CMOS logic gates

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Lab due Oct 24, 2016 21:59 -02 Past due

CMOS logic gates

0.0/2.0 points (graded)

There are 16 possible 2-input combinational logic gates. The cost of implementing these gates varies dramatically, requiring somewhere between 0 and 10 mosfets depending on the gate. For example, it takes 2 mosfets to implement $F = \overline{A}$ but 4 mosfets (organized as two inverters) to implement $F = A$.

For each of the 2-input gates whose Karnaugh maps are given below, indicate the minimum number of mosfets required to implement the gate. You should only consider static fully-complementary circuits like those shown in the presentations; these implementations meet the following criteria:

- no static power dissipation
- $V_{OL} = 0V$, V_{OH} = power supply voltage
- NFETs appear only in pulldown circuits, PFETs appear only in pullup circuits
- the pullup and pulldown are complementary, i.e., when one path is "on", the other is "off"
- the pullup and pulldown circuits can be decomposed into series and parallel connections of mosfets
- all gate implementations restore incoming logic levels (so a wire connecting an input terminal to an output terminal would not be a legal gate implementation)

$\overline{A + B}$		A	
		0	**1**
B	**0**	1	0
	1	0	0

Number of MOSFETs need to implement NOR: 4 Answer: 4

$A \cdot B$		A	
		0	**1**
B	**0**	0	0
	1	0	1

Number of MOSFETs need to implement AND: 6 Answer: 6

$A \oplus B$		A	
		0	**1**
B	**0**	0	1
	1	1	0

Number of MOSFETs need to implement XOR: 12 Answer: 10

Hint: see discussion in following design problem.

$\overline{B}$		A	
		0	**1**
B	**0**	1	1
	1	0	0

Number of MOSFETs need to implement $\overline{B}$: 2 Answer: 2

$A \cdot \overline{B}$		A	
		0	**1**
B	**0**	0	1
	1	0	0

Number of MOSFETs need to implement $A \cdot \overline{B}$: Answer: 6

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XOR using 10 gates only !!

question posted 7 years ago by **atarief**

I solved the xor gate using 12 gates. How possible to make it work with only 10 gates ? Thanks

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Ferdinandzanni
7 years ago

Try this expression: not(not(A)+B) + not(A+not(B)).

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