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 COMPUTER SCIENCE ENGINEERING

19ECB231 – DIGITAL ELECTRONICS

II YEAR/ III SEMESTER

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

TOPIC - BOOLEAN EXPRESSIONS,MINIMIZATION OF BOOLEAN EXPRESSION

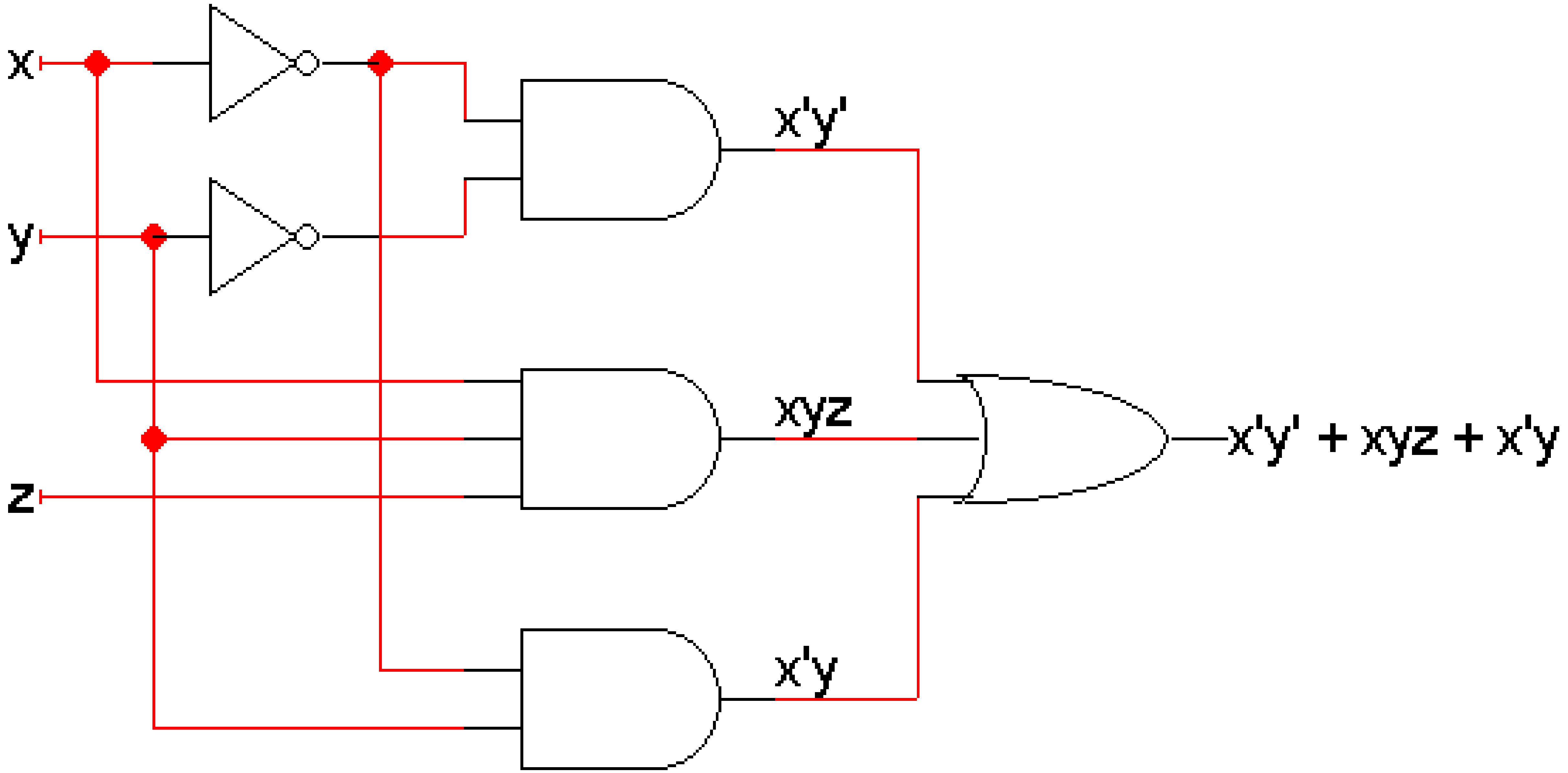
What is Minimization?

- 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

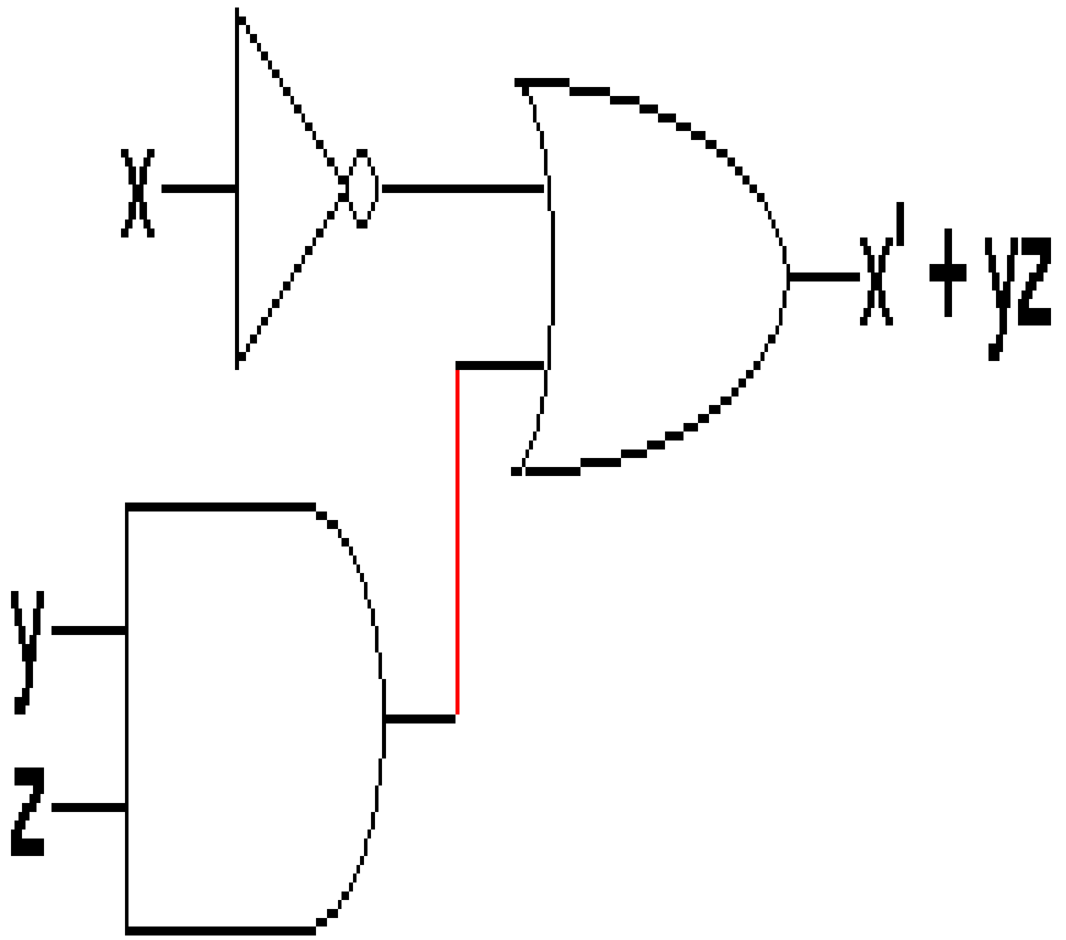
- Minimisation can be achieved by a number of methods, three well known methods are:
  1. Algebraic Manipulation of Boolean Expressions
  2. Tabular Method of Minimization
  3. Karnaugh Maps

Algebraic Manipulation of Boolean Expressions



Algebraic Manipulation of 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

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

$= x'(y' + y) + xyz$ [Distributive: $x'y' + x'y = x'(y' + y)$]

$= x' \bullet 1 + xyz$ [complement: $x' + x = 1$]

$= x' + xyz$ [identity: $x' \bullet 1 = x'$]

$= (x' + x)(x' + yz)$ [Distributive]

$= 1 \bullet (x' + yz)$ [complement: $x' + x = 1$]

$= x' + yz$ [identity]

PROBLEMS-BOOLEAN MINIMIZATION

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

<u>Proof Steps</u>	<u>Justification</u>
$AB + \overline{A}C + BC$	
$= AB + \overline{A}C + 1 \cdot BC$	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)

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

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

$$= A.\,1 + AB + BC$$

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

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

$$= A + BC$$

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” 4^{TH} Edition PHI/2008, Singapore Pvt.Ltd,new Delhi 2003.

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

THANK YOU