



# Basic Logic Review

## Class Exercise 1A

# Rules

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- If you believe that you know a correct answer, please raise your hand
- I will select *one or more* students  
(independently whether an answer given by the first student is correct or incorrect)
- Please, identify yourself by first name and give an answer
- **Correct answer = 1 bonus point**

# Problem 1

List all 2-input logic gates that you can recall

## Problem 2

How many 2-input logic functions can be theoretically defined (whether they make sense or not)?

## **Problem 3**

List all 1-input logic gates.

## **Problem 4**

What is a minimum set of gates that can be used to implement all logic functions?

## **Problem 5**

List four ways of expressing logic functions.

## Problem 6

How many select inputs does an 8-to-1 MUX have?

How many select inputs does an n-to-1 MUX have?



## Problem 7

How many outputs does a decoder with two data inputs have?

How many outputs does a decoder with  $n$  data inputs have?

## Problem 8

Show how to implement a decoder that recognizes the following 4 ranges of a 16-bit address  $A$ , and generates the corresponding enable signals  $e_0, e_1, e_2, e_3$ :

For $A$ in:	Assert
C000-CFFF:	$e_0$
D000-DFFF:	$e_1$
E000-EFFF:	$e_2$
F000-FFFF:	$e_3$

## Problem 9

How many inputs does an encoder with two data outputs have?

How many inputs does an encoder with  $n$  data outputs have?

## **Problem 10**

What is a difference between encoder and priority encoder?

## Problem 11

Show how to implement a 4-to-2 MSB  
Priority Encoder using multiplexers and  
a minimum number of logic gates

## Problem 12

What is the width of an output of a 4x4 unsigned multiplier?

What is the width of an output of a 4x4 signed multiplier?

What is the width of an output of a NxN unsigned multiplier?

## Problem 13

What is the width of an output of a 4x8 unsigned multiplier?

What is the width of an output of a 4x8 signed multiplier?

What is the width of an output of a NxM unsigned multiplier?

## Problem 14

Give an example of binary inputs to an unsigned 4x4 multiplier and a signed 4x4 multiplier that produce different results.



## Problem 15

Explain using simple diagrams  
(based on medium-scale logic components)  
how to efficiently perform the following  
operations in hardware using combinational  
logic only

A.  $C = A \lll 3$

B.  $C = A \lll B,$

where A, B, and C are 8-bit variables.

## Problem 16

What is a size of a memory with a 4-bit address input and an 8-bit data output?

What is a size of a memory with an  $m$ -bit address input and an  $n$ -bit data output?

## Problem 17

Show how to implement a **3x3 squarer**,  
implementing equation  $y = x^2$ ,  
using **ROM** (diagram + contents of ROM).

## **Problem 18**

What is a function of a tri-state buffer?