

Review

Minterm / Maxterm Expansions

Each minterm in expression forces output to 1 (specific Sum of Products).

Each maxterm in expression forces output to 0 (specific Product of Sums).

Ex: AND

X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

Minterms: $Z = \sum m(3) = XY$

Maxterms: $Z = \prod M(0,1,2) = (x+y)(x+y')(x'+y)$

Karnaugh Maps

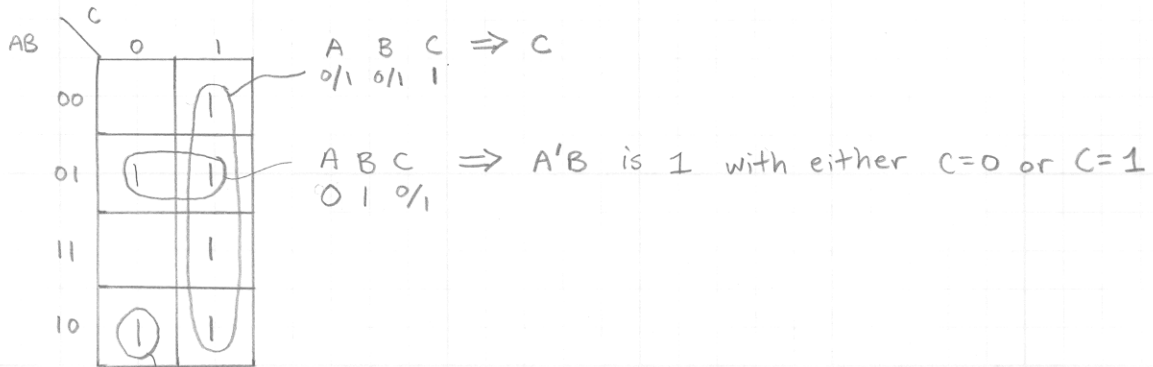
K-map is an alternate way of representing a truth table.

Rules for combining groups:

- 1.) Groups must contain 1, 2, 4, 8, ... 2^n minterms
- 2.) Except for smallest/largest group cases, a group can be split/joined with $XY + XY' = X$

K-map Size (# of variables)	Group Size / # of literals in term
2	1/2, 2/1
3	1/3, 2/2, 4/1
4	1/4, 2/3, 4/2, 8/1
5	1/5, 2/4, 4/3, 8/2, 16/1

Ex:

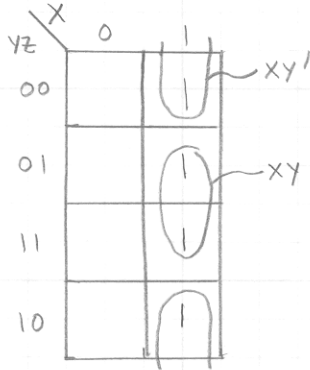


$ABC \Rightarrow AB'C'$, minterm is 1 at this combination of inputs only.

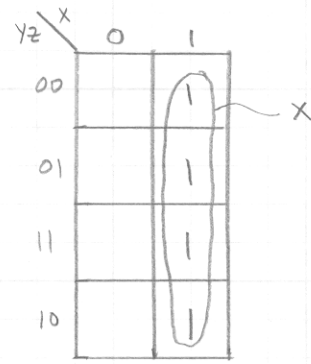
Some theorems with Karnaugh Maps:

Roth, p. 52 (9)

$$XY + XY' = X$$

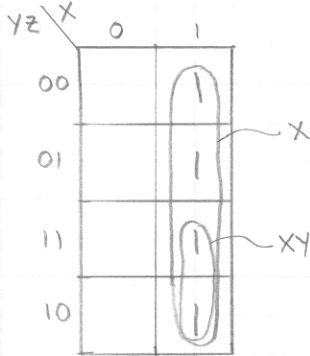


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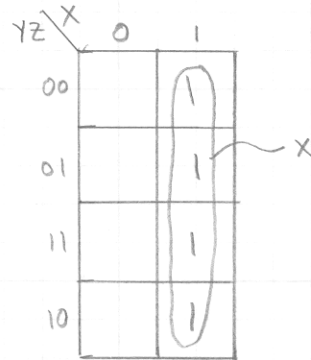


(10)

$$X + XY = X$$

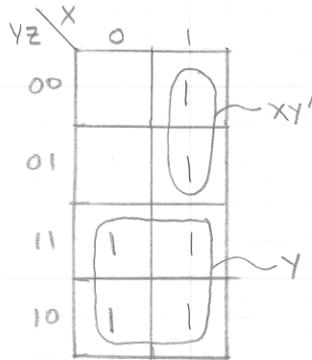


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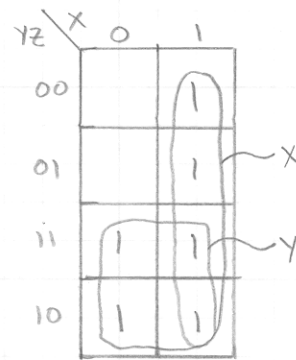


(11D)

$$XY' + Y = X + Y$$



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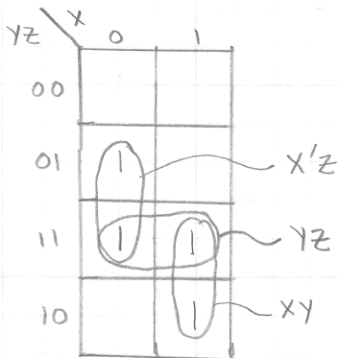


(15)

Consensus

$$XY + YZ + X'Z =$$

$$XY + X'Z$$

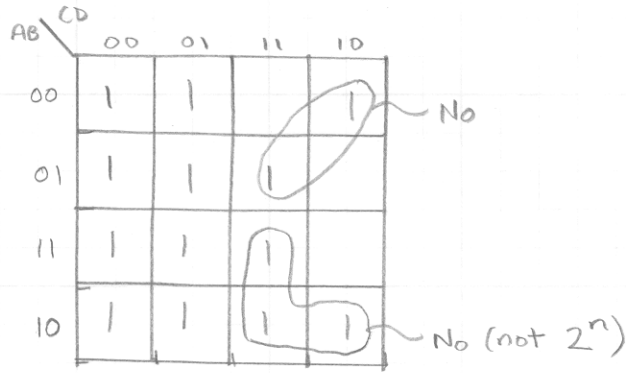


YZ consensus term is redundant

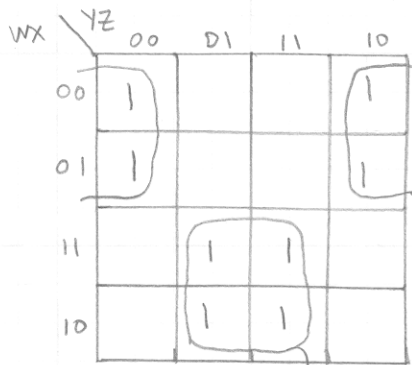


4 Variable Karnaugh Maps

Ex: What not to do:



Ex:

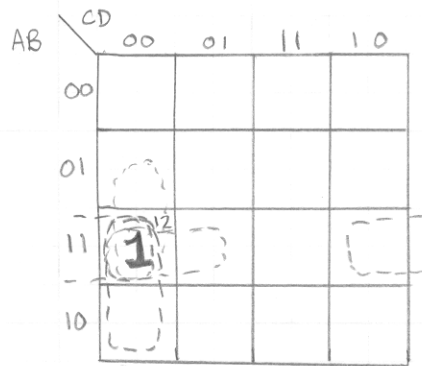


Given a valid group, we can find expressions:

$WXYZ \Rightarrow W'Z'$ Group of 4 1's has 2 literals. ✓

$WXYZ \Rightarrow WZ$

Ex:



How many groups of 2 contain the minterm m_{12} ?

$m_{12} = ABC'D'$ is contained by

- 1) $BC'D'$
 - 2) ABD'
 - 3) $AC'D'$
 - 4) ABC'
- } Answer = 4

K-Map Hint: certain regions correspond to literals = 1

