Digital Logic Reduction K-maps – POS form

Last updated 1/7/25

Digital Logic Reduction – K-maps - POS

- K-Map reduction process – POS form
  1. Create and populate an appropriately sized K-map
     - 2x2, 2x4, 4x4
  2. 0's Collection
     - Use as few ovals as possible to cover all the 0's
       - Each oval must only contain 0's
       - Ovals cannot be diagonal
       - Each oval should be as large as possible
       - Ovals may wrap around the edges of the map
       - Any 0 in the Kmap may be included in multiple ovals
  3. Interpret the ovals
     - Individual 0's are interpreted as an OR of all negated inputs
     - Pairs of 0's will include an x and x-bar term, allowing the input to be removed
     - Quads of 0's will include x, x-bar, y, y-bar, terms, allowing those inputs to be removed
  4. Combine the evaluated circles as an AND term in the reduced logic expression – POS form

Digital Logic Reduction – K-maps - POS

- Example 1
  - Create the K map

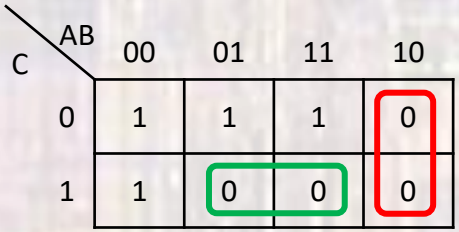
a	b	c	OUT
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

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

Digital Logic Reduction – K-maps - POS

- Example 1
  - Circle groups
    - There may be multiple collection possibilities

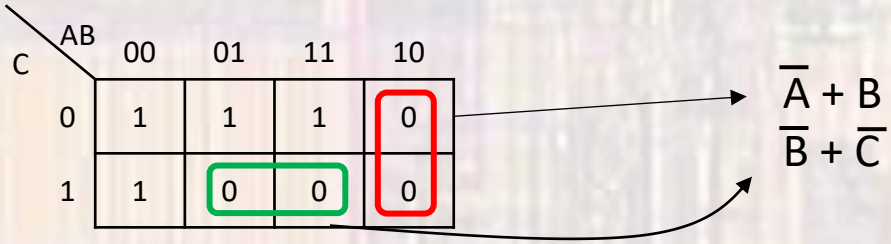
a	b	c	OUT
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0



Digital Logic Reduction – K-maps - POS

- Example 1
  - Interpret
    - Negating the inputs and OR'ing

a	b	c	OUT
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

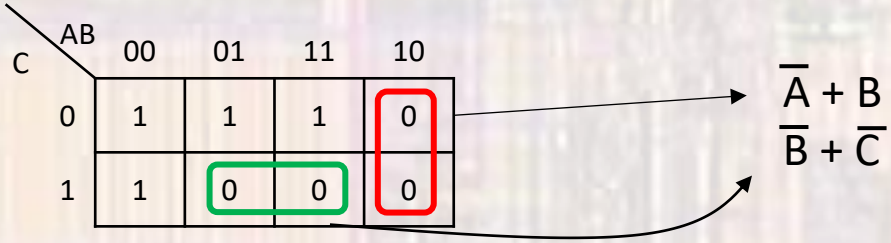


Digital Logic Reduction – K-maps - POS

- Example 1
  - Form POS

$$(\overline{A} + B)\,(\overline{B} + \overline{C})$$

a	b	c	OUT
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0



Digital Logic Reduction – K-maps - POS

- Example 2 - create

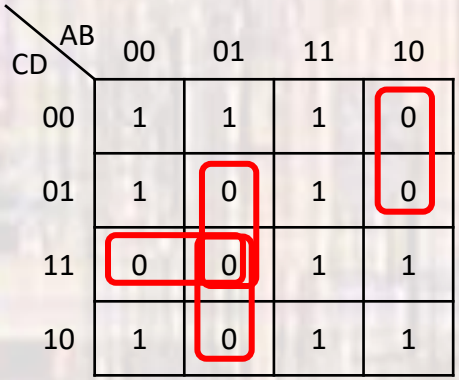
a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

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

Digital Logic Reduction – K-maps - POS

- Example 2 – circle groups
  - There may be multiple collection possibilities

a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

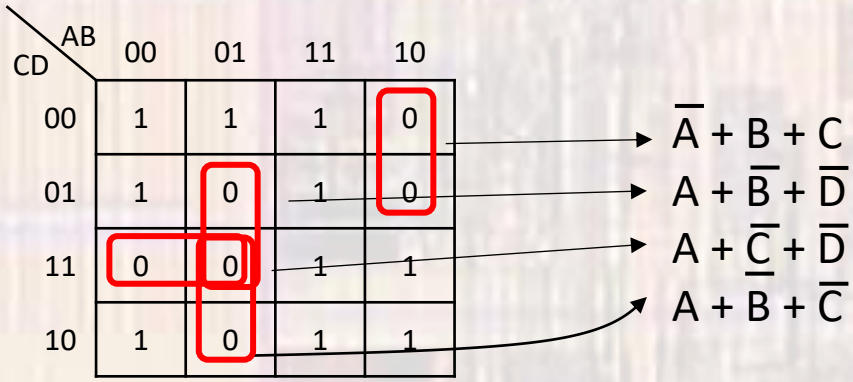


Digital Logic Reduction – K-maps - POS

- Example 2 - interpret

a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Negating the inputs and OR'ing

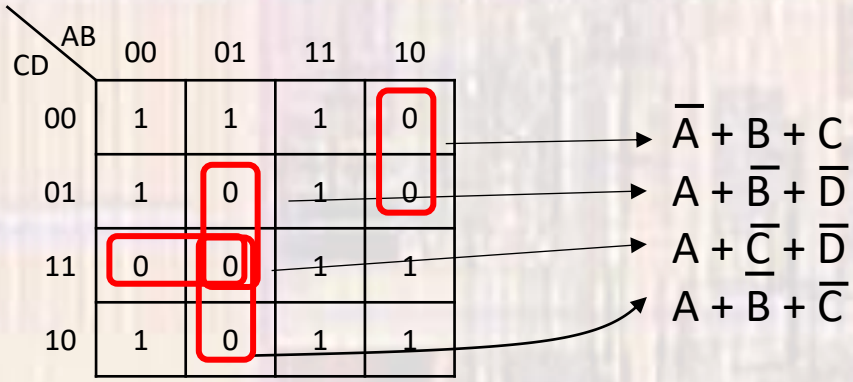


Digital Logic Reduction – K-maps - POS

- Example 2 – Form POS

a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$$(\overline{A}+B+C)(A+\overline{B}+\overline{D})(A+\overline{C}+\overline{D})(A+\overline{B}+\overline{C})$$



Digital Logic Reduction – K-maps - POS

- Example 3 – don't cares - create

a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	X
0	0	1	1	X
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	X
1	0	0	0	0
1	0	0	1	0
1	0	1	0	X
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

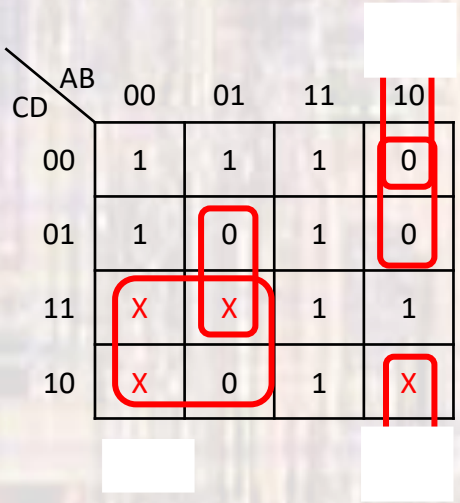
CD \ AB	00	01	11	10
CD	1	1	1	0
01	1	0	1	0
11	X	X	1	1
10	X	0	1	X

Digital Logic Reduction – K-maps - POS

- Example 3 – don't cares - circle groups
  - There may be multiple collection possibilities

a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	X
0	0	1	1	X
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	X
1	0	0	0	0
1	0	0	1	0
1	0	1	0	X
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

x's can be treated as 0's or 1's

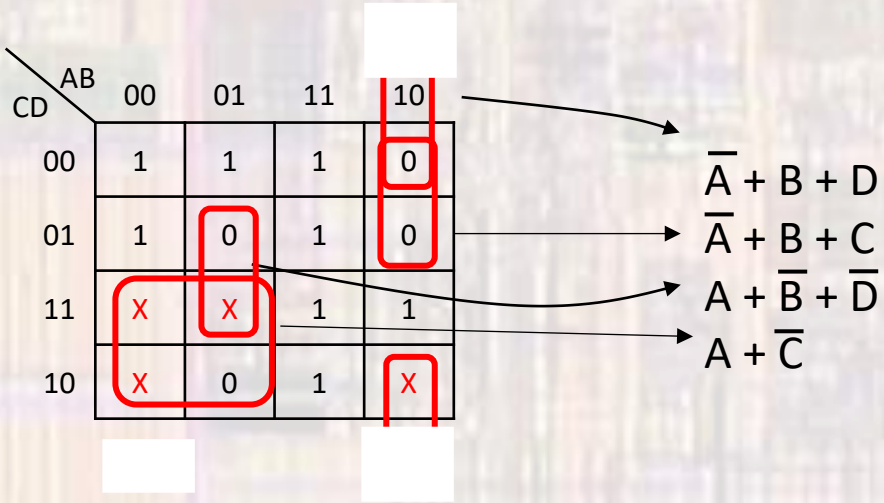


Digital Logic Reduction – K-maps - POS

- Example 3 – don't cares – interpret

a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	X
0	0	1	1	X
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	X
1	0	0	0	0
1	0	0	1	0
1	0	1	0	X
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Negating the inputs and OR'ing



Digital Logic Reduction – K-maps - POS

- Example 3 – don't cares – form POS

a	b	c	d	OUT
0	0	0	0	1
0	0	0	1	1
0	0	1	0	X
0	0	1	1	X
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	X
1	0	0	0	0
1	0	0	1	0
1	0	1	0	X
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$(\overline{A}+B+D)(\overline{A}+B+C)(A+\overline{B}+\overline{D})(A+\overline{C})$