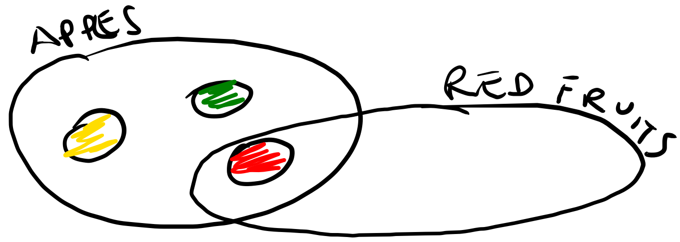
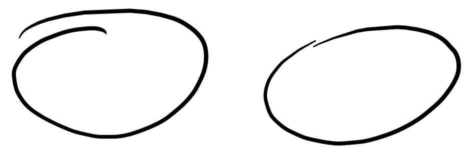
SETS (insiemi), Functions (funzioni)

Set : is a collection of elements (objects) that share some kind of property.

- the set of red fruits -

$R = \{$red apples, cherries, red pears, red tomatoes$\}$





EMPTY SET $\emptyset$

$a \in A$, if a is in the set A

belongs to
(appartiene a)

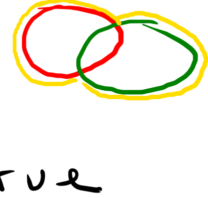
$A = \{a, b, c, d\}$

$B = \{b, c, e\}$

$\boxed{\text{union}}$: is the set of elements contained in both A and B

$\cup$

$A \cup B = \{a, b, c, d, e\} = C$



$c \in A \rightarrow$ true, $c \in B \rightarrow$ true

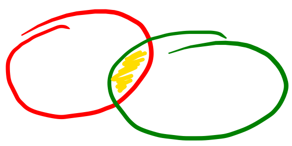
$c \in C \rightarrow$ true

<u>intersection</u> : is the set of elements contained in both A & B

$\cap$

$A = \{a, b, c, d\}$ $\quad$ $A \cap B = \{b, c\} = C$

$B = \{b, c, e\}$

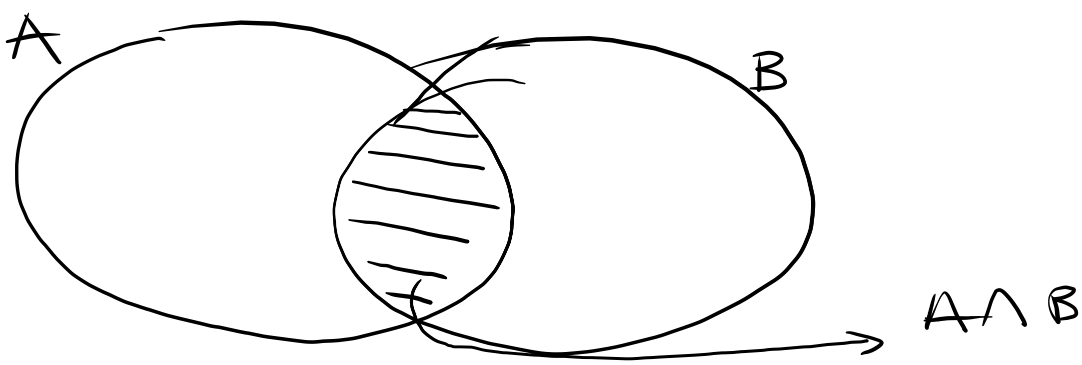


<u>cardinality</u> : the number of elements in a set

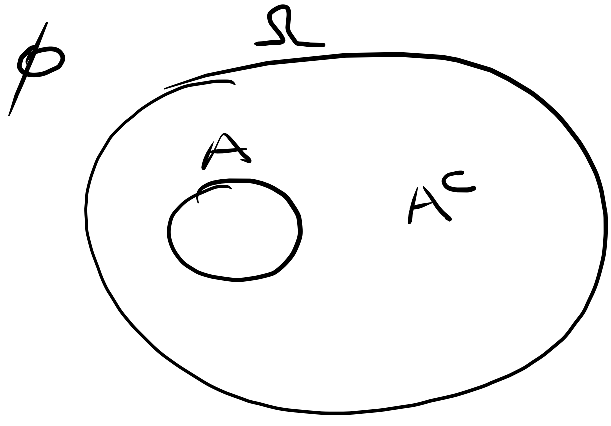
$\#$

$\#A$ $\quad$ $\#B$ are known

$$\#(A \cup B) = \#A + \#B - \#(A \cap B)$$



<u>complement</u> : is the set of elements not contained in the given set



$A' = \bar{A} = A^c$

$\Omega^c = \phi$

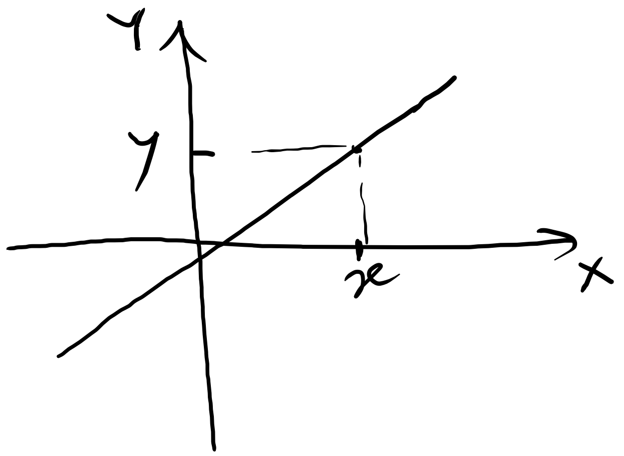
$A \cap A^c = \phi$

$\# \phi = 0$

<u>Functions</u> : is a relation betwen two sets

<u>injecture</u> : every image in the domain has exactly one counterimage in the codomain

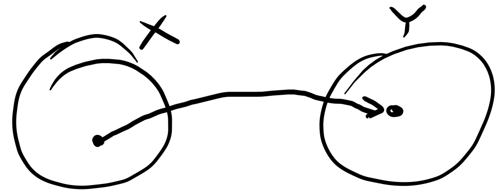
<u>surjecture</u> : every image in the domain has at least one counterimage in the codomain



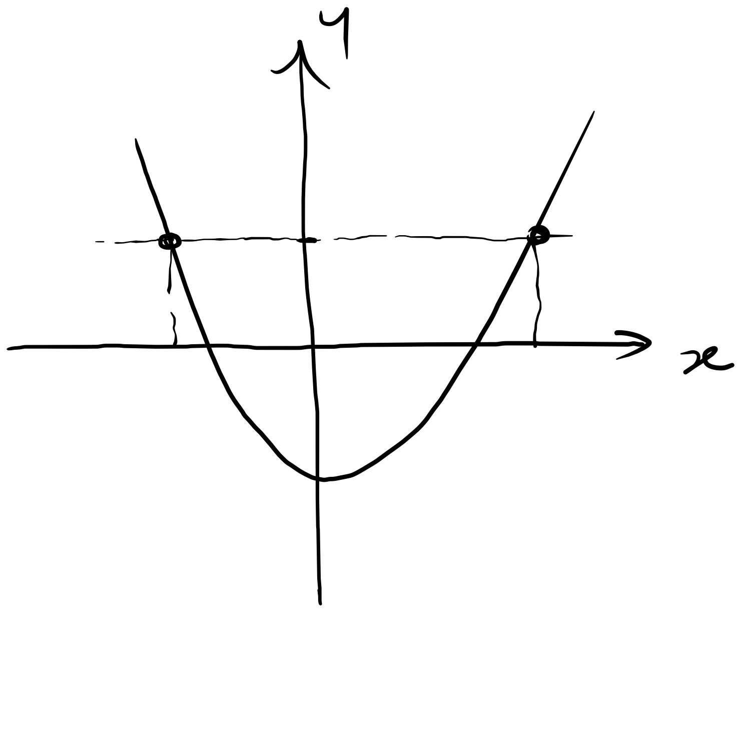
X is the domain
Y is the codomain

$f(x) = y$ **bijective**

$f: X \to Y$

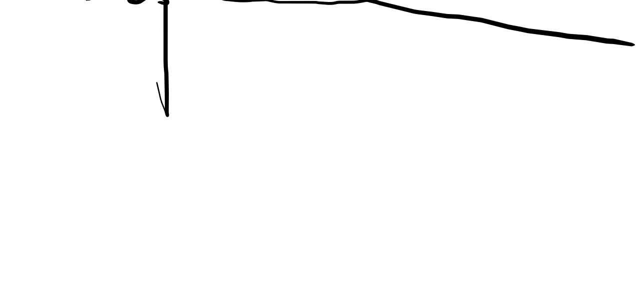


PARABOLA



$y = ax^2 + bx + c$

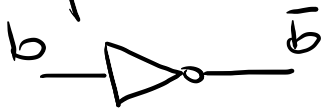
$y = \sqrt{x}$



Digital Logic Gates — Boolean Algebra (5)

$B = \{0, 1\} = \{F, T\}$, $b \in B$

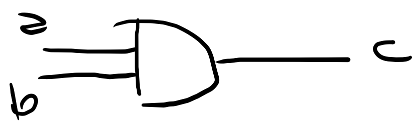
- complement : $\neg b$, $\bar{b}$



NOT

b	$\bar{b}$
0	1
1	0

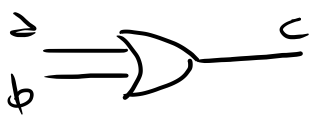
- operation AND



$c = a \cdot b$

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

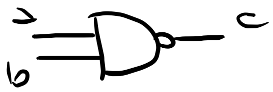
- OR



$c = a + b$

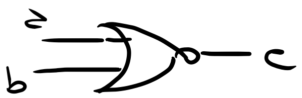
a	b	c
0	0	0
0	1	1
1	0	1
1	1	1

NAND



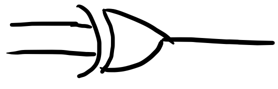
$\overline{a \cdot b}$

NOR



$\overline{a + b}$

XOR



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

NOT $\overline{\overline{A}} = A$

AND $A \cdot A = A$, $A \cdot 0 = 0$, $A \cdot 1 = A$
$A \cdot \overline{A} = 0$

OR $A + A = A$, $A + 0 = A$, $A + 1 = 1$
$A + \overline{A} = 1$

distributive $A \cdot (B + C) = A \cdot B + A \cdot C$

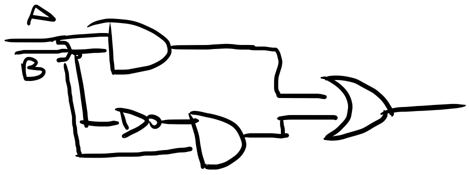
commutative $A + B = B + A$
$A \cdot B = B \cdot A$

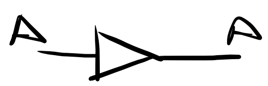
associative $A \underset{+}{\cdot} (B \underset{+}{\cdot} C) = (A \underset{+}{\cdot} B) \underset{+}{\cdot} C$

De Morgan's laws

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

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





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A	B	C	F	
0	0	0	0	m_0
0	0	1	0	m_1
0	1	0	1	m_2
0	1	1	0	m_3
1	0	0	1	m_4
1	0	1	1	
1	1	0	1	
1	1	1	1	m_7

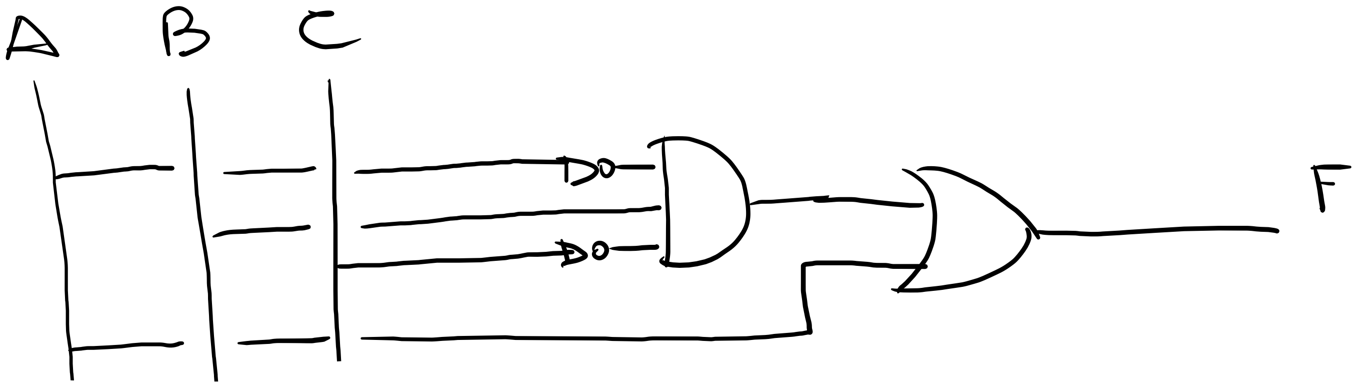
"Sum" (OR) is going 1 if at least one term in the sum is one

$F(A,B,C) = m_0 + m_1 + m_2 + m_3 + m_4 + m_5 + m_6 + m_7$

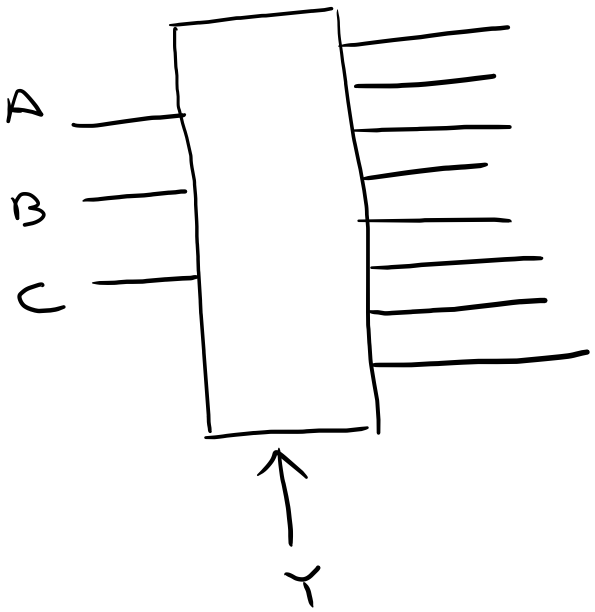
$$F = \underbrace{\bar{A}B\bar{C}}_{m_2} + \underbrace{A\bar{B}\bar{C}}_{m_4} + \underbrace{A\bar{B}C}_{m_5} + \underbrace{AB\bar{C}}_{m_6} + ABC =$$

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

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



minterms
maxterms



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A	B	C	Y	F_0	F_1	F_2	…