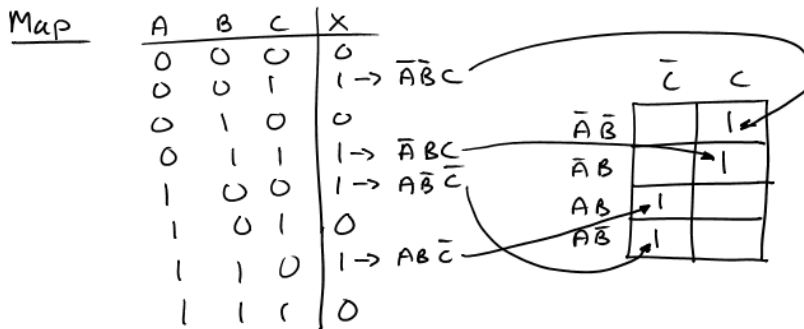
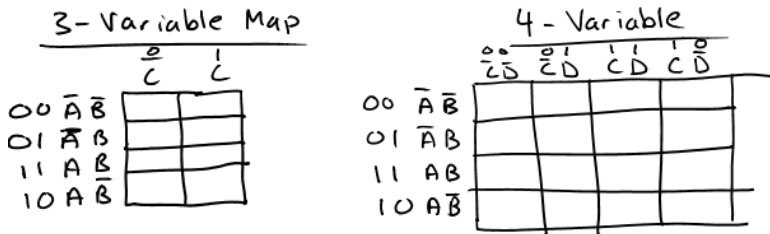


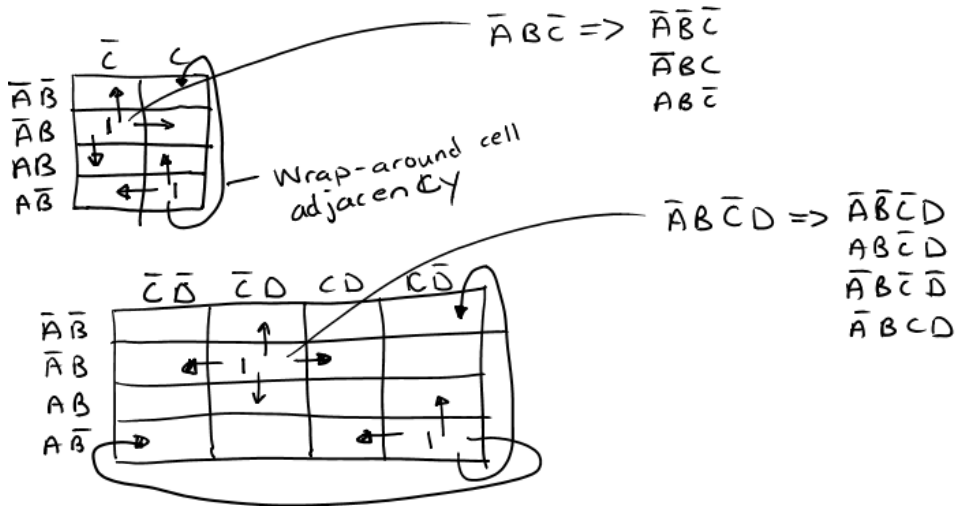
Karnaugh Maps

- Rearranges the truth table into a grid of cells
- Cell Location: Product Term
- Cell Value: Output of the Product Term



Grouping the Cells

- Adjacent Cells
 - 3-Variable Map: One cell will be adjacent to three other cells
 - 4-Variable Map: One cell will be adjacent to four other cells

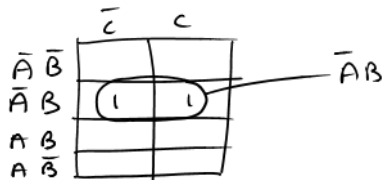


Cell Grouping

- Combine adjacent cells containing 1's into groups
- Form rows, columns, rectangles (including wrap-around cell adjacency)
- Groups can only have 1, 2, 4, 8, or 16 members

ENGR 2218 – Digital Logic
Karnaugh Maps

- Goals of Cell Grouping
 - Every 1 must be in at least one group
 - Fewest number of groups
 - Large groups
- Eliminating Variables in Product Terms
 - Variables that are both inverted and not inverted in the group (Contradictory Variables) can be eliminated from the product term



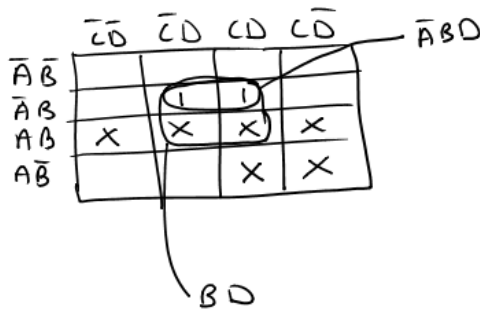
$C \Rightarrow$ Contradictory Variable
 \Rightarrow Eliminate C

$$\begin{aligned} &\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C \\ &\bar{A}\bar{B}(\bar{C} + C) \\ &= \bar{A}\bar{B} \end{aligned}$$

Don't Care Conditions

- Don't care what the output is for a set of inputs
- Map as an 'X'
- Don't have to group X's, but can if it results in a larger group
- Example: BCD Code

A	B	C	D	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9



1	0	1	0	$\bar{A}\bar{B}C\bar{D}$
1	0	1	1	$\bar{A}\bar{B}CD$
1	1	0	0	$A\bar{B}\bar{C}\bar{D}$
1	1	0	1	$A\bar{B}\bar{C}D$
1	1	1	0	$A\bar{B}C\bar{D}$
1	1	1	1	$A\bar{B}CD$

} Invalid States in BCD

Fewer Groups \Rightarrow Fewer Product Terms
Larger Groups \Rightarrow Fewer variables for each product term