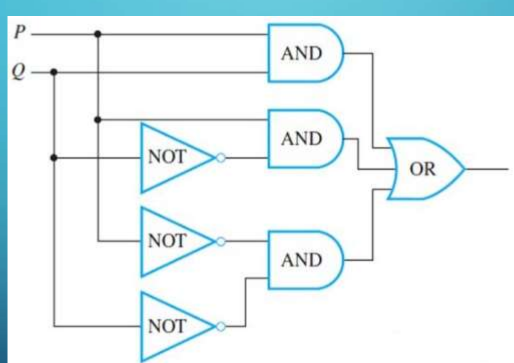
BOOLEAN IDENTITIES

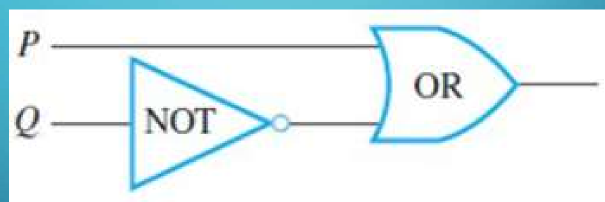
1

- Complete the truth table and find the Boolean Expression for the output



2

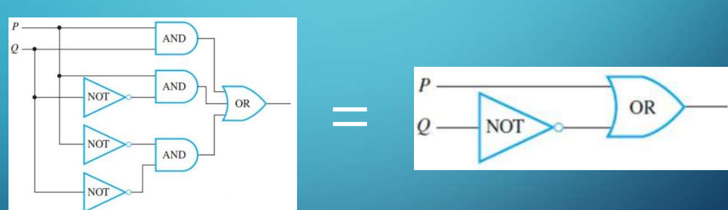
- Complete the truth table and find the Boolean Expression for the output



3

WHY DO WE NEED BOOLEAN ALGEBRA?

- Boolean algebra allows for the simplification of complex logic circuits



4

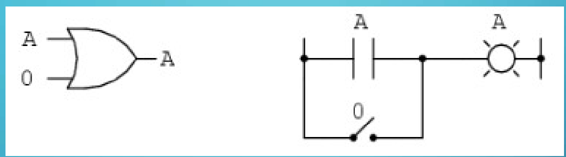
PROVING EQUIVALENCE

- Method 1: Proof by perfect induction (brute force)
  - Compare the complete truth tables of both circuits
- Method 2: Boolean Identities
  - Compare LS to RS

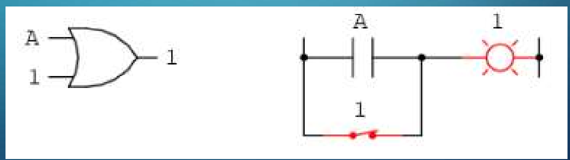
5

BOOLEAN IDENTITIES

- A+0=A

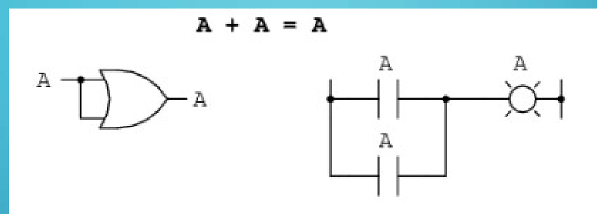


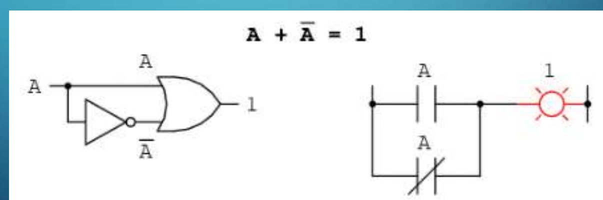
- A+1=1



6

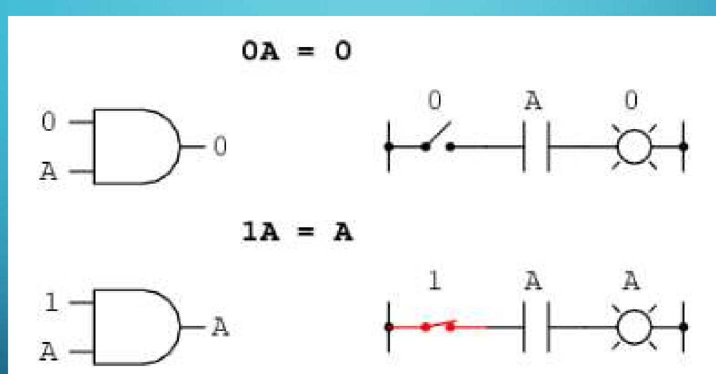
BOOLEAN IDENTITIES





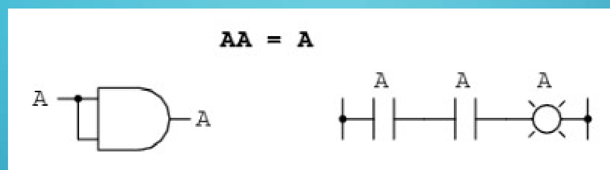
7

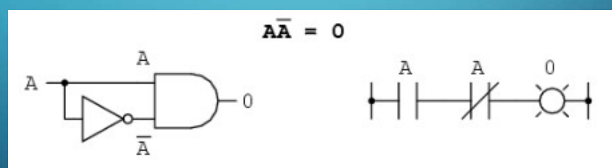
BOOLEAN IDENTITIES



8

BOOLEAN IDENTITIES





9

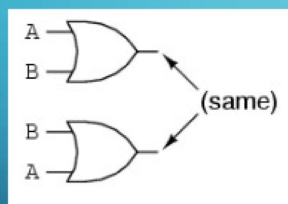
SUMMARY OF IDENTITIES

Additive	Multiplicative
$A + 0 = A$	$0A = 0$
$A + 1 = 1$	$1A = A$
$A + A = A$	$AA = A$
$A + \overline{A} = 1$	$A\overline{A} = 0$

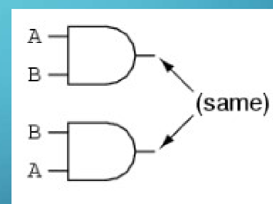
10

COMMUTATIVE PROPERTY

- Addition
  - A+B=B+A



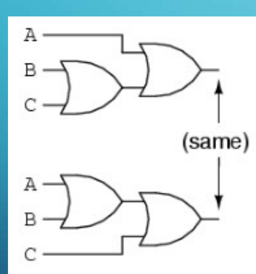
- Multiplication
  - AB=BA



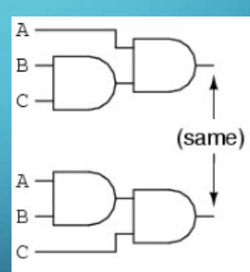
11

ASSOCIATIVE PROPERTY

- Addition
  - A+(B+C)=(A+B)+C



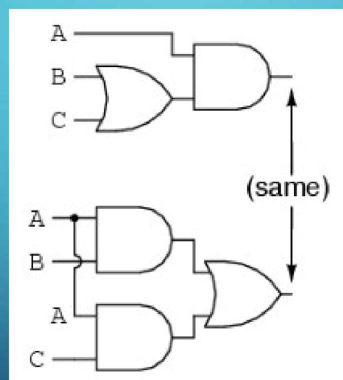
- Multiplication
  - A(BC)=(AB)C



12

DISTRIBUTIVE PROPERTY

- A(B+C)=AB+AC



13

INVOLUTION PROPERTY

- $\bar{\bar{A}} = A$

DEMORGAN'S THEOREM

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

14

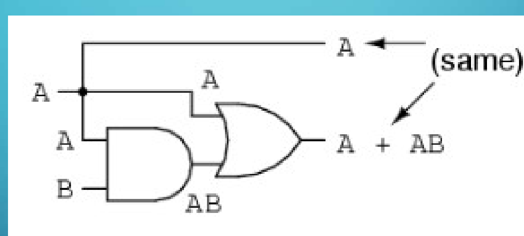
SUMMARY

- $AA = A$
- $A0 = 0$
- $A1 = A$
- $A\bar{A} = 0$
- $A + A = A$
- $A + 0 = A$
- $A + 1 = 1$
- $A + \bar{A} = 1$
- $AB = BA$
- $A + B = B + A$
- $A + (B + C) = (A + B) + C$
- $(AB)C = A(BC)$
- $A(B + C) = AB + AC$
- $\bar{\bar{A}} = A$
- $\overline{AB} = \bar{A} + \bar{B}$
- $\overline{A + B} = \bar{A} \cdot \bar{B}$

15

BOOLEAN SIMPLIFICATIONS

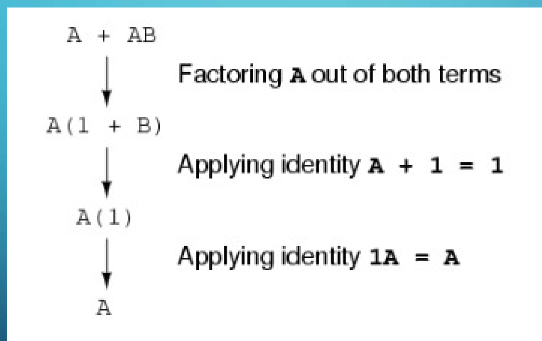
- A+AB=A



16

BOOLEAN SIMPLIFICATIONS

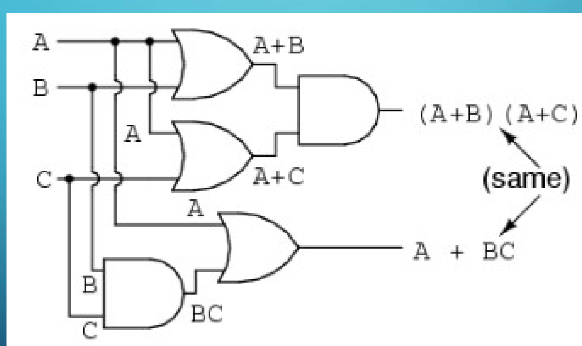
- A+AB=A



17

BOOLEAN SIMPLIFICATIONS

- $(A+B)(A+C) = A + BC$



18

BOOLEAN SIMPLIFICATIONS

- $(A + B)(A + C) = A + BC$

(A + B)(A + C)

↓ Distributing terms

AA + AC + AB + BC

↓ Applying identity **AA = A**

A + AC + AB + BC

↓ Applying rule **A + AB = A** to the A + AC term

A + AB + BC

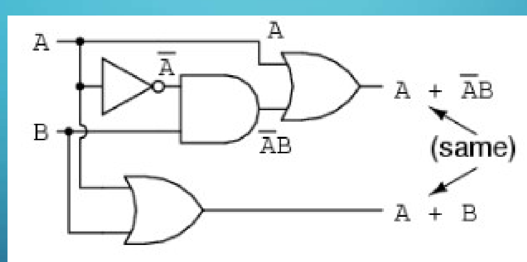
↓ Applying rule **A + AB = A** to the A + AB term

A + BC

19

BOOLEAN SIMPLIFICATIONS

- $A + \bar{A}B = A + B$



20

BOOLEAN SIMPLIFICATIONS

- $A + \bar{A}B = A + B$

$A + \overline{A}B$

↓ Applying the previous rule to expand **A** term **A + AB = A**

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

↓ Factoring **B** out of 2nd and 3rd terms

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

↓ Applying identity $\mathbf{A + \overline{A} = 1}$

$A + B(1)$

↓ Applying identity **1A = A**

$A + B$

21

22