ICEEP
Iran Center of ESL Education and Promotion

Digital Logic Design

Lecture 4

Dr. Navabi

Lecture 4 (Karnaugh)

2-Var Maps

Definitions

3- Var Maps

4- Var - - -

3

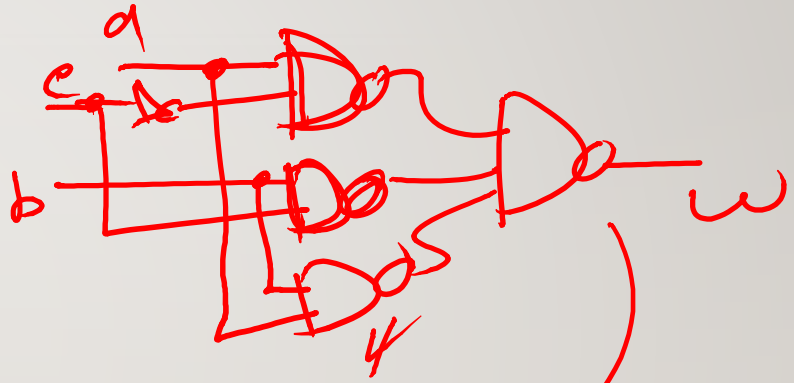
$$w = a\bar{c} + bc + \bar{a}\bar{b}$$

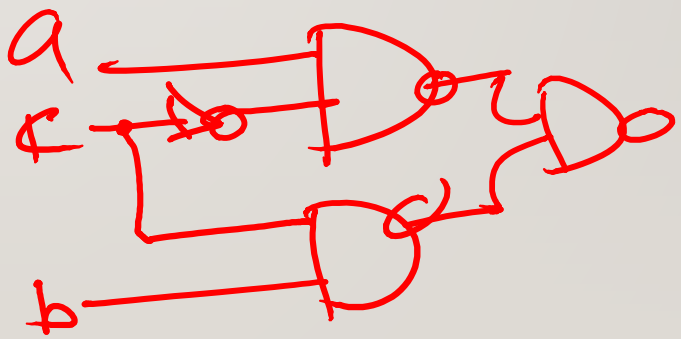
$$= a\bar{c} + bc + ab(c + \bar{c})$$

$$= a\bar{c} + bc + abc + ab\bar{c}$$

$$= a\bar{c}(1 + b) + bc(1 + a)$$

$$= a\bar{c} + bc$$





4 $W = cd + a\bar{c}d + \bar{a}cd + ab\bar{c} + \bar{a}b\bar{d}$

$= cd(a+\bar{a}) + a\bar{c}d + \bar{a}c\bar{d} + ab\bar{c}(d+\bar{d}) + \bar{a}b\bar{d}(c+\bar{c})$

$= acd + \bar{a}cd + a\bar{c}d + \bar{a}c\bar{d} + ab\bar{c}d + ab\bar{c}\bar{d} + \bar{a}bcd + \bar{a}bc\bar{d} =$

$= ad(c+\bar{c}) + \bar{a}c(d+\bar{d})$

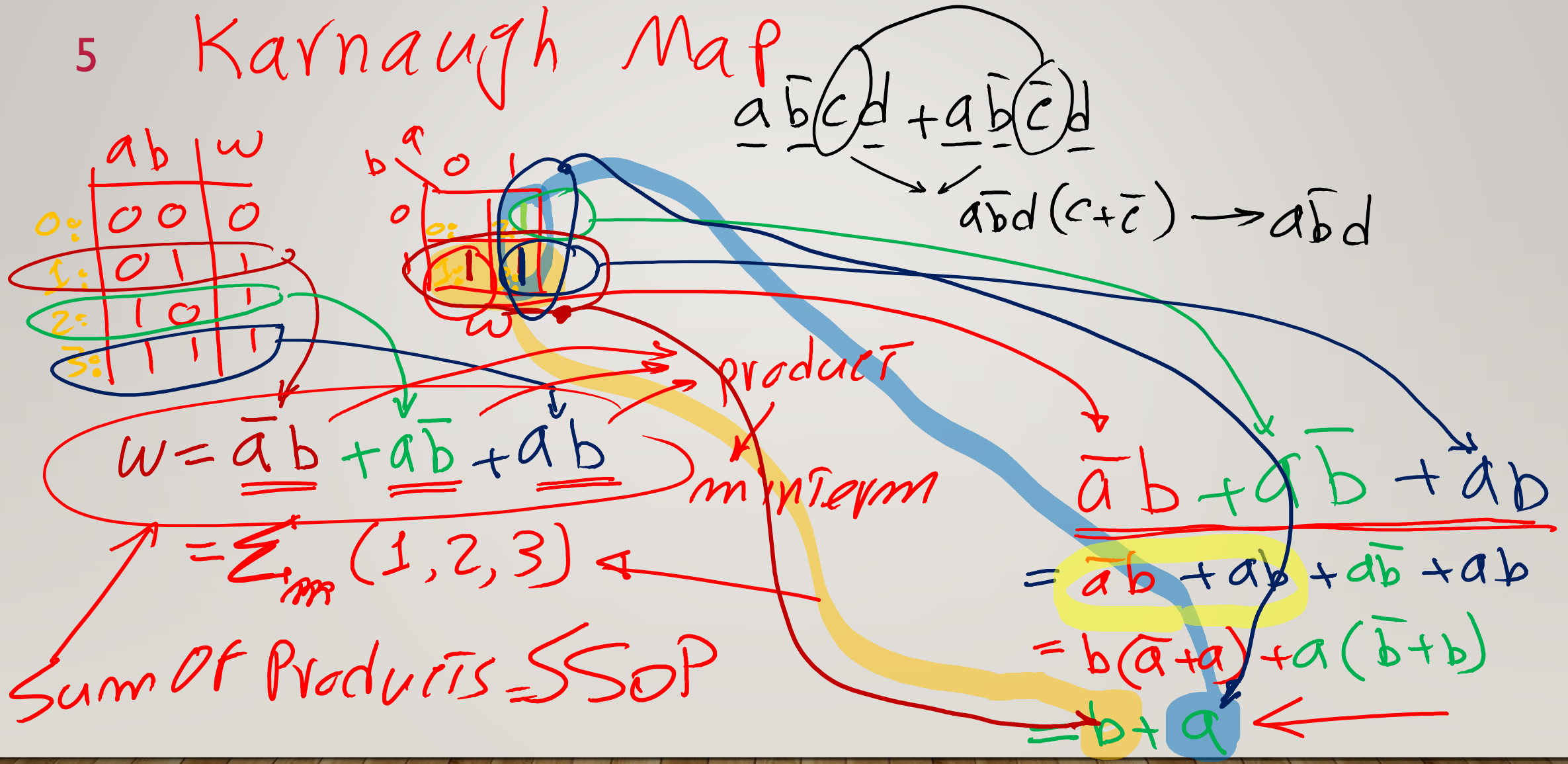
$= ad + \bar{a}c + ab\bar{c}d + \bar{a}bcd + b\bar{c}\bar{d}$

$= ad(1+b\bar{c}) + \bar{a}c(1+b\bar{d}) + b\bar{c}\bar{d} = ad + \bar{a}c + b\bar{c}\bar{d}$

$b\bar{c}\bar{d}(a+\bar{a})$

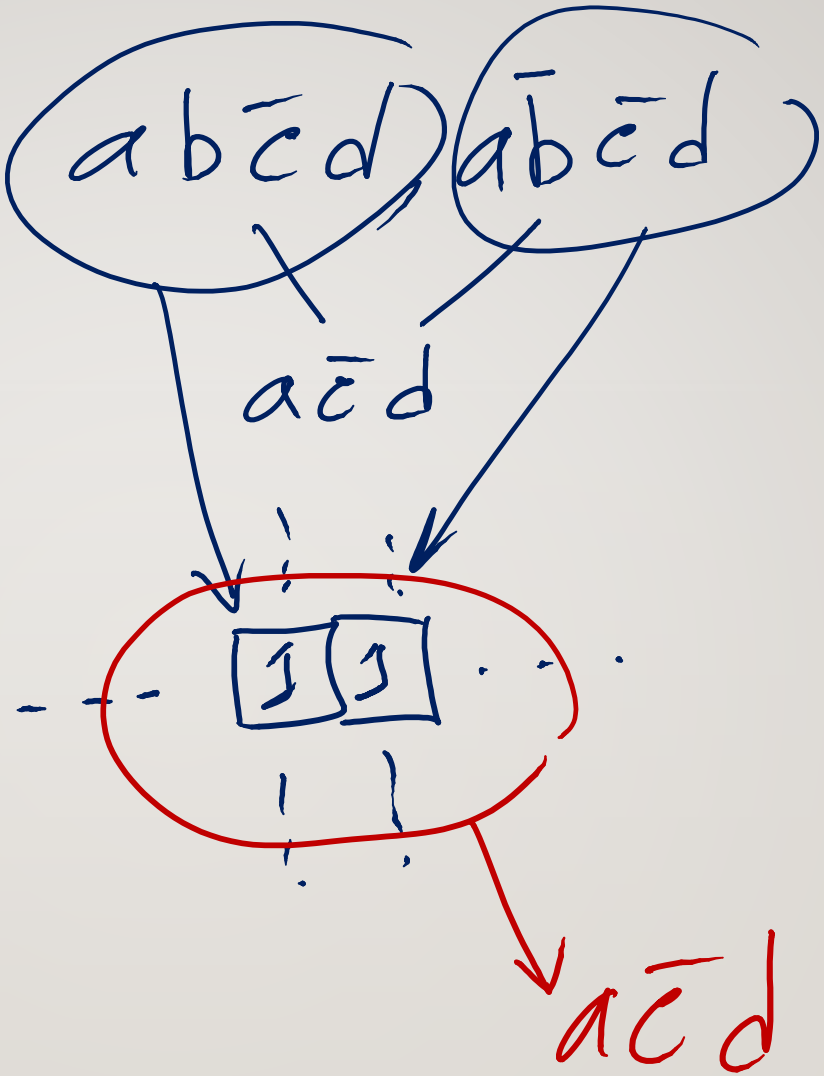
$b\bar{c}\bar{d}$

5 Karnaugh Map

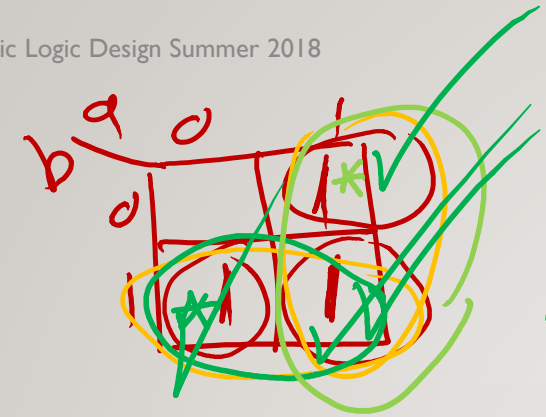


6 Boolean adj

Physical =



7



$a\bar{b}, \bar{a}b, ab, a, b$

a, b

a, b

Minterm: a prod term of all func variables

Prod: any numb of var anded

Sum: " " " " or term ored

any product term than when 1, func is 1:

An Imp not Comp covered by any other Implicant

implicant is a PI

EPI: imp with at least a minterm not covered by any other PI

8 Min coverage

1. List all EPJ ✓

2. any uncovered min? ✓
   exit if none

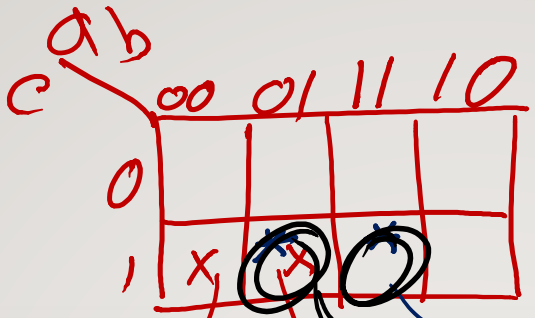
3. Take PJ covering most # of uncovered minterms

$w = a + b$

9

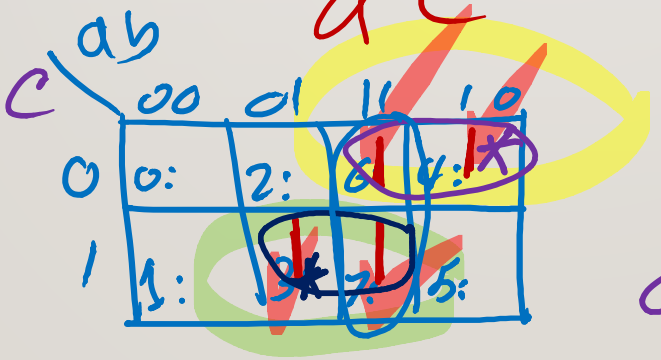
	a b c	w
0:	0 0 0	0
1:	0 0 1	0
2:	0 1 0	0
3:	0 1 1	1
4:	1 0 0	1
5:	1 0 1	0
6:	1 1 0	1
7:	1 1 1	1

$\Sigma_m(3,4,6,7)$



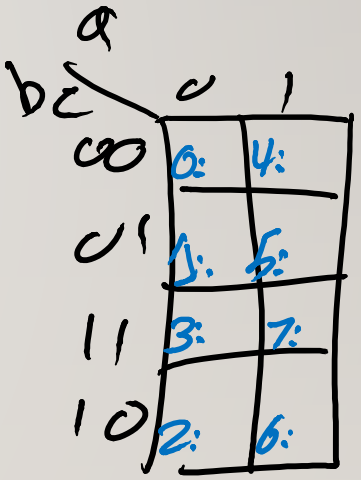
$\bar{a}bc$ $\bar{a}bc$ $\bar{a}bc$ ~~abc~~

$\bar{a}c$



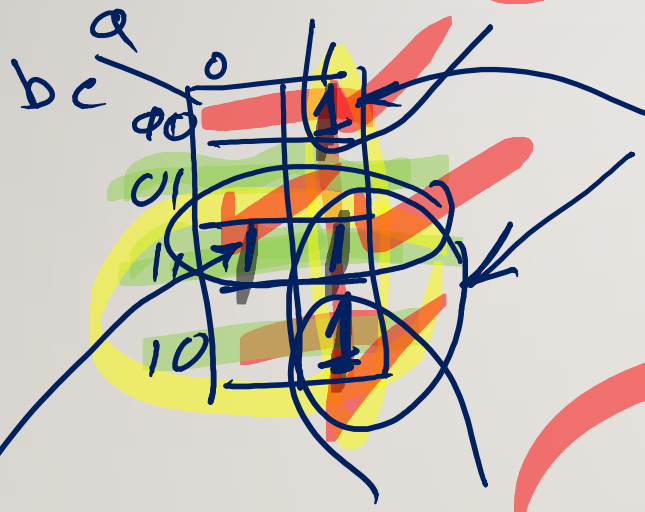
$\bar{a}bc$ abc

$a\bar{c} + bc$



10

$$F(a,b,c) = a\bar{c} + bc + ab$$



$bc, ab, a\bar{c}$

$$F = bc + a\bar{c}$$

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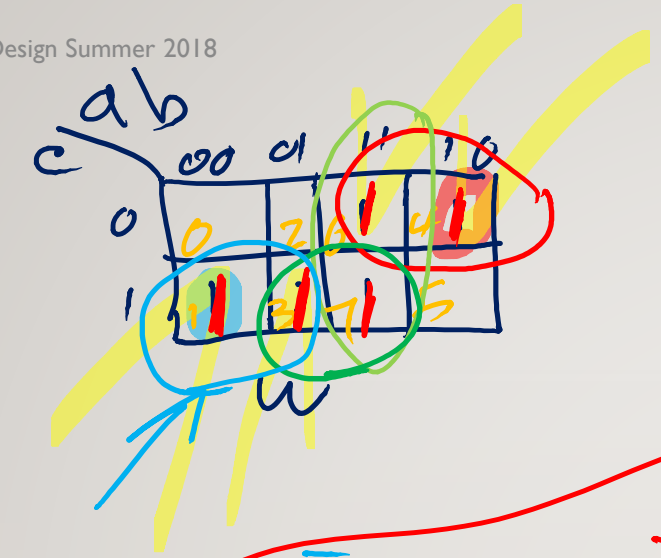
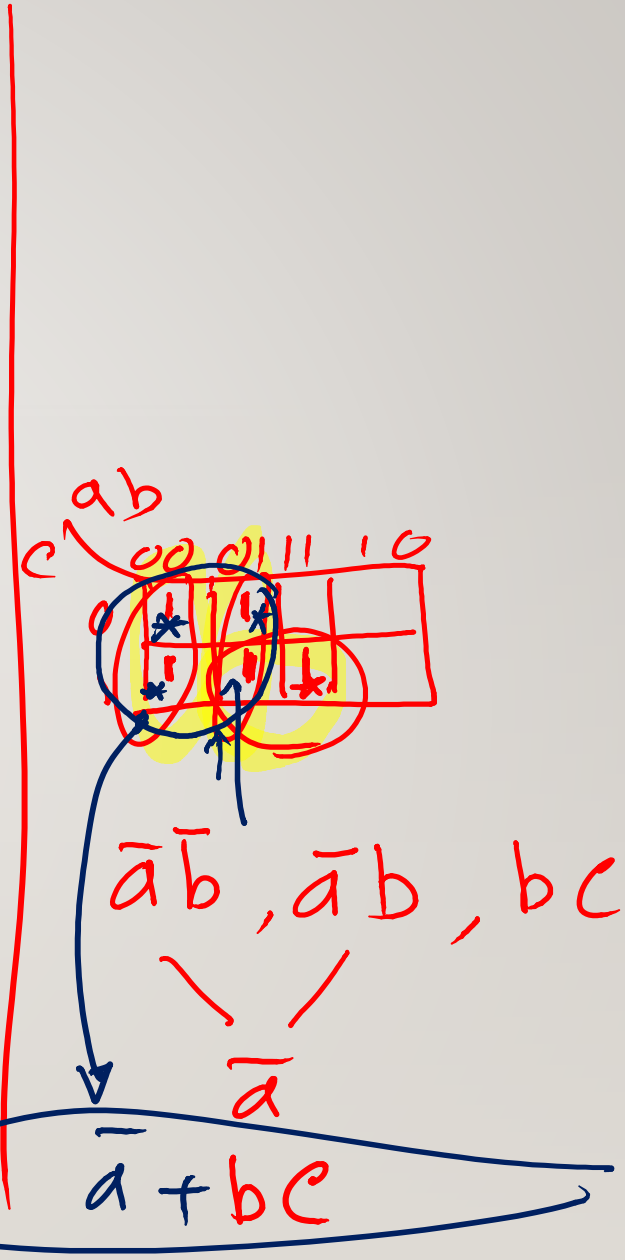
	a	b	c	w
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	1
4	1	0	0	1
5	1	0	1	0
6	1	1	0	1
7	1	1	1	1

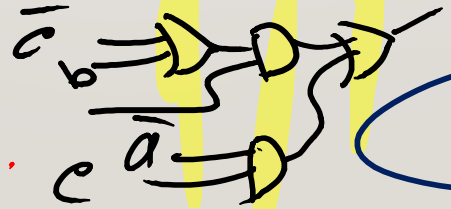


$\Sigma_m(1,3,4,6,7)$

$\bar{a}c + a\bar{c} + \{ab, bc\}$



$\bar{a}c + a\bar{c} + ab = \bar{a}c + a(\bar{c} + b)$



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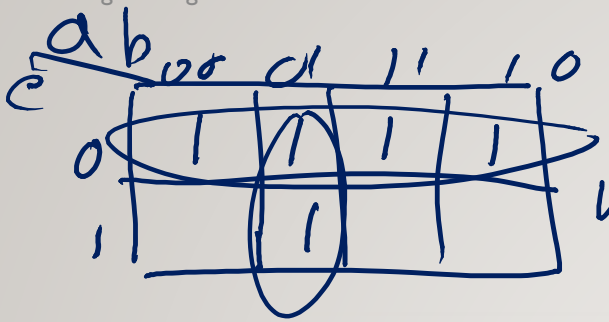
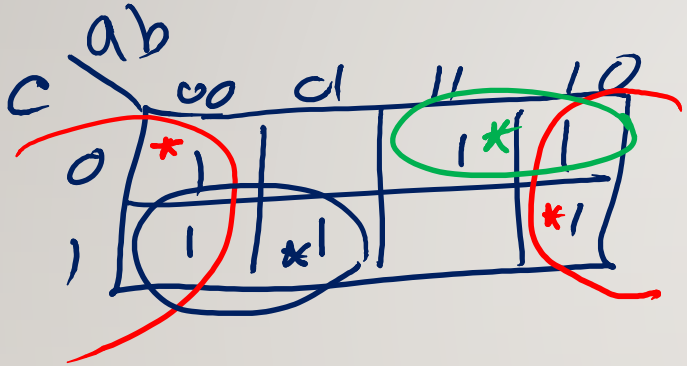
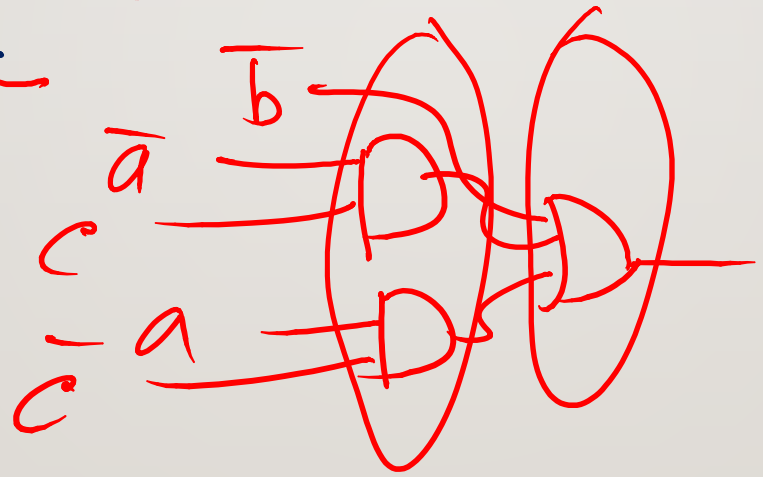


$$w = \bar{c} + \bar{a}b$$



$$w = \bar{b} + \bar{a}c + a\bar{c}$$



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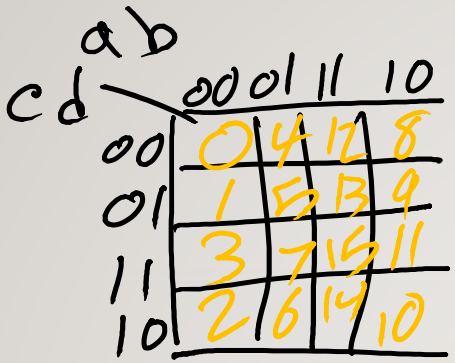
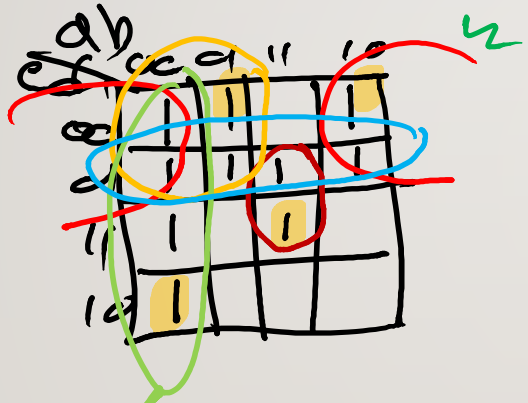
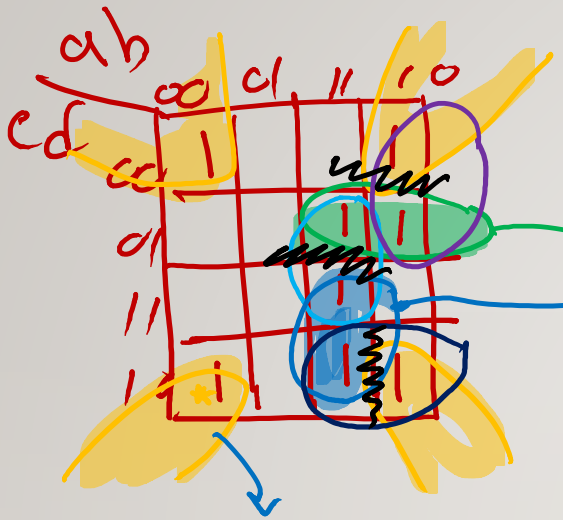
	a b c d	w
0	0 0 0 0	
1	0 0 0 1	
2	0 0 1 0	
3	0 0 1 1	
4	0 1 0 0	
5	0 1 0 1	
6	0 1 1 0	
7	0 1 1 1	
8	1 0 0 0	
9	1 0 0 1	
10	1 0 1 0	
11	1 0 1 1	
12	1 1 0 0	
13	1 1 0 1	
14	1 1 1 0	
15	1 1 1 1	





$$\bar{a}\bar{b} + \bar{a}\bar{c} + abd + \bar{b}\bar{c}$$

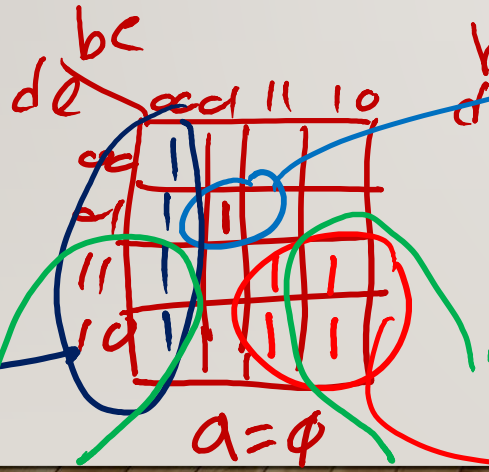
14

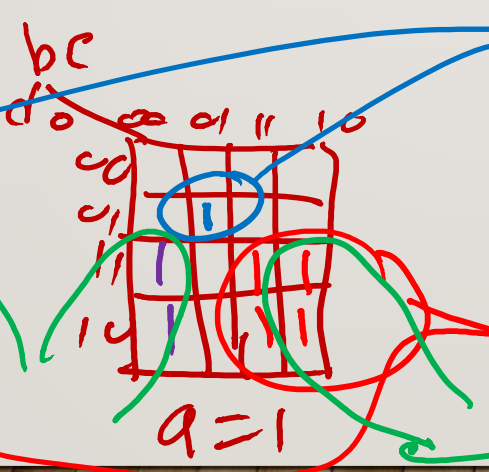


$f = \bar{b}\bar{d} + a\bar{c}\bar{d} + abc$

abcd
1000 ↔ 1001
1101 ↔ 1111
1110 ↔ 1010

5 var





$\bar{b}\,cde$

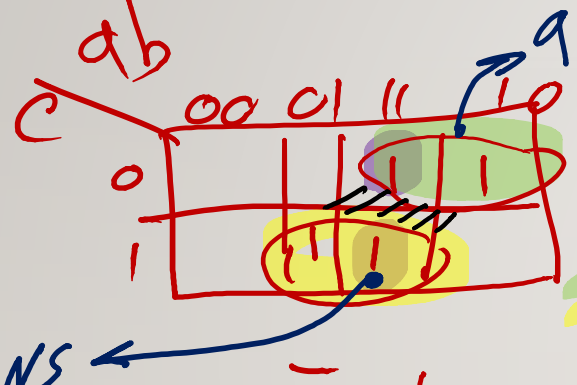
$\bar{a}\bar{b}\,cde$, $a\bar{b}cde$

$\bar{a}\,\bar{b}\bar{c}$

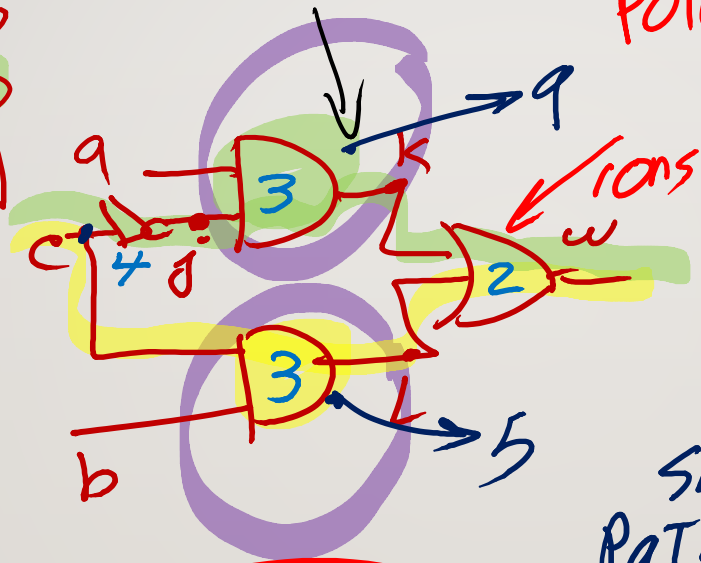
bd

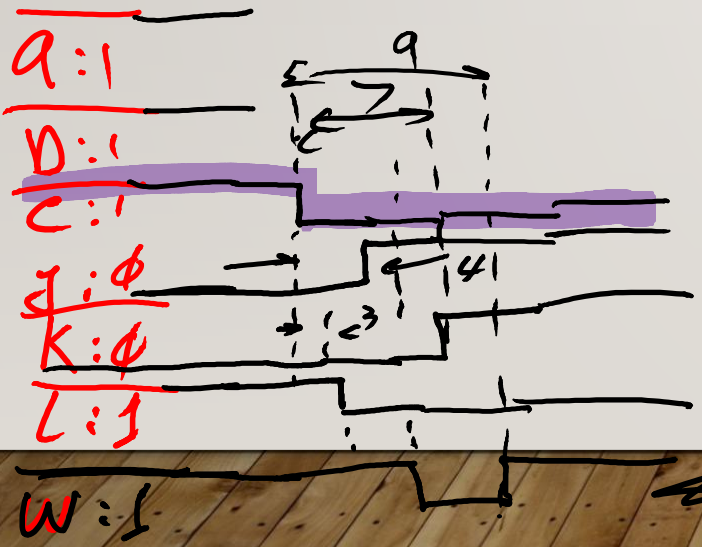
$\bar{c}\bar{d}$

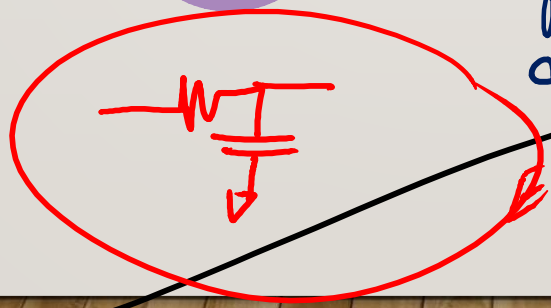
15 Timing : STATIC POTENTIAL + Hazard

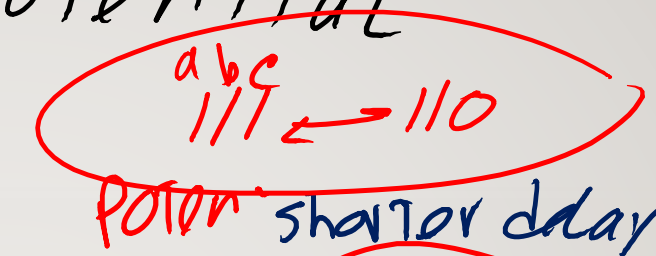


$a\bar{c} + bc$

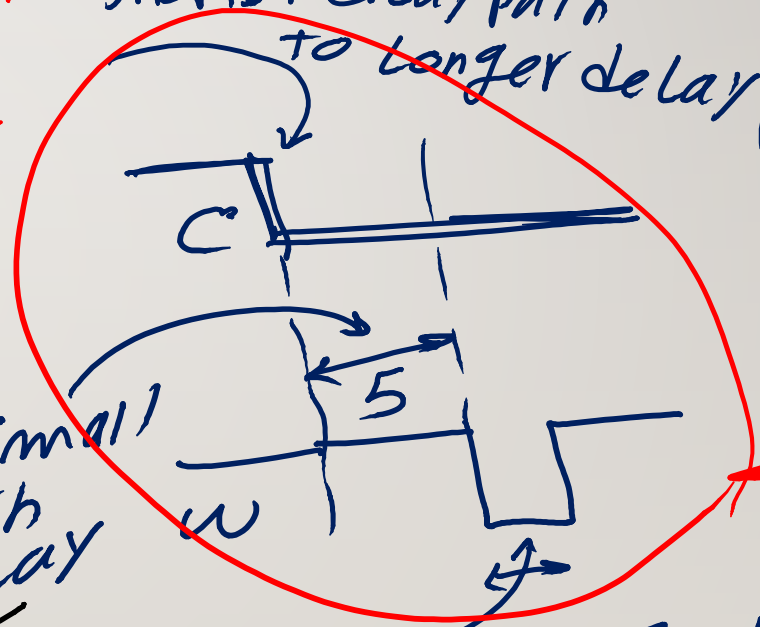








Potential shorter delay path to longer delay path



Logical

Electrical

$q - 5 = 4$

Longer del − Shorter delay