

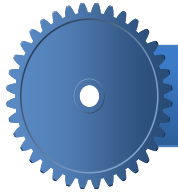
CS 311 Computer Architecture

2025/2026

Lecture 1

Assis. Prof. Dr. Elmahdy Maree

CH1: Computer Architecture and Organization



Learning Objectives

Upon completion of this lecture, you will be able to:

- ◆ **Describe** the design of digital basic building blocks



* Computer architecture

Refers to those attributes of a system visible to a programmer or those attributes that have a direct impact on the logical execution of a program.

Examples of architectural attributes

Includes the instruction set, the number of bits used to represent various data types (e.g., numbers, characters), I/O mechanisms, and techniques for addressing memory.

* Computer organization;

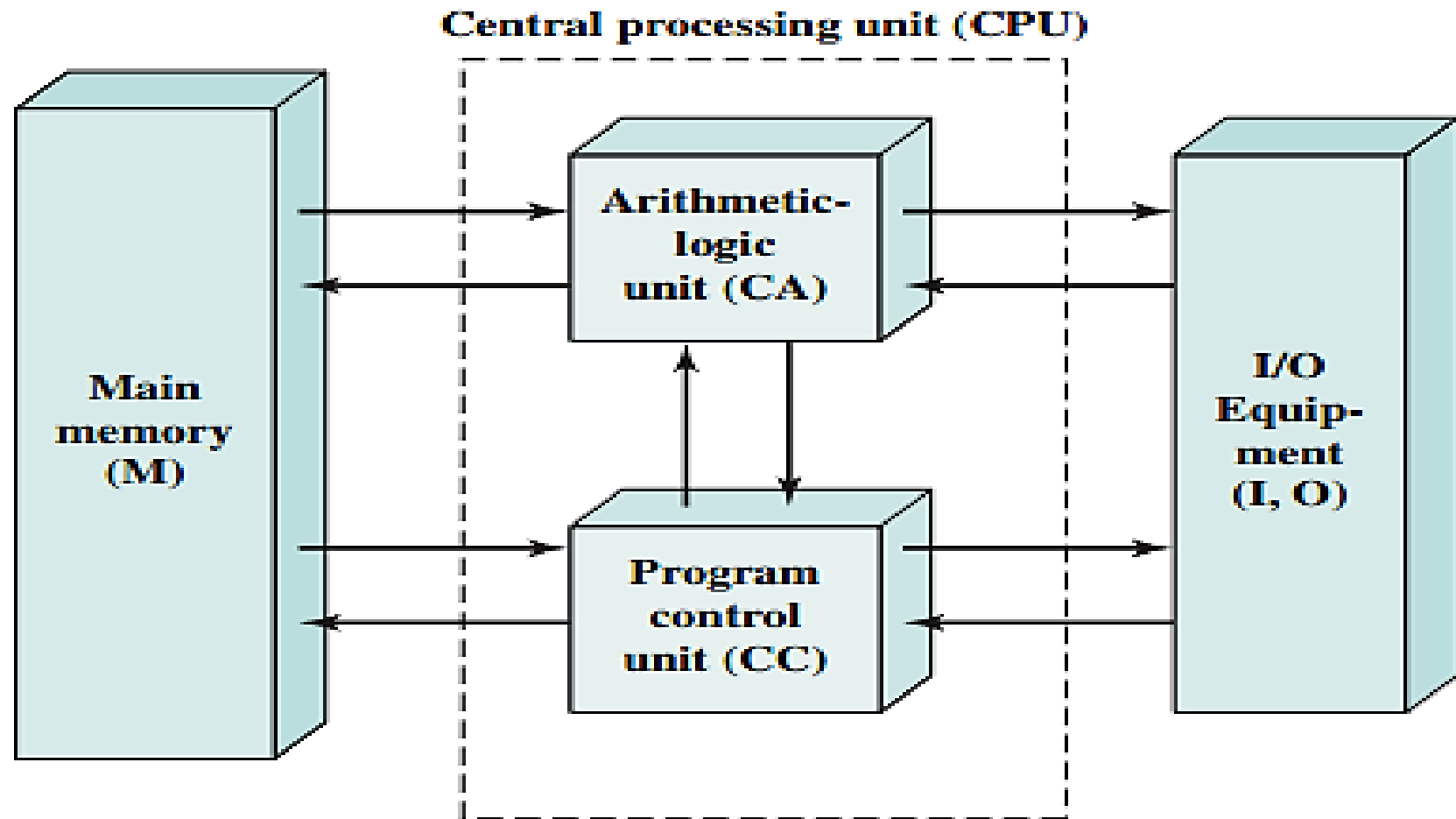
Refers to the operational units and their interconnections that realize the architectural specifications.

Organizational attributes

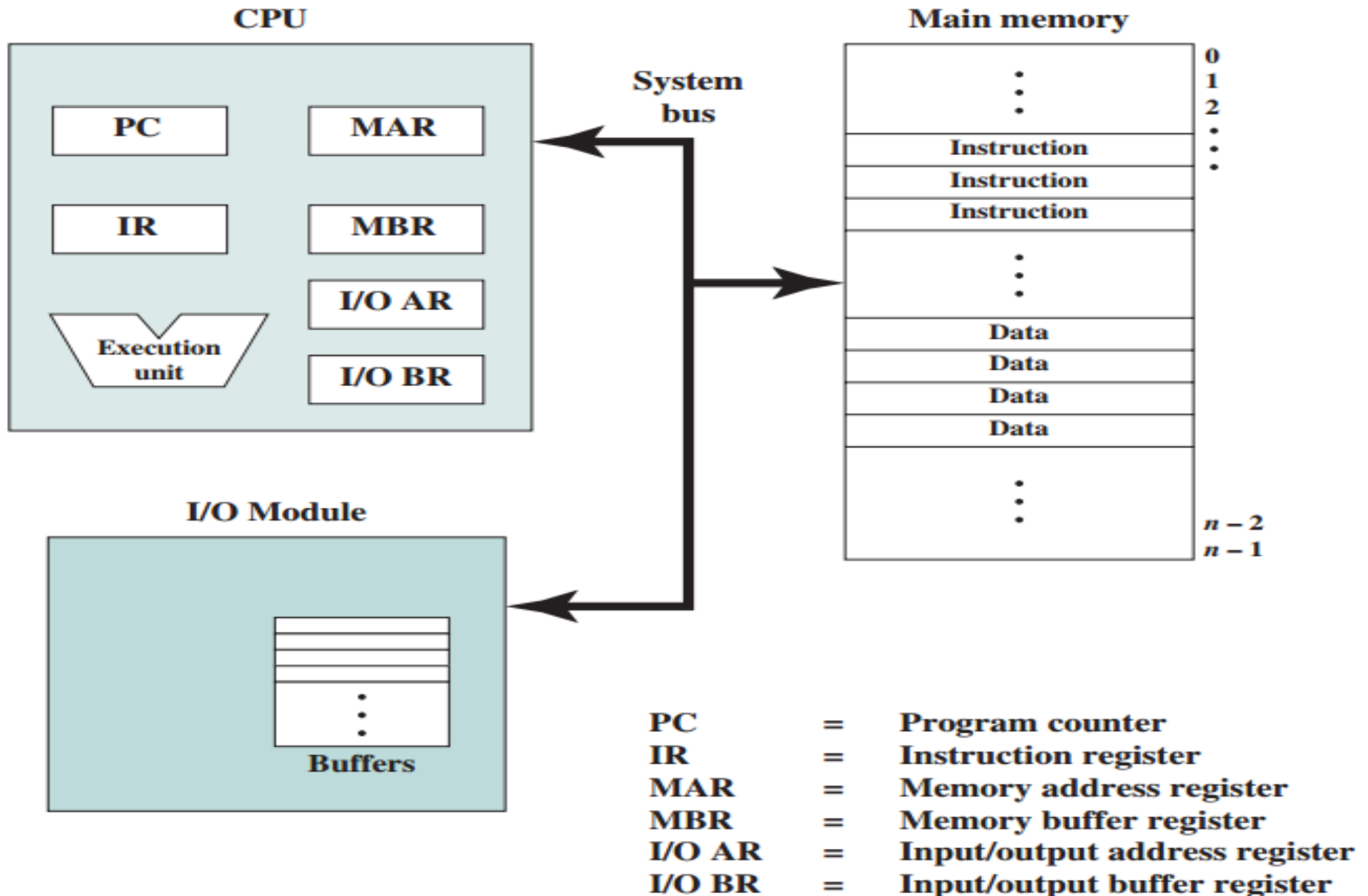
Includes those hardware details transparent to the programmer, such as control signals; interfaces between the computer and peripherals; and the memory technology used.

A Top-Level View of Computer Function and Interconnection

A Top-Level View of Computer Interconnection

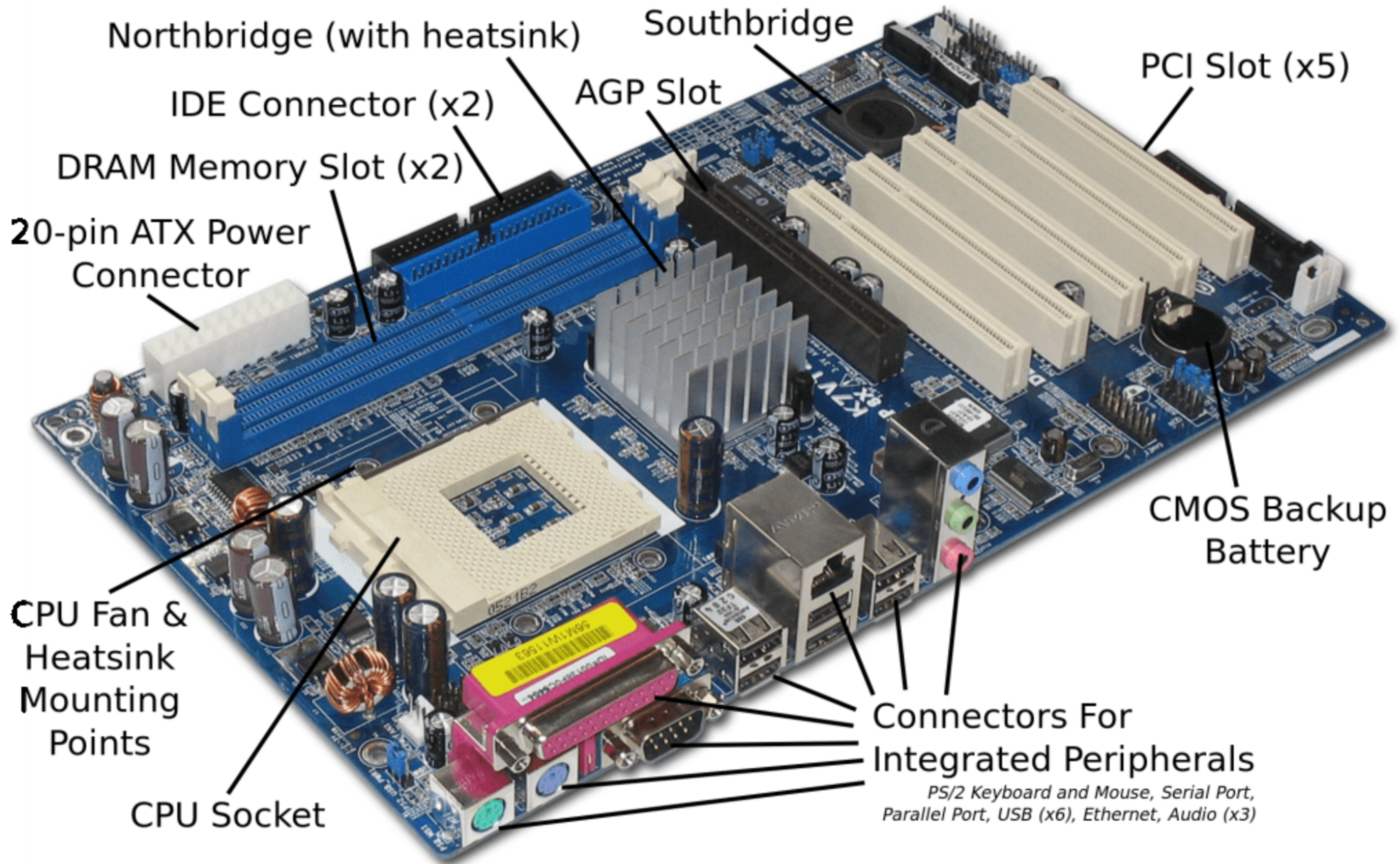


Computer Components: Top-Level View



IAS stands for Princeton Institute for Advanced Studies. (Von Neumann)

Computer Components: Top-Level View

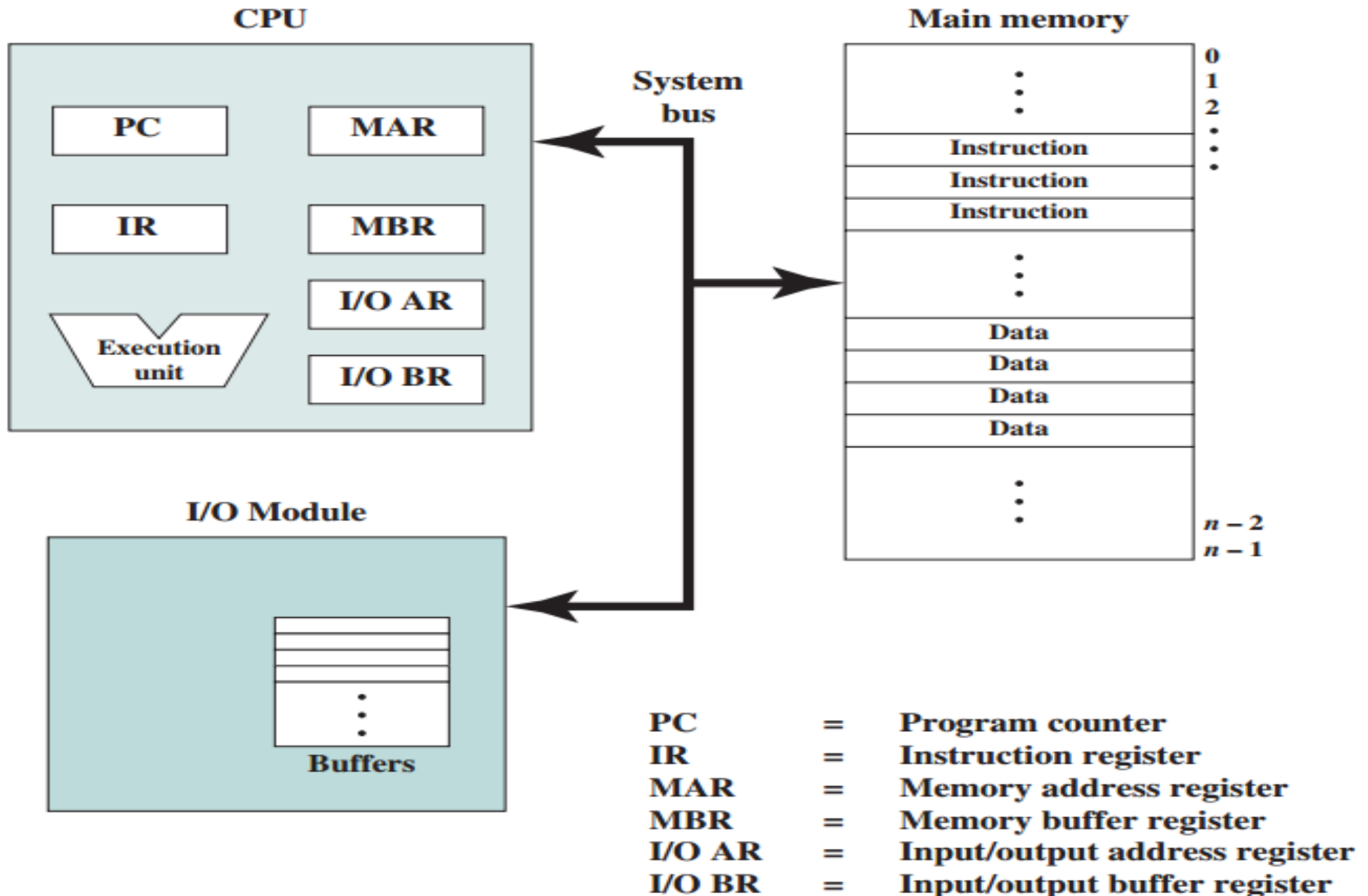


Computer Components: Top-Level View



IAS stands for Princeton Institute for Advanced Studies. (Von Neumann)

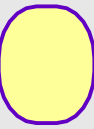
Computer Components: Top-Level View



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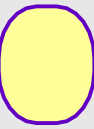
Digital Building Blocks

- 1. Registers**
- 2. COUNTERS**
- 3. BUS**
- 4. RAMS**



Review of Flip Flops

Characteristic and Excitation Table



D Flip flop

Characteristic Table of "D" Flip Flop

\Downarrow Given D	\Downarrow Q(t)	\Uparrow Required Q(t+1)
0	0	0
0	1	0
1	0	1
1	1	1

Output Follows Input

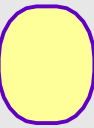
Function Table

D	Q(t+1)	Output Follows Input
0	0	
1	1	

Equations

$$Q(t+1) = D$$

Symbol :



T Flip flop

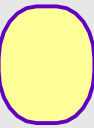
Characteristic Table of "T" Flip Flop			
Given		Required	
T	Q(t)	Q(t+1)	
0	0	0	No Change
0	1	1	
1	0	1	Toggle
1	1	0	

Function Table

T	Q(t+1)	
0	Q(t)	No change
1	$\overline{Q(t)}$	Toggle

Symbol :

$Q(t+1) = T \oplus Q(t)$



JK Flip flop

Characteristic Table of JK Flip Flop				
Given			Required	
	J	K	Q(t)	Q(t+1)
No Change	0	0	0	0
	0	0	1	1
Reset	0	1	0	0
	0	1	1	0
Set	1	0	0	1
	1	0	1	1
Toggle	1	1	0	1
	1	1	1	0

Function Table			
J	K	Q(t+1)	
0	0	Q(t)	No change
0	1	0	Reset
1	0	1	Set
1	1	$\overline{Q(t)}$	Toggle

$$Q(t+1) = J\overline{Q(t)} + \overline{K}Q(t)$$

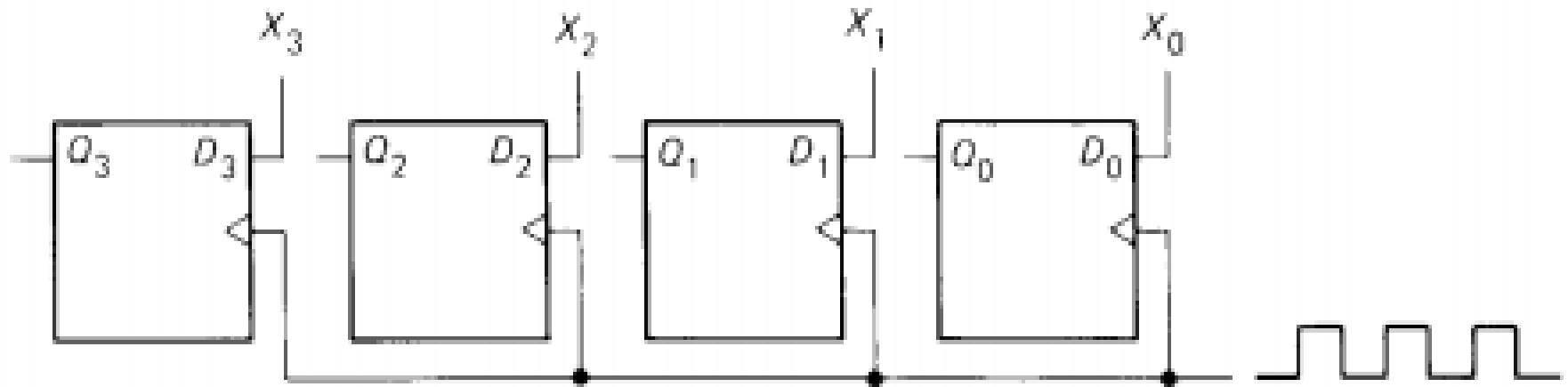
Symbol :

Registers

Buffer Registers

Registers are a type of computer memory built directly into the processor or CPU (Central Processing Unit) that is used to store and manipulate data during the execution of instructions. A register may hold an instruction, a storage address, or any kind of data

Buffer register.

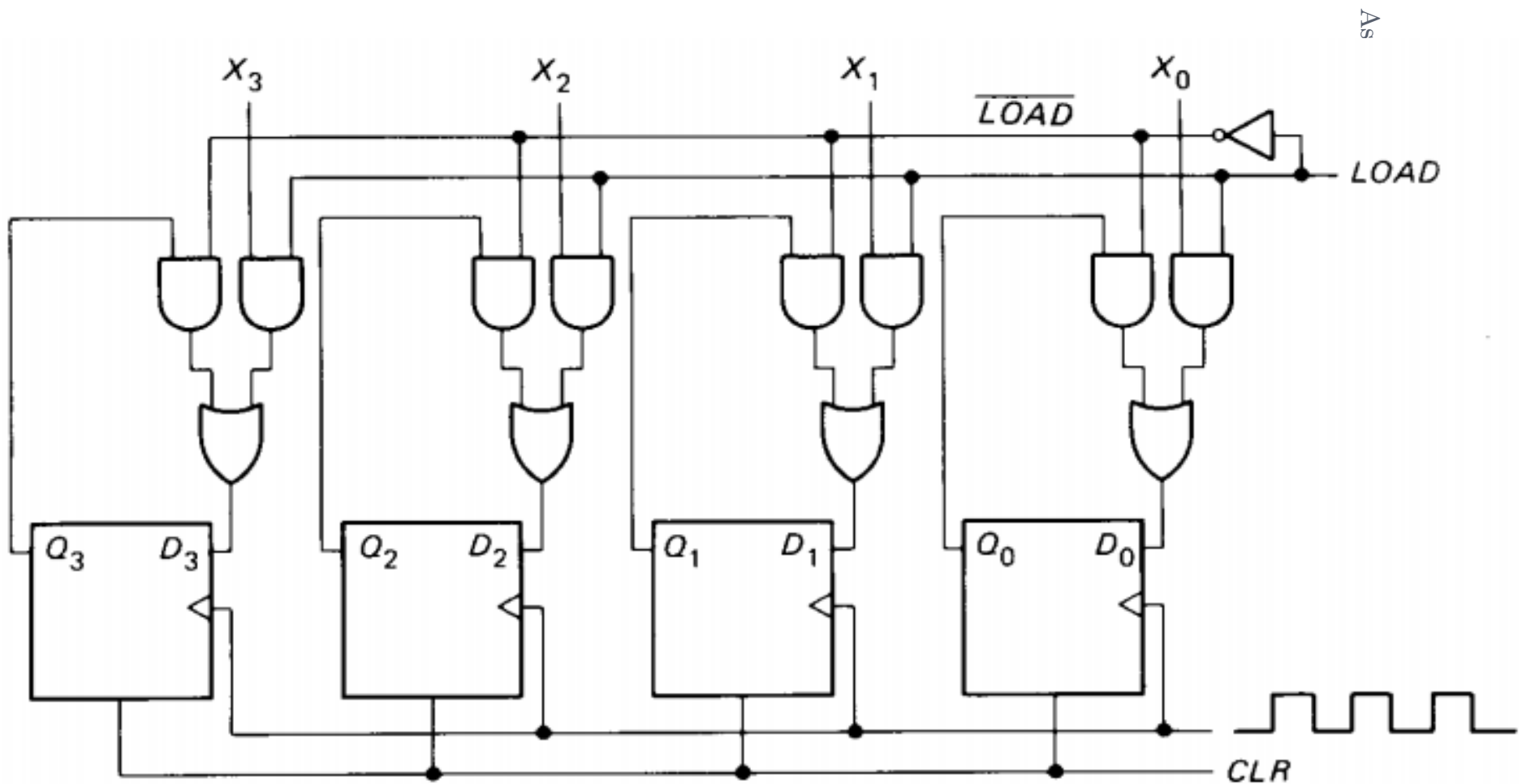


Symbol :

BUFFER REGISTERS

Controlled buffer register with parallel load.

Symbol :

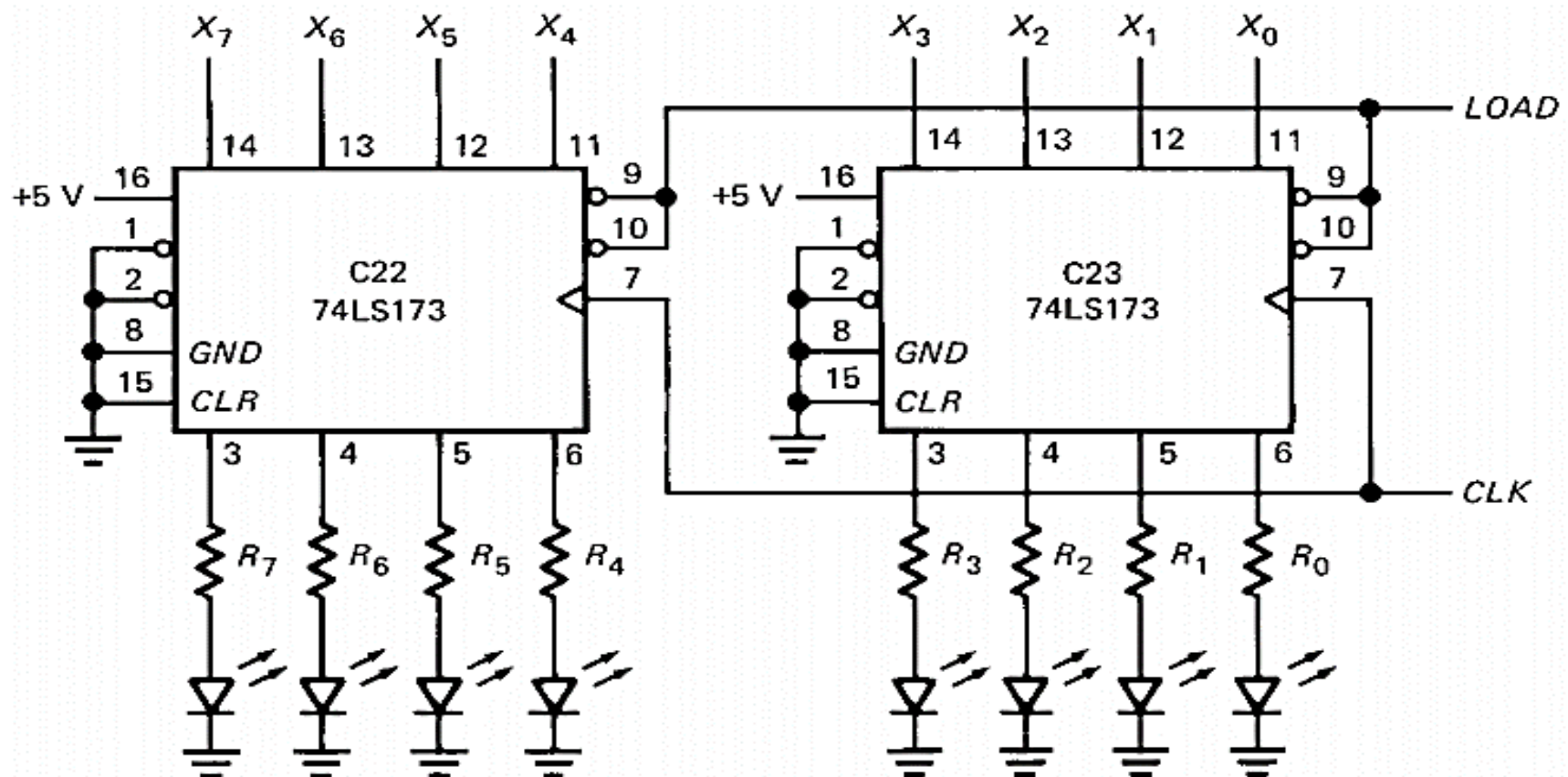


Controlled Buffer Registers

BUFFER REGISTERS

Controlled buffer register.

Hardware Implementation :



Note: All resistors are 1 k Ω .

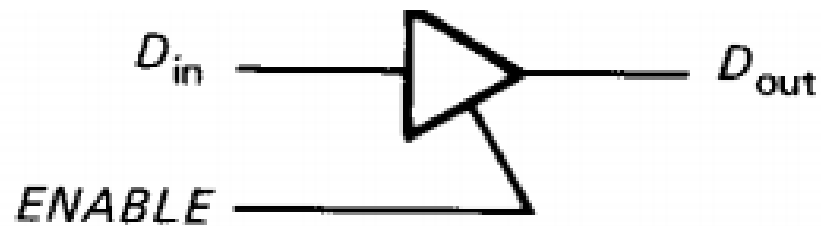
Three-State Registers

NORMALLY OPEN

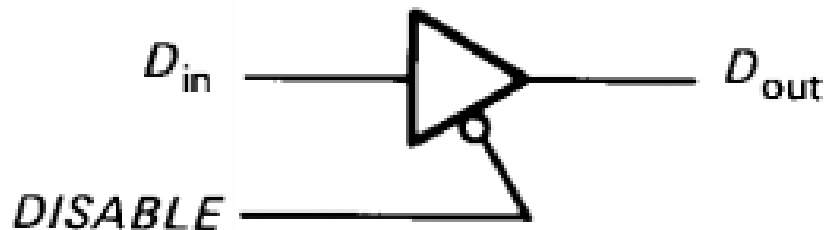
<i>ENABLE</i>	D_{in}	D_{out}
0	X	Open
1	0	0
1	1	1

NORMALLY CLOSED

<i>DISABLE</i>	D_{in}	D_{out}
0	0	0
0	1	1
1	X	Open



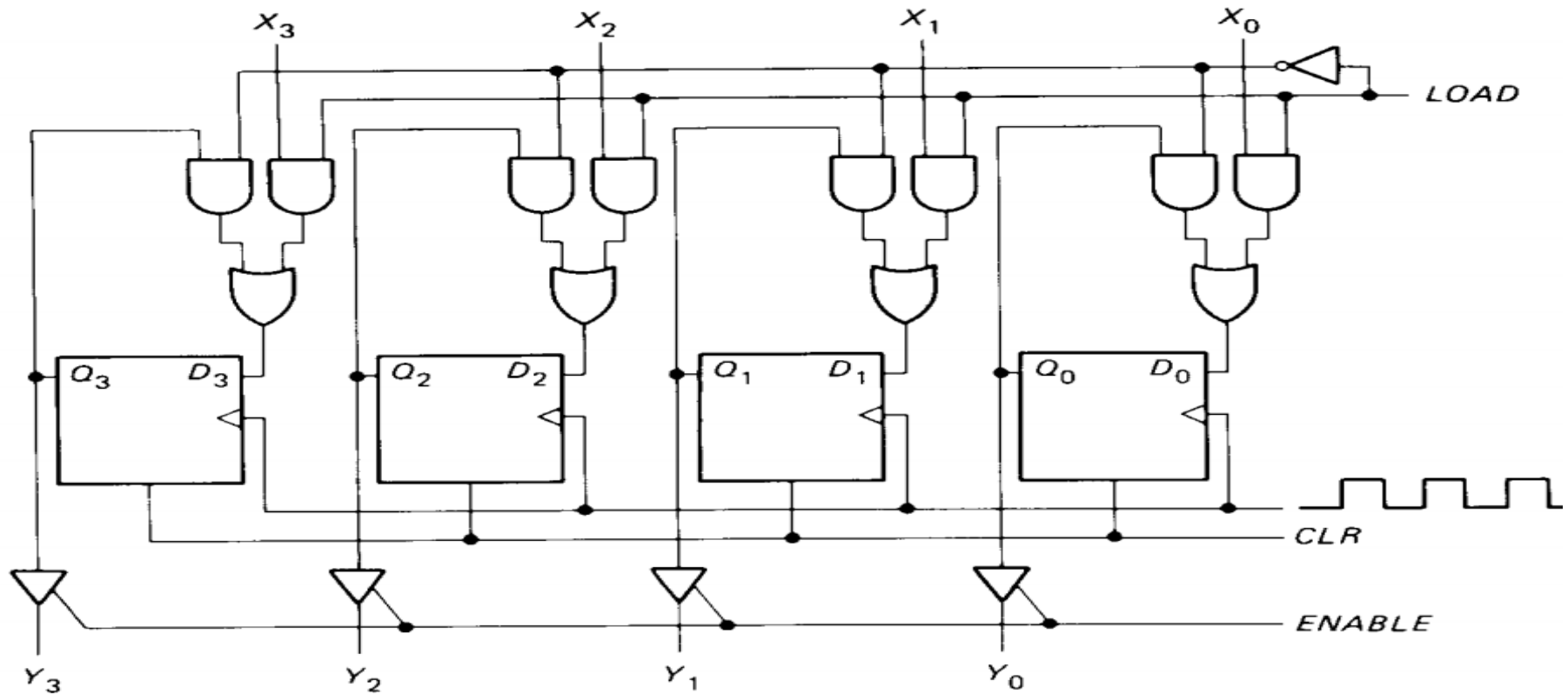
Normally open switch



Normally closed switch.

Three-State Registers

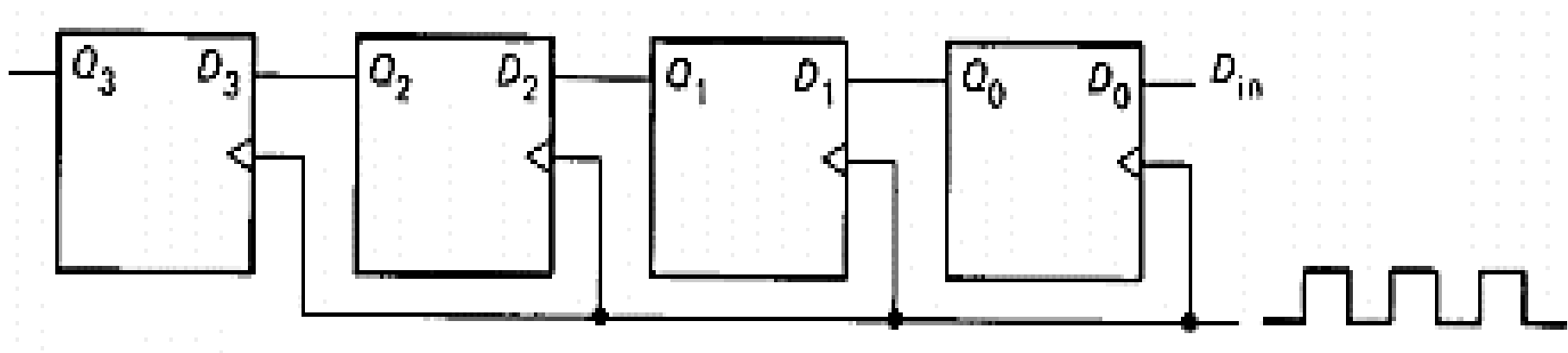
The main application of **three-state switches** is to convert the two-state output of a register to a **three-state output**.



Symbol :

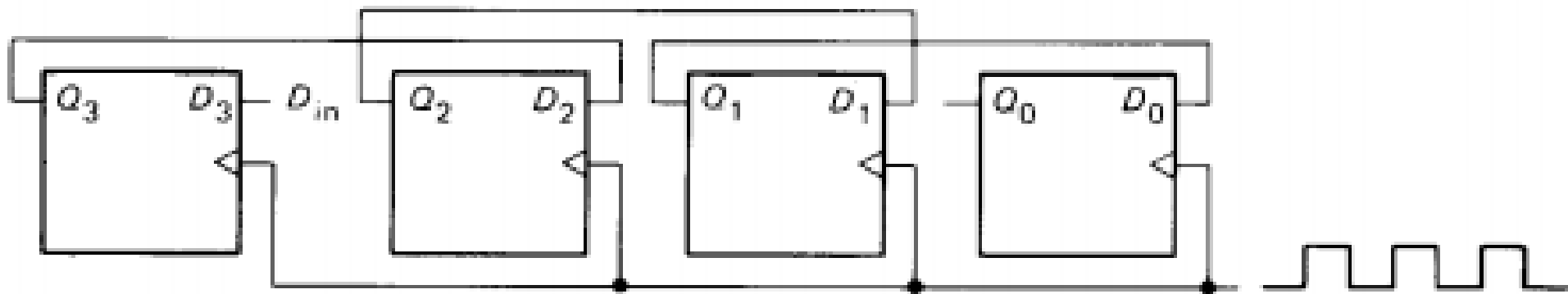
Three-state buffer register

Shift Registers



Shift-left register.

Symbol :

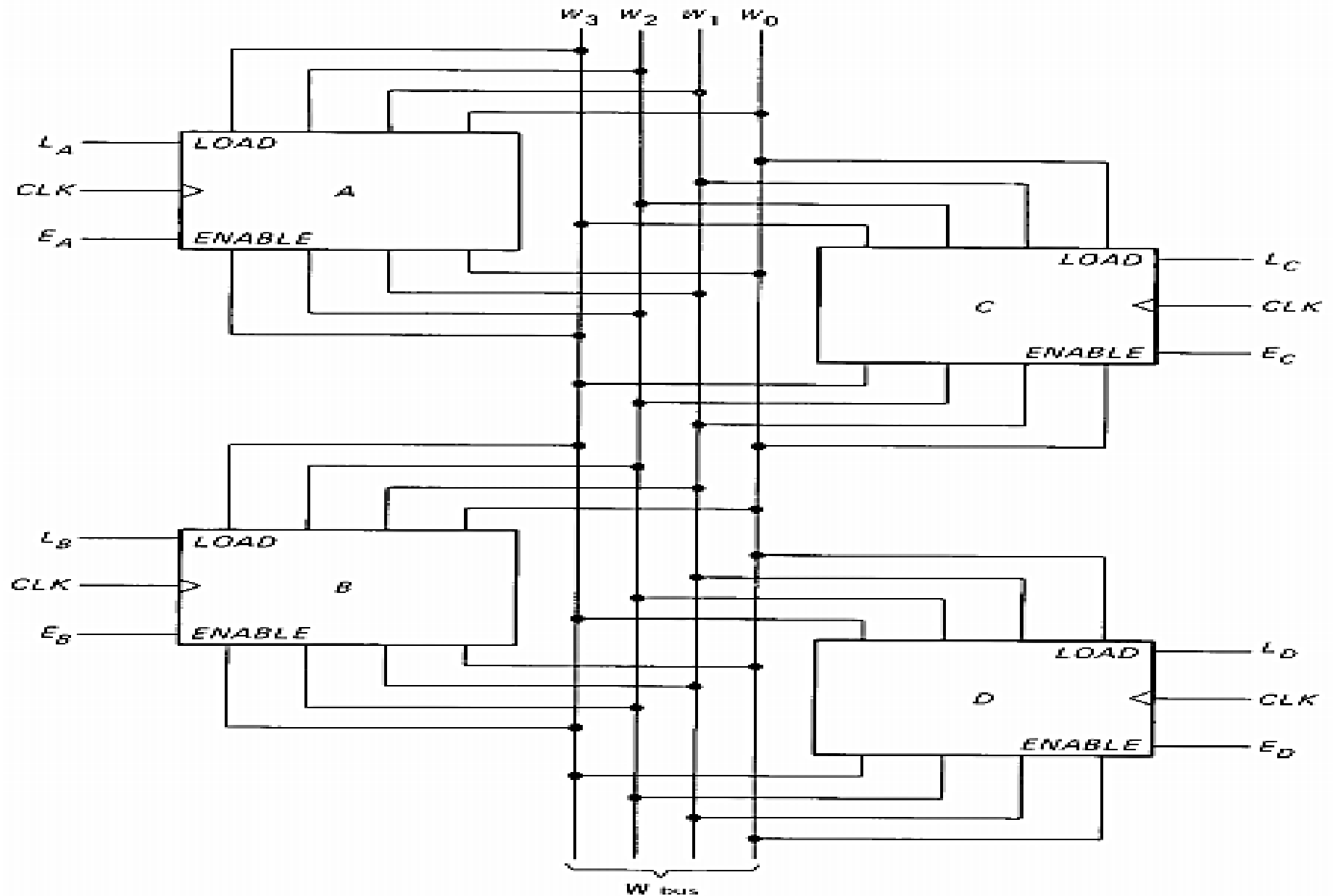


Shift-right register.

BUS-ORGANIZED COMPUTERS

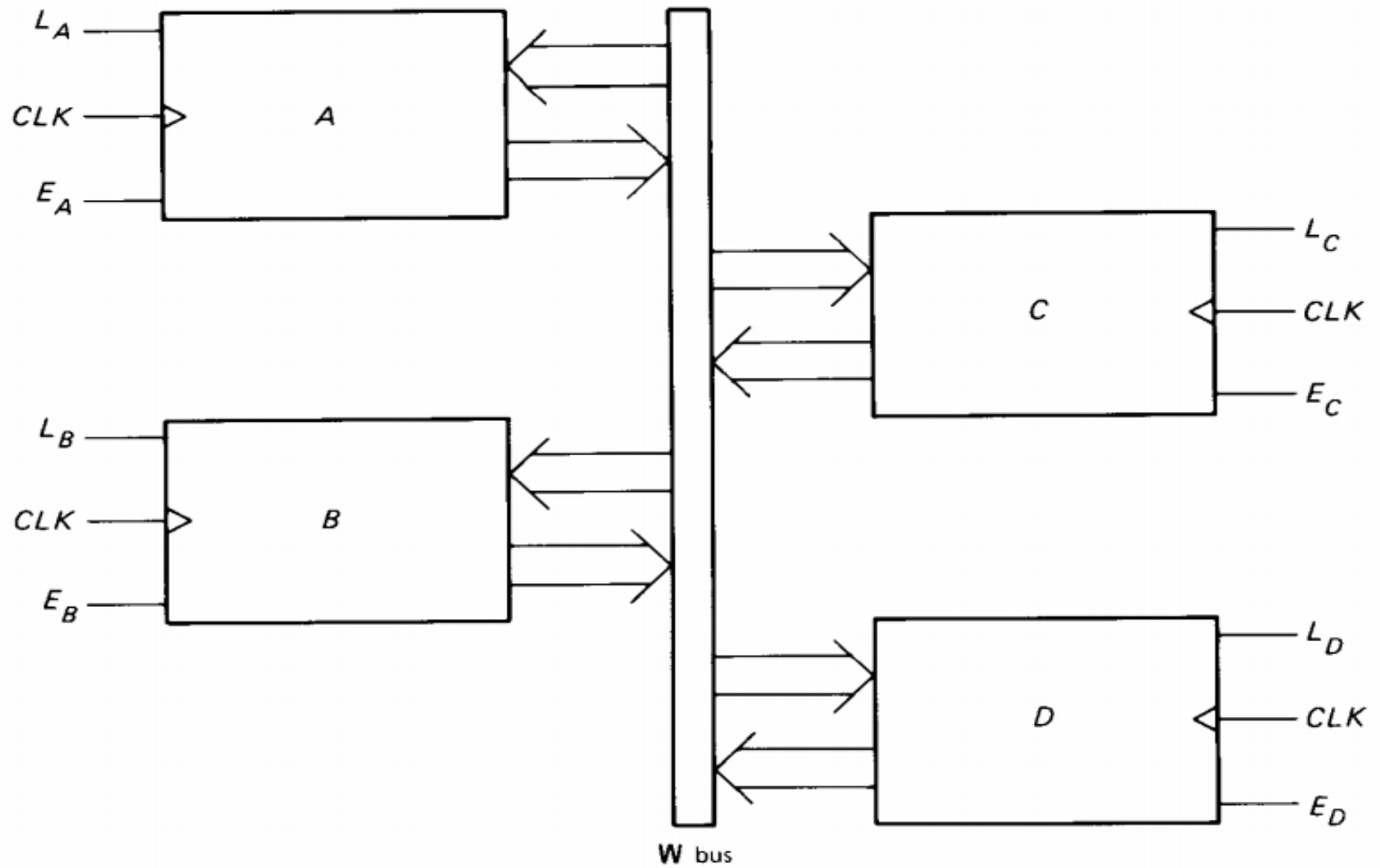
Bus-Organized Computers

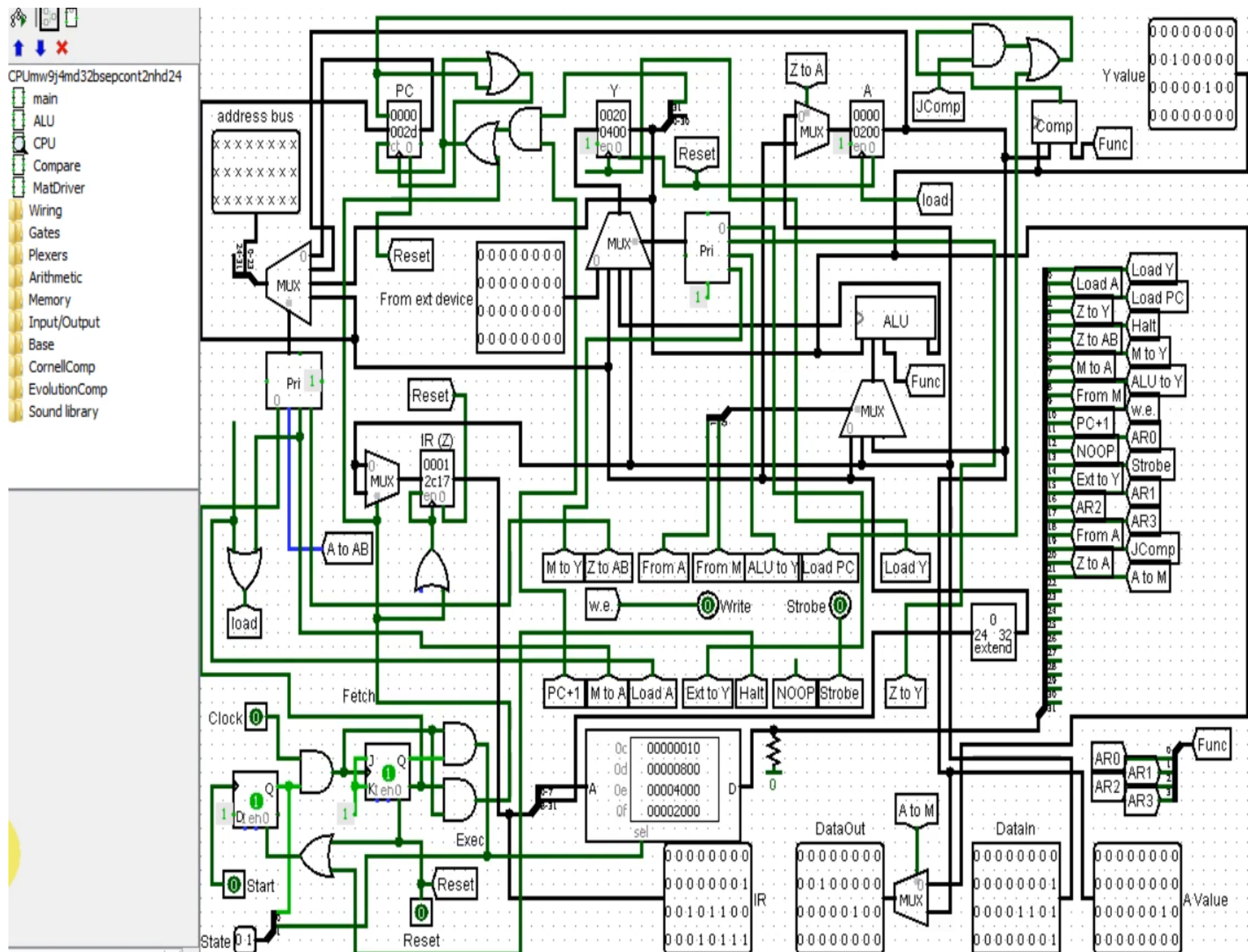
A bus is a group of wires that transmit a binary word

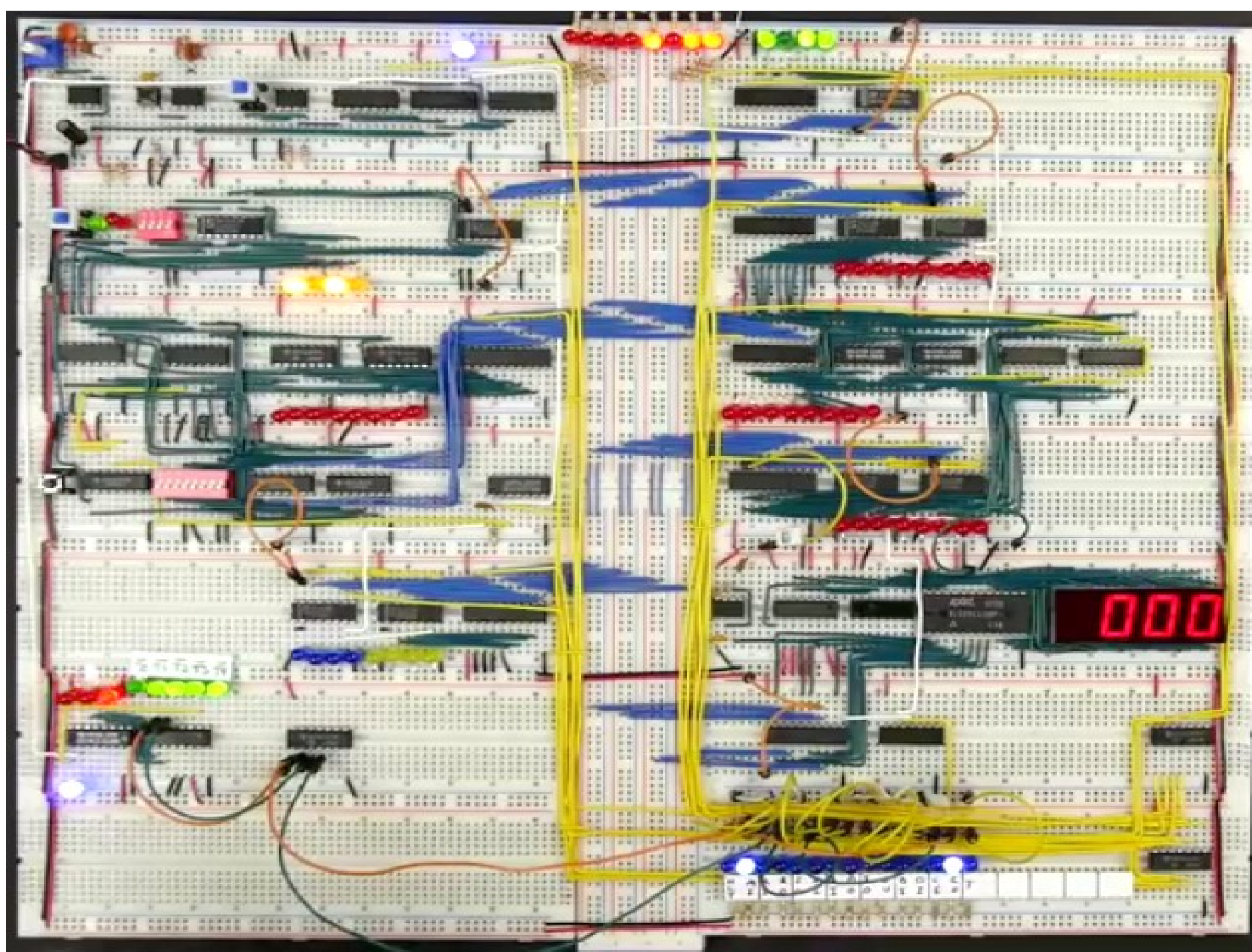


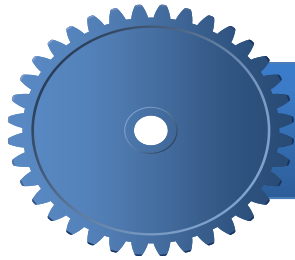
Bus

An abbreviated form of the bus example









Questions





THANK YOU

