

Topics for today:

More digital logic

Basic circuits

### Question

Given a truth table, how do you find a circuit that produces it?

Use *sum-of-products* analysis.

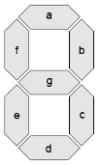
### Example

<u>A</u>	<u>B</u>	<u>C</u>	<u>Output</u>
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

Identity Name	AND Form	OR Form
Identity Law	$1x = x$	$0 + x = x$
Null (or Dominance) Law	$0x = 0$	$1 + x = 1$
Idempotent Law	$xx = x$	$x + x = x$
Inverse Law	$xx' = 0$	$x + x' = 1$
Commutative Law	$xy = yx$	$x + y = y + x$
Associative Law	$(xy)z = x(yz)$	$(x + y) + z = x + (y + z)$
Distributive Law	$x + (yz) = (x + y)(x + z)$	$x(y + z) = xy + xz$
Absorption Law	$x(x + y) = x$	$x + xy = x$
DeMorgan's Law	$(xy)' = x' + y'$	$(x + y)' = x'y'$
Double Complement Law	$x'' = x$	

TABLE 3.5 Basic Identities of Boolean Algebra

## Seven-Segment Display



Binary Inputs				Decoder Outputs							Output
A	B	C	D	a	b	c	d	e	f	g	
0	0	0	0	1	1	1	1	1	1	0	0
0	0	0	1	0	1	1	0	0	0	0	1
0	0	1	0	1	1	0	1	1	0	1	2
0	0	1	1	1	1	1	1	0	0	1	3
0	1	0	0	0	1	1	0	0	1	1	4
0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	0	1	1	1	1	1	6
0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	1	1	1	1	0	1	1	9

## Half-adder

A half-adder is a circuit which takes two input bits and produces two outputs, a *sum* and a *carry*.

## Full-adder

A full-adder is a circuit which takes three input bits (two ordinary inputs and a *carry-in*) and produces two outputs, a *sum* and a *carry-out*.

## Note:

A *logic diagram* shows the gates in a circuit and the connections between them.

A *block diagram* shows the major components of a circuit and the connections between them.

*Ripple carry* is simple but slow.

More complicated circuits for multi-bit adders speed up the computation (at the cost of additional gates.)