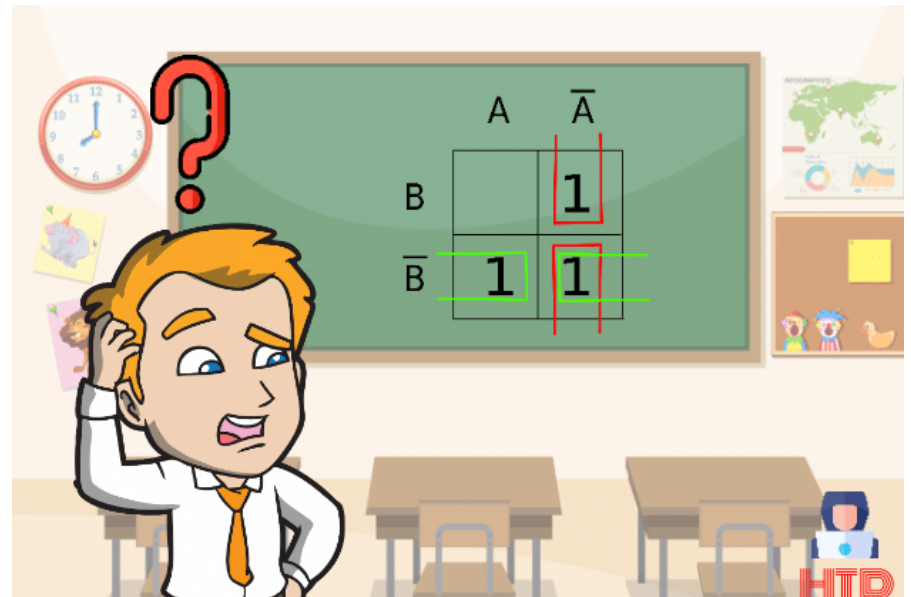


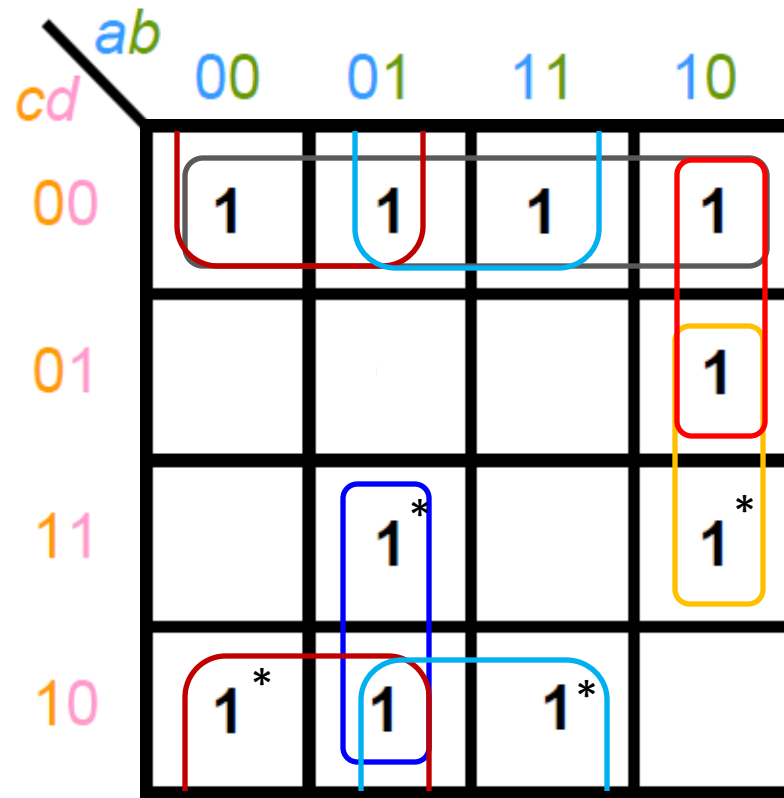
EE2000 Logic Circuit Design

Lecture 2 – Karnaugh Map and Quine-McCluskey (QM) Method



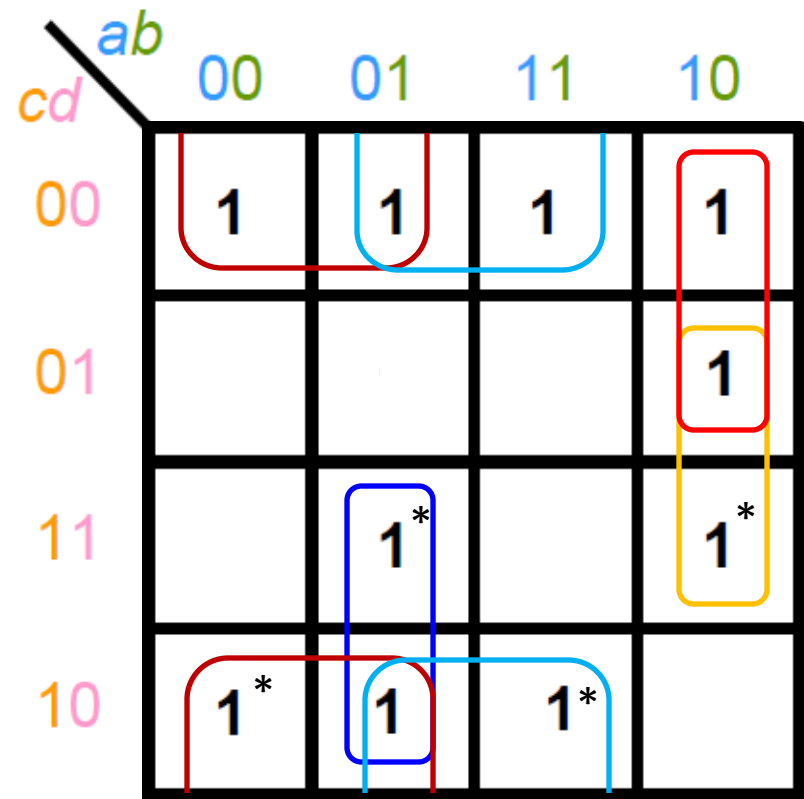
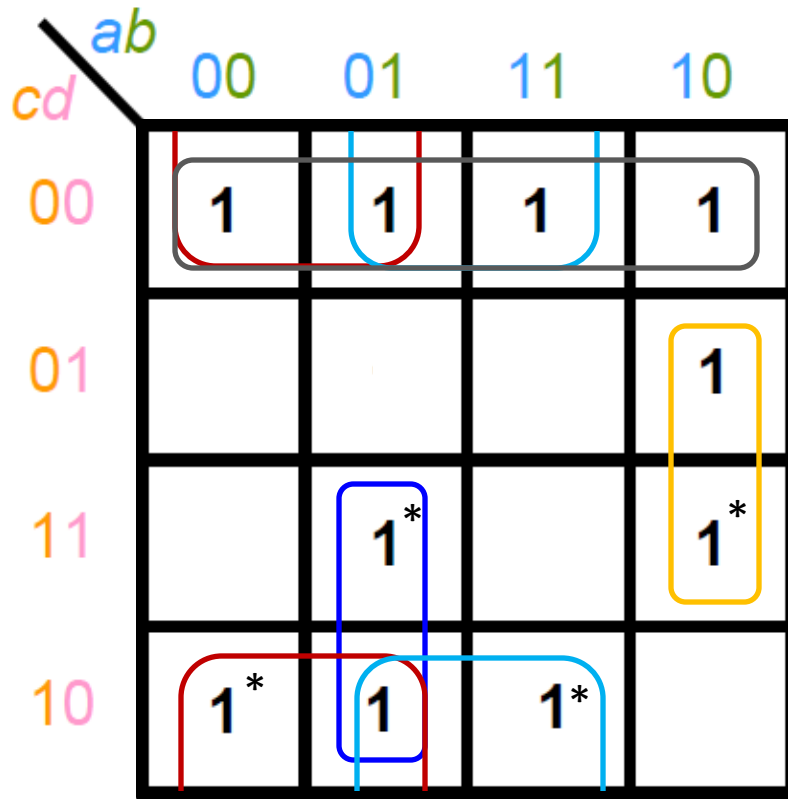
Exercise

1. Identify all PIs.
2. Select all EPIs.
3. Add PIs of remaining minterms.



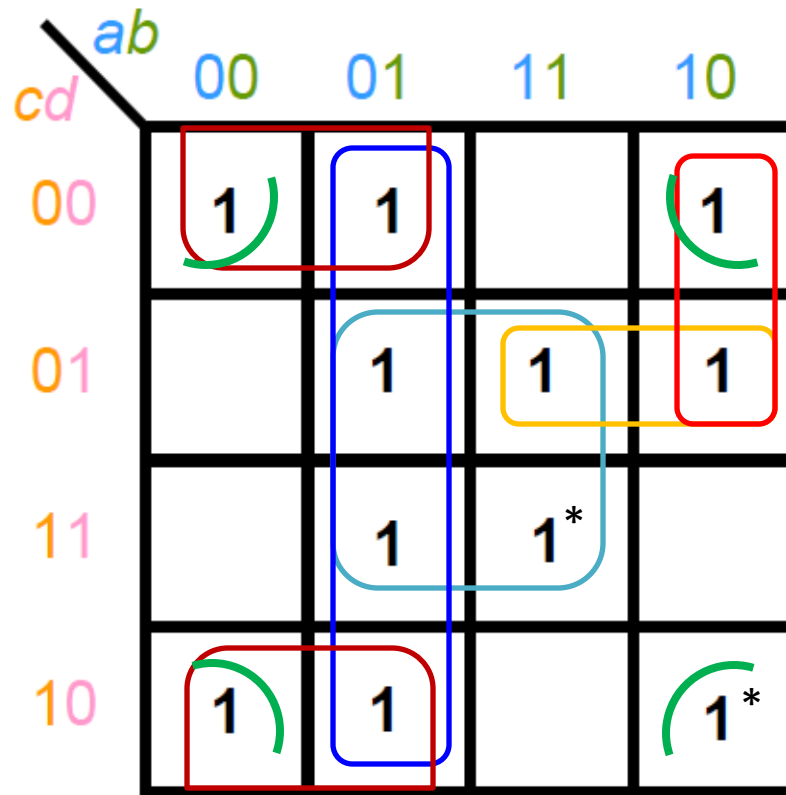
Exercise

1. Identify all PIs.
2. Select all EPIs.
3. Add PIs of remaining minterms.

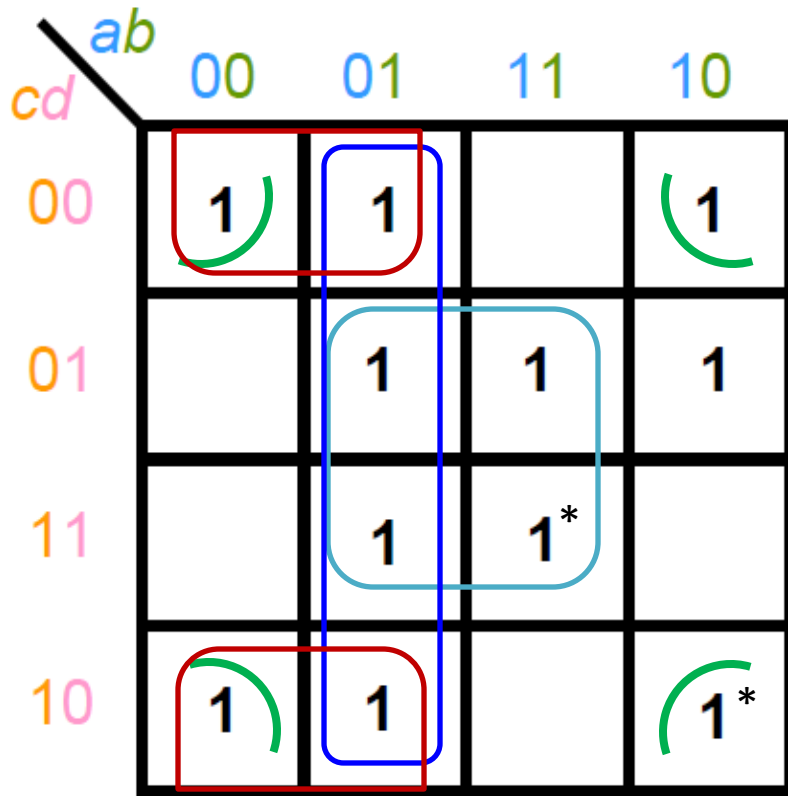


Exercise

Find all minimum sum of products expressions for the following K-map.

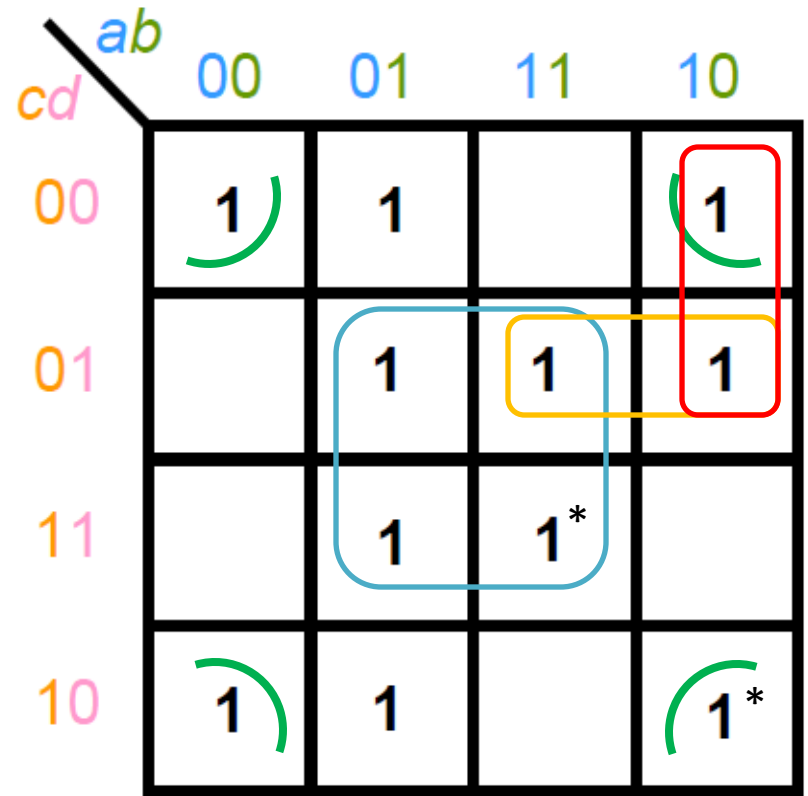


Exercise



$$f = bd + b'd' + a'd' + ac'd$$

$$f = bd + b'd' + a'b + ac'd$$



$$f = bd + b'd' + a'd' + ab'c'$$

$$f = bd + b'd' + a'b + ab'c'$$

Exercise

Find all minimum sum of products and all minimum product of sums expressions for the following Boolean Function.

$$f(a, b, c, d) = \sum m(1, 3, 4, 6, 11) + \sum d(0, 8, 10, 12, 13)$$

cd \ ab	ab			
	00	01	11	10
00	m_0	m_4	m_{12}	m_8
01	m_1	m_5	m_{13}	m_9
11	m_3	m_7	m_{15}	m_{11}
10	m_2	m_6	m_{14}	m_{10}

cd \ ab	ab			
	00	01	11	10
00	X	1	X	X
01	1		X	
11	1			1
10		1*		X

Exercise

		<i>ab</i>			
		00	01	11	10
<i>cd</i>	00	x	1	x	x
	01	1		x	
	11	1			1
	10		1*		x

		<i>ab</i>			
		00	01	11	10
<i>cd</i>	00	x	1	x	x
	01	1		x	
	11	1			1
	10		1*		x

		<i>ab</i>			
		00	01	11	10
<i>cd</i>	00	x	1	x	x
	01	1		x	
	11	1			1
	10		1*		x

$$f = a'bd' + a'b'd + b'cd$$

$$f = a'bd' + a'b'c' + b'cd$$

$$f = a'bd' + a'b'd + ab'c$$

Exercise

Reduce the following functions that will use the least number of gates and gate inputs.

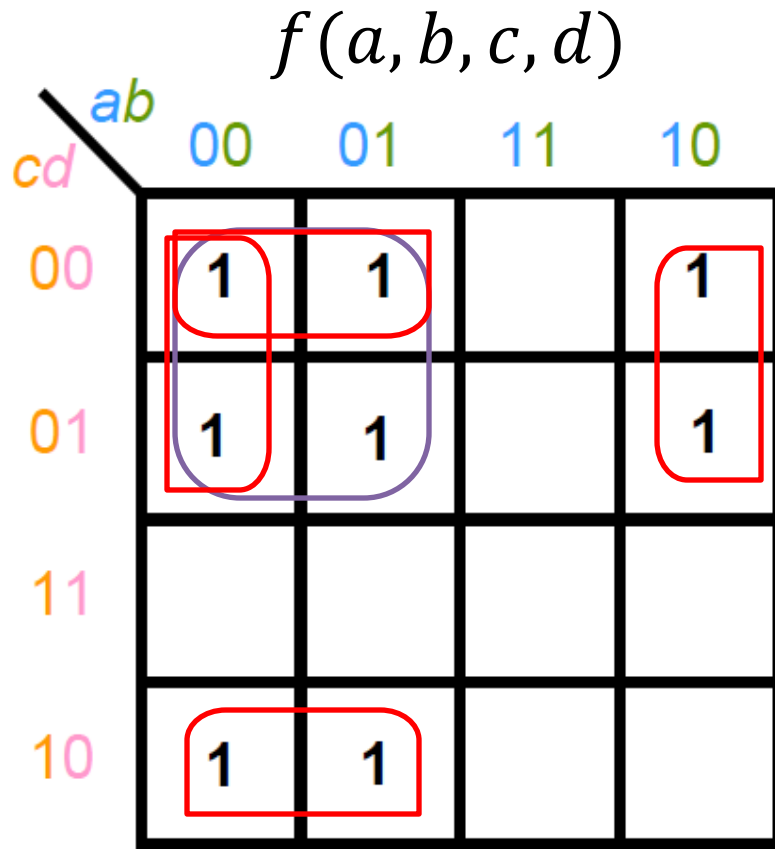
$f(a, b, c, d)$

$cd \backslash ab$	00	01	11	10
00	1	1		1
01	1	1		1
11				
10	1	1		

$g(a, b, c, d)$

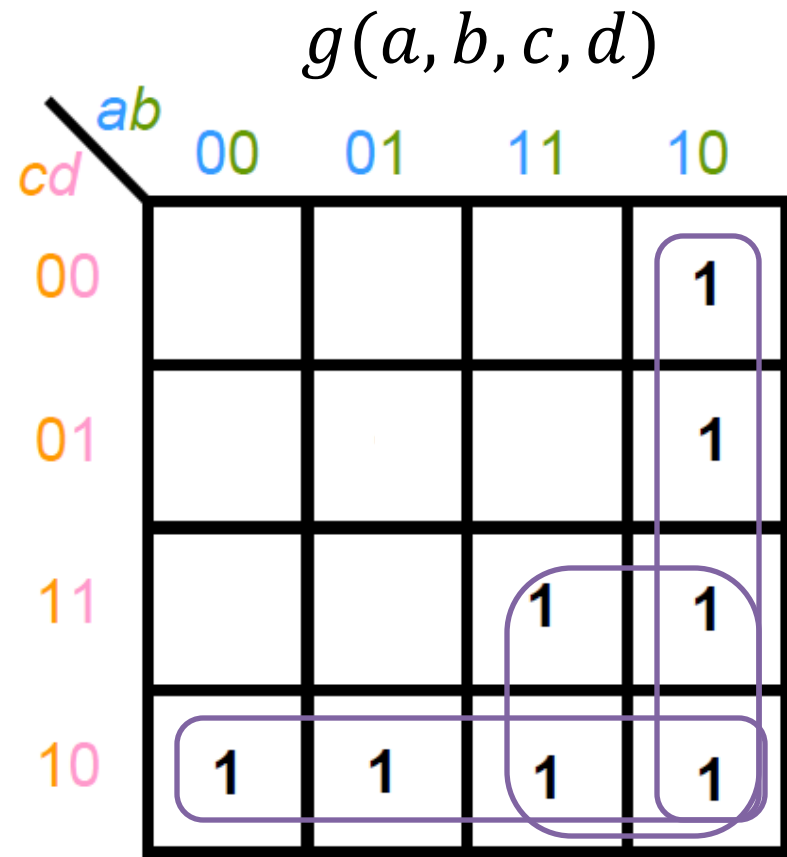
$cd \backslash ab$	00	01	11	10
00				1
01				1
11			1	1
10	1	1	1	1

Exercise



$$f(a, b, c, d) = a'c' + b'c' + a'd'$$

$$g(a, b, c, d) = ab' + ac + cd'$$



18 gate inputs
and 8 gates!!!

Exercise

$f(a, b, c, d)$

ab	00	01	11	10
cd				
00	1	1		1
01	1	1		1
11				
10	1	1		

$g(a, b, c, d)$

ab	00	01	11	10
cd				
00				1
01				1
11			1	1
10	1	1	1	1

$$f(a, b, c, d) = a'c' + ab'c' + a'cd'$$

$$g(a, b, c, d) = ac + ab'c' + a'cd'$$

16 gate inputs
and 6 gates!!!