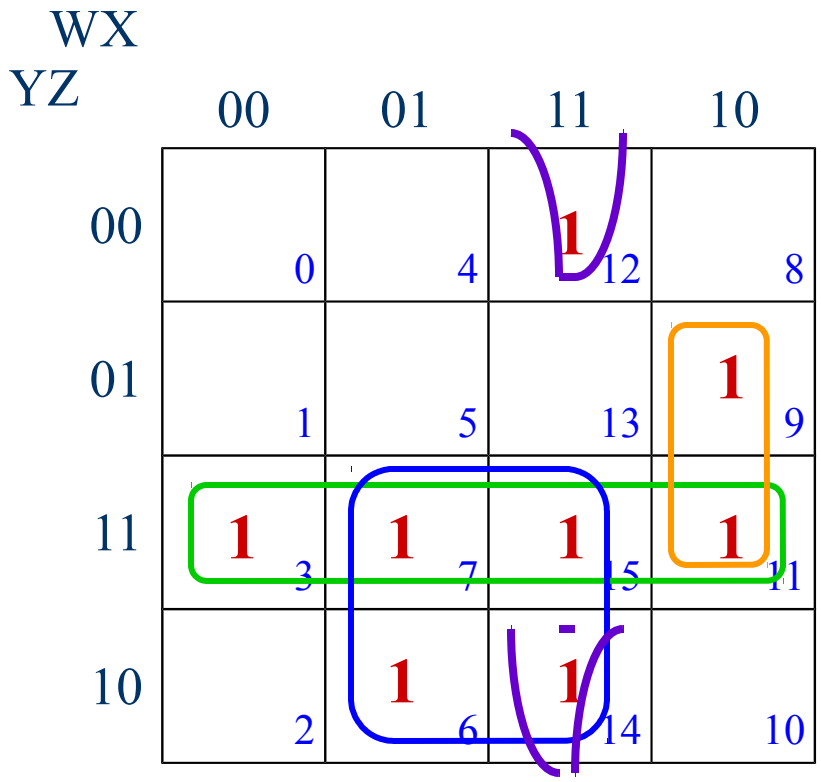
Terminology

- Minterm
- Implicant
- Cover
- Prime Implicant
- Essential Prime Implicant
- Secondary Prime Implicant
- Minimal Sum

Methodology

- Minimal Sum
  - Essential Prime Implicants
  - Secondary Prime Implicants
  - Minimal Cover

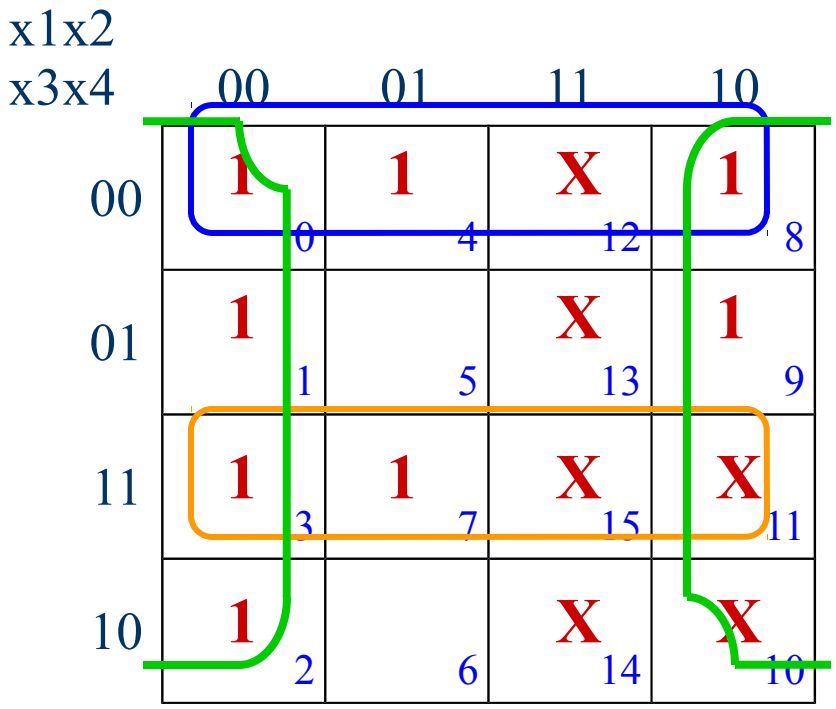
Example



F = (YZ) + (XY) + (WX′Z) + (WXZ′)

$F(W,X,Y,Z) = \Sigma m(3,6,7,9,11,12,14,15)$

Don't Cares



B = x2′ + (x3′x4′) + (x3x4)

$$B(x1,x2,x3,x4) = \Sigma m\,(0,1,2,3,4,7,8,9) + \Sigma d(10\text{-}15)$$

Summary

- Minimizing Switching Functions
- Karnaugh Maps
  - Three-Variable
  - Four-Variable
  - Don't Cares