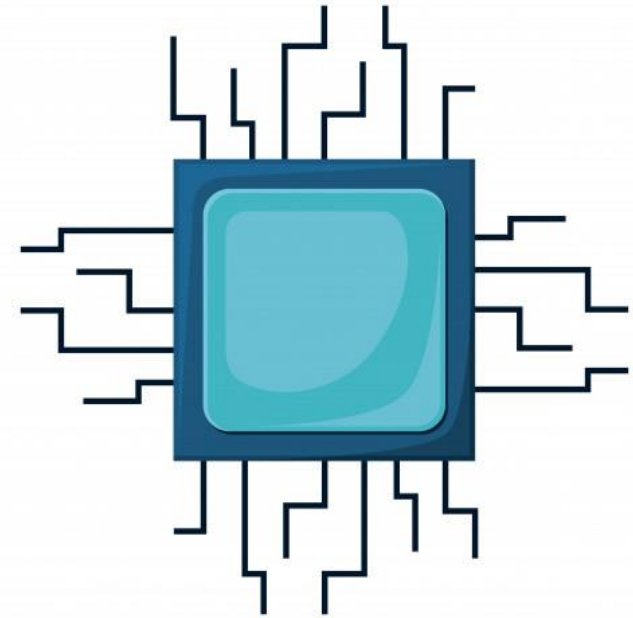


Microprocessor

Lecture 1: Introduction

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Reference Book

- Ramesh S. Goankar, “Microprocessor Architecture, Programming and Applications with 8085”, 5th Edition, Prentice Hall
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Basic Concepts of Microprocessors

- Differences between:
 - **Microcomputer:** a computer with a microprocessor as its CPU. Includes memory, I/O etc.
 - **Microprocessor:** silicon chip which includes ALU, register circuits & control circuits
 - **Microcontroller:** silicon chip which includes microprocessor, memory & I/O in a single package.
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What is a Microprocessor?

- The word comes from the combination micro and processor.
 - Processor means a device that processes whatever. In this context processor means a device that processes numbers, specifically binary numbers, 0's and 1's.
 - To process means to manipulate. It is a general term that describes all manipulation. Again, in this content, it means to perform certain operations on the numbers that depend on the microprocessor's design.
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What about micro?

- Micro is a new addition.
 - 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.
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Was there ever a -mini- processor?

- No
 - It went directly from discrete elements to a single chip. However, comparing today's microprocessors to the ones built in the early 1970's you find an extreme increase in the amount of integration.
 - So, What is a microprocessor?
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Definition of the Microprocessor

- 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.
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Programmable Device and Instructions

- Let's 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.
 - **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.
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Data in Microprocessor

- 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.
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Data in Microprocessor

- 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).
 - Bit: **0** or **1**
 - The microprocessor recognizes and processes a group of bits together. This group of bits is called a **word**.
 - Word: **00101101**
 - The number of bits in a Microprocessor's word, is a measure of its **abilities**.
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Execution

- The earliest microprocessor **the Intel 8085** 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.
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Execution

- Later microprocessors **the Intel 8086** were designed with 16-bit words.
 - A group of 8-bits were referred to as a **half-word** or **byte**.
 - **8 Bits = 1 Byte**
 - A group of 4 bits is called a **nibble**.
 - Also, a 32 bit groups were given the name **long word**.
 - Today, all processors manipulate at least 32 bits at a time and there exists microprocessors that can process 64, 80, 128 bits
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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.
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Arithmetic and Logic Operations

- 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.
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Stored in Memory

- Memory is the location where information is kept while not in current use.
 - Memory is a collection of storage devices. 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.
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Stored in Memory

- Memory is usually measured by the number of bytes it can hold.
 - It is measured in **Kilos**, **Megas** and lately **Gigas**.
 - A Kilo in computer language is $2^{10} = 1024$.
 - So, a **KB (Kilo-Byte)** is 1024 bytes.
 - Mega is 1024 Kilos and Giga is 1024 Mega.
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Stored in Memory

- 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.
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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.
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