


# Class Exercise 1B

# Rules

- 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 15

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 16

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 17

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

## Problem 18

Show how to implement Full Adder using two 2-to-1 multiplexers and a minimum number of logic gates

## Problem 19

Explain how to perform the following operations

A. $Z = X+Y \bmod 2^4$

B. $Z = X*Y \bmod 2^4$

using a 4-bit adder with carry in (cin)
and carry out (cout),
and a 4x4 multiplier, respectively,
where X, Y, and Z are 4-bit variables.

## Problem 20

Explain how to perform the following operation using simple arithmetic and logic circuits:

$$Y = (X*(2X + 1)) \bmod 2^4,$$

where X and Y are 4-bit variables.

## Problem 21

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 <<< 3

B. C = A <<< B,

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

## Problem 22

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 23

Show how to implement Full Adder using ROM
(diagram + contents of ROM)

## Problem 24

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

## Problem 25

Explain how to perform the following operation using a single-port ROM only:

$$Y = (X*(2X + 1)) \bmod 2^8,$$

where X and Y are 8-bit variables.

Show the implementation as a ROM, including the width of the address input and the width of the data output, as well as the contents of memory locations with addresses 0, 1, 8 and 16.

## Problem 26

What is a function of a tri-state buffer?

## Problem 27

What is a difference between a D-flip-flop and a latch?

## Problem 28

What is a difference between a D-flip-flop with asynchronous vs. synchronous clear?

## Problem 29

What is a difference in terms of required inputs and outputs between ROM and RAM of the same size (e.g. $2^m$ x n)?