SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ECE

23ECB222- Digital Principles and Computer Organization

II YEAR/ III SEMESTER

UNIT 1 – **MINIMIZATION TECHNIQUES AND LOGIC GATES**

TOPIC - BOOLEAN EXPRESSIONS,MINIMIZATION OF BOOLEAN EXPRESSION

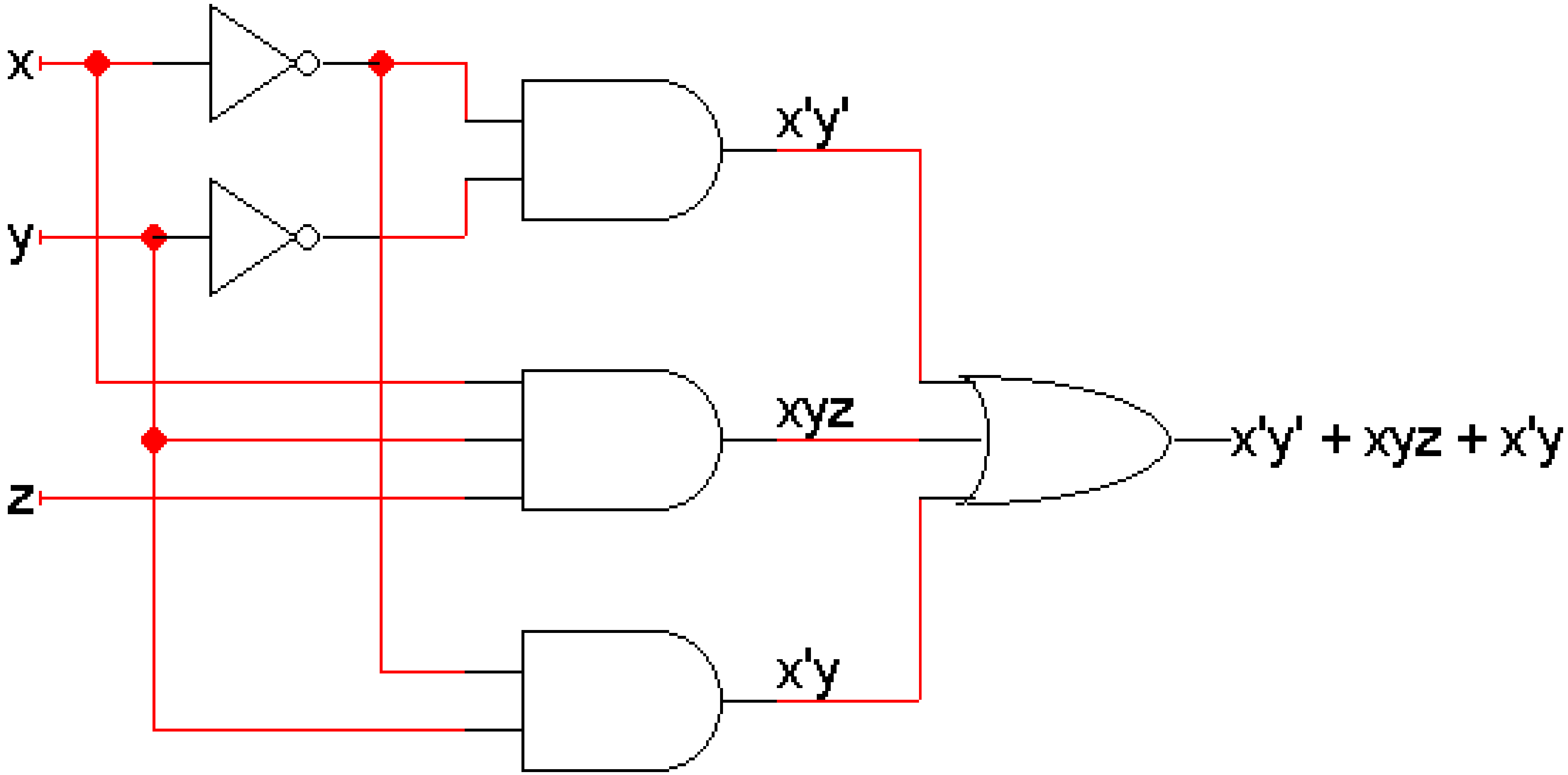
What is Minimization?

- A Boolean expression is composed of variables and terms. The simplification of Boolean expressions can lead to more effective computer programs, algorithms and circuits.

MINIMIZATION METHODS

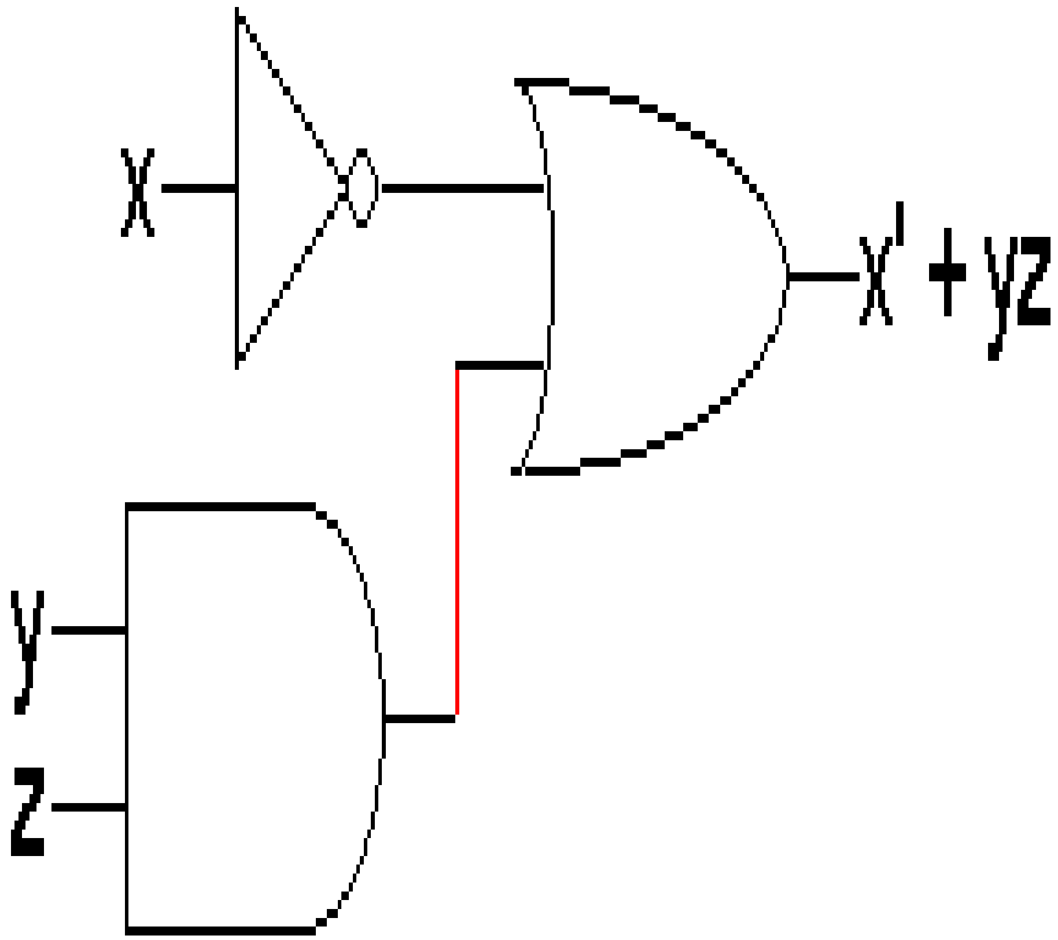
- Minimization can be achieved by a number of methods, three well known methods are:
  1. Algebraic Manipulation of Boolean Expressions
  2. Tabular Method of Minimization
  3. Karnaugh Maps

Algebraic Manipulation of Boolean Expressions



Algebraic Manipulationof Boolean Expressions

- Here are two different but *equivalent* circuits.
- In general the one with fewer gates is "better":
  - It costs less to build
  - It requires less power
  - But we had to do some work to find the second form



ALGEBRAIC MANIPULATION

EXAMPLE 1

$$x'y' + xyz + x'y$$

$$= x'(y' + y) + xyz \quad [\text{Distributive: } x'y' + x'y = x'(y' + y)]$$

$$= x' \bullet 1 + xyz \quad [\text{complement: } x' + x = 1]$$

$$= x' + xyz \quad [\text{identity: } x' \bullet 1 = x']$$

$$= (x' + x)(x' + yz) \quad [\text{Distributive}]$$

$$= 1 \bullet (x' + yz) \quad [\text{complement: } x' + x = 1]$$

$$= x' + yz \quad [\text{identity}]$$

PROBLEMS-BOOLEAN MINIMIZATION

- $AB + \overline{A}C + BC = AB + \overline{A}C$ (Consensus Theorem)

Proof Steps	**Justification**
$AB + \overline{A}C + BC$	
$= AB + \overline{A}C + 1 \cdot BC$	Identity element
$= AB + \overline{A}C + (A + \overline{A}) \cdot BC$	Complement
$= AB + \overline{A}C + ABC + \overline{A}BC$	Distributive
$= AB + ABC + \overline{A}C + \overline{A}CB$	Commutative
$= AB \cdot 1 + ABC + \overline{A}C \cdot 1 + \overline{A}CB$	Identity element
$= AB\,(1+C) + \overline{A}C\,(1 + B)$	Distributive
$= AB\,.\,1 + \overline{A}C\,.\,1$	$1+X = 1$
$= AB + \overline{A}C$	Identity element

- Example 1: A two-level logic expression

$$Z = A'BC + AB'C' + AB'C + ABC' + ABC$$

$= AB'C + AB'C' + A'BC + ABC' + ABC$	rearrange
$= AB'(C + C') + A'BC + AB(C' + C)$	distributive
$= AB' + A'BC + AB$	comp.
$= AB' + AB + A'BC$	rearrange
$= A(B' + B) + A'BC$	distributive
$= A + A'BC$	comp.

- *Use absorption #2D {(X•Y')+Y=X+Y} with X=BC and Y=A*

$$Z = A + BC$$

EXAMPLE

- $(A + B)(A + C) = A + BC$
- This rule can be proved as follows:
- $(A + B)(A + C) = AA + AC + AB + BC$ (Distributive law)

$= A + AC + AB + BC$ $(AA = A)$

$= A(1 + C) + AB + BC$ $(1 + C = 1)$

$= A.\ 1 + AB + BC$

$= A(1 + B) + BC$ $(1 + B = 1)$

$= A.\ 1 + BC$ $(A\ .\ 1 = A)$

$= A + BC$

ASSESSMENT TIME

SOLVE THE EXPRESSIONS USING BOOLEAN LAWS

1. $F(A,B,C) = A'B + BC' + BC + AB'C'$

2. $F(A,B,C) = (A+B)(A+C)$

REFERENCES

1.M. Morris Mano, “Digital Design” 4TH Edition PHI/2008, Singapore Pvt.Ltd,new Delhi 2003.

2.John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.

THANK YOU