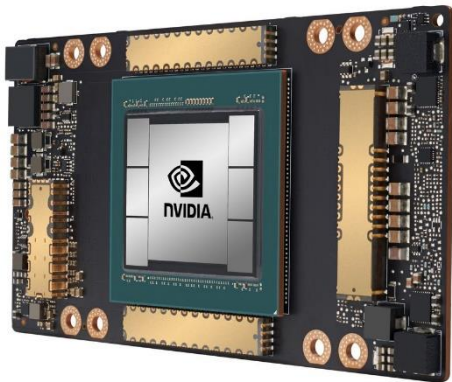


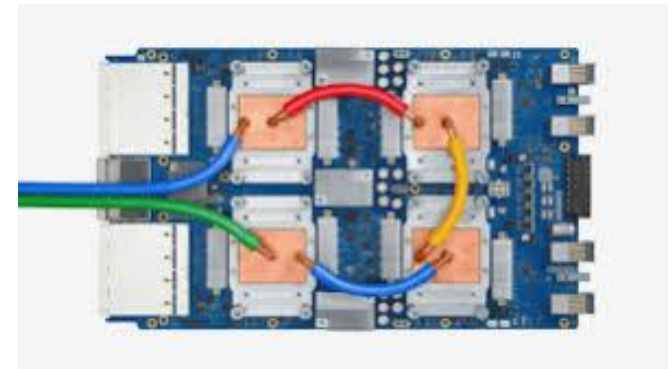
CSCB58: Computer Organization



Prof. Gennady Pekhimenko

University of Toronto

Fall 2020

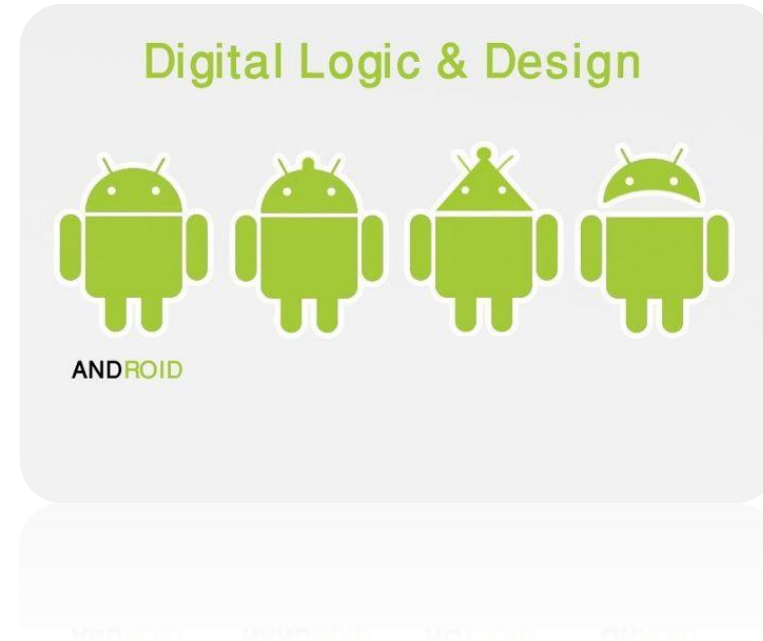


*The content of this lecture is adapted from the lectures of
Larry Zheng and Steve Engels*

CSCB58 Week 2: Summary

Week 2 review

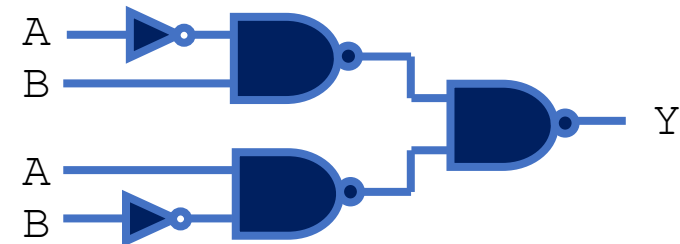
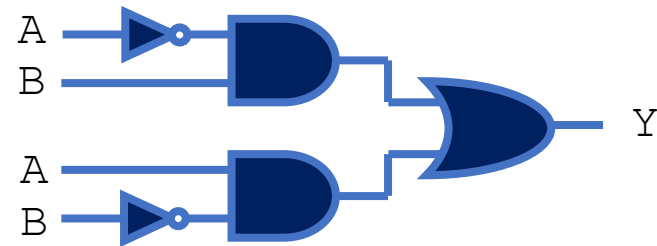
- Using logic gates
 - Combinational circuits
 - Circuit reduction
 - Karnaugh maps



Question #1

- How can you express a two-input XOR gate as a combination of NAND and NOT gates?
 - Draw the circuit using only these two logic gates.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0



- Remember De Morgan's!
 - $(\overline{W} + \overline{Z}) = \overline{(W Z)}$

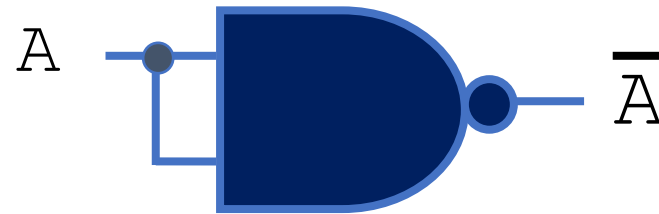
Question #2

- How can you implement a NOT gate from a 2-input NAND gate?



Question #2

- How can you implement a NOT gate from a 2-input NAND gate?



Question #3 - Minterms

- Write Y in SOM (Sum Of Minterms) form.

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

$$Y = m_1 + m_2 + m_4 + m_7$$

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Question #4

- Given the minterms below, can you fill in the truth table on the right?

$$Y = m_2 + m_3 + m_7 + m_9 + m_{12} + m_{14}$$

A	B	C	D	Y
0	0	0	0	
0	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	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

Question #5

- What is the most reduced form, in sum of products form, of the function from the truth table on the right?

$$Y = m_0 + m_1 + m_2 + m_5 \\ + m_7 + m_8 + m_9 \\ + m_{10} + m_{13} + m_{15}$$

A	B	C	D	Y
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

Question #5 (cont'd)

	$\bar{C} \cdot \bar{D}$	$\bar{C} \cdot D$	$C \cdot D$	$C \cdot \bar{D}$
$\bar{A} \cdot \bar{B}$	1	1	0	1
$\bar{A} \cdot B$	0	1	1	0
$A \cdot B$	0	1	1	0
$A \cdot \bar{B}$	1	1	0	1

$$Y = \bar{C} \cdot D + B \cdot D + \bar{B} \cdot \bar{D}$$

Question #5 (alternative)

- An alternative grouping:

	$\bar{C} \cdot \bar{D}$	$\bar{C} \cdot D$	$C \cdot D$	$C \cdot \bar{D}$
$\bar{A} \cdot \bar{B}$	1	1	0	1
$\bar{A} \cdot B$	0	1	1	0
$A \cdot B$	0	1	1	0
$A \cdot \bar{B}$	1	1	0	1

$$Y = \bar{B} \cdot \bar{C} + B \cdot D + \bar{B} \cdot \bar{D}$$

Helpful Hint

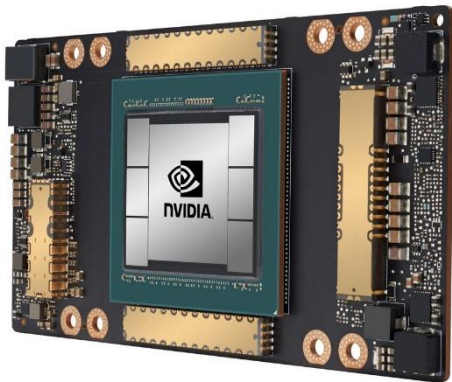
AB \ CD		C			
		00	01	11	10
A	00	1	1	0	1
	01	0	1	1	0
	11	0	1	1	0
	10	1	1	0	1

The diagram shows a 4x4 Karnaugh map with the following annotations:

- A**: A bracket on the left side groups the rows with AB values 11 and 10.
- B**: A bracket on the right side groups the columns with CD values 01 and 10.
- C**: A bracket above the columns with CD values 11 and 10.
- D**: A bracket below the columns with CD values 01 and 10.

The cell at the intersection of row 11 and column 11 (value 1) is highlighted in blue. The top row (AB=00) is highlighted in light green, and the bottom two rows (AB=11 and 10) are highlighted in light blue.

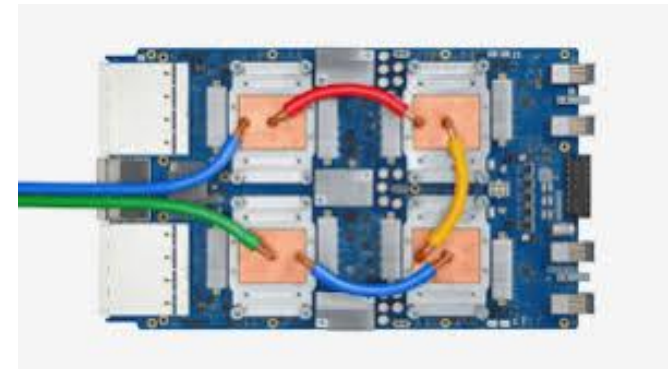
CSCB58: Computer Organization



Prof. Gennady Pekhimenko

University of Toronto

Fall 2020



*The content of this lecture is adapted from the lectures of
Larry Zheng and Steve Engels*