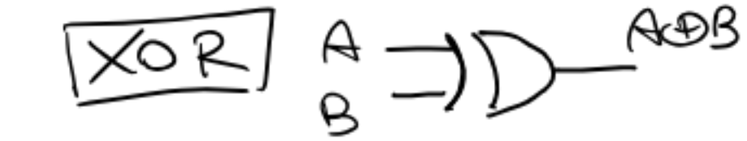
XOR



$\overline{X + Y} = \overline{X} \cdot \overline{Y}$

A	B	A⊕B	
0	0	0	
0	1	1	← $A\overline{B}$
1	0	1	← $\overline{A}B$
1	1	0	

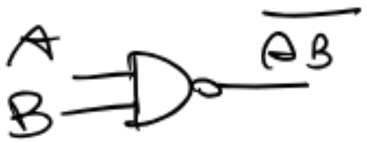
$A \oplus B = \overline{A}B + A\overline{B} = \overline{\overline{A}B} \cdot \overline{A\overline{B}}$

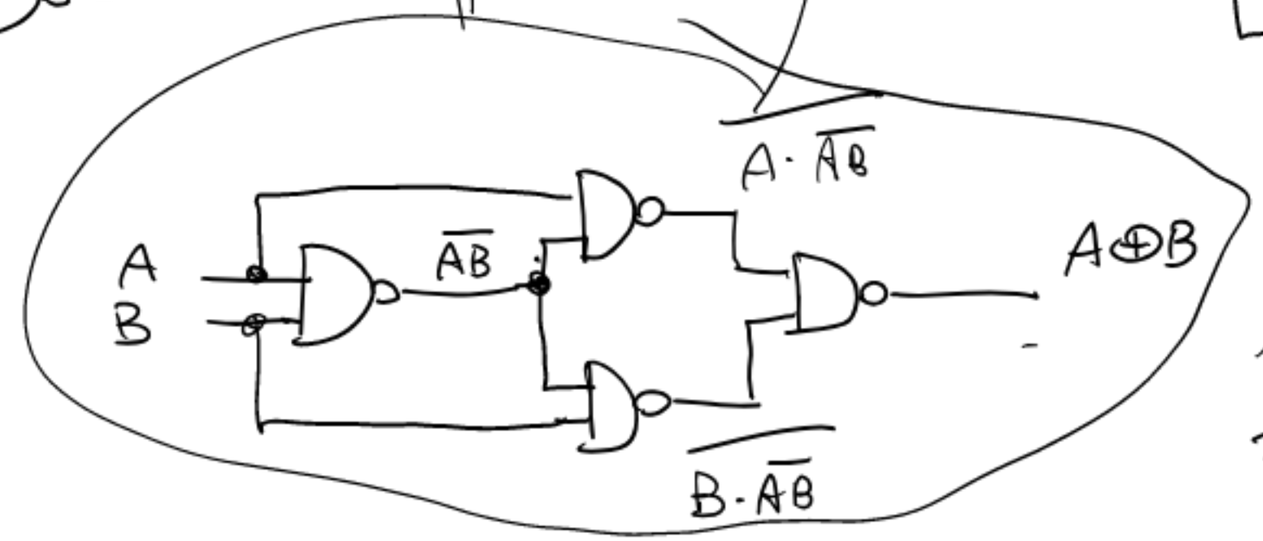
$\overline{\overline{A}B} = \overline{\overline{A}B + 0} = \overline{\overline{A}B + B\overline{B}} = B(\overline{A} + \overline{B}) = \overline{B \cdot \overline{AB}}$

$\overline{A\overline{B}} = \overline{A\overline{B} + A\overline{A}} = A(\overline{A} + \overline{B}) = \overline{A \cdot \overline{AB}}$

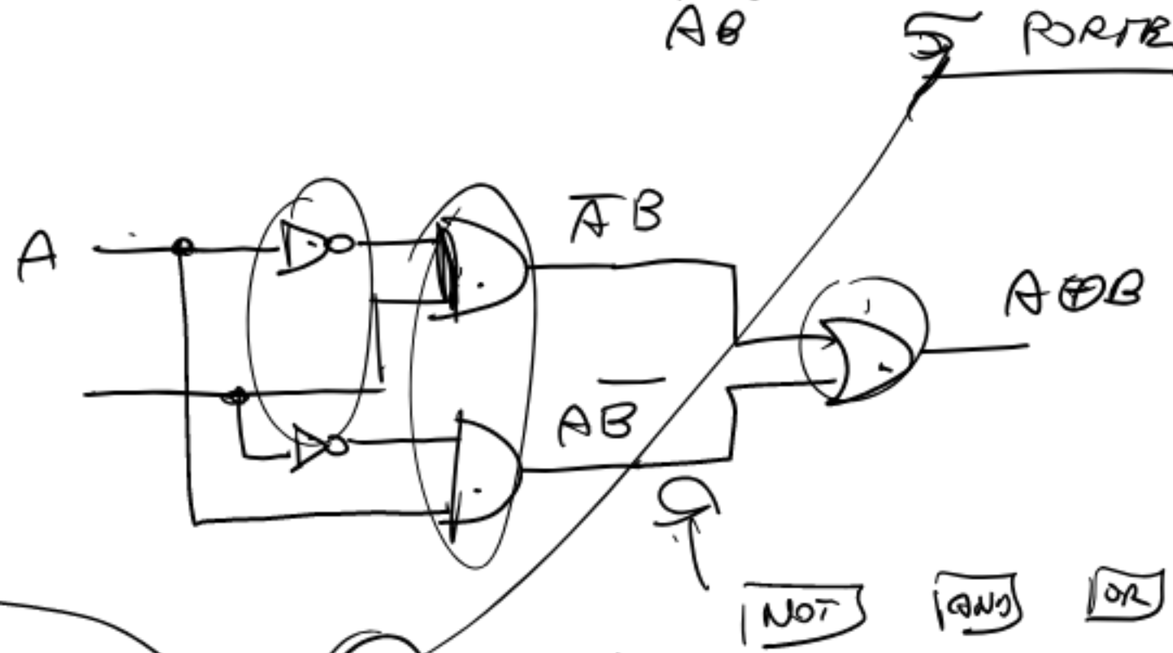
$A \oplus B = \overline{A}B + A\overline{B}$

$= \overline{\overline{AB} \cdot B} \cdot \overline{\overline{AB} \cdot A}$





PORTE



G PORTE

⇒ NAND

XOR $A \oplus B = \overline{\overline{AB} \cdot B} \cdot \overline{\overline{AB} \cdot A} = F_{XOR}$ ✱✱

SCAMBIO AND → OR ⇒ F

$F = \overline{\overline{A+B}+B} + \overline{\overline{A+B}+A} = \overline{\overline{A}\overline{B}+B} + \overline{\overline{A}\overline{B}+A}$

$= \overline{(\overline{A}\overline{B}+B)\cdot(\overline{A}\overline{B}+A)} = (\overline{A}\overline{B}+B)(\overline{A}\overline{B}+A) =$

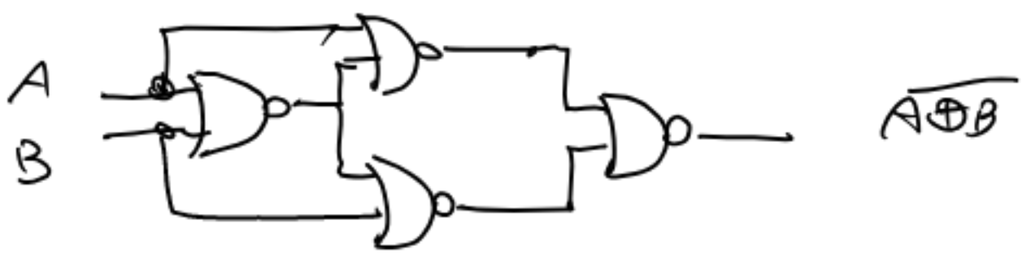
$= \overline{A}\overline{B} + \overline{A}\overline{B}A + B\overline{A}\overline{B} + A \cdot B = \overline{A}\overline{B} + AB$

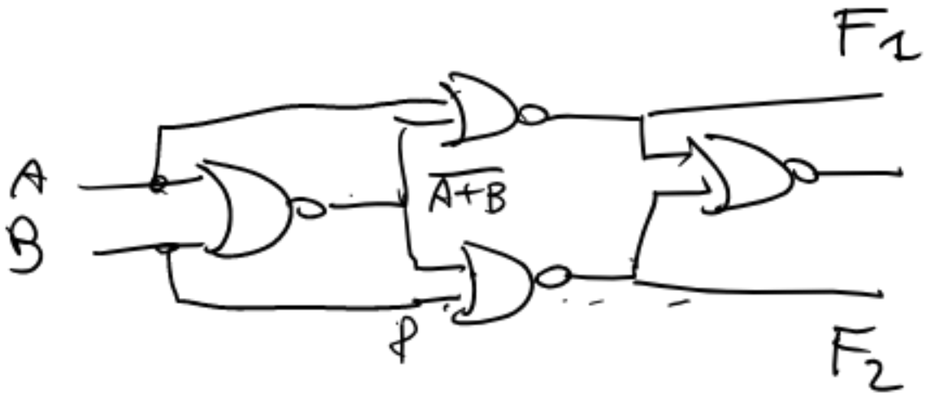
A	B	F	XOR
0	0	1	0
0	1	0	1
1	0	0	1
1	1	1	1

XNOR

XOR → (F) AND OR ? → D

XNOR F ? D





$\overline{A \oplus B}$

A	B	$\overline{A \oplus B}$	F_1	F_2
0	0	1	0	0
0	1	0	1	0
1	0	0	0	1
1	1	1	0	0

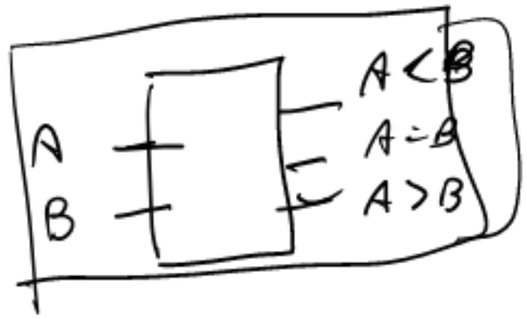
UGUAGLIANZA → E

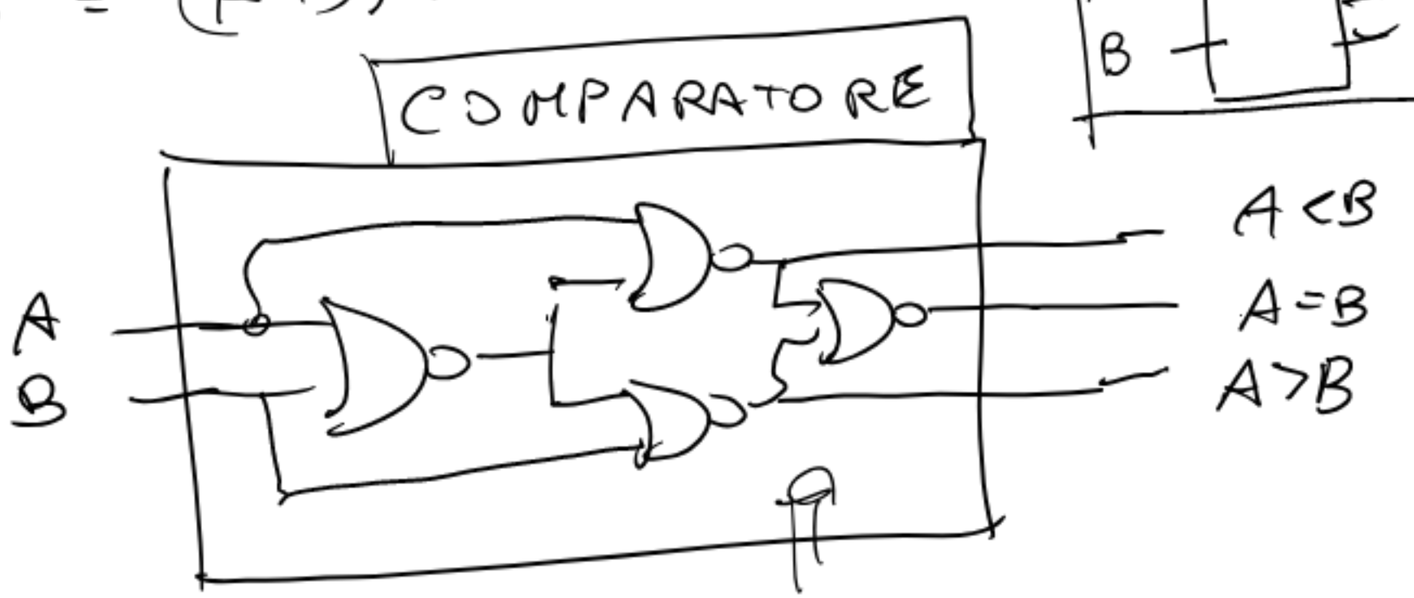
A<B

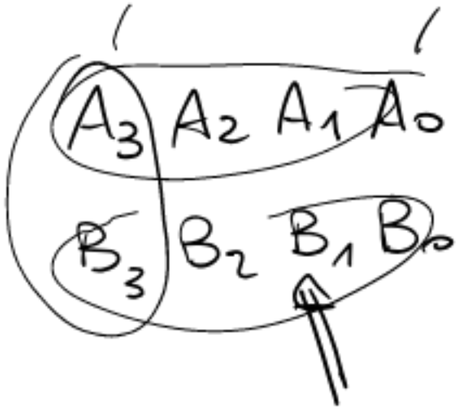
A>B

$$F_1 = \overline{\overline{A+B} + A} = (A+B)\cdot\overline{A} = \overline{A}\,\overline{B} + \overline{A}B = \overline{A}\,B$$

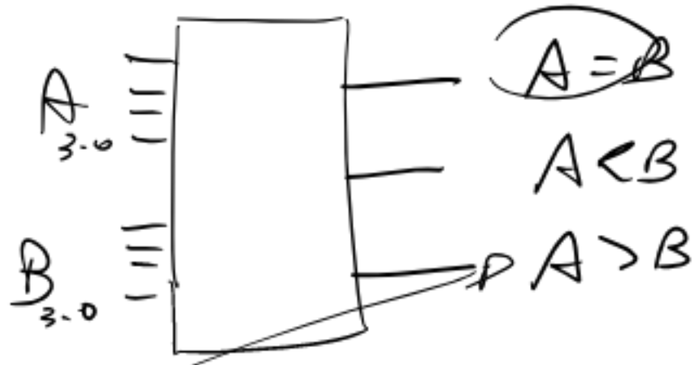
$$F_2 = \overline{\overline{A+B} + B} = (A+B)\,\overline{B} = A\overline{B} + B\overline{B} = A\overline{B}$$

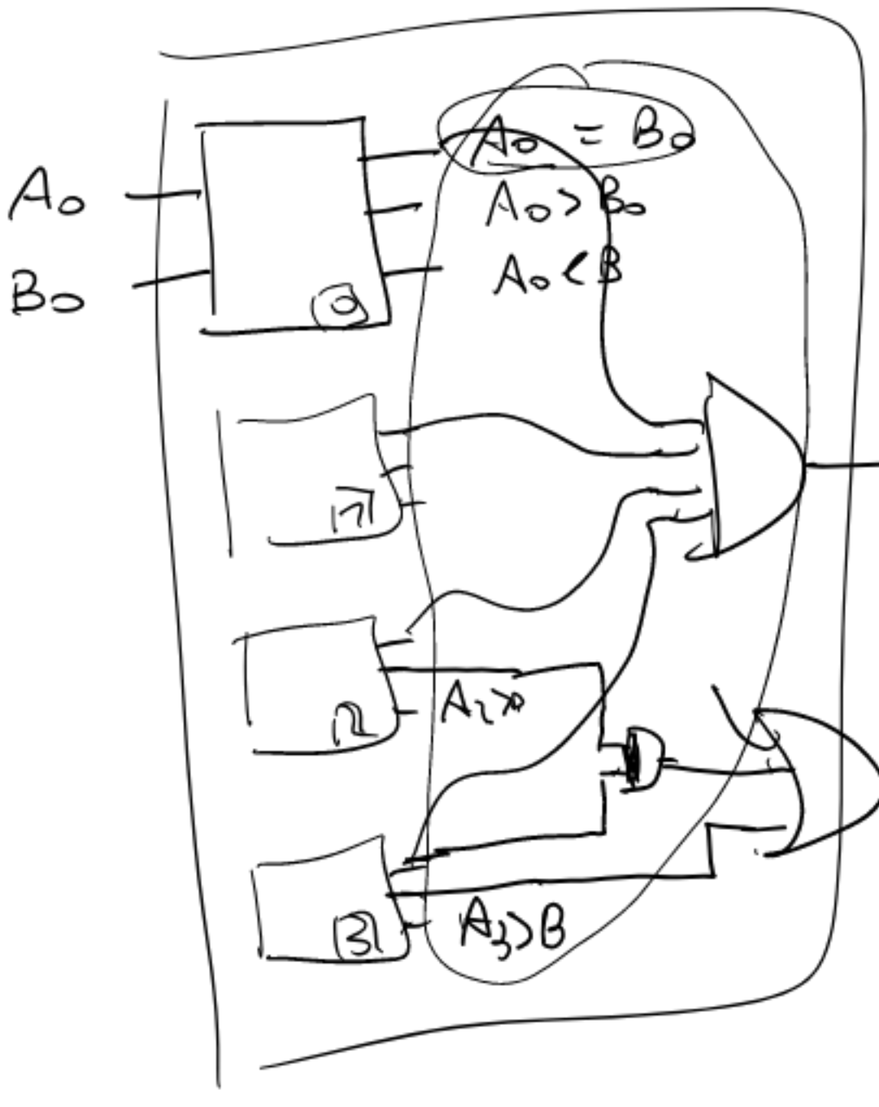






→ 0 ÷ 15





A=B

A0=B0 AND A1=B1 AND A2=B2 AND A3=B3

A>B

A3>B3 OR

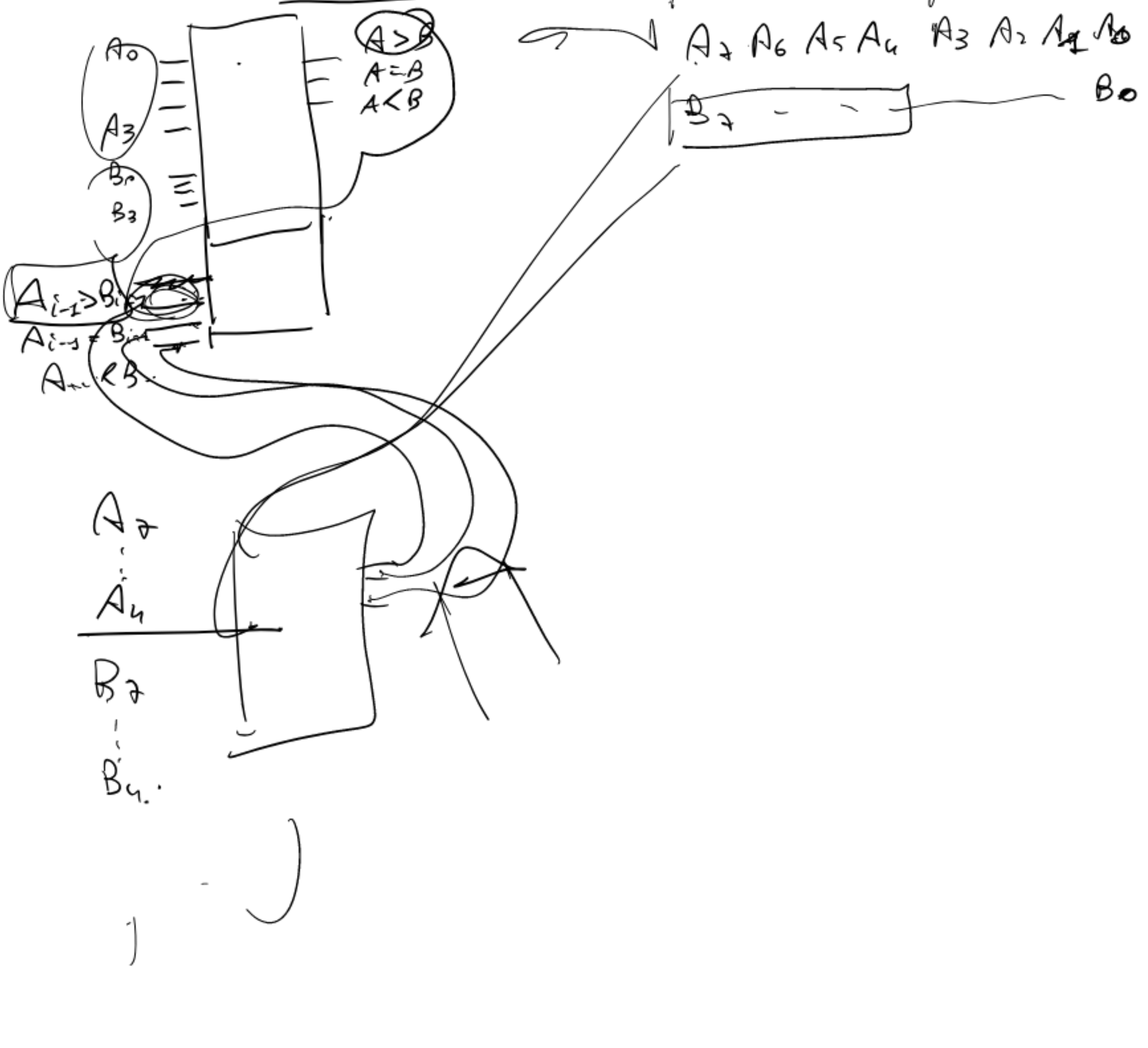
A3=B3 AND A2>B2 OR

A3=B3 AND A2=B2 AND A1>B1 OR

E3 AND E2 AND E1 AND A0>B0

A<B

COMPARATORE 4 BIT.



XOR → XNOR. XOR, XNOR } SIMMETRICITÀ RISPETTO VAR IN $A \oplus B$

AND → OR

$F \to \overline{F}$

1) AND → OR
2) OR → AND
3) NOT VAR

$F(A,B,C\ldots,+) \Rightarrow \overline{F}(\overline{A},\overline{B},\overline{C},+,\cdot)$

doubo De Morgan

$A \oplus B \to \overline{A+B} = \overline{A} \oplus \overline{B}$

$A \cdot B \to \overline{A \cdot B} = \overline{A} + \overline{B}$

$F = \sum_{\Pi} = \prod$

$\overline{F} =$

- PORTE. BASE
- UNIVERS
- XOR XNOR
- ENABLE / DISABLE
- TRUE / FALSE
- HALF ADDER / FULL ADDER
- COMPARATORR
- MUX / DEMUX

A	B	C	A ⊕ B	(A⊕B) ⊕ C
0	0	0	0	0
0	0	1	0	1
0	1	0	1	1
0	1	1	1	0
1	0	0	1	1
1	0	1	1	0
1	1	0	0	0
1	1	1	0	1

→ Somma aritmetica

→ N 1 DISPARI

MAPPE DI KARNAUGH

TAV. VERITÀ

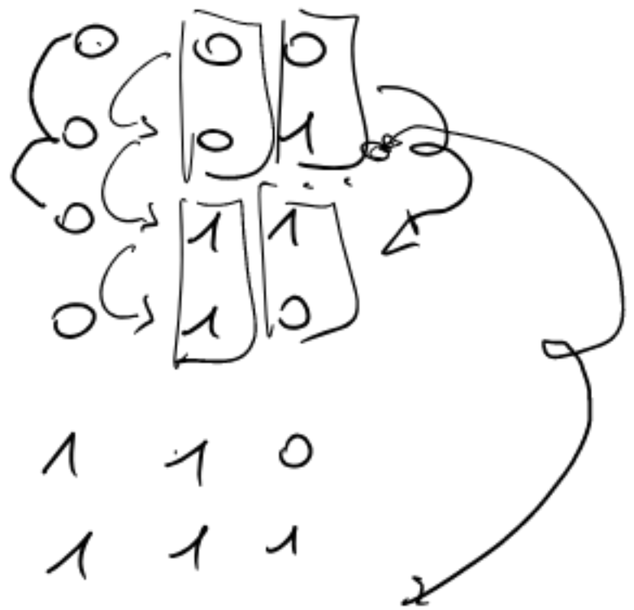
A	B	F
0	0	0
0	1	1
1	0	0
1	1	0

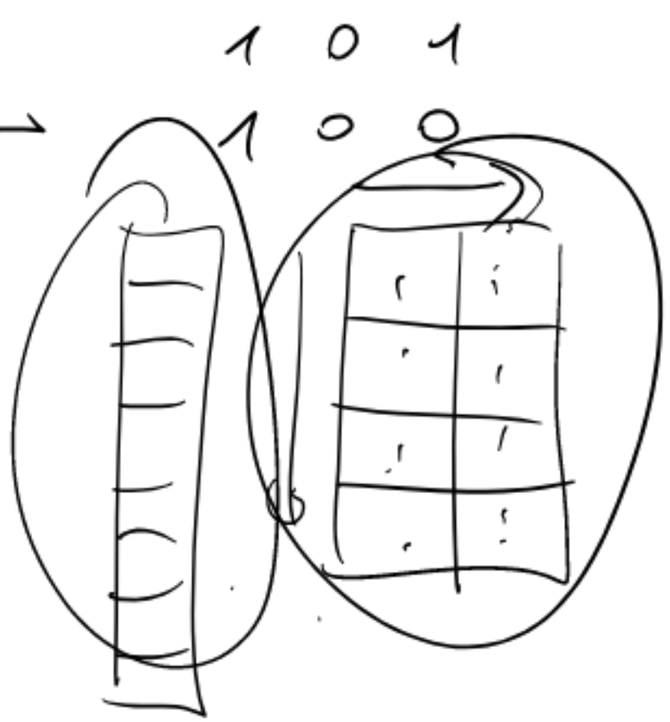
0 1 1

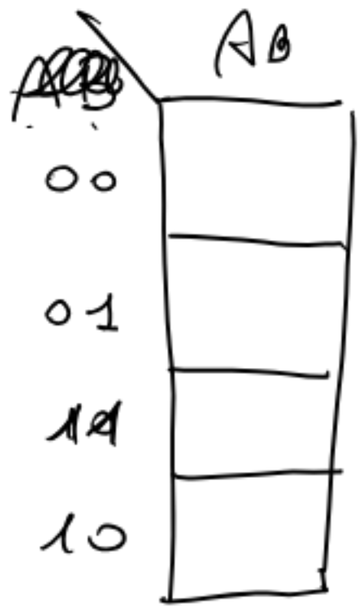
SEQ. COMBINAZIONI : fra una combinazione e quella succ/prec deve cambiare solo UNA VARIABILE.

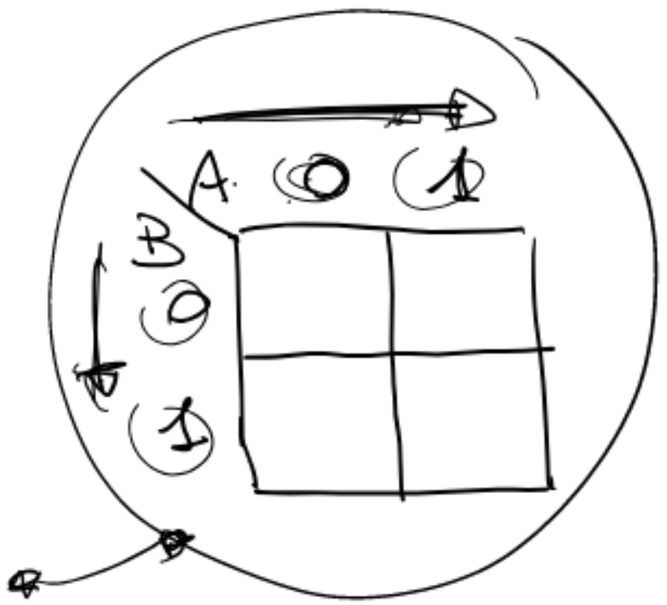
A, B

TAB N° CELLE = $2^{N^{\circ}VAR} = N^{\circ}$ combinazioni









A	B	F	M
0	0	0	$\bar{A}\bar{B}$
0	1	1	$\bar{A}B$
1	1	1	AB
1	0	0	$A\bar{B}$

B \ A	0	1
0	$\bar{A}\bar{B}$	$A\bar{B}$
1	$\bar{A}B$	AB

SOLO CELLE MIN, $F_i = 1$

$\bar{B}$

$B = \cos$

B \ A	0	1
0	1	1
1	1	1

M-K

$F = \bar{A}B + AB$

$F = \bar{A}B + AB = B(\bar{A}+A)$

$F = B$

SEMPLIF. ALGEBR.

RAGGRUPPAMENTO CELLE ADIACENTI

$\Rightarrow$ TERMINE SEMPLIFICATO

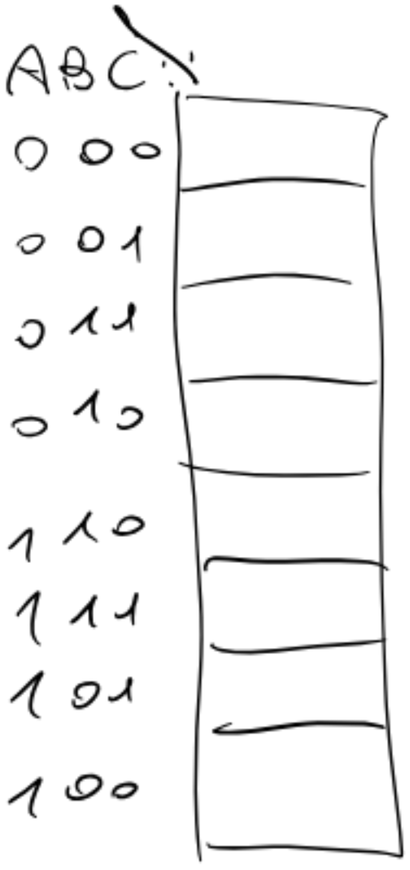
VAR CAMBIANO + se tutte le combinazioni

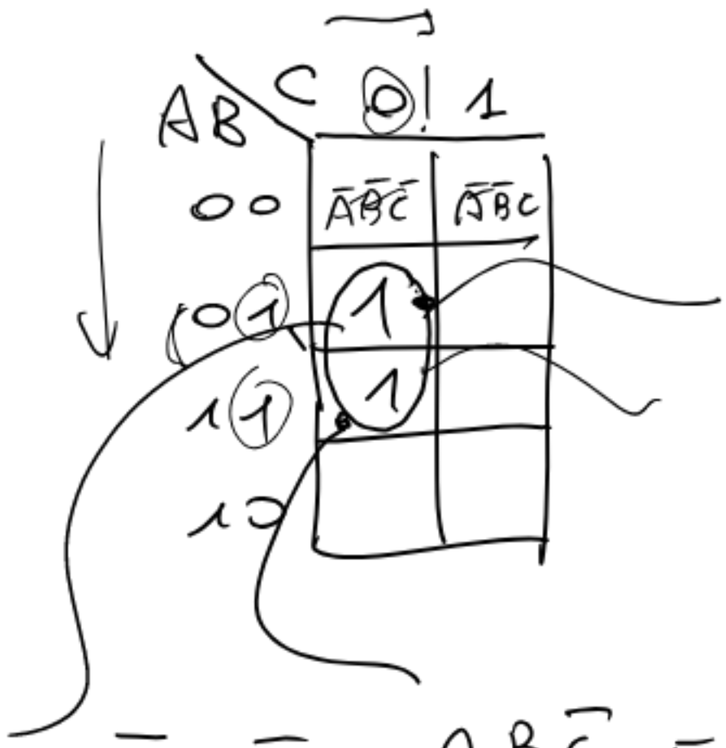
VAR COSTANTI

RIMANE

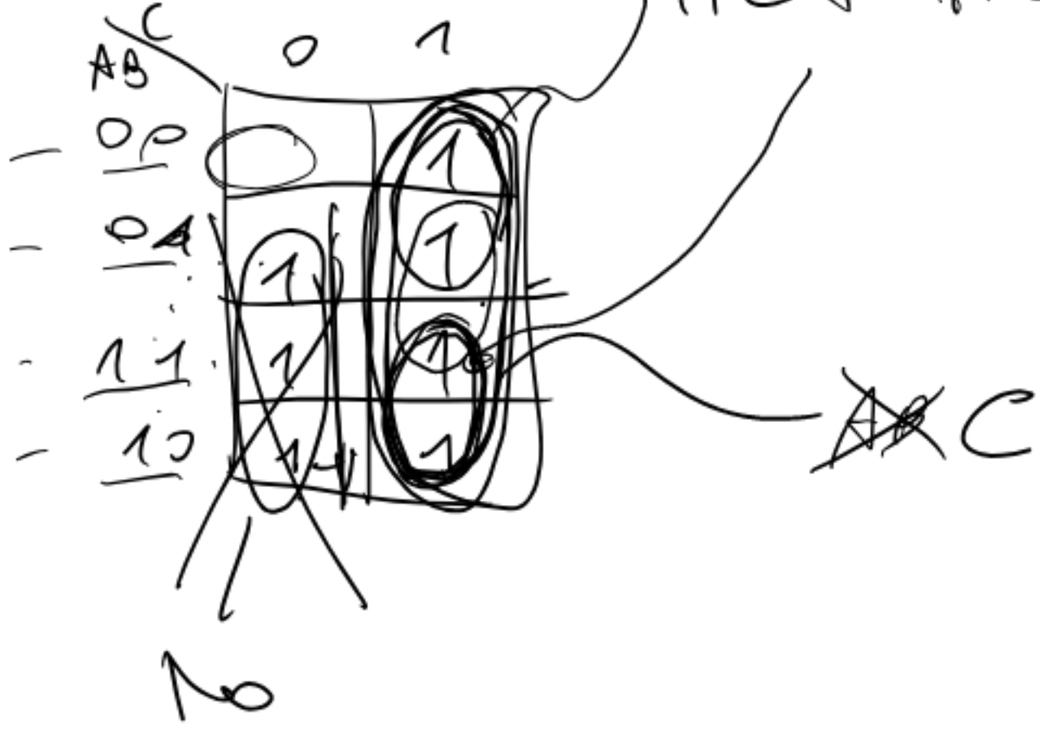
U SEMPLIFICATO

REGOLE



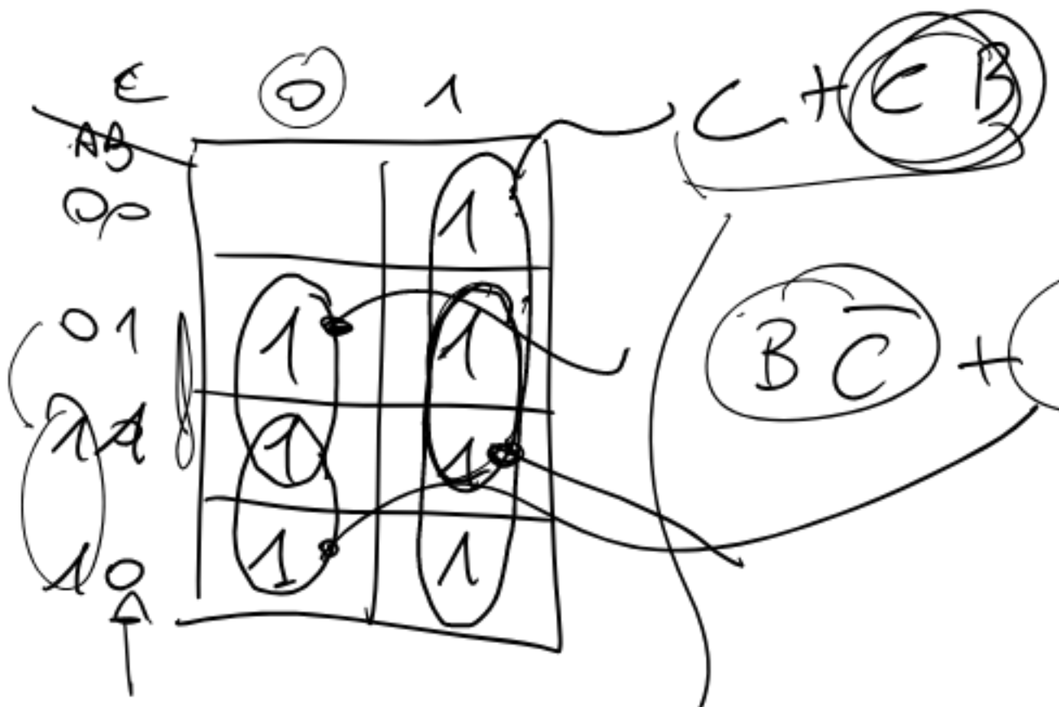


$\bar{A}B\bar{C} + AB\bar{C} = B\bar{C}(\bar{A}+A) = B\bar{C}$



I) RAGGRUPPAMENTO PIÙ GRANDE POSSIBILE

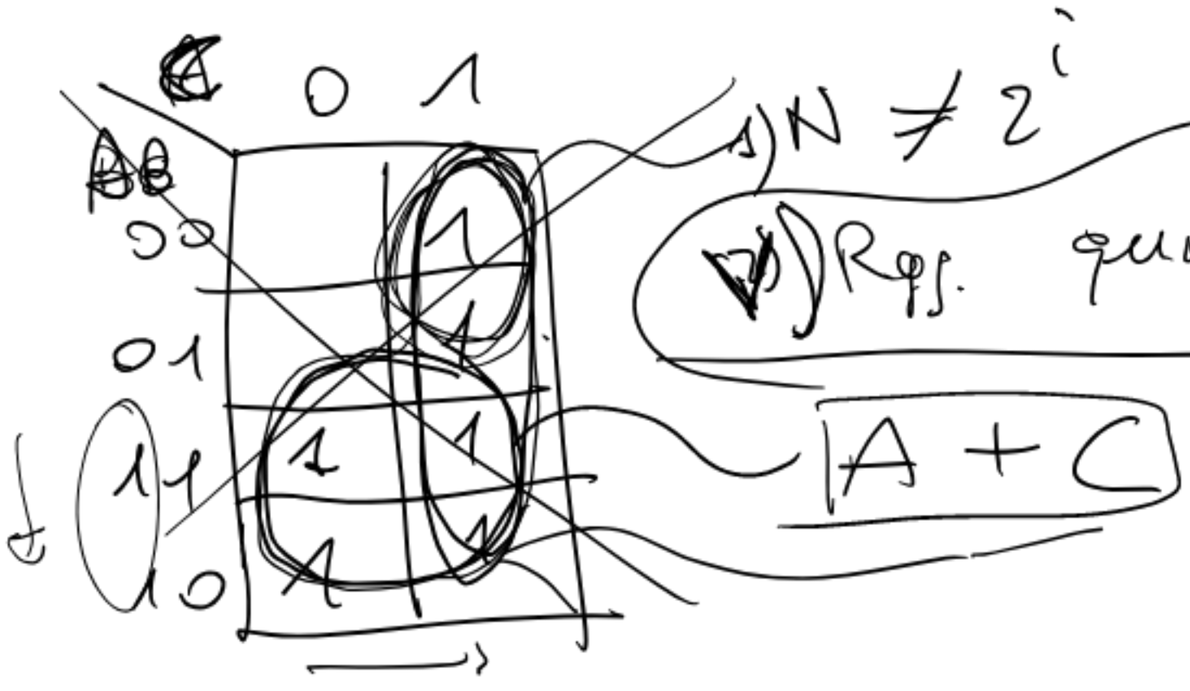
II) NUMERO CELLE RAGGRUPPAMENTO 2^i !!!



III) Regg. si possono intersecare.

IV) NO Regg. contenuto in altro regg.

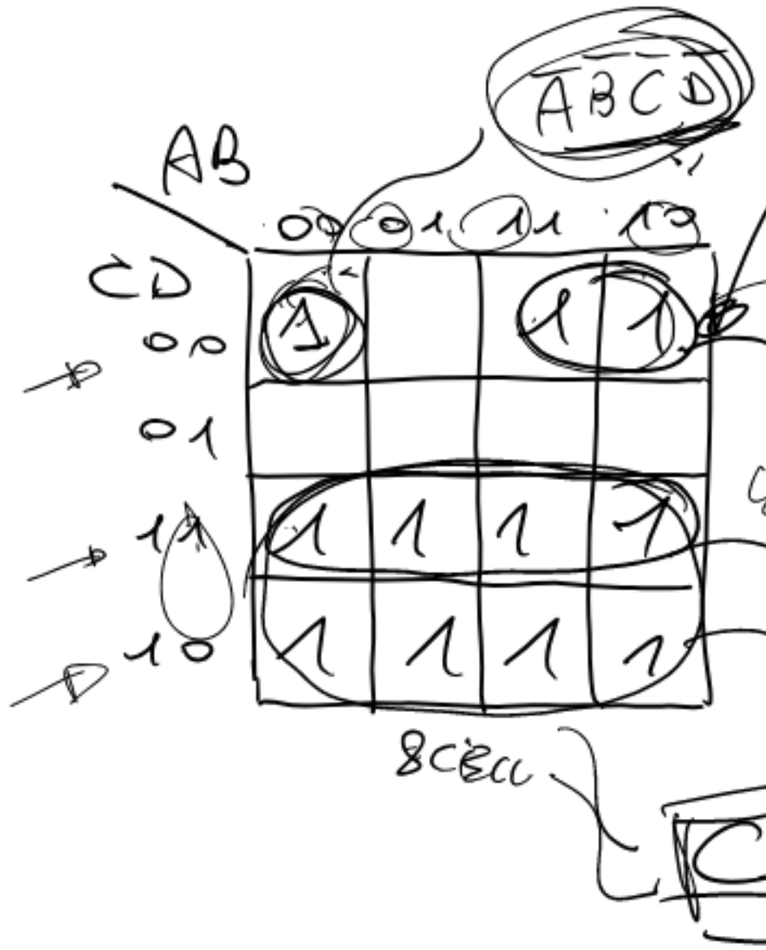
$\bar{C}(A+B)$



V) $N \neq 2^i$

VI) Regg. quadrato / rettangolare.

Più sono grandi Regg. ⟹ MENO VAR contenute

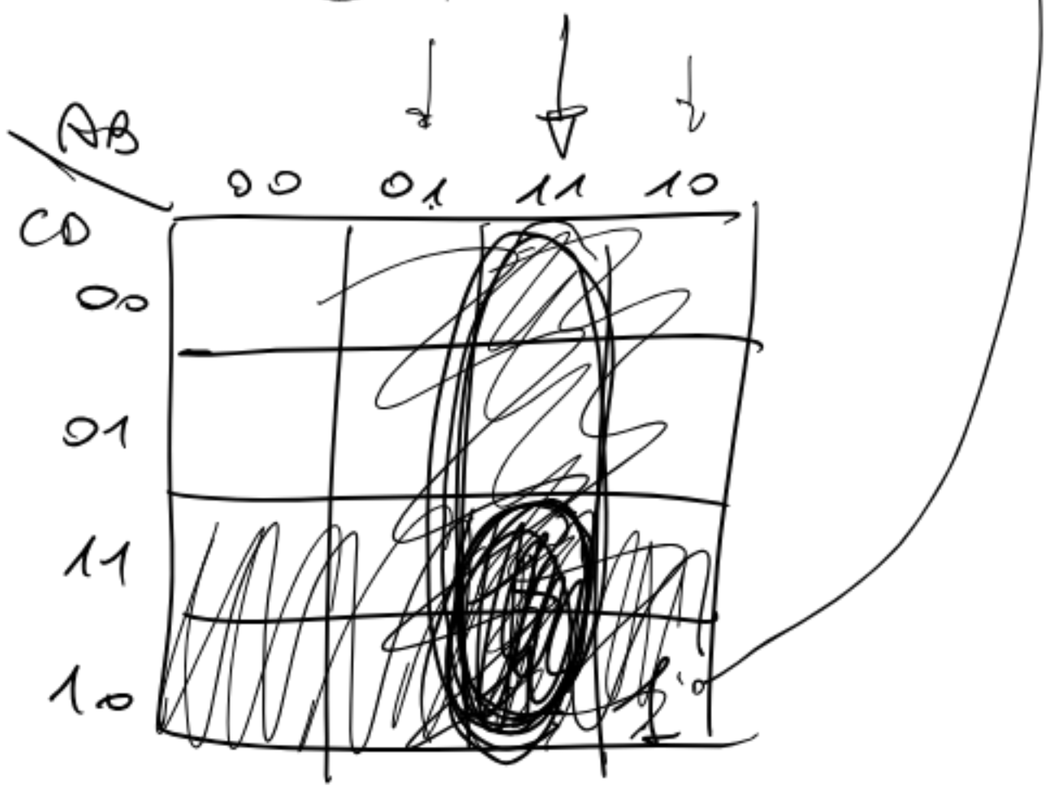


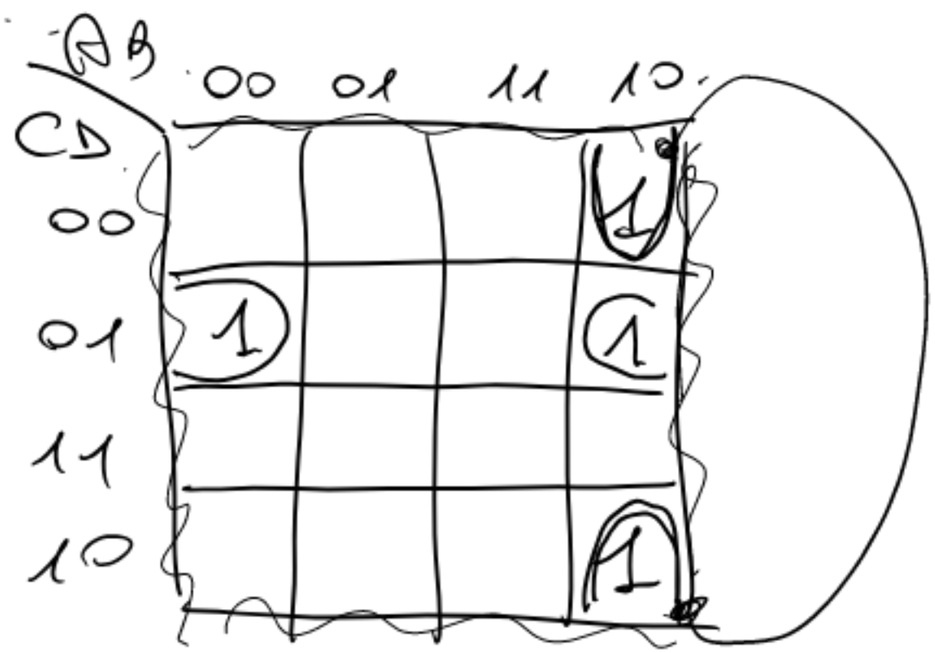
F = MINTERM

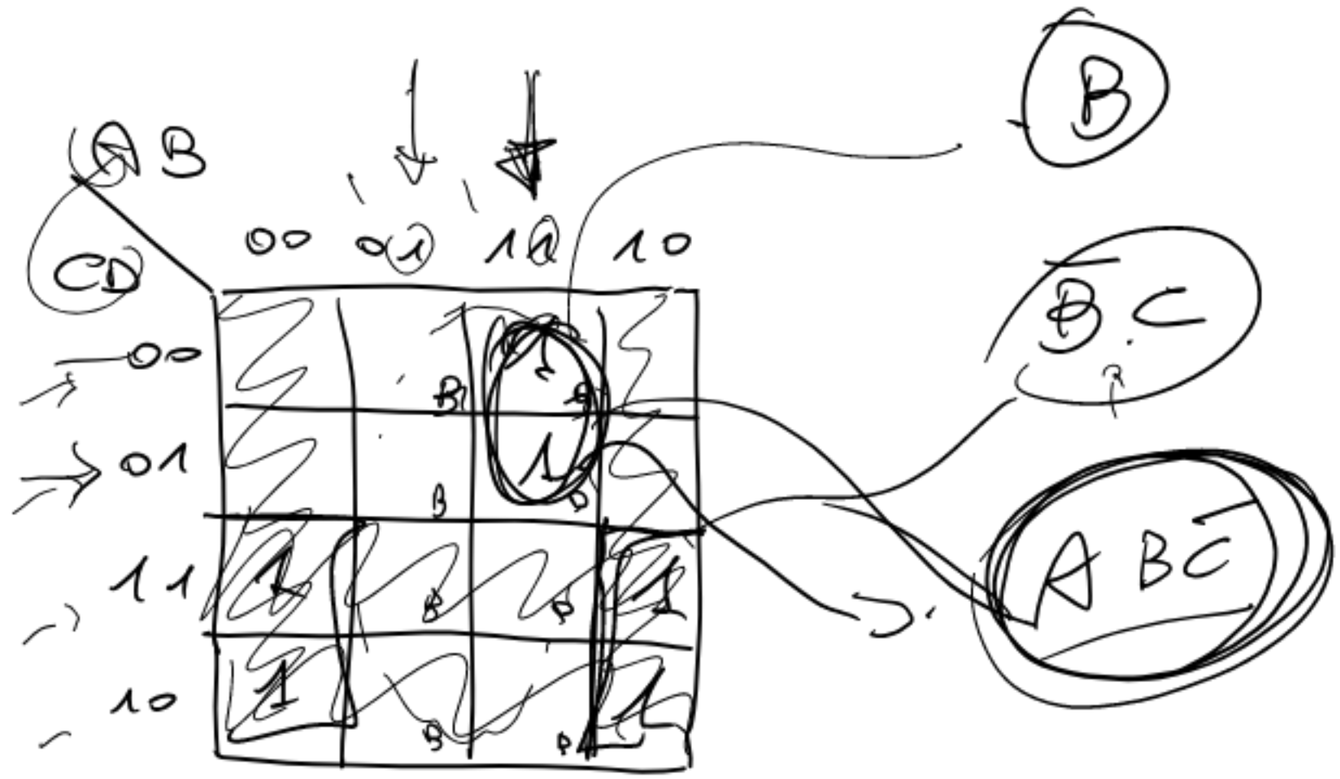
A

= A.BC + AB̄CD

A







- MAPPA "QUADRATA"
- SEQ COMBINATIONI
  ⇒ CELLE ADIACENTI
- CELLA MINTERM.
- Raggr.
  a) $N = 2^i$
  b) N più grande possibile
  c) quadrato/rettangolo
  d) si intersecano
  e) "NO" CONTENUTO.