SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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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

MINIMIZATION OF BOOLEAN ALGEBRA

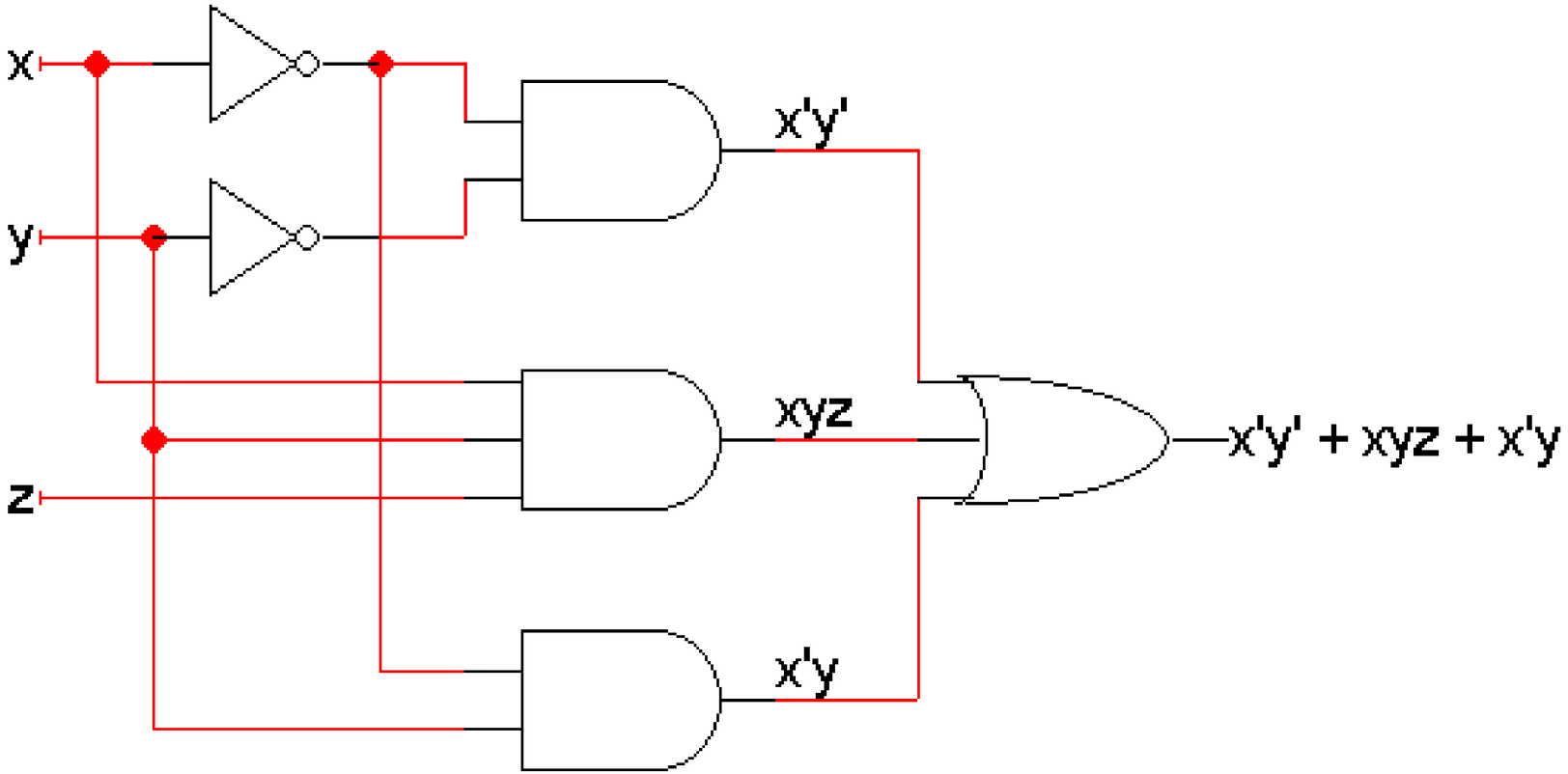
What is Minimization?

- 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

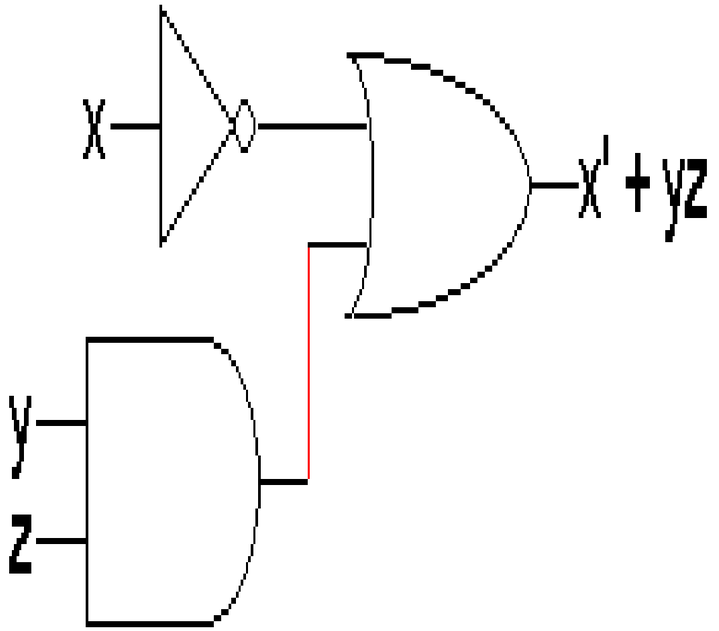
- Minimisation can be achieved by a number of methods, three well known methods are:
  1. Algebraic Manipulation of Boolean Expressions
  2. Tabular Method of Minimization
  3. Karnaugh Maps

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: $x'y' + x'y = x'(y' + y)$]

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

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

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

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

$= x' + yz$ [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

$$
\begin{aligned}
Z &= A'BC + AB'C' + AB'C + ABC' + ABC \\
&= AB'C + AB'C' + A'BC + ABC' + ABC && \text{rearrange} \\
&= AB'(C + C') + A'BC + AB(C' + C) && \text{distributive} \\
&= AB' + A'BC + AB && \text{comp.} \\
&= AB' + AB + A'BC && \text{rearrange} \\
&= A(B' + B) + A'BC && \text{distributive} \\
&= A + A'BC && \text{comp.}
\end{aligned}
$$

- *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)

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

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

$= A.\ 1 + AB + BC$

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

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

$= A + BC$

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