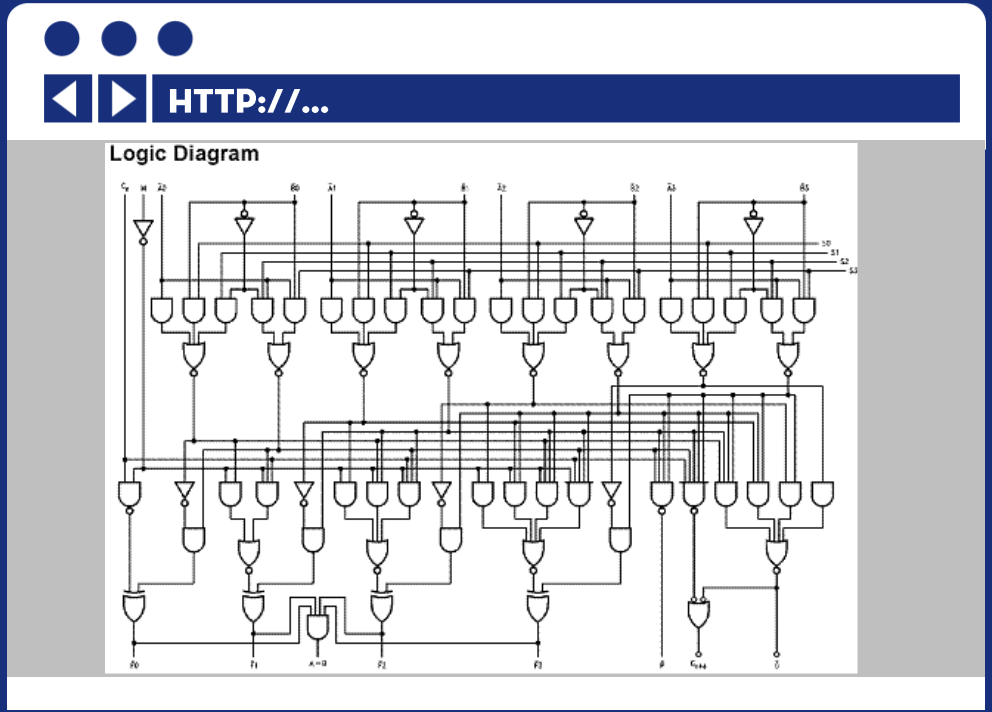
BOOLEAN ALGEBRA AND TRUTH TABLES

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

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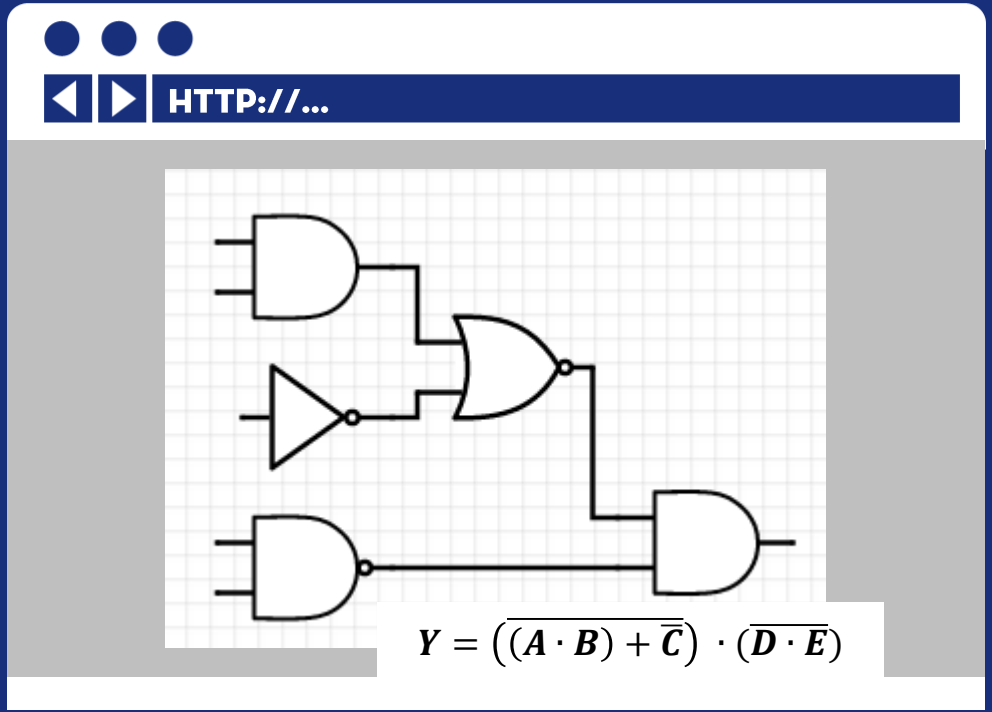
NOT A:	$\overline{A}$	A XOR B:	$A \oplus B$
A AND B:	$A \cdot B$	A NAND B:	$\overline{A \cdot B}$
A OR B:	$A + B$	A NOR B:	$\overline{A \oplus B}$

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



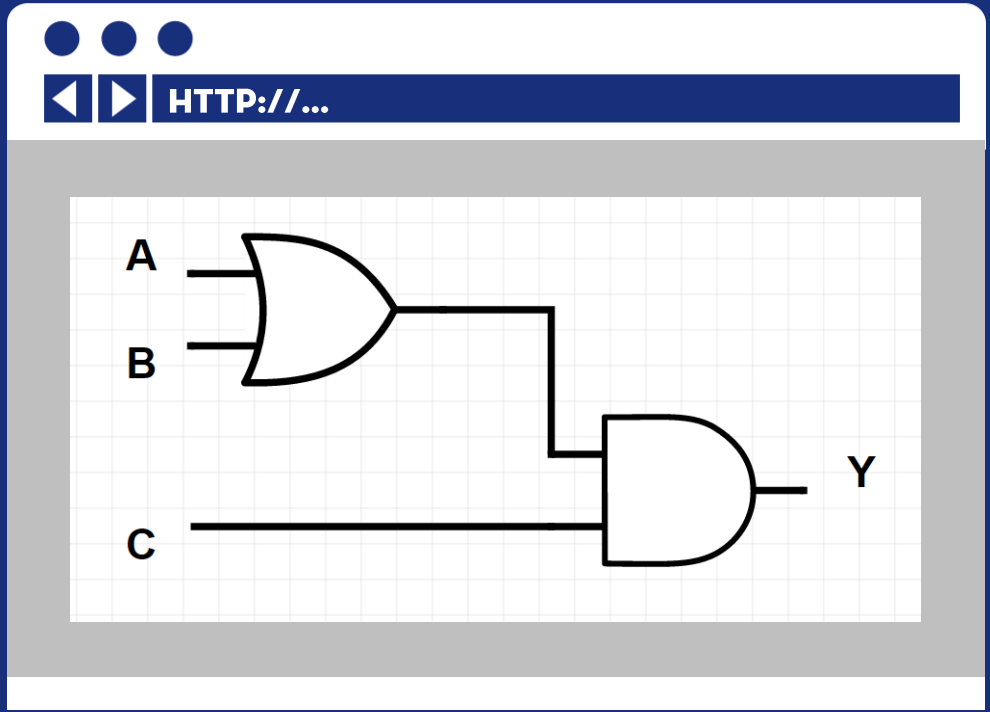
COMBINING GATES

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:

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

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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 OR ROWS WILL DEPEND ON THE NUMBER OF INPUTS
- A CIRCUIT WITH 1 INPUT WILL HAVE 2^1 COMBINATIONS (ROWS)
  - $2^1 = 2$
  - EXAMPLE: $Y = \overline{A}$
- A CIRCUIT WITH 2 INPUTS WILL HAVE 2^2 COMBINATIONS
  - $2^2 = 4$
  - EXAMPLE: $Y = A + B$

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ONE INPUT

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

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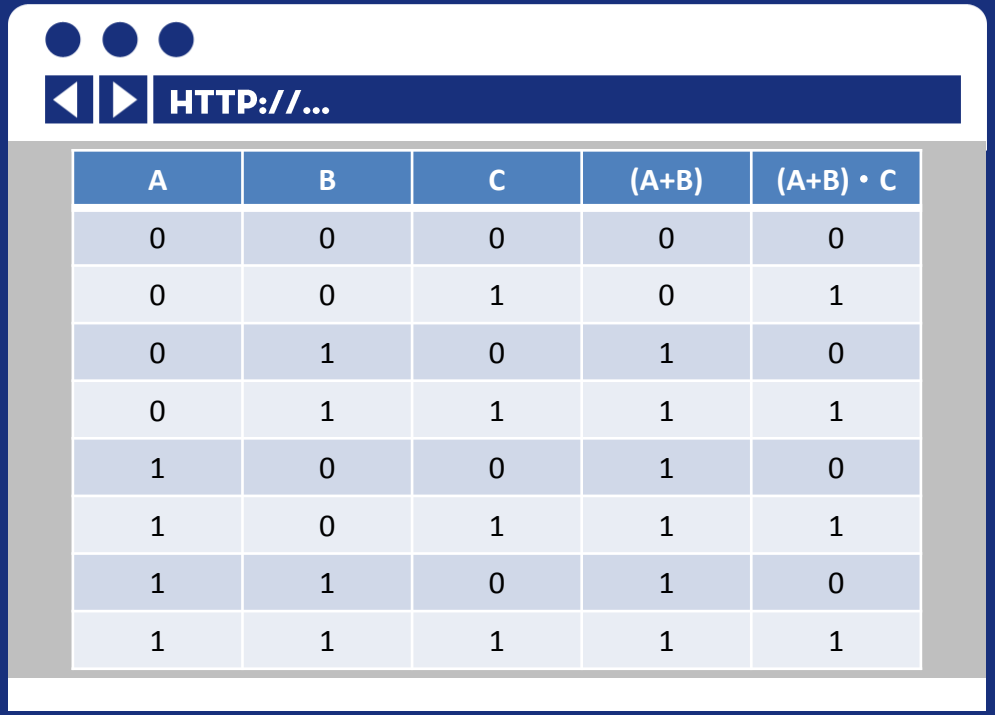
A	B	C	(A+B)	(A+B) • C
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0
1	1	1	1	1

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:
    - 0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1...
  - 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!

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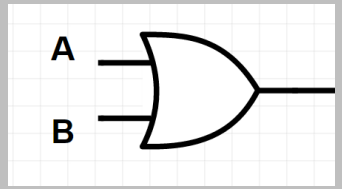

$$Y = A + B$$

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

THE END!