Episode 6.03 - Makin' Rectangles

(Transcript URL: https://intermation.com/episode-6-03-makin-rectangles/)

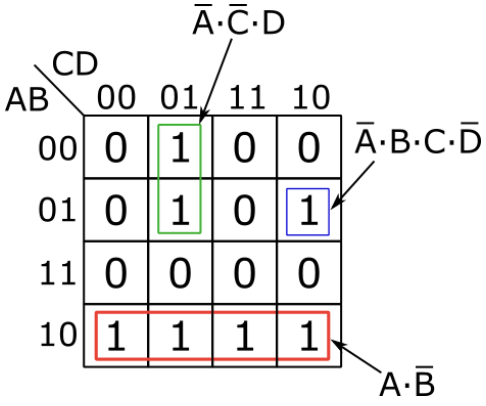
Show Description: Let's expand the capabilities of Karnaugh maps to combine more than just two rows of the truth table into a single product.

Podcast Timestamp	Supporting Details

1:26

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

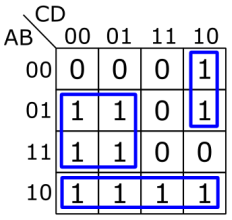
A	B	C	D	X	
0	0	0	0	0	
0	0	0	1	1	$\leftarrow \overline{A} \cdot \overline{C} \cdot D$
0	0	1	0	0	
0	0	1	1	0	
0	1	0	0	0	
0	1	0	1	1	$\leftarrow \overline{A} \cdot \overline{C} \cdot D$
0	1	1	0	1	$\leftarrow \overline{A} \cdot B \cdot C \cdot \overline{D}$
0	1	1	1	0	
1	0	0	0	1	$\leftarrow A \cdot \overline{B}$
1	0	0	1	1	$\leftarrow A \cdot \overline{B}$
1	0	1	0	1	$\leftarrow A \cdot \overline{B}$
1	0	1	1	1	$\leftarrow A \cdot \overline{B}$
1	1	0	0	0	
1	1	0	1	0	
1	1	1	0	0	
1	1	1	1	0	



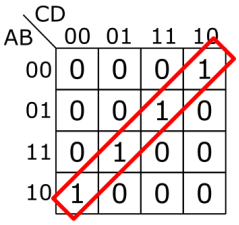
Podcast Timestamp	Supporting Details

5:01

Rule 1: No diagonal adjacencies allowed

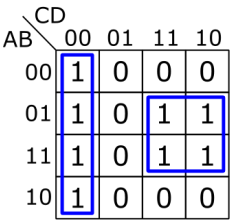


Correct ✓

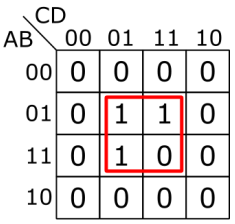


Incorrect ✗

Rule 2: No zeros allowed in a rectangle

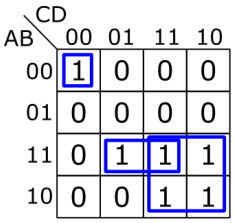


Correct ✓

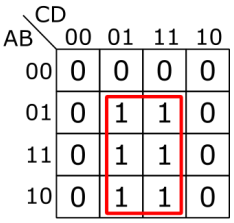


Incorrect ✗

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

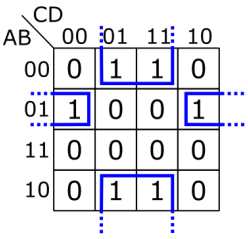


Correct ✓

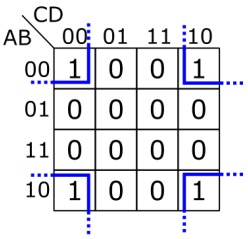


Incorrect ✗

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

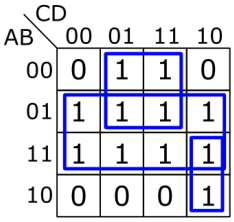


Correct ✓

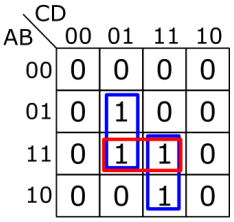


Also correct ✓

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

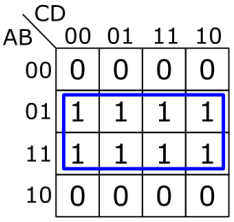


Correct ✓

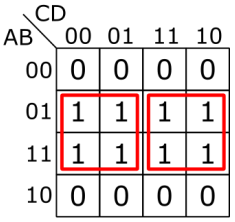


Incorrect ✗

Rule 6: Make rectangles as large as possible

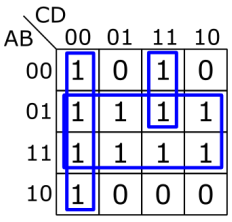


Correct ✓

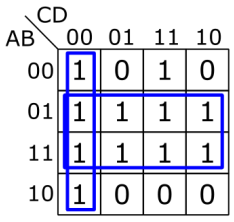


Incorrect ✗

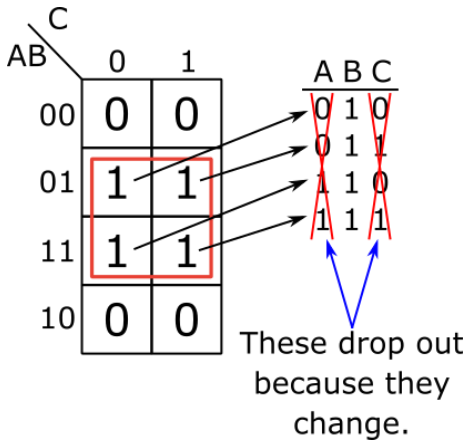
Rule 7: Every one in the map must be covered by at least one rectangle



Correct ✓



Incorrect ✗

Podcast Timestamp	Supporting Details
8:22	Demonstration of three-input Karnaugh map simplifying expression to $X = B$ 
10:20	Boolean algebra simplification alternative to Karnaugh map $X = \overline{A} \cdot B \cdot \overline{C} + \overline{A} \cdot B \cdot C + A \cdot B \cdot \overline{C} + A \cdot B \cdot C$ $X = \overline{A} \cdot B \cdot (\overline{C} + C) + A \cdot B \cdot \overline{C} + A \cdot B \cdot C$ $X = \overline{A} \cdot B \cdot 1 + A \cdot B \cdot \overline{C} + A \cdot B \cdot C$ $X = \overline{A} \cdot B + A \cdot B \cdot \overline{C} + A \cdot B \cdot C$ $X = \overline{A} \cdot B + A \cdot B \cdot (\overline{C} + C)$ $X = \overline{A} \cdot B + A \cdot B \cdot 1$ $X = \overline{A} \cdot B + A \cdot B$ $X = B \cdot (\overline{A} + A)$ $X = B \cdot 1$ $X = B$

Sample Problems

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

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

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

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

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

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

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