Tishk International University
Science Faculty
IT Department

Computer Hardware

Lecture 01: Introduction

2nd Grade – Spring Semester

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Course Name: COMPUTER HARDWARE
Code/Section: IT 232/A

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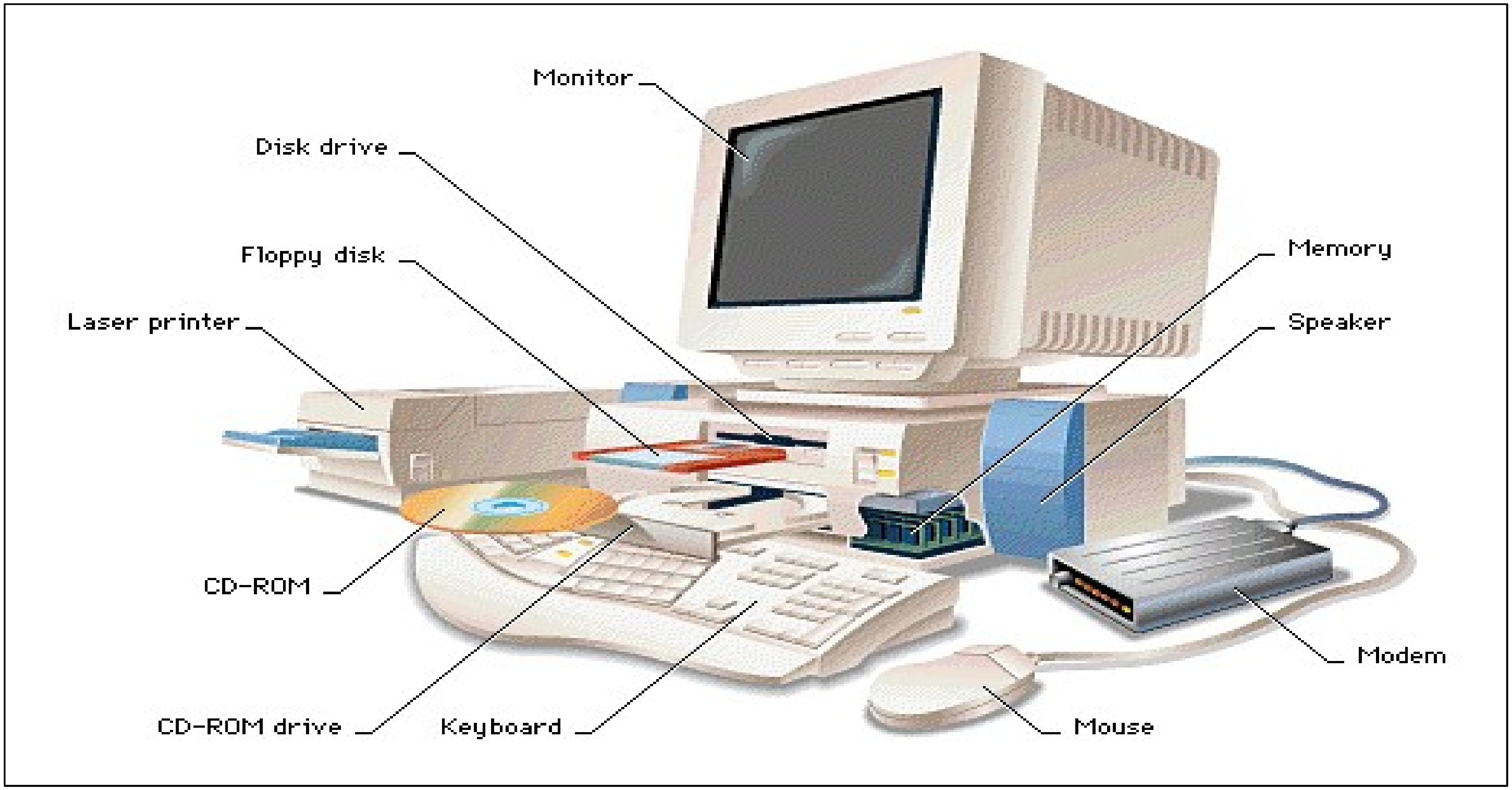
Room No.: 313

Reference: Mueller, Scott. Upgrading and Repairing PCs: Upgrading and Repairing_e22. Que Publishing, 2015.

COURSE CONTENT

#	Topic
1	Introduction
2	CPU (part 1 –8086 , part 2 –80386)
3	Standard Input Output Systems
4	Network Cards
5	Motherboard
6	Memory Organization
7	Video and Audio Systems
8	Storage Devices

Lecture 01: Introduction
Part 1 - Computer Evolution



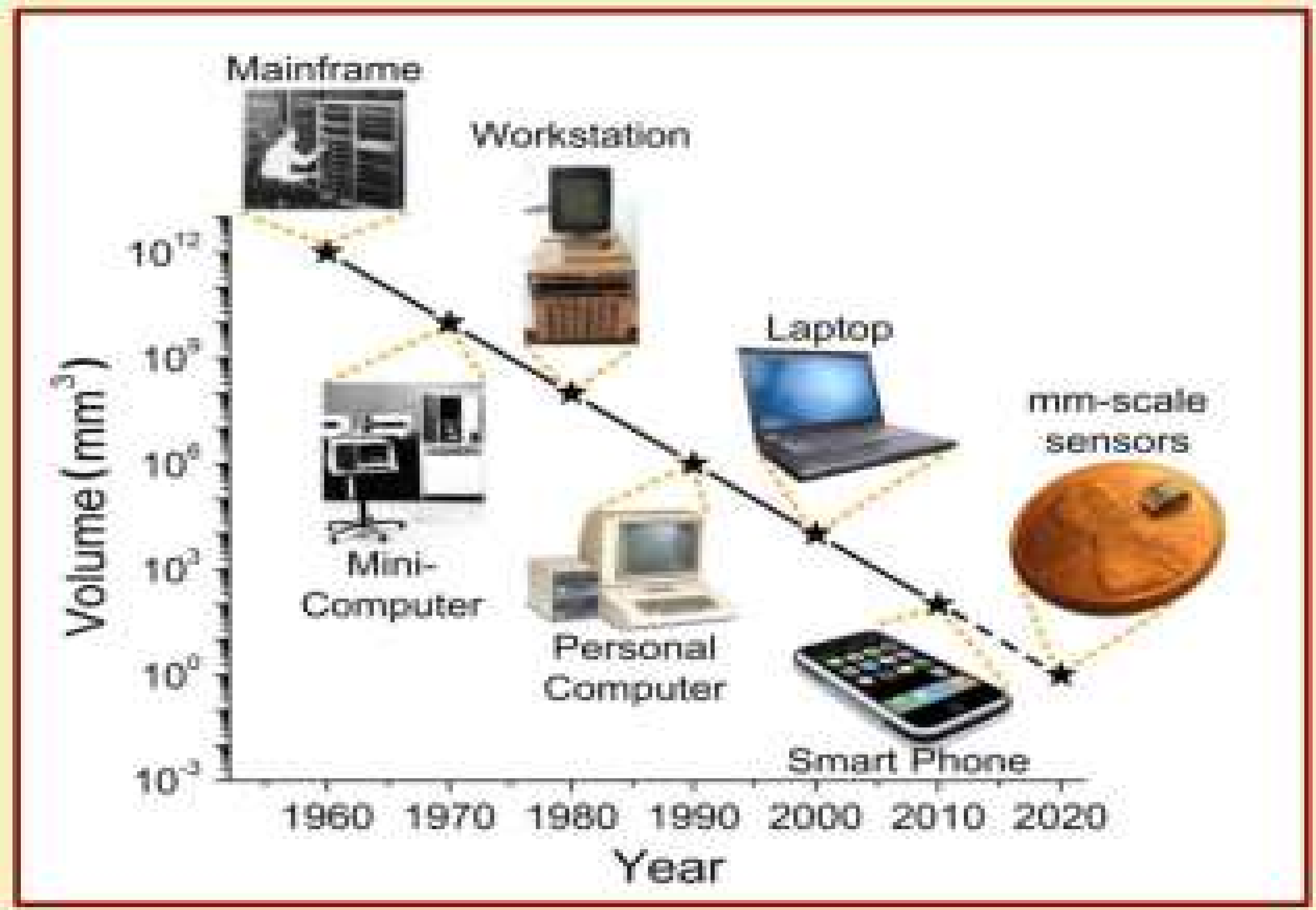
Computer Architecture Definition

- **Computer Architecture**: is how to integrate computer components to build a computer system to achieve a desired level of performance.

– Analogy: architect's task during the planning of a building (overall layout, floorplan, etc).

- This lecture will focus on the IBM PC evolution, since it remains the most popular architecture and, most computers could still run MS-DOS based programs from the 80's and 90's
- Understanding how the design of the PC has evolved will help when solving problems as it is necessary have a deeper understanding of why things are done and what problems can happen to it.

Evolution of the Types of Computers (not required in the exam)



Mainframe: IBM System/360

- Very popular mainframe computer of the 60s and 70s.
- Introduced many advanced architectural concepts that appeared in microprocessors several decades later.

IBM PC History

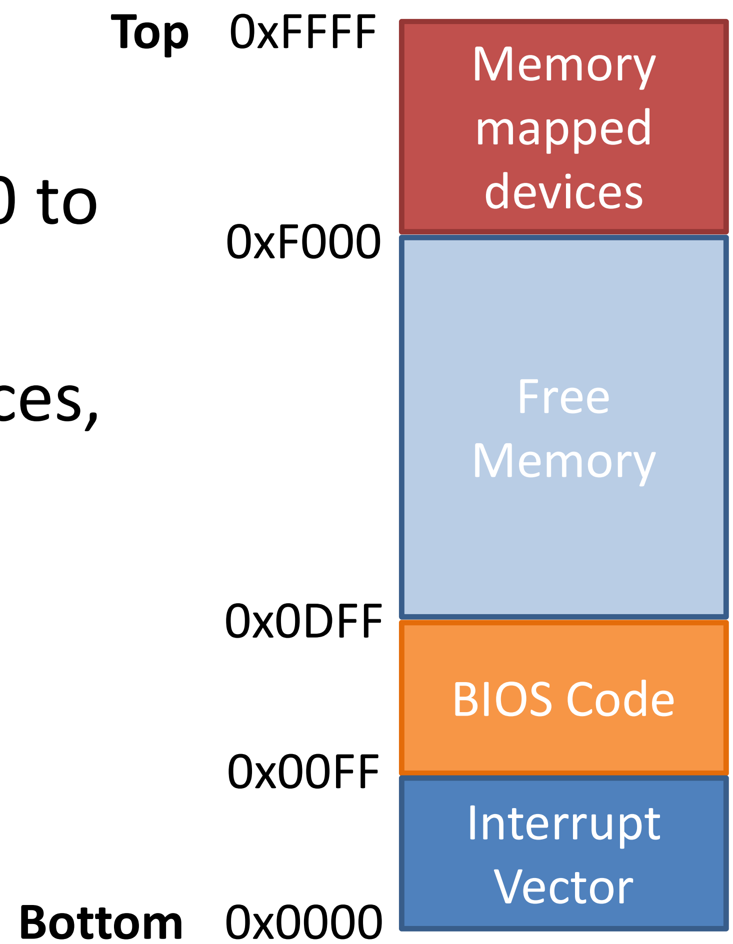
- 1981: IBM releases a Personal Computer (PC. It has the below features
  - Basic Input/Output System (BIOS) for low-level control
  - Microsoft made the operating system MSDOS.
  - 3rd party designers were asked to design extension cards.
  - 3rd party developers were asked to write software for MSDOS.
  - **IBM PC hardware became the de-facto standard**

IBM Loses Control

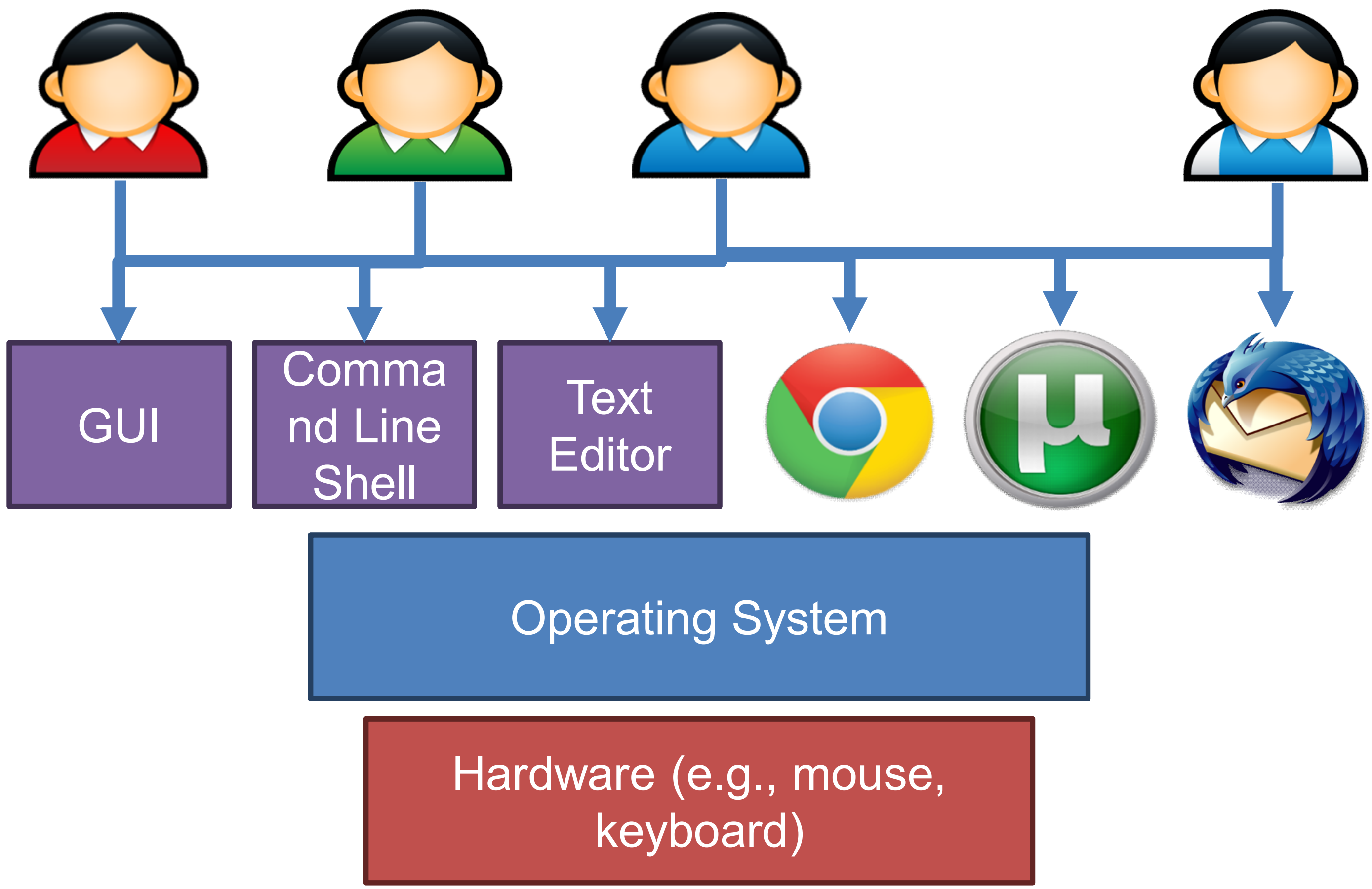
- 1982: Compaq, HP and others release IBM-compatible PCs
  - Different hardware implementations (except 8086 CPU)
  - Reverse engineered and re-implemented BIOS
  - Relied on customized version of MS-DOS
- 1985: IBM clones dominated computer sales
  - Used the same underlying CPUs and hardware chips
  - Close to 100% BIOS compatibility
  - MS-DOS compatible
  - Until recently, most computers could still run MS-DOS based programs from the 80’s and 90’s.

Typical Memory Layout of IBM PC

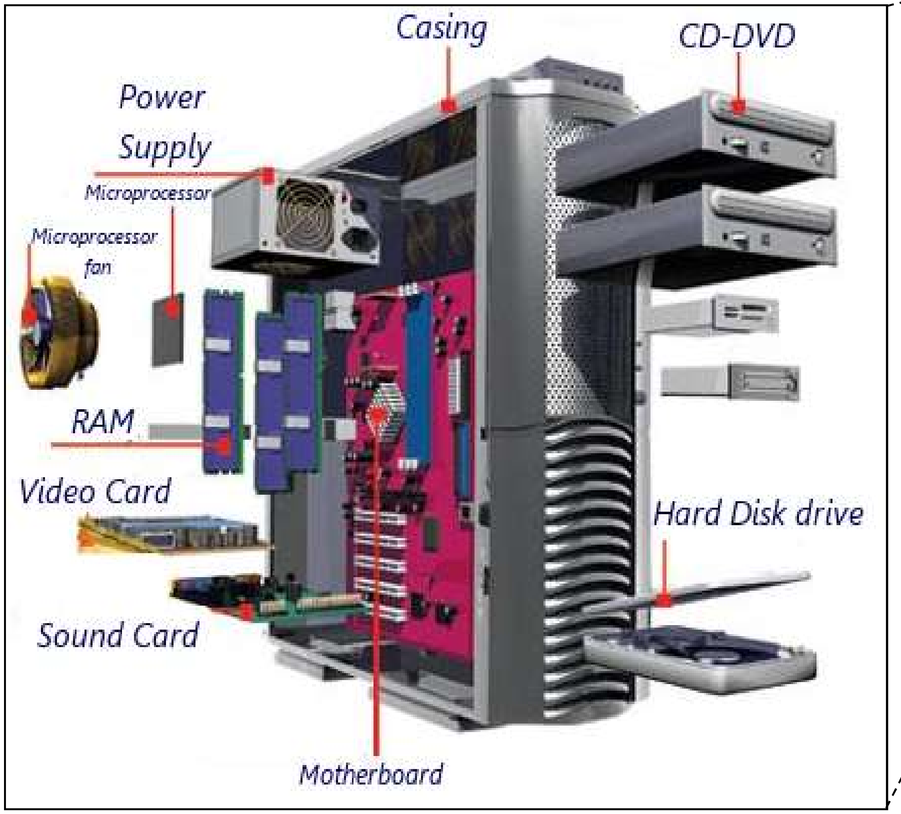
- 64KB of memory
- Memory Addresses from 0x0000 to 0xFFFF
- Specific ranges get used by devices, system services, the BIOS, etc.

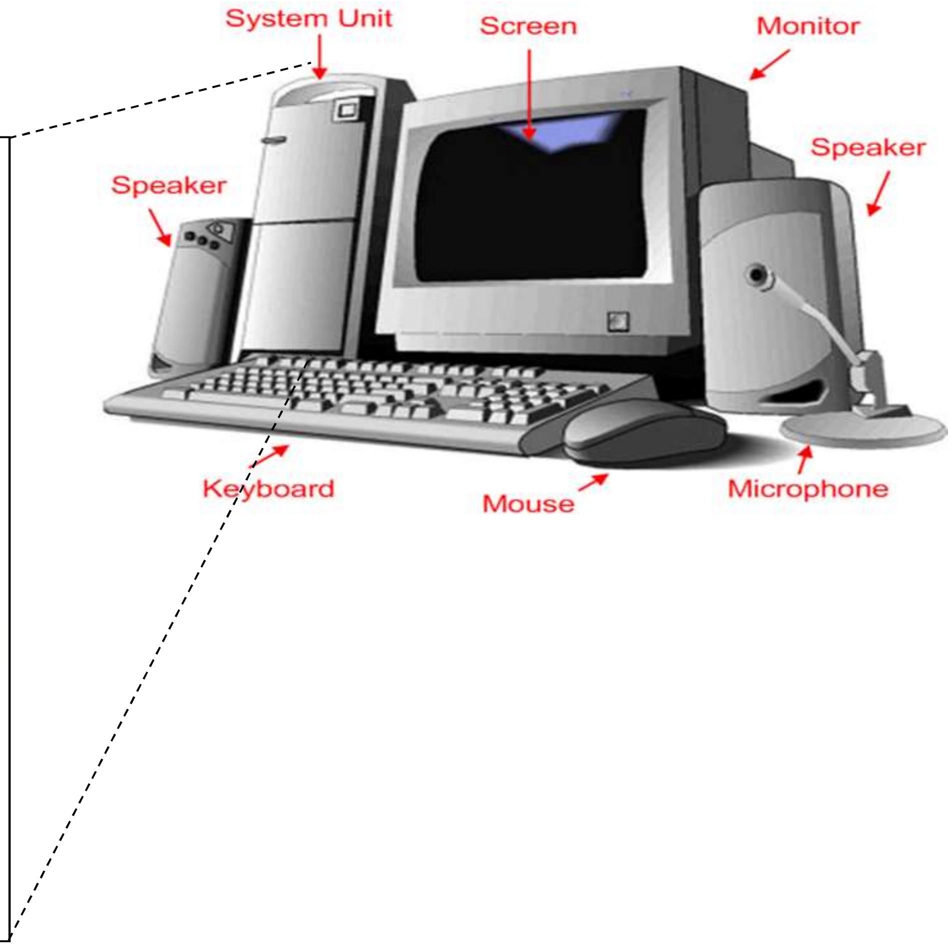


OS and Hardware Relation (not required in the exam)

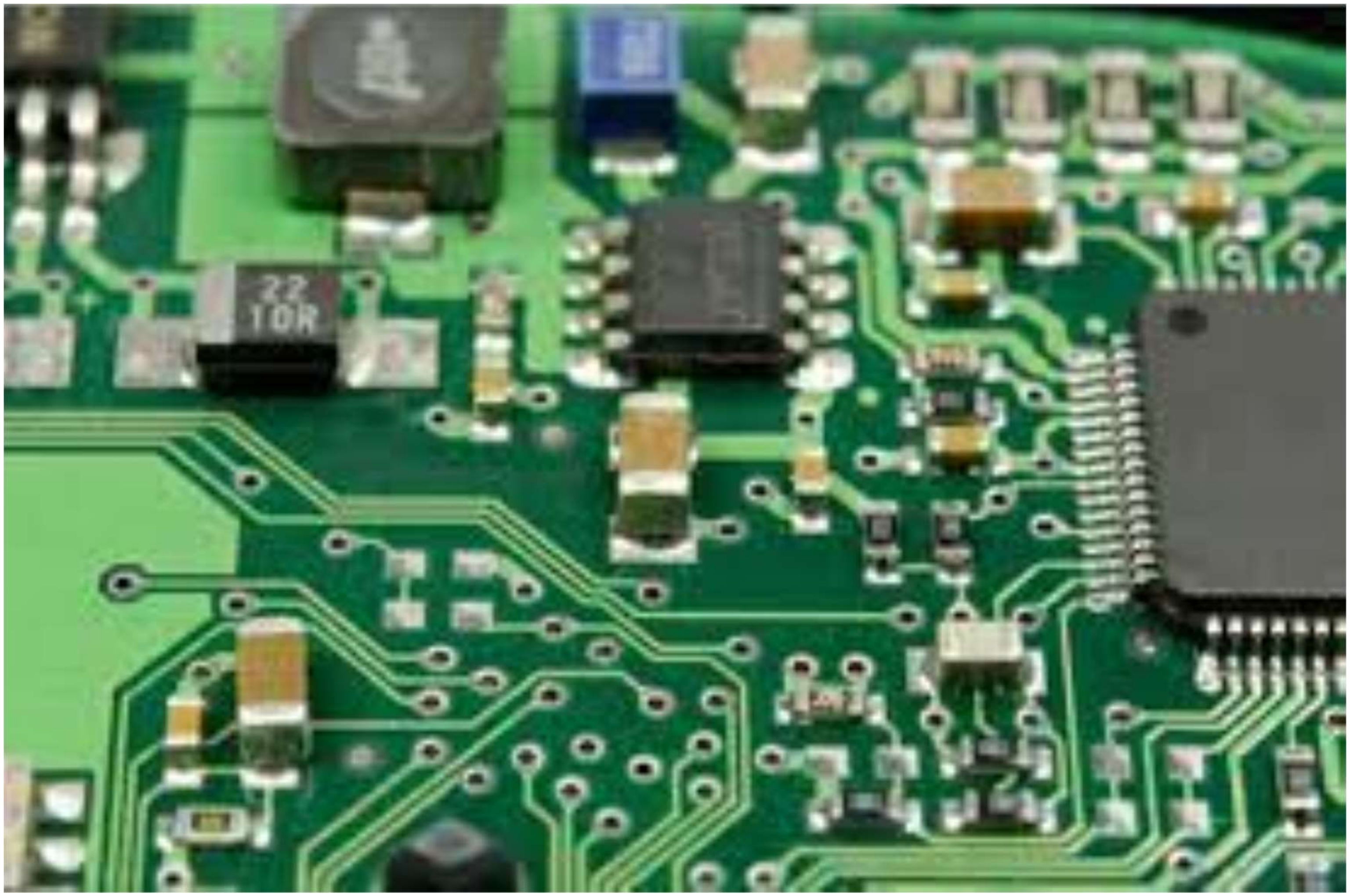


Typical Modern Computer Hardware Components

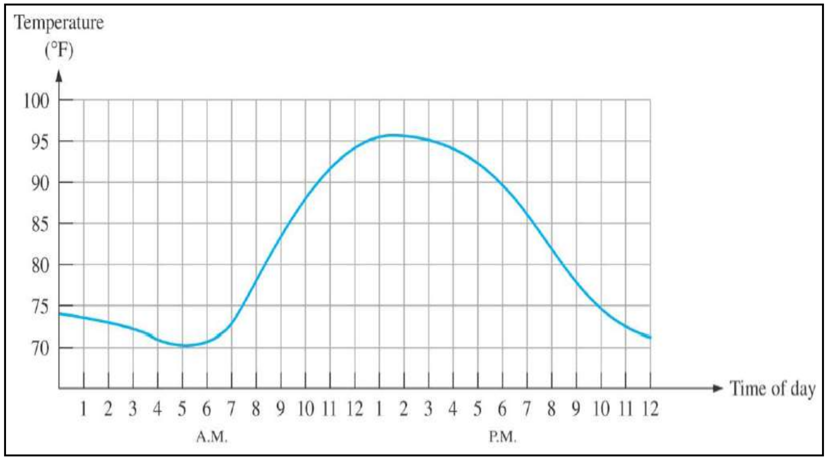


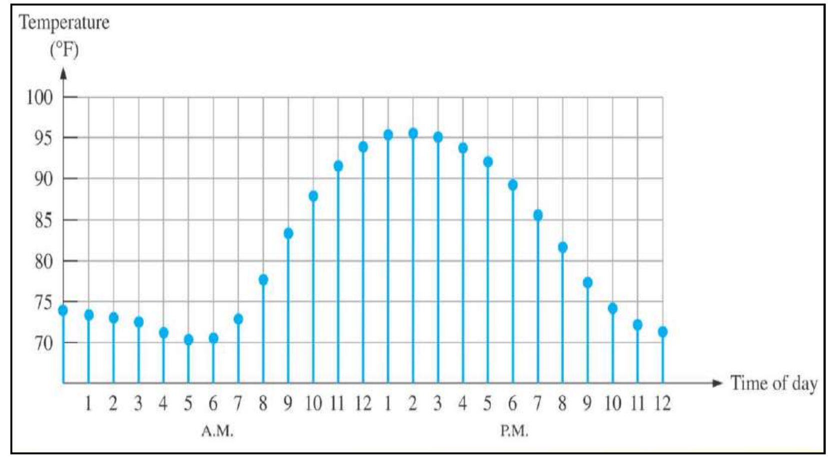


Lecture 01: Introduction
Part 2 – Digital Signals and Circuits



Digital and Analog Quantities

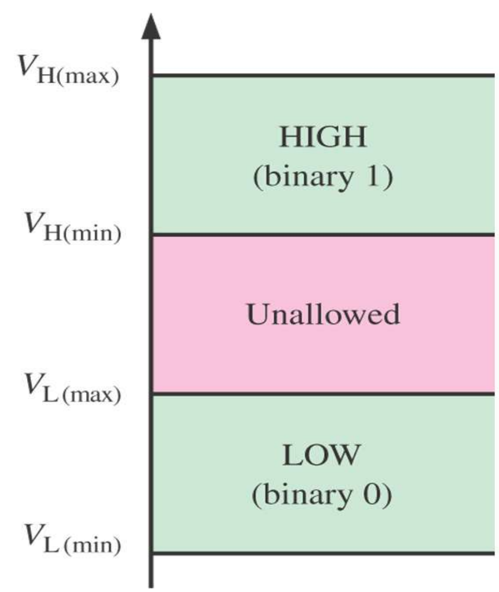




Analog quantities have continuous values

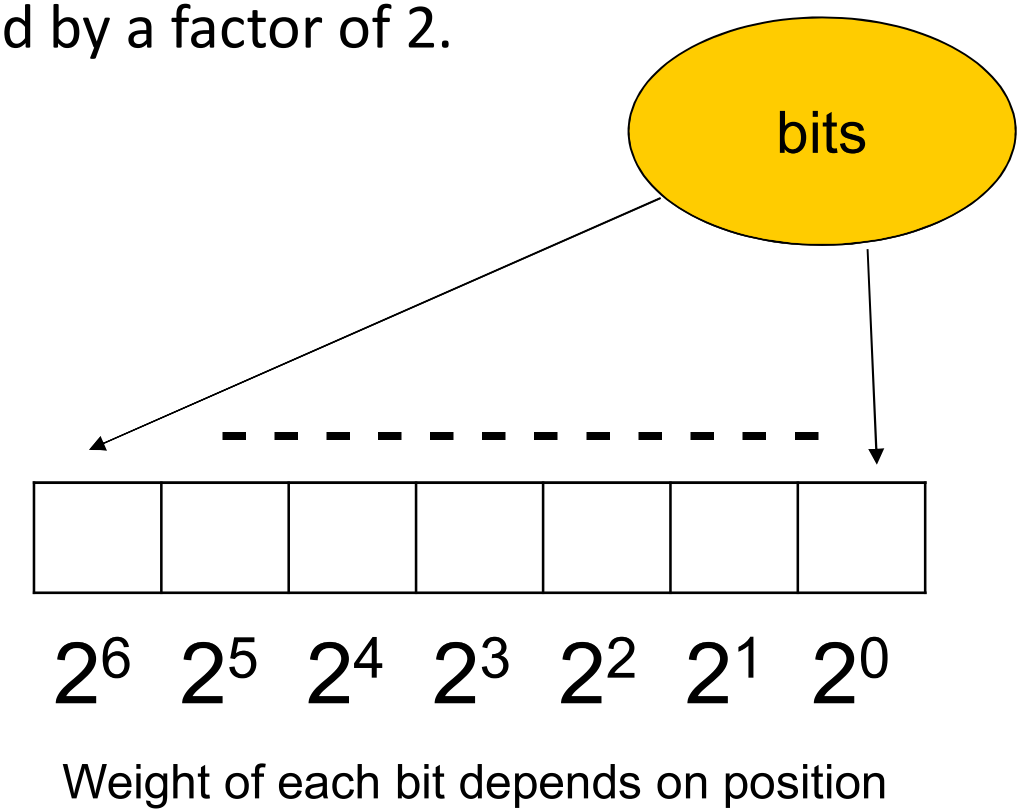
Digital quantities have discrete sets of values

- **Sampling** Converts Analog quantity to Digital Quantity.
- Each discrete number will be represented in Digital Systems (like computer, Smartphone,..etc) as a binary number with set of bits.
- Each bit can have two values **0** or **1**
- **The Binary values 0 and 1 are represented by voltage levels.**
- They can also be called LOW and HIGH, where **LOW = 0** and **HIGH = 1**



Binary Numbers

- The binary digit is called bit which can be either 0 or 1
- Right most bit is least significant bit LSB
- Left most bit is most significant bit MSB
- Each position is weighted by a factor of 2.

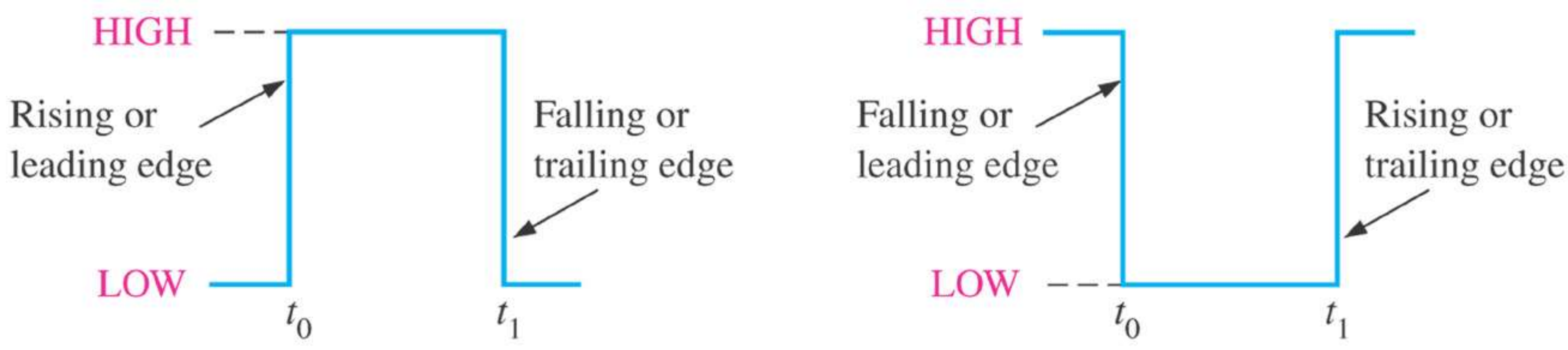


Counting in Binary

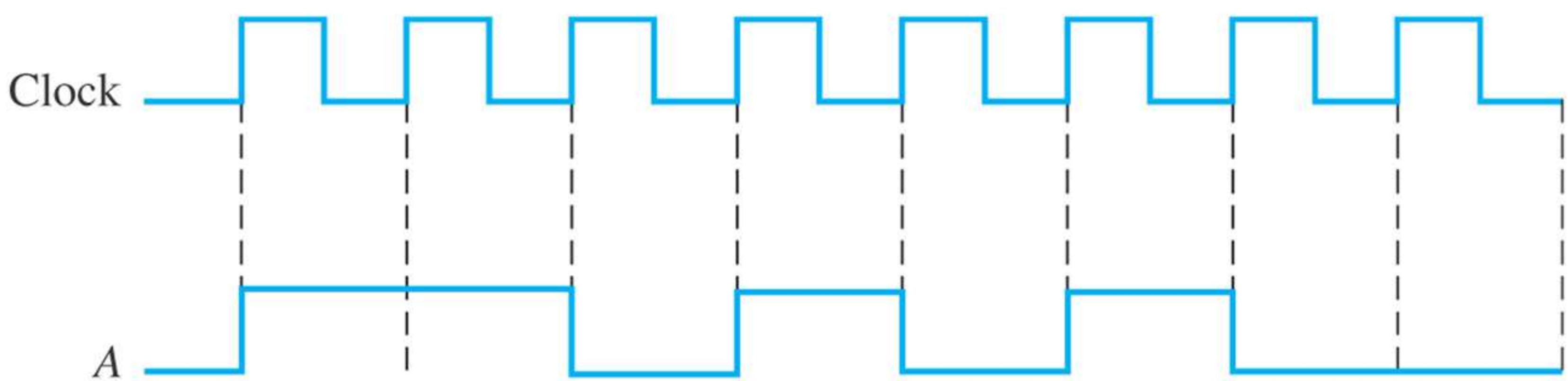
Decimal	Binary			
	2^3	2^2	2^1	2^0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Digital Pulse

Binary values represented by voltage levels over time.

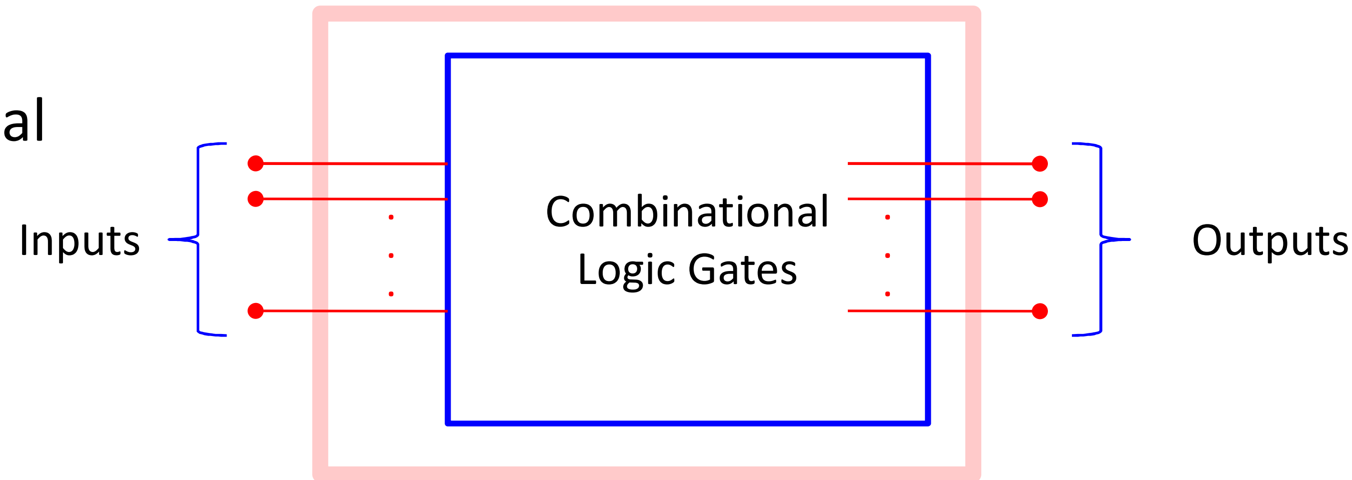


(a) Positive–going pulse (b) Negative–going pulse

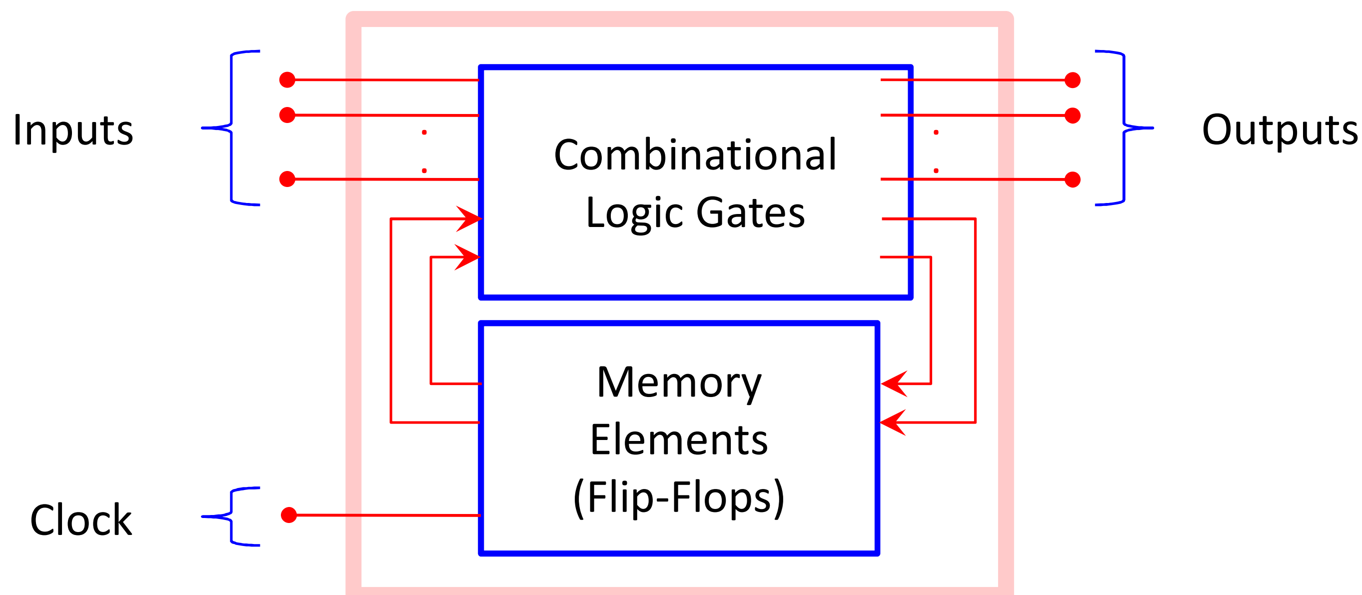


Combinational & Sequential Logic

Combinational Logic



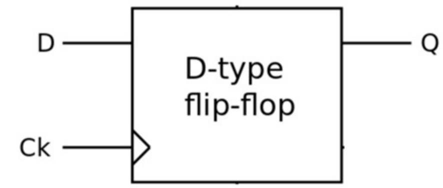
Sequential Logic

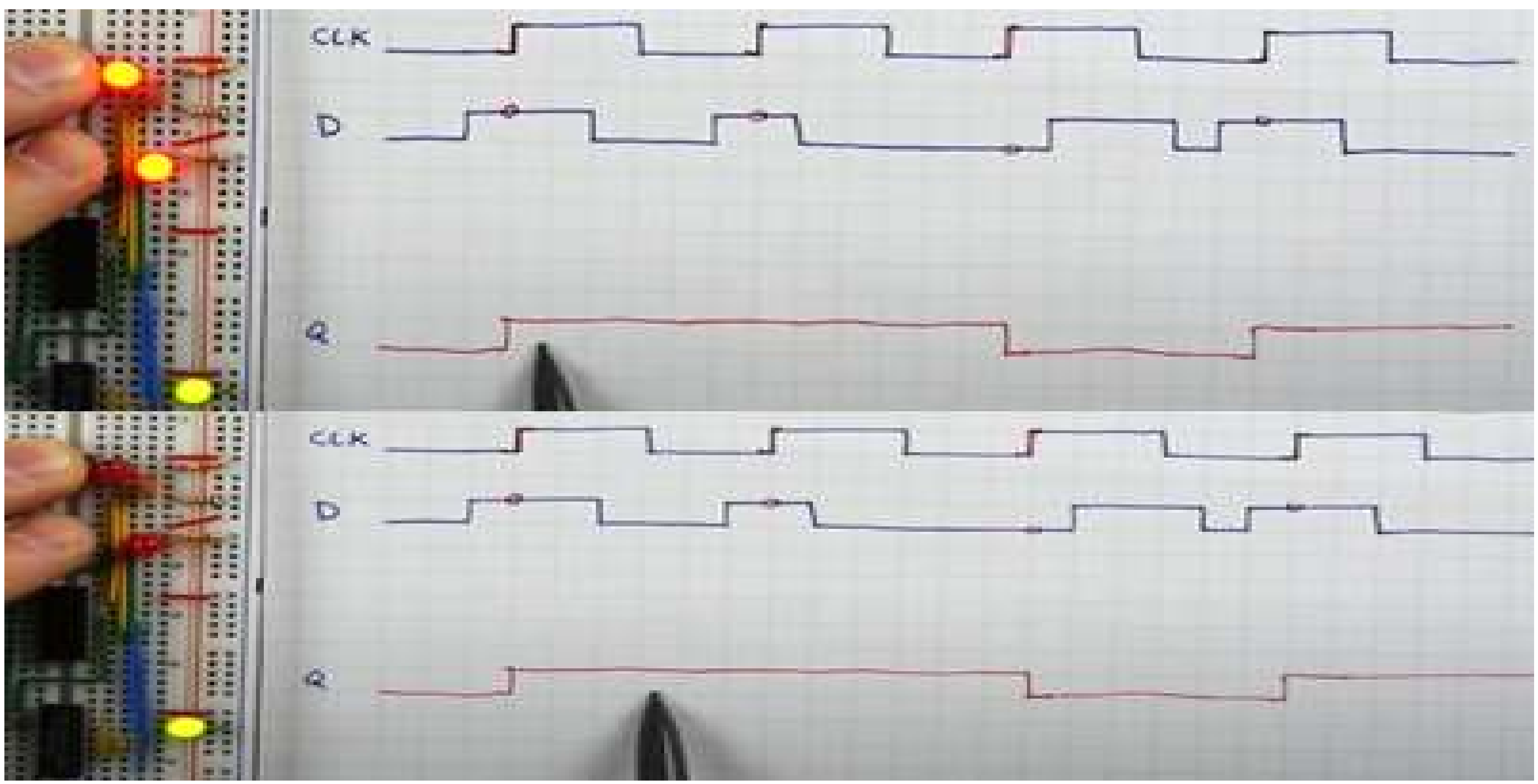


Flip-Flop

A **Flip-Flop** is a memory to store 1 bit, in which only the clock edge determines when a new bit is entered.

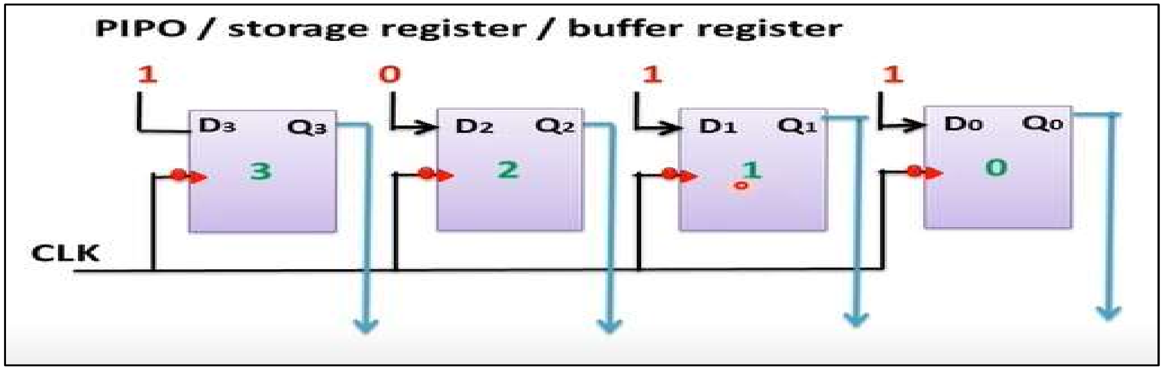
In D-type Flip-Flop the output Q assumes the state of the D input on the triggering edge of a clock pulse and keep memorizing this value till next clock edge.





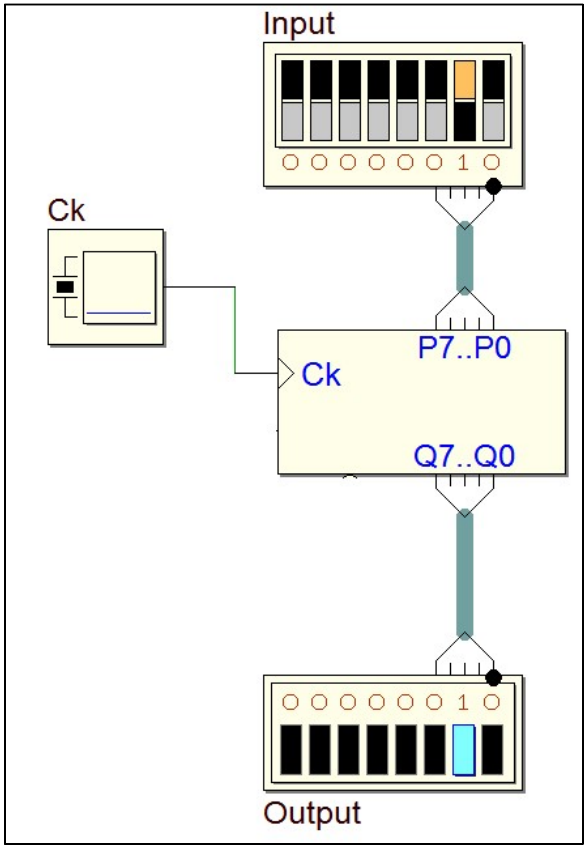
Register

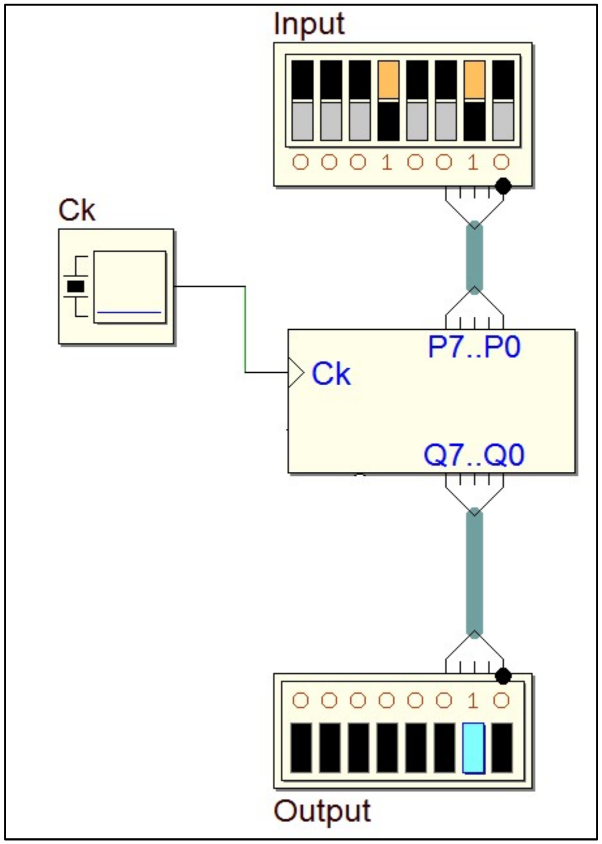
- An register has a group of *n* flip-flops so it is capable of storing *n* bits of information.
- The maximum value that a register can represent is 2^n-1
- Example: A 4-bit register. A new 4-bit data is loaded every clock cycle. The maximum value for this register is 2^4-1 =15
- Register Functions:
  - ❖ Read data from register
  - ❖ Write new data into register
  - ❖ Shift the data within register

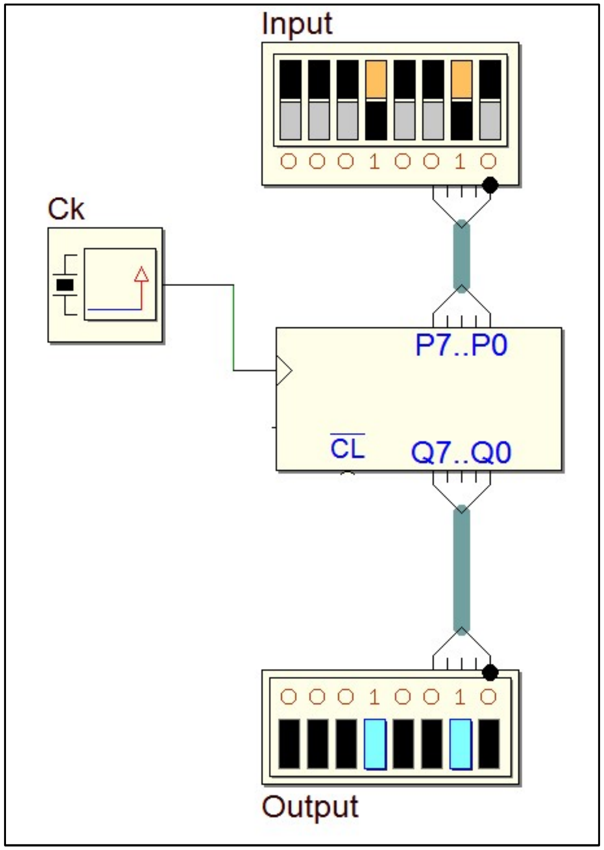


Register States & Clock Signal

The output of the register will memorize the last state even when input changes until clock edge present







State 1 State 2 State 3

Von-Neumann Architecture

- All instructions and data are stored in memory.
- An instruction and the required data are brought into the CPU for execution.
- Input and Output devices interface the CPU with the outside world.

CPU: Central Processing Unit

❖At the heart of all personal computers and smart phones sits a microprocessor.

❖In the world of computers, the terms ***microprocessor*** (**µP**)*,* ***processor,*** and ***CPU*** have the same meaning.

❖Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

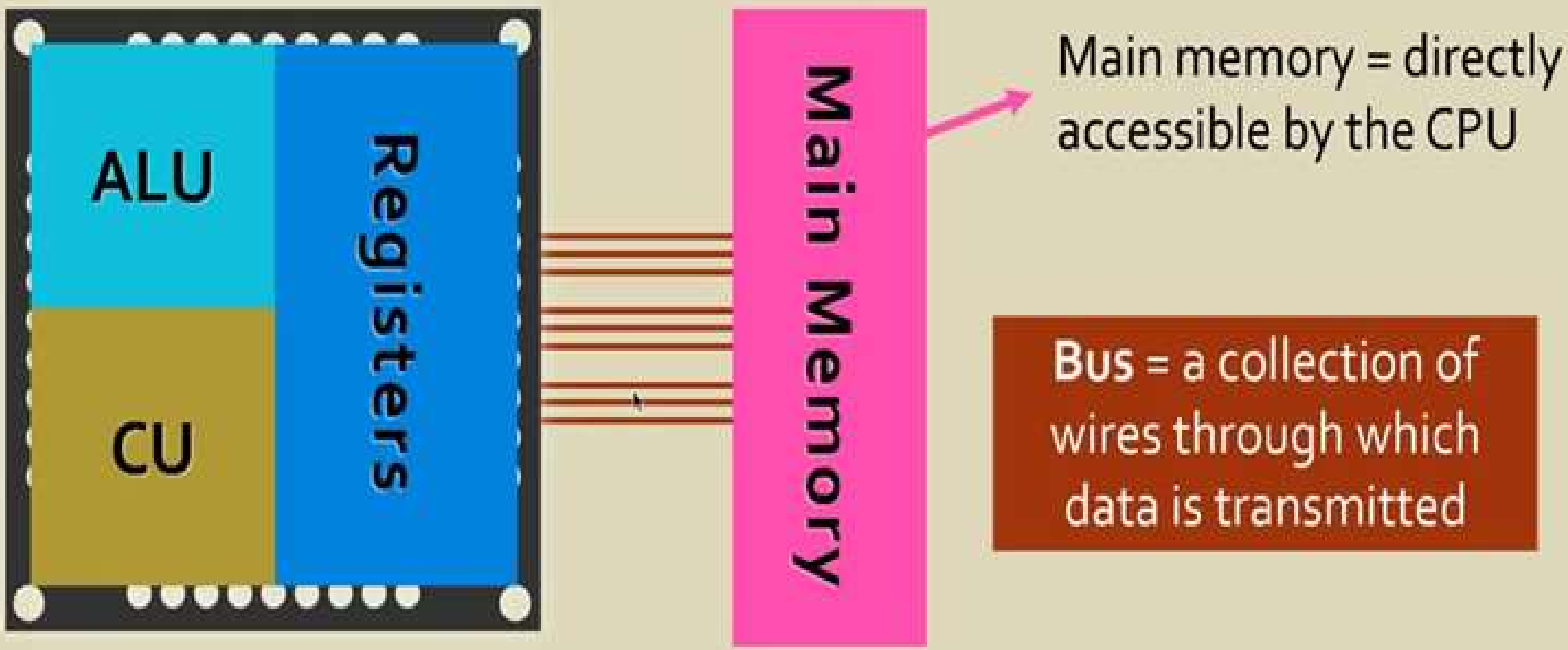
❖Three basic characteristics differentiate microprocessors:

i) **Instruction set**: The set of instructions that the CPU can execute.

ii) **Bus width**: The number of bits processed in a single instruction.

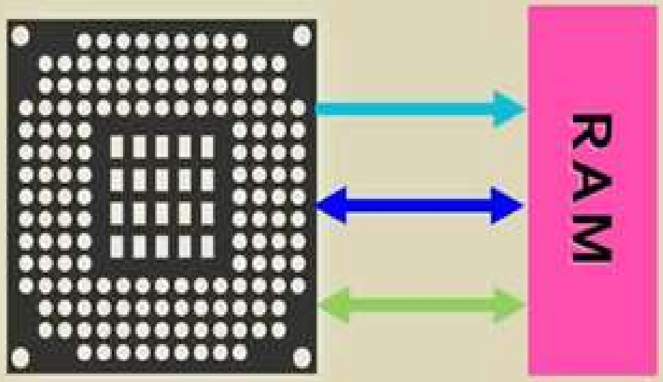
iii) **Clock speed** (in MHz): determines how many instructions per second the processor can execute.

Bus Concept



- The speed of a bus is measured in megahertz (MHz)
- The size of a bus (its **width**) is how many bits it can transfer at a time
  E.g. a 64 bit computer has buses with 64-bit widths

Bus Types

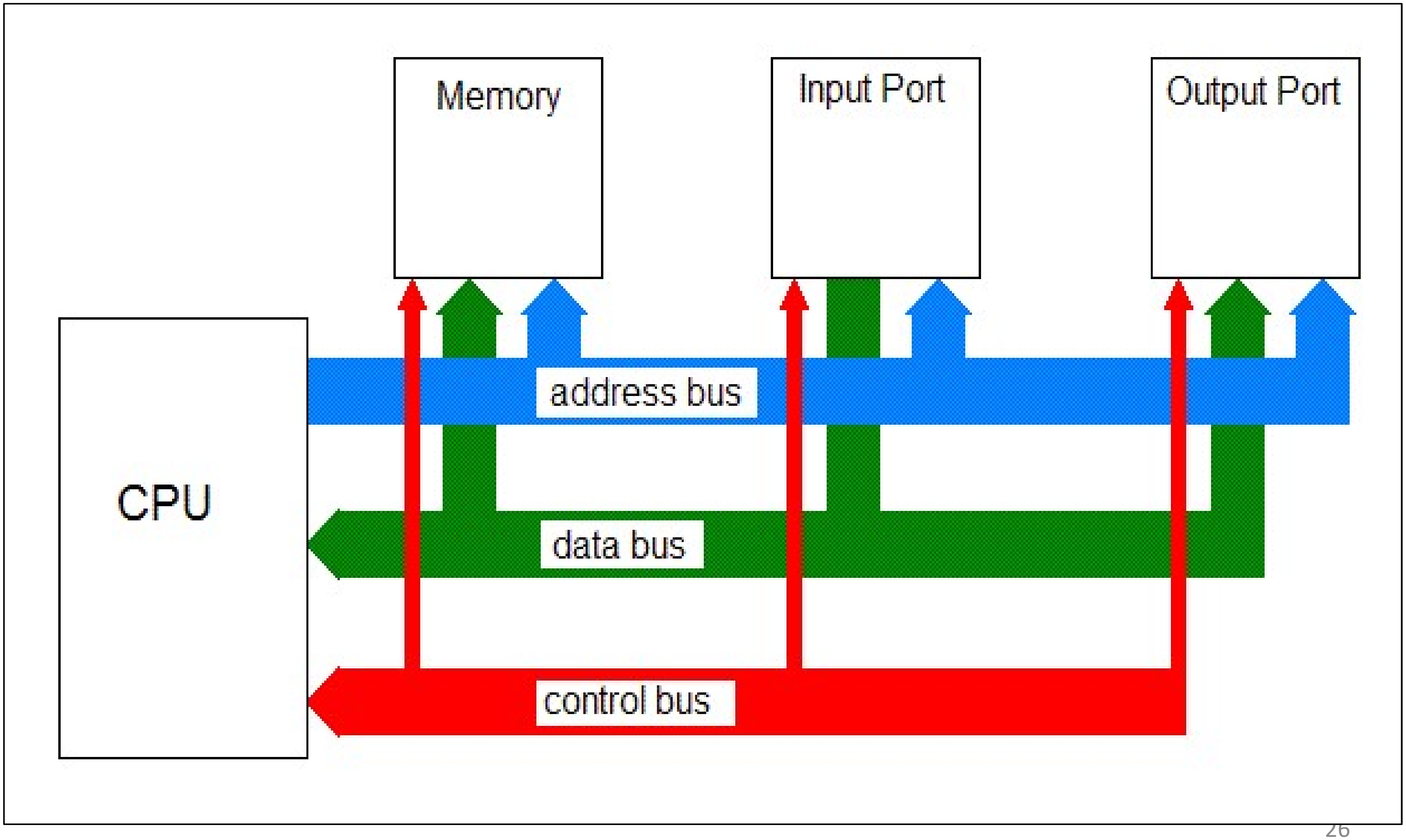


- *Can be unidirectional or bidirectional*
- 3 types of bus:

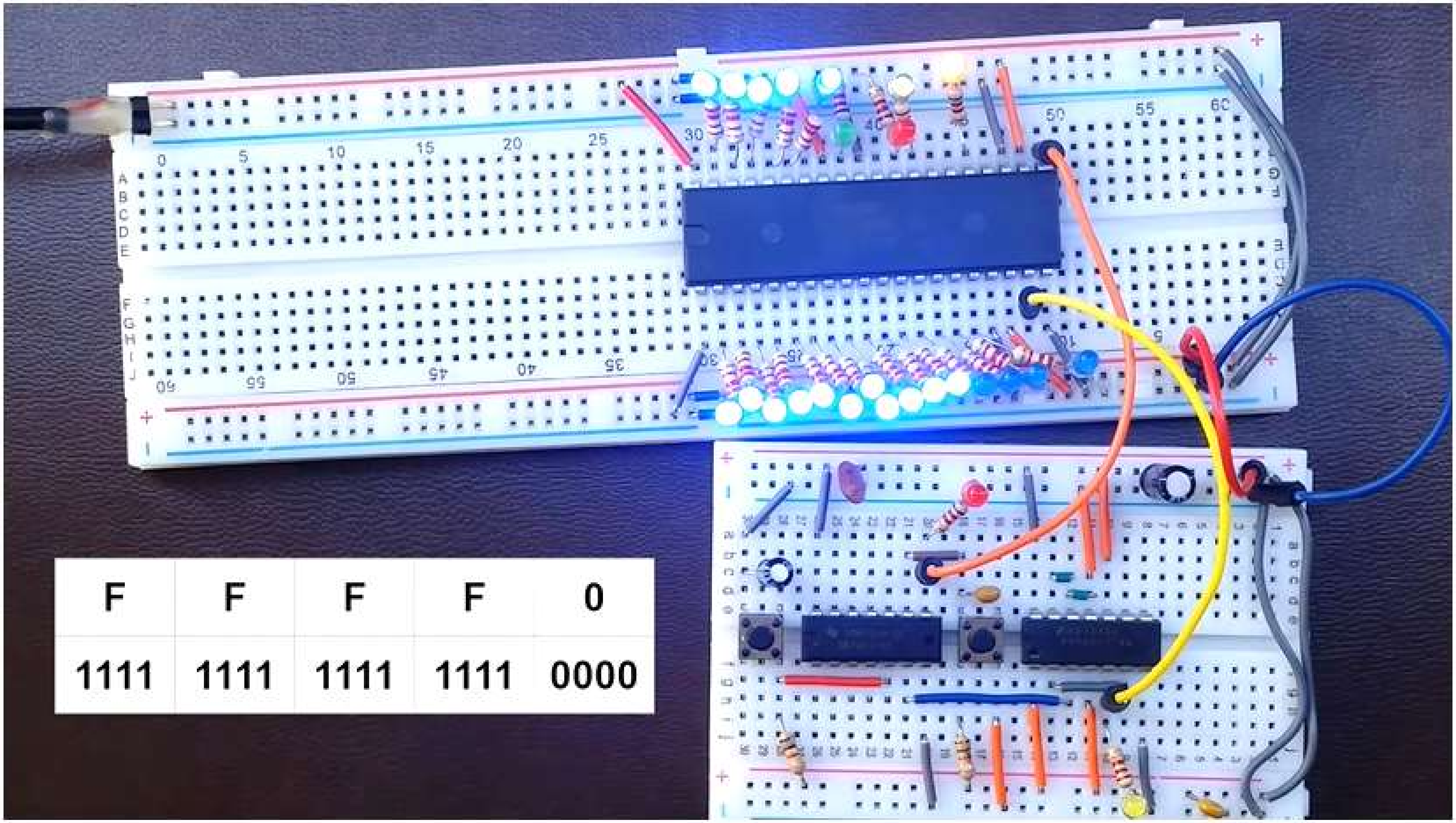
- An address bus sends a memory address along the bus from the CPU *to the memory*. To fetch/write data, the CPU needs to tell the RAM the address
- A data bus sends the actual data *to and from the memory*.
- A control bus carries commands from the CPU and status messages from other hardware devices.

Clock	Read	Write	Interrupt
1	0	1	1

Computer Architecture Block Diagram



CPU Buses Practical Demo



CPU Buses Practical Demo