

## Episode 6.03 - Makin' Rectangles

(Transcript URL: <https://intertainment.com/episode-6-03-makin-rectangles/>)

**Show Description:** Let's expand the capabilities of Karnaugh maps to combine more than just two rows of the truth table into a single product.

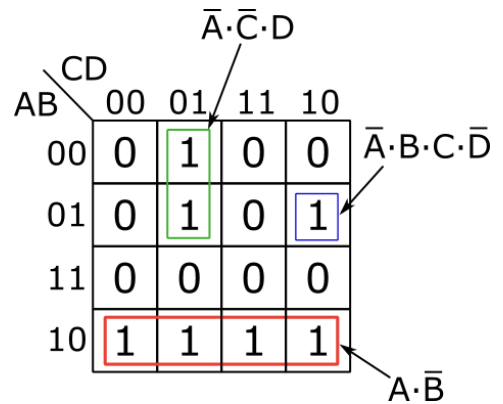
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Details

Example SOP expression:  $X = \bar{A} \cdot B \cdot C \cdot \bar{D} + \bar{A} \cdot \bar{C} \cdot D + A \cdot \bar{B}$

1:26

A	B	C	D	X	
0	0	0	0	0	
0	0	0	1	1	← $\bar{A} \cdot \bar{C} \cdot D$
0	0	1	0	0	
0	0	1	1	0	
0	1	0	0	0	
0	1	0	1	1	← $\bar{A} \cdot \bar{C} \cdot D$
0	1	1	0	1	← $\bar{A} \cdot B \cdot C \cdot \bar{D}$
0	1	1	1	0	
1	0	0	0	1	← $A \cdot \bar{B}$
1	0	0	1	1	← $A \cdot \bar{B}$
1	0	1	0	1	← $A \cdot \bar{B}$
1	0	1	1	1	← $A \cdot \bar{B}$
1	1	0	0	0	
1	1	0	1	0	
1	1	1	0	0	
1	1	1	1	0	



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5:01

Rule 1: No diagonal adjacencies allowed

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

Correct ✓

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

Incorrect ✗

Rule 2: No zeros allowed in a rectangle

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

Correct ✓

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

Incorrect ✗

Rule 3: The number of cells in a rectangle must be a power of 2

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

Correct ✓

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

Incorrect ✗

Rule 4: Rectangles may wrap from left to right or from top to bottom

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

Correct ✓

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

Also correct ✓

Rule 5: Rectangles may overlap, but every rectangle must have at least one unique cell

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

Correct ✓

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

Incorrect ✗

Rule 6: Make rectangles as large as possible

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

Correct ✓

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

Incorrect ✗

Rule 7: Every one in the map must be covered by at least one rectangle

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

Correct ✓

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

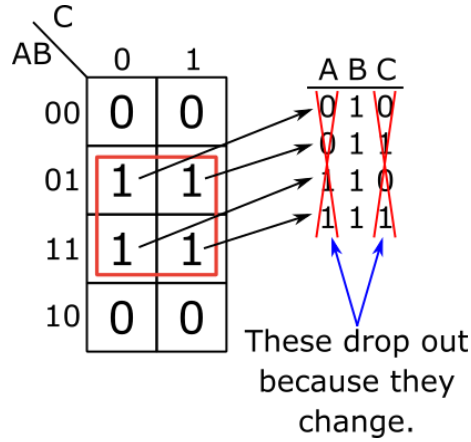
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Demonstration of three-input Karnaugh map simplifying expression to  $X = B$

8:22



Boolean algebra simplification alternative to Karnaugh map

10:20

$$X = \bar{A} \cdot B \cdot \bar{C} + \bar{A} \cdot B \cdot C + A \cdot B \cdot \bar{C} + A \cdot B \cdot C$$

$$X = \bar{A} \cdot B \cdot (\bar{C} + C) + A \cdot B \cdot \bar{C} + A \cdot B \cdot C$$

$$X = \bar{A} \cdot B \cdot 1 + A \cdot B \cdot \bar{C} + A \cdot B \cdot C$$

$$X = \bar{A} \cdot B + A \cdot B \cdot \bar{C} + A \cdot B \cdot C$$

$$X = \bar{A} \cdot B + A \cdot B \cdot (\bar{C} + C)$$

$$X = \bar{A} \cdot B + A \cdot B \cdot 1$$

$$X = \bar{A} \cdot B + A \cdot B$$

$$X = B \cdot (\bar{A} + A)$$

$$X = B \cdot 1$$

$$X = B$$

**Sample Problems**

For each of the Karnaugh maps shown below, create a most simplified sum-of-products expression.

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

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

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

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

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

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