

# MICROPROCESSOR & MICROCONTROLLERS

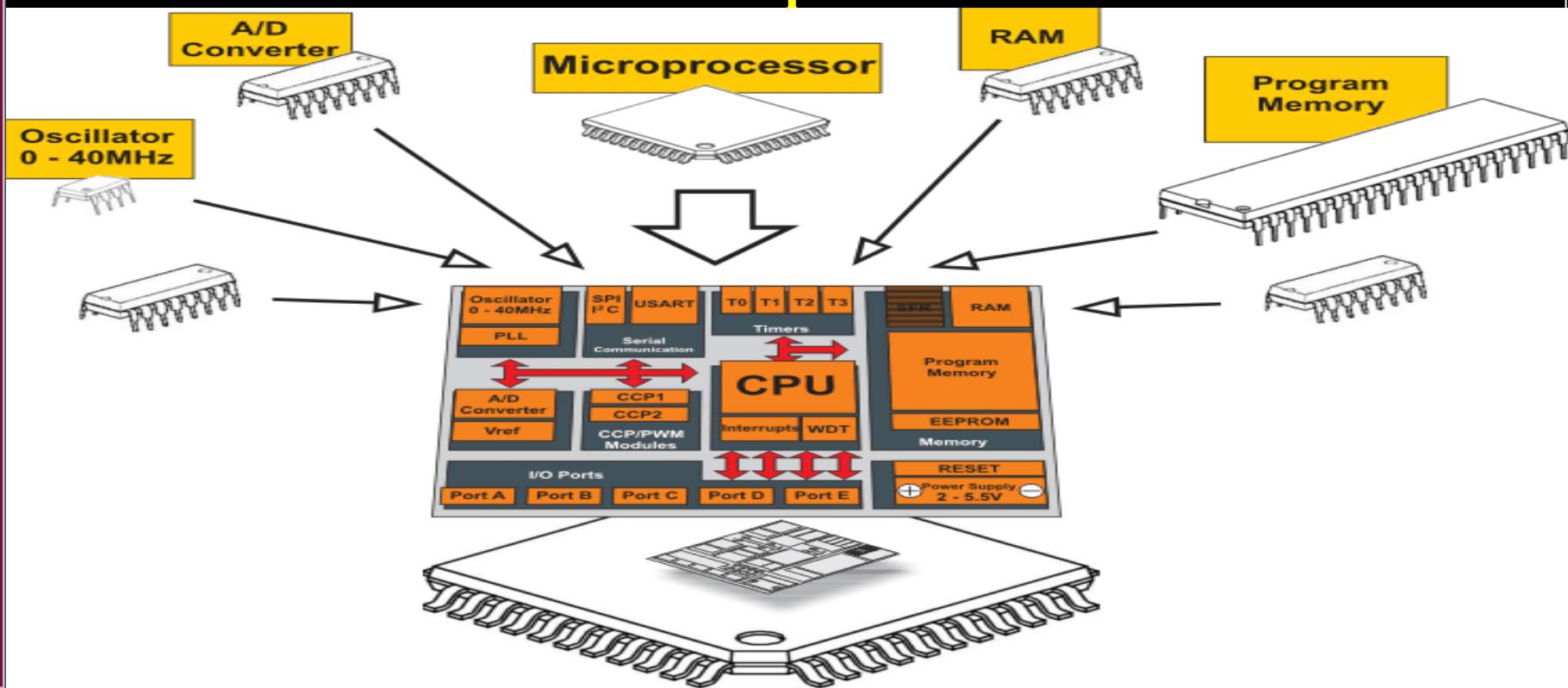
## 53 EC 65

### Unit 1 – 8085 MICROPROCESSOR

#### Lecture 1-1 : Introduction to Microprocessors

By **DICKSON NKONGO, MSc.**

**EECE Department**



## *Lecture 1-1: Outline*

- 1** Course Overview & Introduction
- 2** Evolution of Microprocessor
- 3** Definition of Microprocessor
- 4** Inside the Microprocessor
- 5** Microprocessor vs. Microcontroller

## *Course Overview*

- *Unit 1: Intel 8085 Microprocessor*
- *Unit 2: Intel 8051 Microcontroller*
- *Unit 3: Intel 80x86 Microprocessors*
- *Unit 4: Special Purpose Support Devices*
- *Unit 5: Microprocessor based systems  
Design and Digital Interfacing*



# INTRODUCTION TO MICROPROCESSORS



# Lecture 1-1 – Introduction To Microprocessor

## *Evolution of Microprocessor*

- *Fair child semiconductors (founded in 1957) invented the first Integrated Circuit in 1959.*
- *In 1968, Gordan Moore, Robert Noyce and Andrew Grove resigned from the Fair child semiconductors and started their own company: **Integrated Electronics (Intel)**.*
- *In 1971, the **first microprocessor Intel 4004** was invented.*
- *A microprocessor is also known as a central processing unit in which numbers of peripherals' are fabricated on a single chip*

# Lecture 1-1 – Introduction To Microprocessor

## *Evolution of Microprocessor*

- *In the late 1960's, processors were built using discrete elements.*
- *These devices performed the required operation, but were too large and too slow.*
- *In the early 1970's the microchip was invented. All of the components that made up the processor were now placed on a single piece of silicon. The size became several thousand times smaller and the speed became several hundred times faster. The "Micro" Processor was born.*

## Introduction

*The basis on which microprocessors are classified*

*a) P- Channel technology (PMOS): Here the mobility of holes is used for conduction. This is an old established type, which yields lesser number of transistors per chip.*

*b) N- Channel technology (NMOS): Here the mobility of electrons is used for conduction. The mobility of electrons is greater than that of holes; hence NMOS technology results in faster devices.*

*c) C-MOS technology: This uses the combination of PMOS and NMOS. Low power consumption and noise immunity are the essential features of this technology.*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

The microprocessor is a programmable device that takes in numbers, performs on them arithmetic or logical operations according to the program stored in memory and then produces other numbers as a result.

Lets expand each of the underlined words:

➤ **Programmable device:** The microprocessor can perform different sets of operations on the data it receives depending on the sequence of instructions supplied in the given program.

By changing the program, the microprocessor manipulates the data in different ways.

# Lecture 1-1 – Introduction To Microprocessor

## Definition

The microprocessor is a programmable device that takes in numbers (data), performs on them arithmetic or logical operations according to the program stored in memory and then produces other numbers as a result.

Lets expand each of the underlined words:

➤ **Programmable device:** The microprocessor can perform different sets of operations on the data it receives depending on the sequence of instructions supplied in the given program.

By changing the program, the microprocessor manipulates the data in different ways.

# Lecture 1-1 – Introduction To Microprocessor

## Definition

- **Instructions:** Each microprocessor is designed to execute a specific group of operations. This group of operations is called **an instruction set**. This instruction set defines what the microprocessor can and cannot do.

**Takes in:** The data that the microprocessor manipulates must come from somewhere.

- It comes from what is called “input devices”.
- These are devices that bring data into the system from the outside world.
- These represent devices such as a keyboard, a mouse, switches, and the like.

# Lecture 1-1 – Introduction To Microprocessor

## Definition

- **Numbers:** *The microprocessor has a very narrow view on life. It only understands binary numbers.*
- **A binary digit is called a bit** (which comes from binary digit). *The microprocessor recognizes and processes a group of bits together.*
- **This group of bits is called a “word”.** *The number of bits in a Microprocessor’s word, is a measure of its “abilities”.*  
*e.g. 8-bit, 16-bit, 32-bit etc.*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

- *Words, Bytes, etc.*

- *The earliest microprocessor (the Intel 8088 and Motorola's 6800) recognized 8-bit words.*
- *They processed information 8-bits at a time. That's why they are called “8-bit processors”. They can handle large numbers, but in order to process these numbers, they broke them into 8-bit pieces and processed each group of 8-bits separately.*
- *Later microprocessors (8086 and 68000) were designed with 16-bit words.*

## Definition

- *A group of 8-bits is referred to as a “half-word” or “byte”.*
- *A group of 4 bits is called a “nibble”.*
- *Also, 32 bit groups were given the name “long word”.*
- *Today, all processors manipulate at least 32 bits at a time (Like in PCs) and there exists microprocessors that can process 64, 80, 128 bits or more at a time.*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

### *Arithmetic and Logic Operations:*

- *Every microprocessor has arithmetic operations such as add and subtract as part of its instruction set.*
- *Most microprocessors will have operations such as multiply and divide.*
- *Some of the newer ones will have complex operations such as square root.*
- *In addition, microprocessors have logic operations as well. Such as AND, OR, XOR, shift left, shift right, etc.*
- *Again, the number and types of operations define the microprocessor's instruction set and depends on the specific microprocessor.*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

### *Program:*

- *A program is a sequence of instructions that bring data into the microprocessor, processes it and sends it out.*
- *There are many programming languages (C, C++, FORTRAN, and JAVA...). However, these programming languages can be grouped into three main levels*

### *Programming Languages*

- *Machine language: is the lowest level programming language. It is a language intended to be understood by the microprocessor (the machine only).*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

### *Assembly language*

- *This language is more understandable by humans. In this language, the binary patterns are assigned mnemonics (short abbreviated names).*
- *e.g. “Add 1,2” is assigned to the machine language pattern 11001101 mentioned above to refer to the operation 1+2.*
- *There is usually one assembly language instruction for each machine language instruction.*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

### *High level languages*

- *These are languages like C, PASCAL and FORTRAN. These are more natural for humans to use than assembly or machine languages. They are also more compact (i.e. it takes less statements to write the program).*
- *One high level instruction translates into many assembly or machine language instructions.*

*e.g.  $x = y + z$  may translate into:*

*MOV 1000, R1*

*MOV 1004, R2*

*ADD R1, R2*

*MOV R1, 1008*

## Definition

### *Ultra high level:*

- *Things would contain things like C++, and JAVA.*
- *Here a single instruction may translate into hundreds of assembly or machine language instructions.*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

*Stored in memory :*

- *What is memory?*
- *Memory is the location where information (data) is kept while not in current use.*
- *Memory is a collection of storage devices (e.g. registers, flip-flops). Usually, each storage device holds one bit.*
- *Also, in most kinds of memory, these storage devices are grouped into groups of 8. These 8 storage locations can only be accessed together. So, one can only read or write in terms of bytes to and from memory.*

# Lecture 1-1 – Introduction To Microprocessor

## Definition

- *Memory is usually measured by the number of bytes it can hold. It is measured in Kilos, Megas, Gigas, lately Teras. A Kilo in computer language is  $2^{10} = 1024$ . So, a KB (KiloByte) is 1024 bytes. Mega is 1024 Kilos and Giga is 1024 Mega.*
- *When a program is entered into a computer, it is stored in memory. Then as the microprocessor starts to execute the instructions, it brings the instructions from memory one at a time.*
- *Memory is also used to hold the data.*
- *The microprocessor reads (brings in) the data from memory when it needs it and writes (stores) the results into memory when it is done.*

## Definition

### *Produces:*

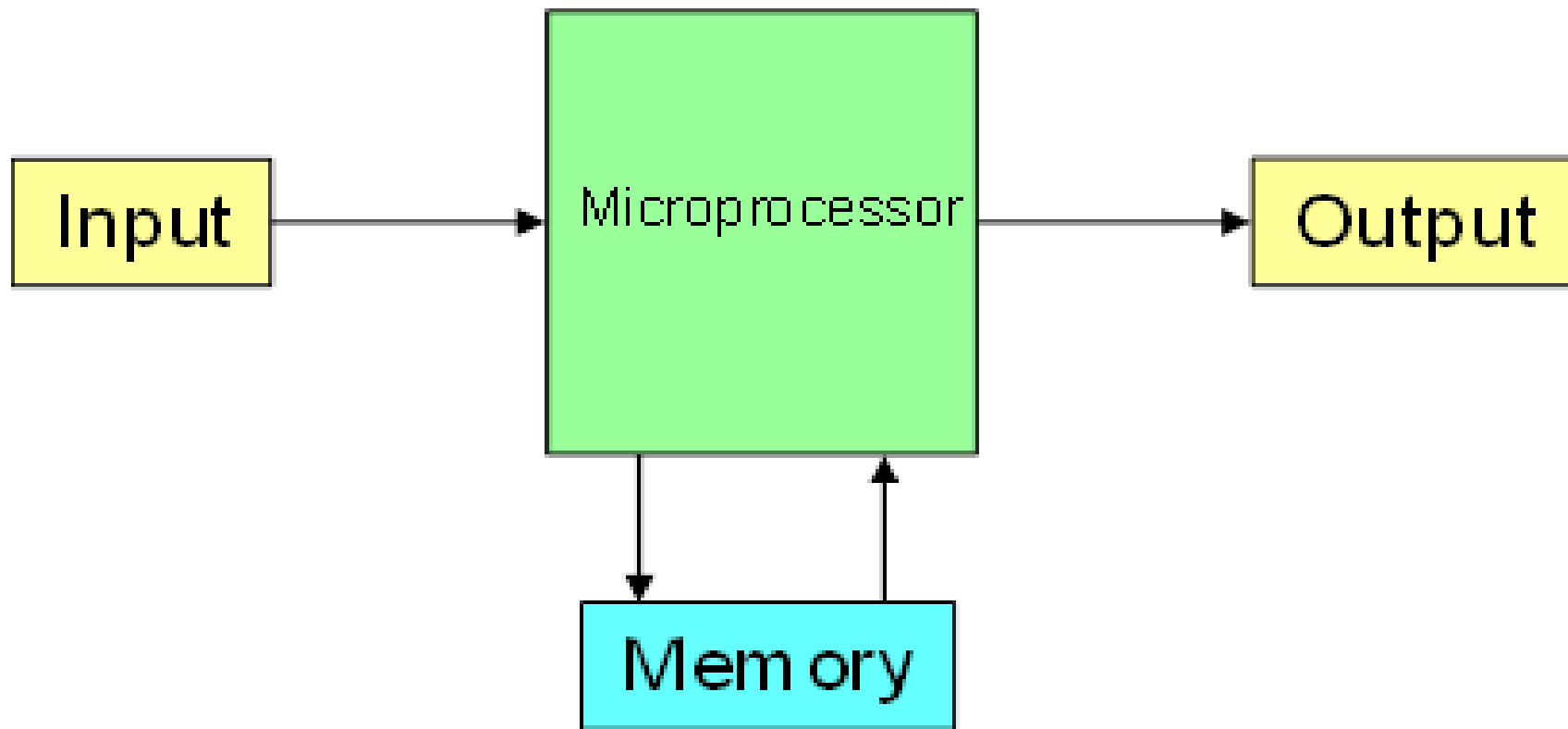
*For the user to see the result of the execution of the program, the results must be presented in a human readable form.*

- *The results must be presented on an output device.*
- *This can be the monitor, a paper from the printer, a simple LED or many other forms.*

# Lecture 1-1 – Introduction To Microprocessor



*From the above description, we can draw the following block diagram to represent a microprocessor-based system*

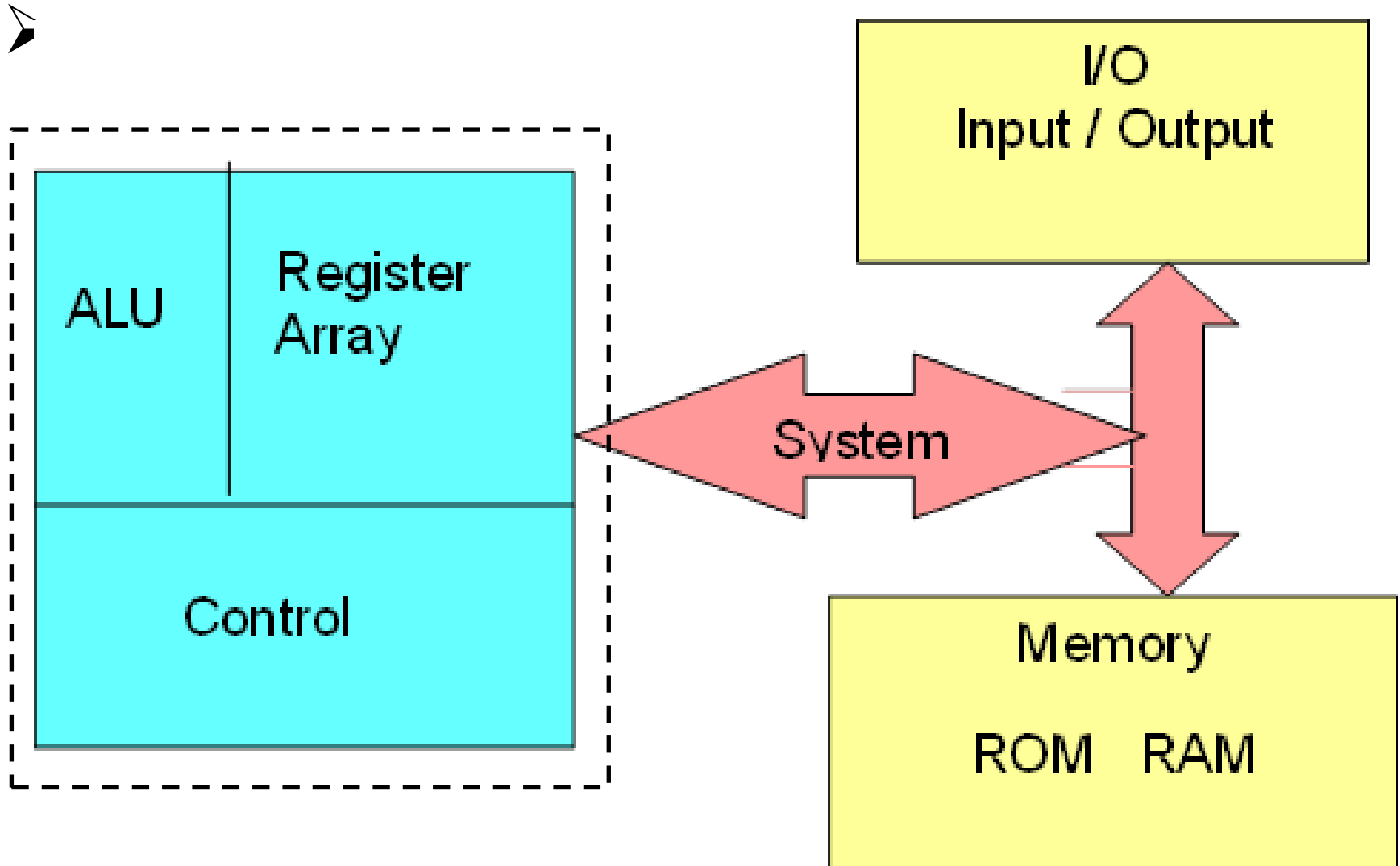


## *Inside The Microprocessor*

- *Internally, the microprocessor is made up of 3 main units.*
- 1. The Arithmetic/Logic Unit (ALU)*
  - 2. The Control Unit.*
  - 3. An array of registers for holding data while it is being manipulated.*

# Lecture 1-1 - Introduction To Microprocessor

## *Inside The Microprocessor*



# Lecture 1-1 – Introduction To Microprocessor

## *Inside The Microprocessor*

➤ *The microprocessor can be divided into three main pieces:*

### *1. Arithmetic/Logic Unit*

➤ *Performs all computing and logic operations such as addition and subtraction as well as AND, OR and XOR.*

### *2. Register Array*

➤ *A collection of registers within the microprocessor itself. These are used primarily for data storage during program execution. The number and the size of these registers differ from one microprocessor to the other.*

### *3. Control Unit*

➤ *Controls the whole operation of the processor such as reading, writing etc.*

## *Microprocessor vs. Microcontroller*

### *Microprocessor*

- *CPU is stand-alone, RAM, ROM, I/O, timer are separate*
- *Designer can decide on the amount of ROM, RAM and I/O ports.*
- *Expansive*
- *Versatility*
- *General-purpose*
- *Access times for memory and I/O devices are more*
- *Microprocessor based system requires more hardware*

## *Microprocessor vs. Microcontroller*

### *Microcontroller*

- *CPU, RAM, ROM, I/O and timer are all on a single chip*
- *Fixed amount of on-chip ROM, RAM, I/O ports*
- *For applications in which cost, power and space are critical*
- *Less access times for built-in memory and I/O devices*
- *Microcontroller based system requires less hardware reducing PCB size and increasing reliability*