EE 200- Digital Logic Circuit Design
1.9 Binary Logic

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Entry Questions

- What is logic?
- What is **binary** logic?

Objectives

1. Binary Logic
   - Basic Logic Operations
   - Logic Circuits
   - Logic Gates

Introduction

- Binary logic deals with binary quantities which can take one of two values (0 & 1, True & False, ... etc).
- A binary number can be represented by a variable (x, y, z, A, B, C ... etc).

Basic Logic Operations

- AND: $x.y = z$ (or $xy = z$), reads x **AND** y is equal to z.
- OR : $x + y = z$, reads x **OR** y is equal to z.
- NOT: $x' = z$ (or $\bar{x} = z$), reads **NOT** x is equal to z.

Truth Tables

Example:

AND $(xy = z)$

x	y	z
F	F	F
F	T	F
T	F	F
T	T	T

OR $(x + y = z)$

x	y	z
F	F	F
F	T	T
T	F	T
T	T	T

NOT $(\bar{x} = z)$

x	z
F	T
T	F

Truth Tables

Example:

AND

x	y	z
0	0	0
0	1	0
1	0	0
1	1	1

OR

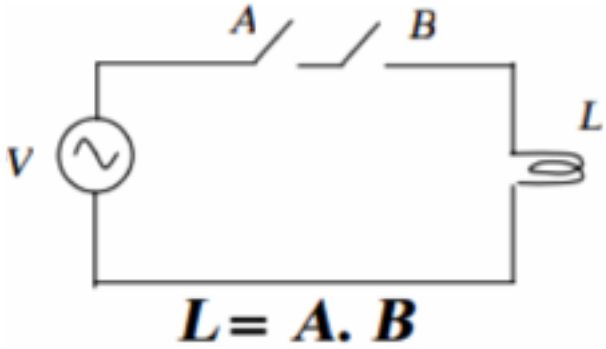
x	y	z
0	0	0
0	1	1
1	0	1
1	1	1

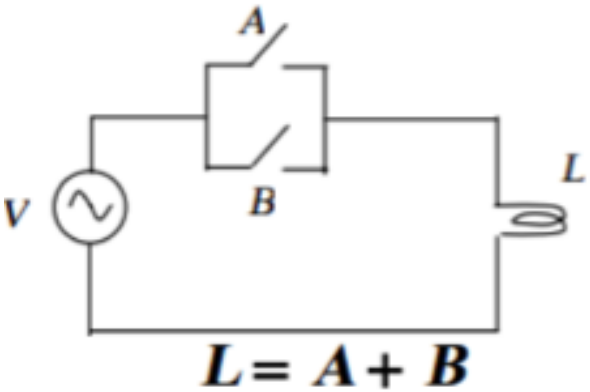
NOT

x	z
0	1
1	0

Logic Circuits

- Binary logic can be demonstrated by switching circuits as follows:





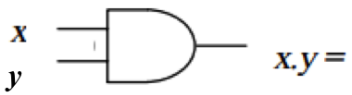
Logic Voltage levels

Binary Arithmetic vs. Binary Logic

- Binary Arithmetic: 1+1=10 (one plus one is equal to two).
- Binary Logic: 1+1=1 (one OR one is equal to one).

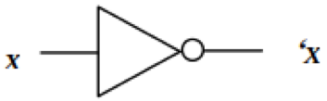
Logic Gates

- Conventional symbols for logic gates.



2-input AND gate

2-input OR gate

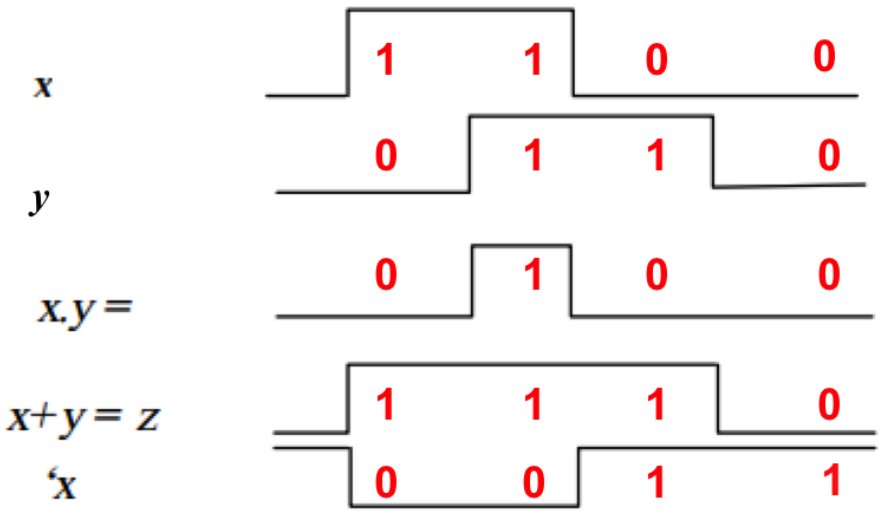


Inverter

- **AND** & **OR** gates can have more than two inputs.

Basic Logic Gates and Signal Waveforms

- Signals for logic gates may be represented in a signal waveform.



Properties of Boolean Algebra

1.	$x + 0 = x$	$x \cdot 1 = x$	Identity
2.	$x + x' = 1$	$x \cdot x' = 0$	Complement
3.	$x + y = y + x$	$x \cdot y = y \cdot x$	Commutative Law
4.	$x + (y + z) = (x + y) + z$	$x \cdot (y \cdot z) = (x \cdot y) \cdot z$	Associative Law
5.	$x + (y \cdot z) = (x + y) \cdot (x + z)$	$x \cdot (y + z) = (x \cdot y) + (x \cdot z)$	Distributive Law

Summary

Next Lecture

- Boolean Algebra