Digital Logic Design

Lecture 4

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Karnaugh Maps

Karnagh Maps

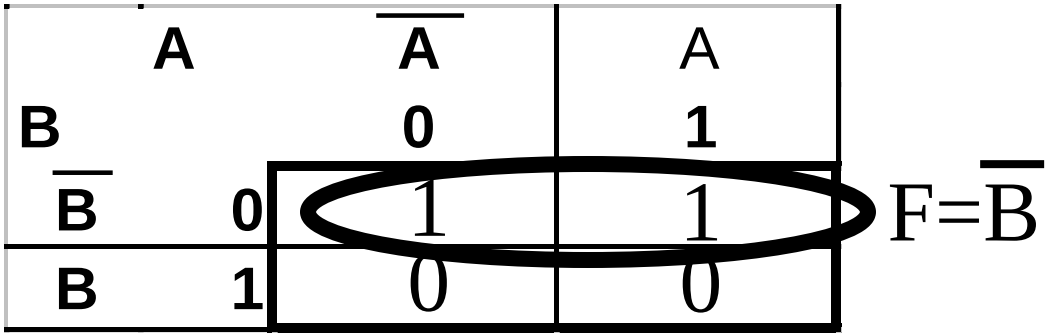
- Signed Numbers
- XOR

Karnaugh Maps

Karnaugh Map Method: A visual method for identifying adjacency groups of 1's or 0's.

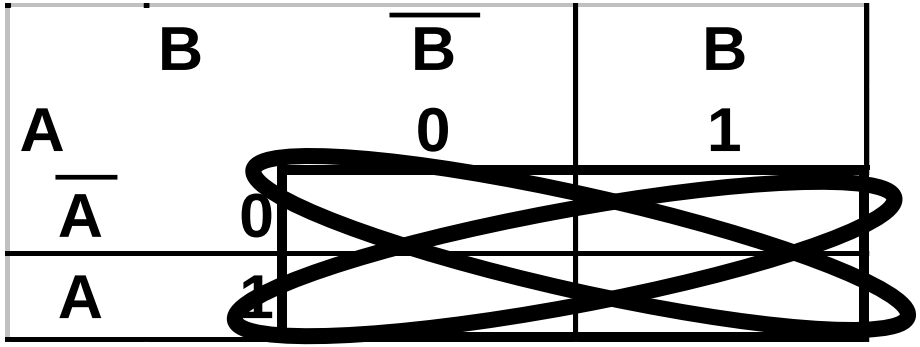
Karnaugh Map: A grid used to store truth table data in an efficient form.

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



Karnaugh Maps

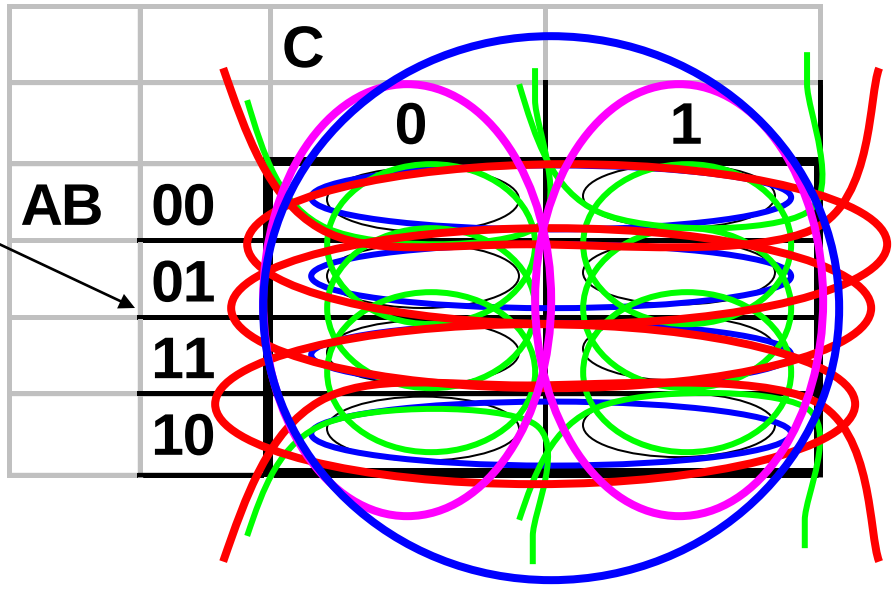
- **Adjacency groups that are valid must have 2k elements. (`1,2,4,8,16 etc.)**
- **Some groups with 2, 4, etc elements are NOT adjacency groupings. Example**



Karnaugh Maps

Q? How many Boolean Cubes on a 3 variable Karnaugh Map?

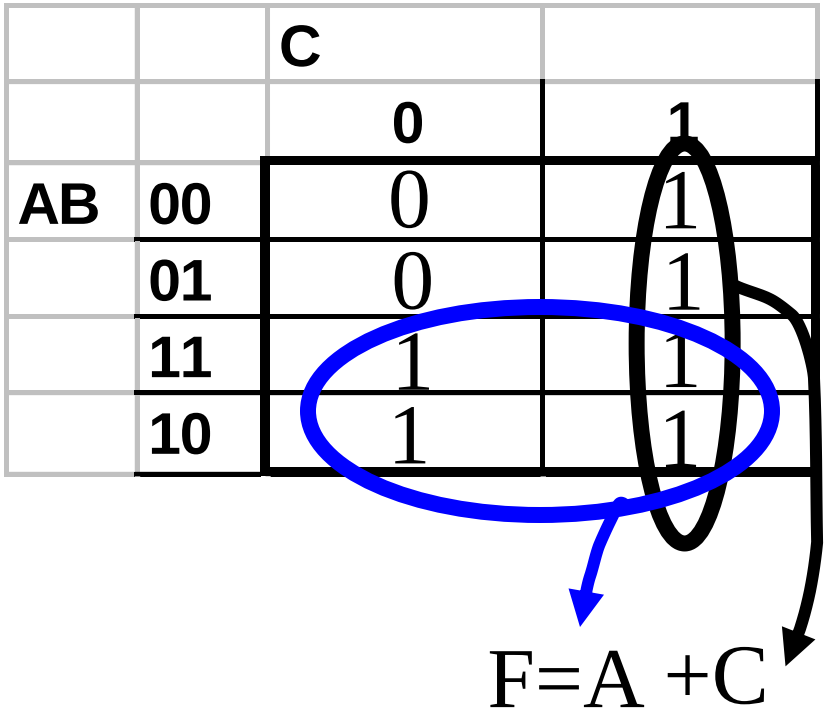
Note the ordering on AB axis.



A: Many.

Karnaugh Maps

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



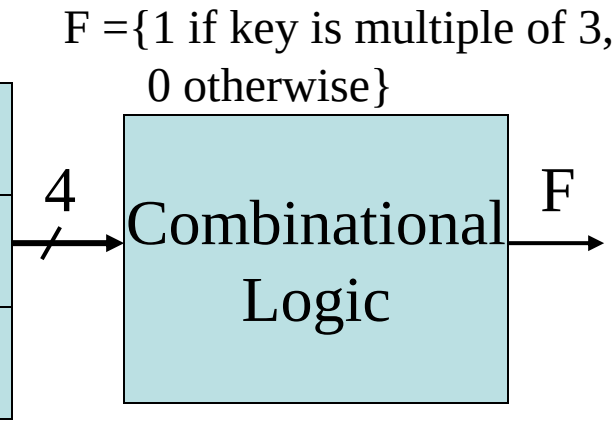
What is PI and EPI

Karnaugh Maps

- Don't Cares: Values assigned to a function for input combinations that can't occur.

Decimal Keypad

1	2	3
4	5	6
7	8	9
	0	



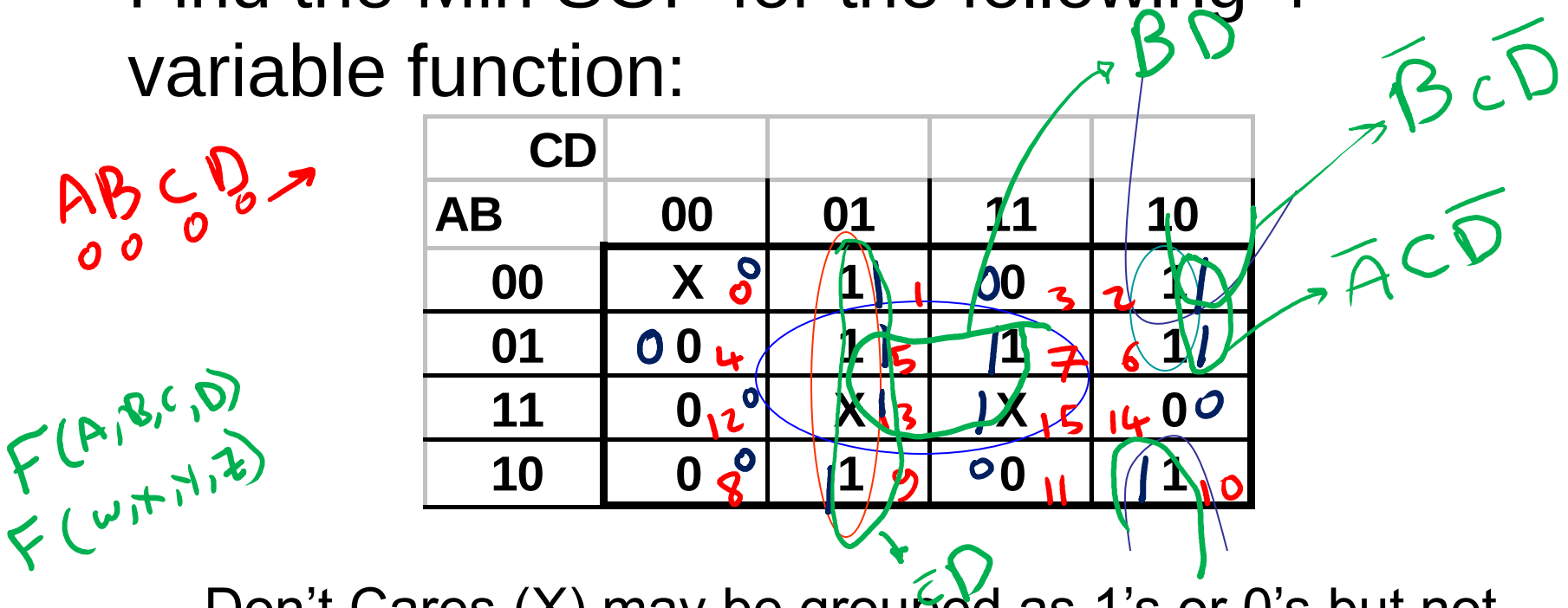
Key	Key Pad Output (ABCD)	F
0	0000	1
1	0001	0
2	0010	0
3	0011	1
4	0100	0
5	0101	0
6	0110	1
7	0111	0
8	1000	0
9	1001	1
-	1010	X
-	1011	X
-	1100	X
-	1101	X
-	1110	X
-	1111	X

F

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

Karnaugh Maps

- Find the Min SOP for the following 4-variable function:



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

Don't Cares (X) may be grouped as 1's or 0's but not both.

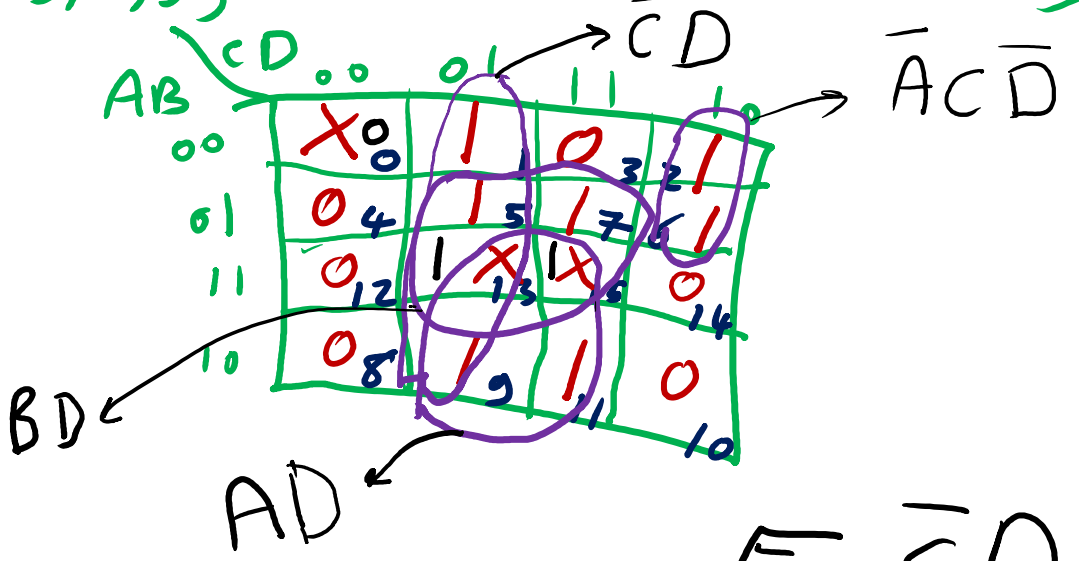
$$F = \sum m(1,2,5,6,7,9,10,13,15)$$

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

$$F = \sum m(1, 2, 5, 6, 7, 9, 11)$$

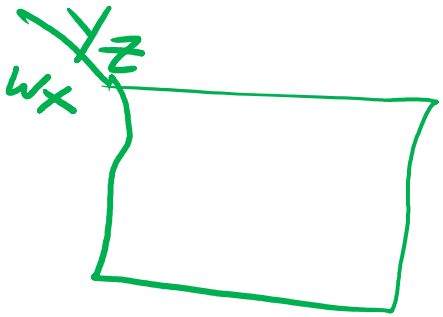
$$\text{don't care} = \sum m(0, 13, 15)$$

$F(A, B, C, D)$



$F = \bar{C}D$

$F(w, x, y, z)$



Karnaugh Maps

What is PI and EPI

Karnaugh Maps

- **Using Karnaugh Maps to minimize functions by grouping 1's gave a Min SOP Form:**
- **Using Karnaugh Maps to minimize functions by grouping 0's gives a Min POS Form:**

Karnaugh Maps

- Find the Min POS for the following 3-variable function:

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