

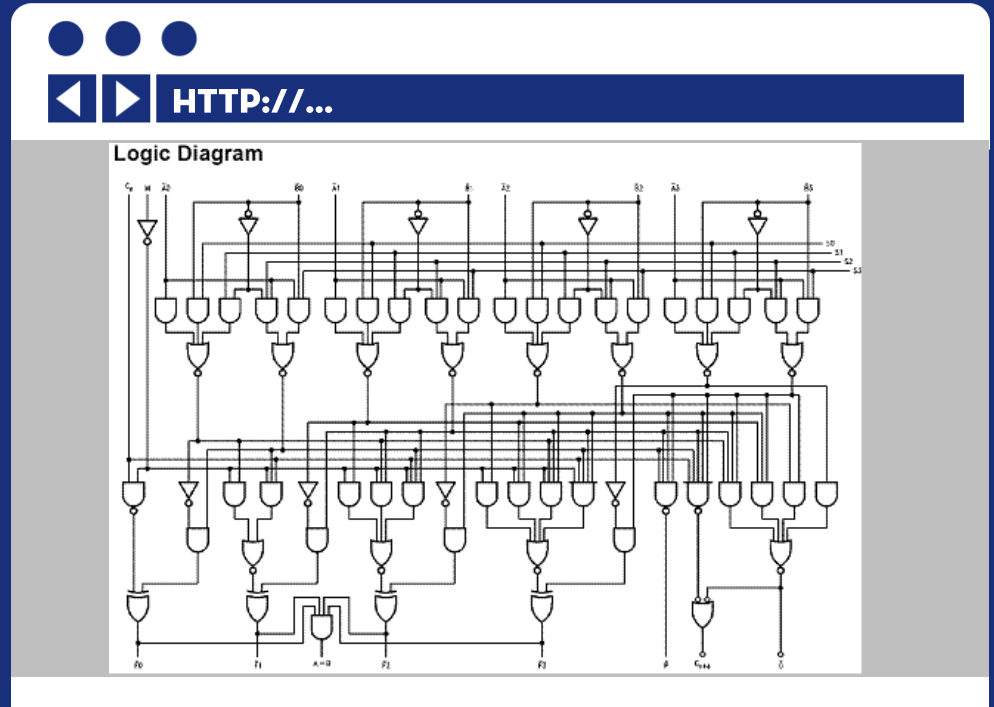
BOOLEAN ALGEBRA AND TRUTH TABLES

REMEMBER...

COMBINING GATES

▪COMBINING LOGIC GATES ALLOWS FOR COMPLEX BINARY OPERATIONS

▪ESSENTIALLY, A COMPUTER CPU IS A COMPLEX ARRANGEMENT OF LOGIC GATES!



BOOLEAN ALGEBRA

REMEMBER...

•THE 6 BASIC GATES HAVE ASSOCIATED METHODS OF WRITING AS AN EXPRESSION

NOT A: \bar{A}

A AND B: $A \cdot B$

A OR B: $A + B$

A XOR B: $A \oplus B$

A NAND B: $\overline{A \cdot B}$

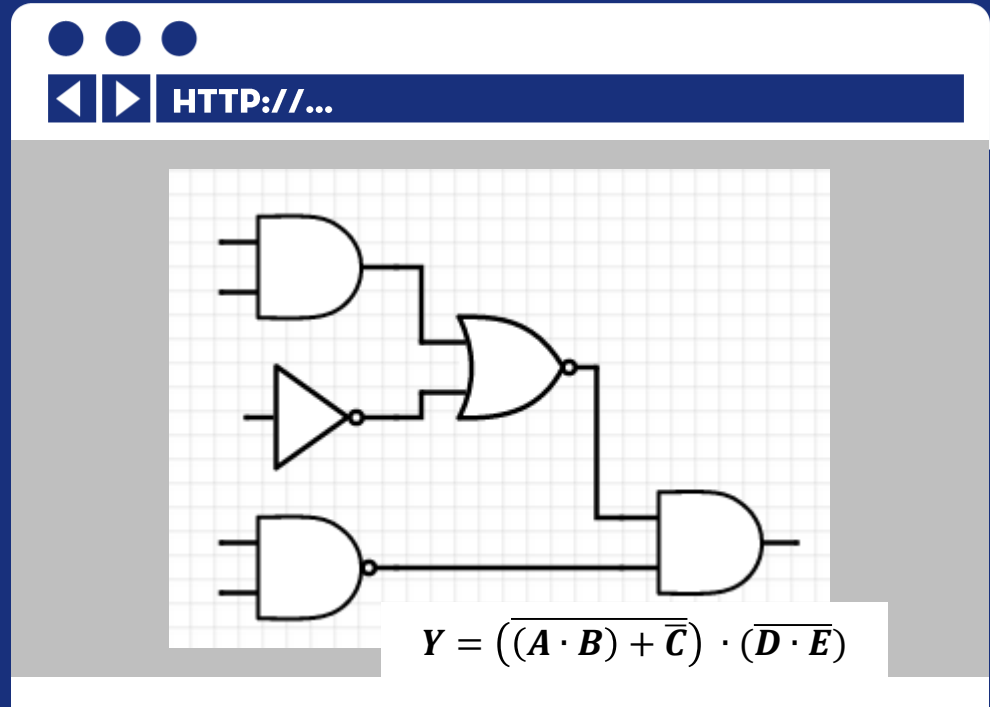
A NOR B: $\overline{A \oplus B}$

COMBINING GATES

GATES AS BOOLEAN EXPRESSIONS

▪BY COMBINING GATES, WE CREATE CIRCUITS THAT PERFORM MORE COMPLEX OPERATIONS

▪WRITING THE COMBINATION OF GATES AS A BOOLEAN EXPRESSION IS A METHOD OF DOCUMENTING THE CIRCUIT DESIGN, AND A STEP TOWARD OPTIMIZING IT'S DESIGN



COMBINING GATES

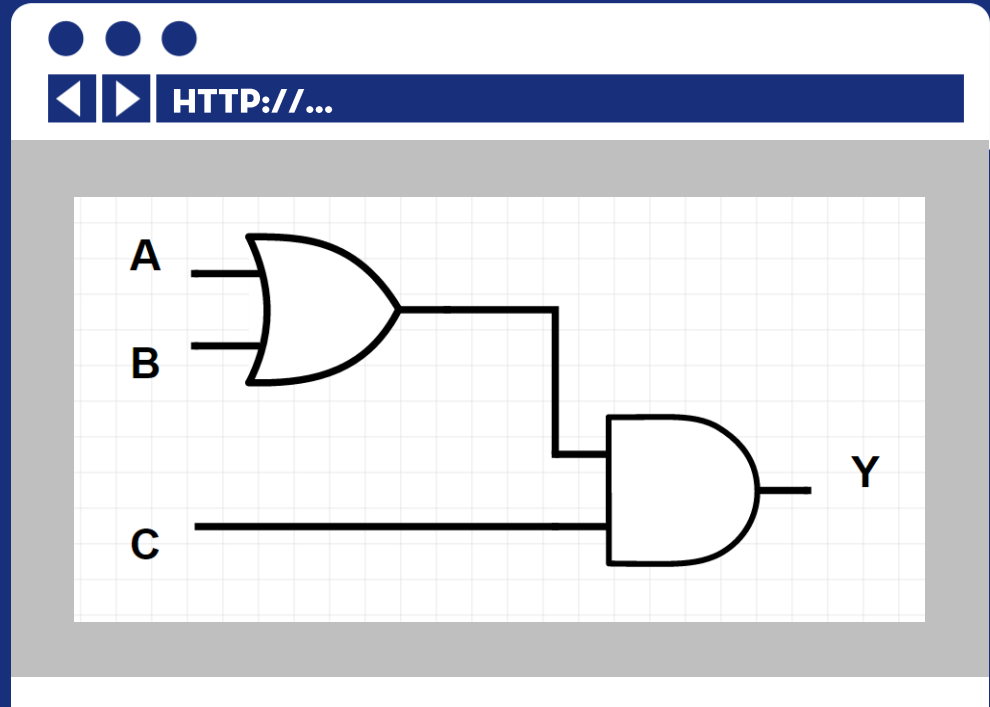
LET'S TRY A MORE SIMPLE ONE...

•WHAT IS THE BOOLEAN EXPRESSION?

1. READ FROM LEFT TO RIGHT
2. IDENTIFY WHICH INPUTS ARE FOR WHICH GATES
3. USE BRACKETS TO CONTROL "ORDER"

$Y = (A + B)$ (THIS MUST BE PART OF IT)

$Y = (A + B) \cdot C$ (COMPLETED EXPRESSION)



NOW THE TRUTH TABLE...

THE TRUTH TABLE

•TO COMPOSE A TRUTH TABLE FOR A BOOLEAN EXPRESSION:

1. MAKE A COLUMN FOR EACH INPUT
2. MAKE A COLUMN FOR EACH GATE
3. SETUP INPUT VALUES
4. COMPLETE OTHER COLUMNS ONE (GATE) AT A TIME

OUR EXAMPLE:

$$Y = (A + B) \cdot C$$

A	B	C	(A+B)	(A+B) · C
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0
1	1	1	1	1

MORE ON T.T.'S

SETTING UP A T.T.

▪ NUMBER OF ROWS WILL DEPEND ON THE NUMBER OF INPUTS

▪ A CIRCUIT WITH 1 INPUT WILL HAVE 2^1 COMBINATIONS (ROWS)

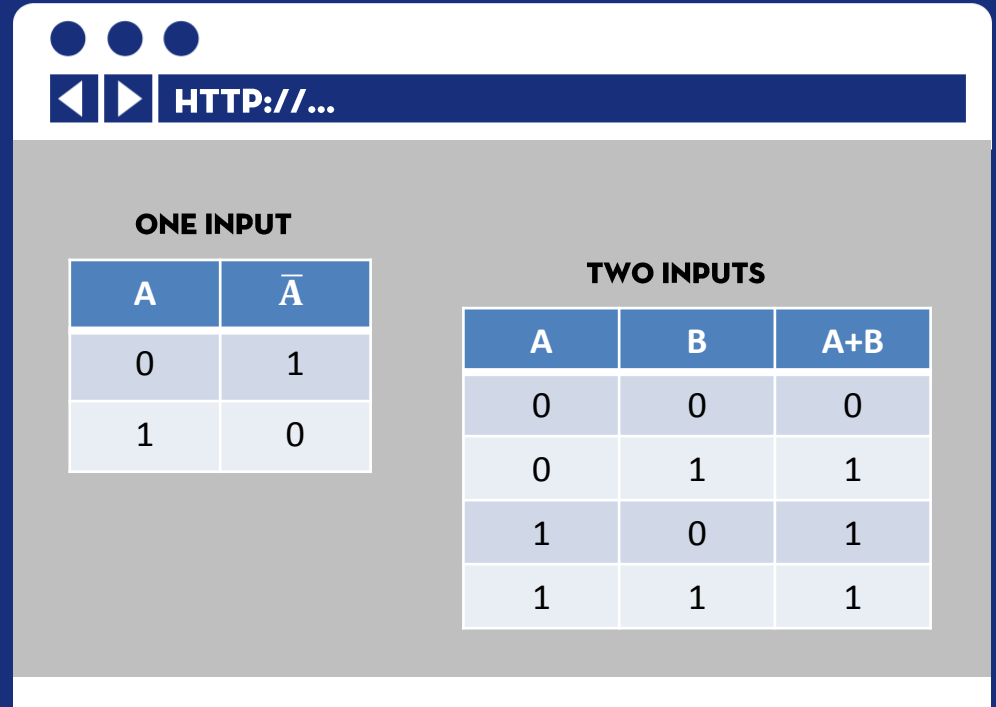
▪ $2^1 = 2$

▪ EXAMPLE: $Y = \bar{A}$

▪ A CIRCUIT WITH 2 INPUTS WILL HAVE 2^2 COMBINATIONS

▪ $2^2 = 4$

▪ EXAMPLE: $Y = A + B$



ONE INPUT

A	\bar{A}
0	1
1	0

TWO INPUTS

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

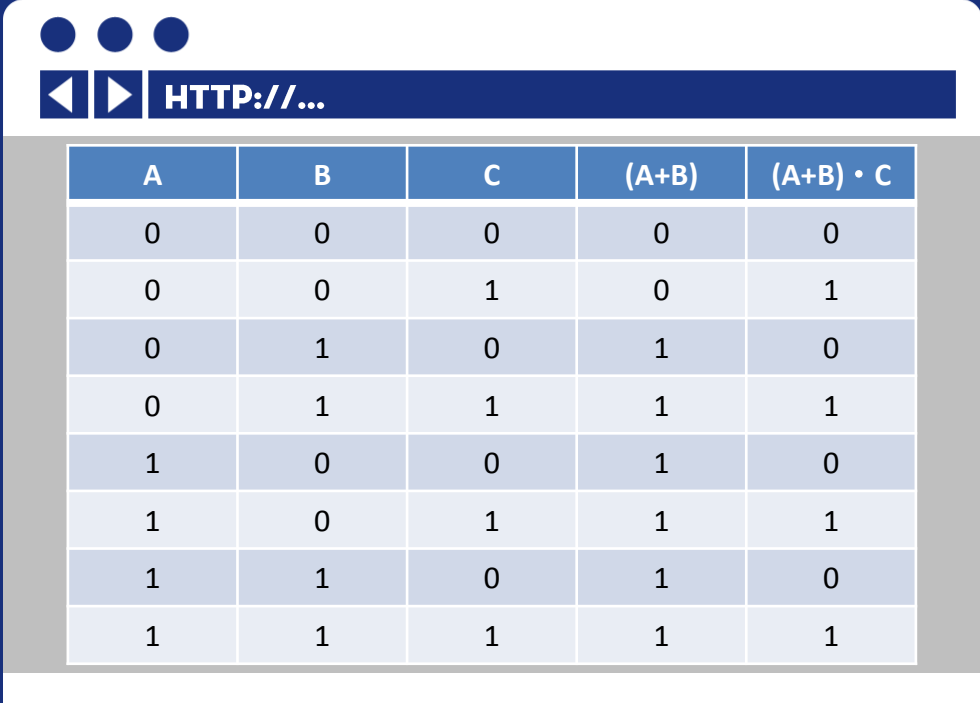
MORE ON T.T.'S

SETTING UP A T.T.

▪ HOW MANY ROWS FOR A CIRCUIT WITH 3 INPUTS?

▪ $2^3 = 8$

▪ EXAMPLE: $Y = (A + B) \cdot C$



A	B	C	(A+B)	(A+B) · C
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0
1	1	1	1	1

MORE ON T.T.'S

SETTING UP A T.T.

▪INPUTS FOLLOW A PATTERN

- FIRST INPUT: 0,1,0,1,0,1...
 - ALTERNATE ZEROS AND ONES
- SECOND INPUT: 0,0,1,1,0,0,1,1...
 - TWO ZEROS, TWO ONES, REPEAT
- THIRD INPUT: 0,0,0,0,1,1,1,1...
- FOURTH INPUT:
 - 0,0,0,0,0,0,0,0,1,1,1,1,1,1...
- AND SO ON...

A	B	C	(A+B)	(A+B) * C
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0
1	1	1	1	1

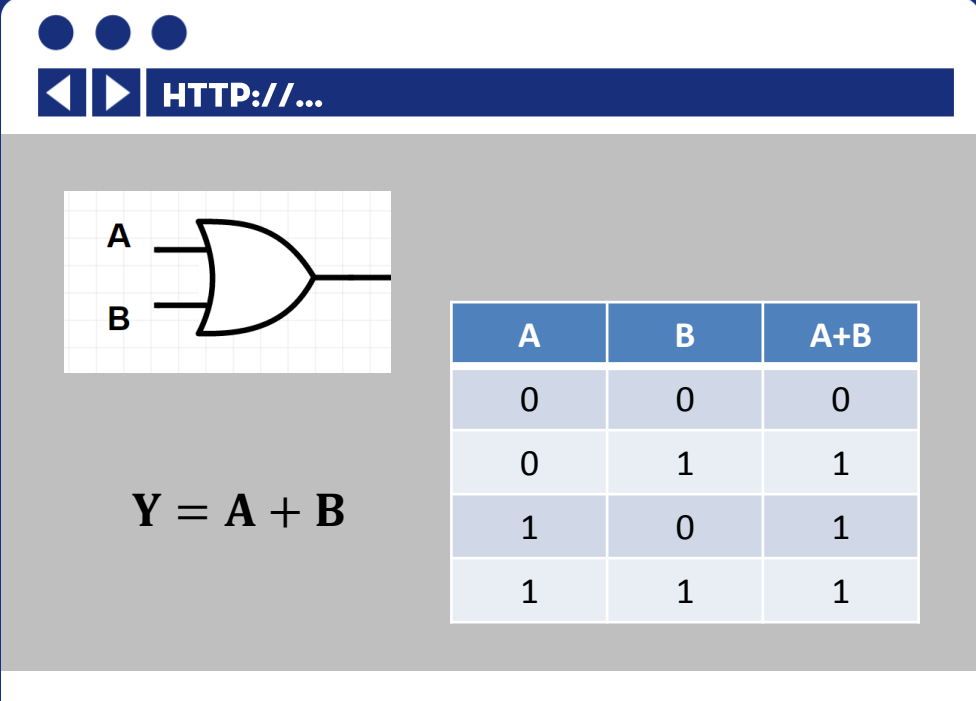
DESCRIBING GATE CIRCUITS

MULTIPLE WAYS

▪ WE NOW HAVE THREE WAYS THAT WE CAN DESCRIBE A CIRCUIT OF LOGIC GATES

- WITH A GATE DIAGRAM
- WITH A BOOLEAN EXPRESSION
- WITH A TRUTH TABLE

▪ ON THE TEST, YOU WILL NEED TO BE COMFORTABLE WITH ALL THREE!



The image shows a browser window with a dark blue header containing three window control buttons and a navigation bar with a back arrow, a forward arrow, and the text "HTTP://...". The main content area is light gray and contains three representations of a logic circuit:

- Gate Diagram:** A logic diagram of an OR gate with two inputs labeled 'A' and 'B' on the left and one output on the right. The gate is drawn on a white grid background.
- Boolean Expression:** The equation $Y = A + B$ is displayed in a large, bold, black font.
- Truth Table:** A table with three columns labeled 'A', 'B', and 'A+B'. The rows show the output for all combinations of inputs.

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

THE END!