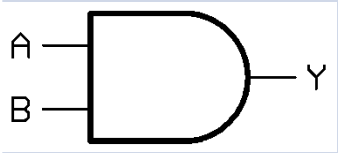
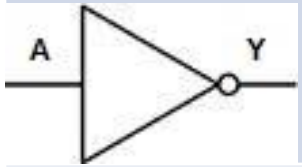
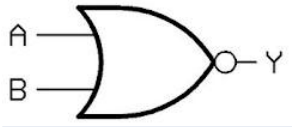
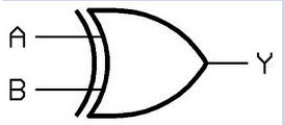
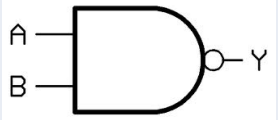
Digital Logic Gates – *Truth Tables to Expressions*

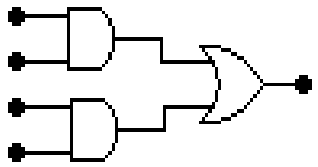
Table of Gate Representations

Schematic	Gate	Algebraic Symbol	Boolean Equation
	AND	•	$Y=A \bullet B$
	OR	+	$Y=A+B$
	NOT	–	$Y=\bar{A}$
	NOR	– +	$Y=\overline{A+B}$
	XOR	$\oplus$	$Y=A \oplus B$
	NAND	– •	$Y=\overline{A \bullet B}$

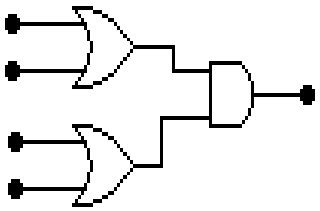
“Tools of the Trade” for Solving Logic Problems

- Gate symbols
- Truth tables
- Boolean expressions

Combinational logic circuits:



AND-OR pattern of gates
from
Sum-of-products Boolean expression such as:
AB + CD = Y
(Also called a min-term Boolean expression)



OR-AND pattern of gates
from
Product-of-sums Boolean expression such as:
(A+B) (C+D) = Y
(Also called a max-term Boolean expression)

Boolean Expression from Truth Table

Write the Boolean expression that describes the logic in this truth table.

Truth Table

Input ABC	Output Y
0 0 0	0
0 0 1	0
0 1 0	1
0 1 1	0
1 0 0	0
1 0 1	0
1 1 0	0
1 1 1	1

Step 1: Focus only on the truth table lines with outputs of 1.

Step 2: AND the inputs for these two lines and logically OR the ANDed groups.

$$\overline{A} \cdot B \cdot \overline{C} + A \cdot B \cdot C = Y$$

Minterm Boolean expression: $\overline{A}\,B\,\overline{C} + A\,B\,C = Y$

QUIZ

Truth Table

Input ABC	Output Y
0 0 0	1
0 0 1	0
0 1 0	0
0 1 1	0
1 0 0	0
1 0 1	0
1 1 0	0
1 1 1	1

Write the Boolean expression that describes the logic in this truth table.

$$\overline{A} \cdot \overline{B} \cdot \overline{C} + A \cdot B \cdot C = Y$$

Minterm Boolean expression: $\overline{A}\,\overline{B}\,\overline{C} + A\,B\,C = Y$

Truth Table From Boolean Expressions

Fill in a truth table from a minterm Boolean Expression.

Minterm Boolean expression: $\bar{A}\bullet\bar{B}\bullet\bar{C} + \bar{A}\bullet B\bullet C + A\bullet B\bullet\bar{C} = Y$

Step 1: Place three 1s in output column.

Step 2: Place five 0s in blanks in output column of truth table.

Truth Table

Input ABC	Output Y
0 0 0	1
0 0 1	0
0 1 0	0
0 1 1	1
1 0 0	0
1 0 1	0
1 1 0	1
1 1 1	0

Truth Table from Boolean Expressions

Fill in a truth table from a minterm Boolean Expression.

Minterm Boolean expression: $\overline{A} \cdot \overline{B} + A \cdot B \cdot C = Y$

Step 1: Place single 1 output column for term with three variables.

Step 2: Place two 1s in output column for term with two variables.

Step 3: Fill in 0s.

Truth Table

Input ABC	Output Y
0 0 0	1
0 0 1	1
0 1 0	0
0 1 1	0
1 0 0	0
1 0 1	0
1 1 0	0
1 1 1	1