TEKNIK DIGITAL (A)
(TI 2104)

Materi Kuliah ke-4

LOGIC GATE

Overview

- **Binary logic and Gates**
- **Boolean Algebra**
  - Basic Properties
  - Algebraic Manipulation
- **Standard and Canonical Forms**
  - Minterms and Maxterms (Canonical forms)
  - SOP and POS (Standard forms)
- **Karnaugh Maps (K-Maps)**
  - 2, 3, 4, and 5 variable maps
  - Simplification using K-Maps
- **K-Map Manipulation**
  - Implicants: Prime, Essential
  - Don't Cares

Binary Logic

- Deals with binary variables that take 2 discrete values (0 and 1), and with logic operations
- Three basic logic operations:
  - AND, OR, NOT
- Binary/logic variables are typically represented as letters: A,B,C,…,X,Y,Z

Binary Logic Function

F(vars) = *expression*

set of binary variables

- Operators (+, •, ')
- Variables
- Constants (0, 1)
- Groupings (parenthesis)

Example: F(a,b) = a'•b + b'

G(x,y,z) = x•(y+z')

Basic Logic Operators

- 1-bit logic AND resembles binary multiplication:

  $0 \bullet 0 = 0, \quad 0 \bullet 1 = 0,$

  $1 \bullet 0 = 0, \quad 1 \bullet 1 = 1$

- 1-bit logic OR resembles binary addition, except for one operation:

  $0 + 0 = 0, \quad 0 + 1 = 1,$

  $1 + 0 = 1, \quad 1 + 1 = 1 \; (? \; 10_2)$

Truth Tables for logic operators

Truth table: tabular form that uniquely represents the relationship between the input variables of a function and its output

2-Input **AND**

A	B	F=A•B
0	0	0
0	1	0
1	0	0
1	1	1

2-Input **OR**

A	B	F=A+B
0	0	0
0	1	1
1	0	1
1	1	1

NOT

A	F=A'
0	1
1	0

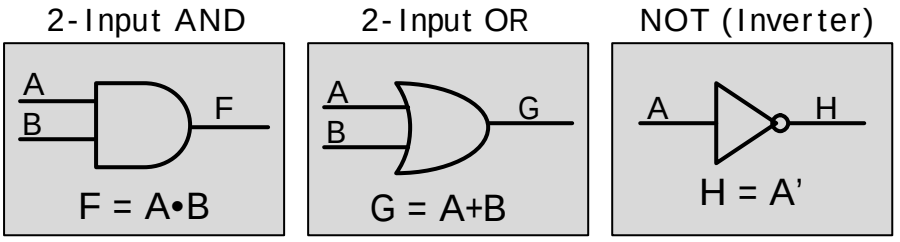
Truth Tables (cont.)

- Q: Let a function F() depend on *n* variables. How many rows are there in the truth table of F() ?

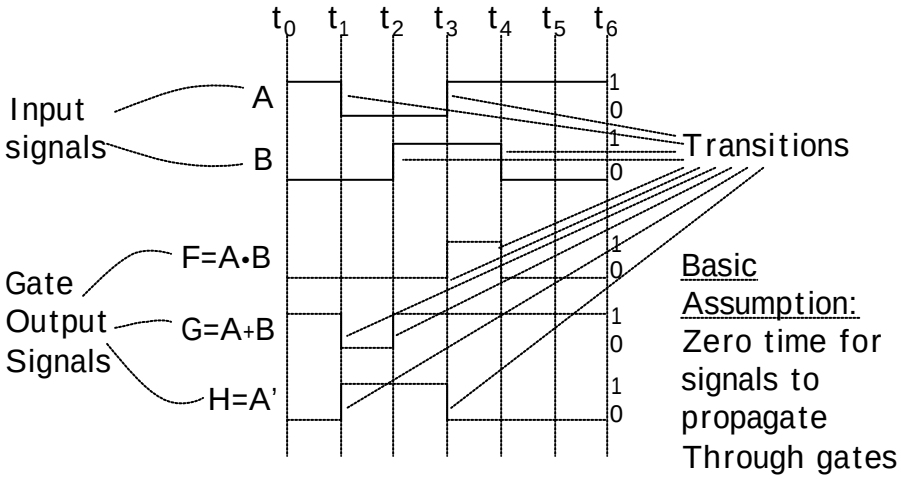
A: 2^n rows, since there are 2^n possible binary patterns/combinations for the *n* variables

Logic Gates

- Logic gates are abstractions of electronic circuit components that operate on one or more input signals to produce an output signal.



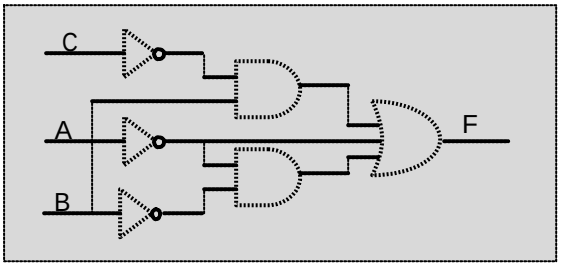
Timing Diagram



Basic Assumption: Zero time for signals to propagate Through gates

Combinational Logic Circuit from Logic Function

- Consider function F = A' + B•C' + A'•B'
- A combinational logic circuit can be constructed to implement F, by appropriately connecting input signals and logic gates:
  - Circuit input signals → from function variables (A, B, C)
  - Circuit output signal → function output (F)
  - Logic gates → from logic operations

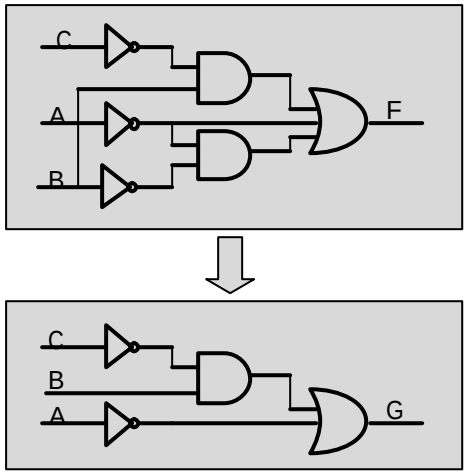


Combinational Logic Circuit from Logic Function (cont.)

- In order to design a cost-effective and efficient circuit, we must minimize the circuit's size (area) and propagation delay (time required for an input signal change to be observed at the output line)
- Observe the truth table of F=A' + B•C' + A'•B' and G=A' + B•C'
- Truth tables for F and G are identical → same function
- Use G to implement the logic circuit (less components)

A	B	C	F	G
0	0	0	1	1
0	0	1	1	1
0	1	0	1	1
0	1	1	1	1
1	0	0	0	0
1	0	1	0	0
1	1	0	1	1
1	1	1	0	0

Combinational Logic Circuit from Logic Function (cont.)



TUGAS 3

CARI DATA SHEET DARI IC CMOS & TTL SERIES DI INTERNET :

$74_{LS}00$, $74_{LS}02$, $74_{LS}04$, $74_{LS}08$, $74_{LS}10$, $74_{LS}11$, $74_{LS}20$, $74_{LS}21$, $74_{LS}27$, $74_{LS}30$, $74_{LS}32$, $74_{LS}86$