Microprocessors

Section 1

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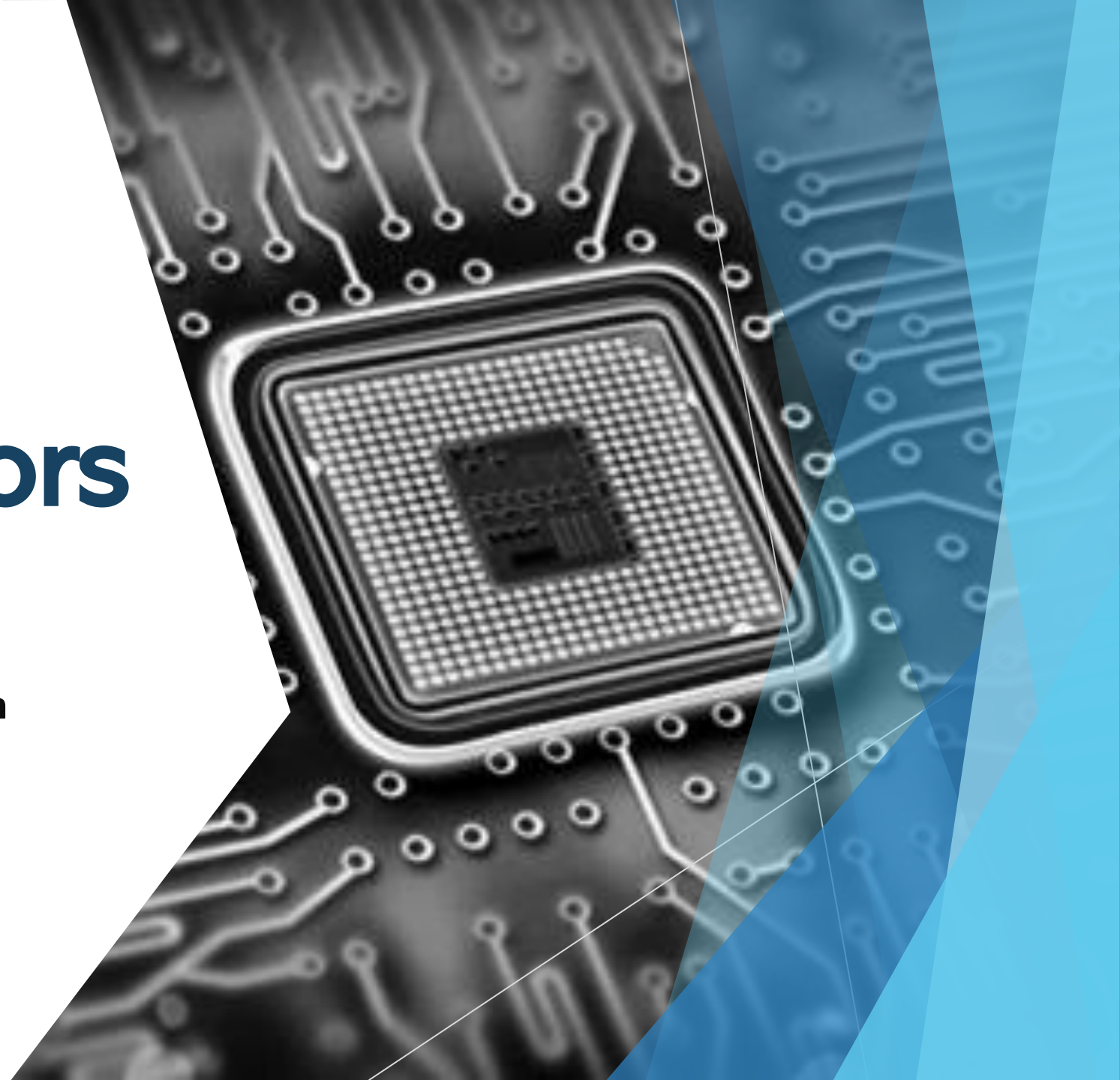
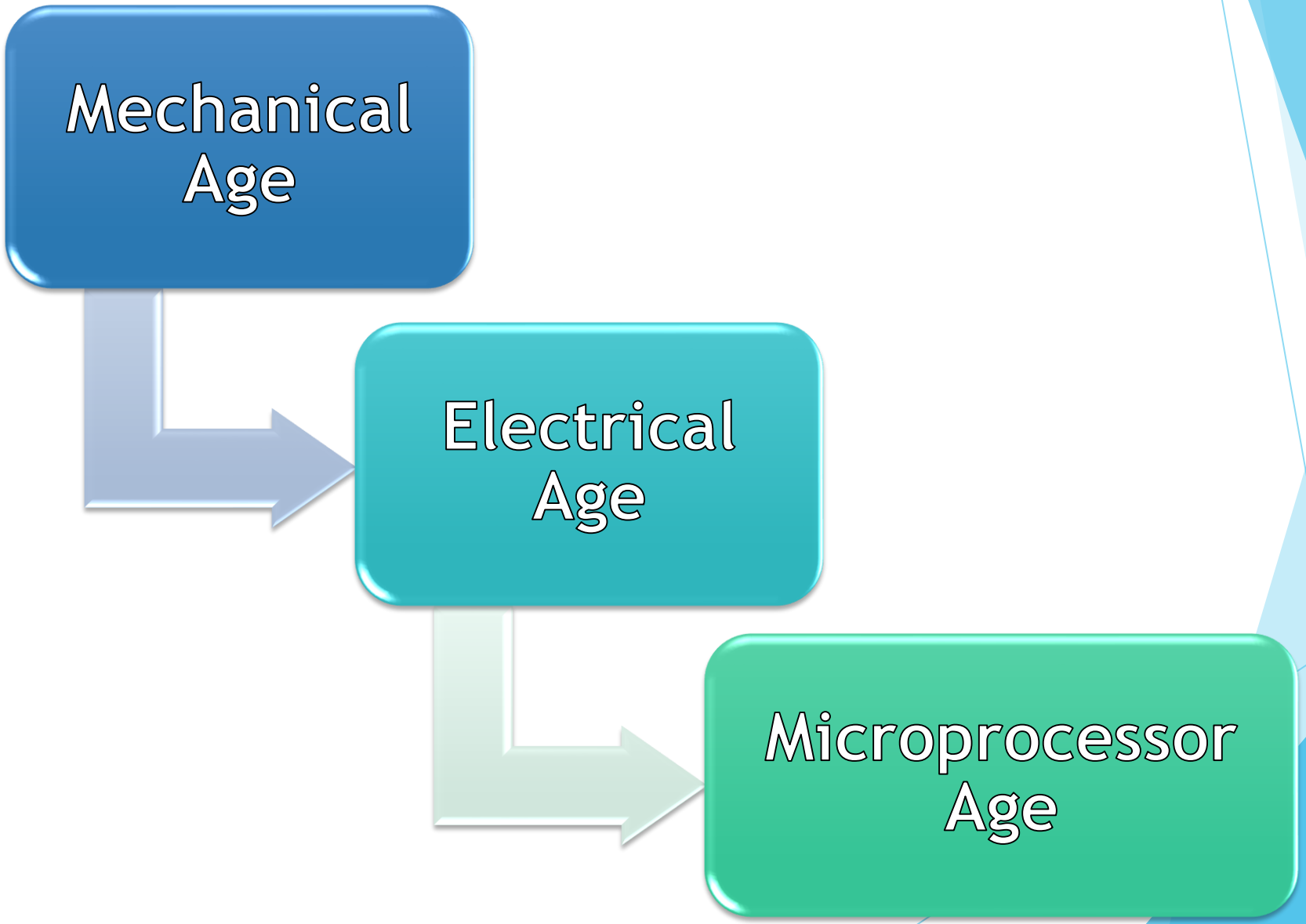
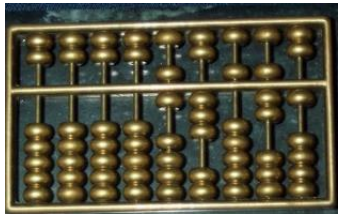


Introduction to Microprocessors and Computers

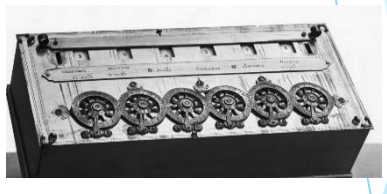


Mechanical Age

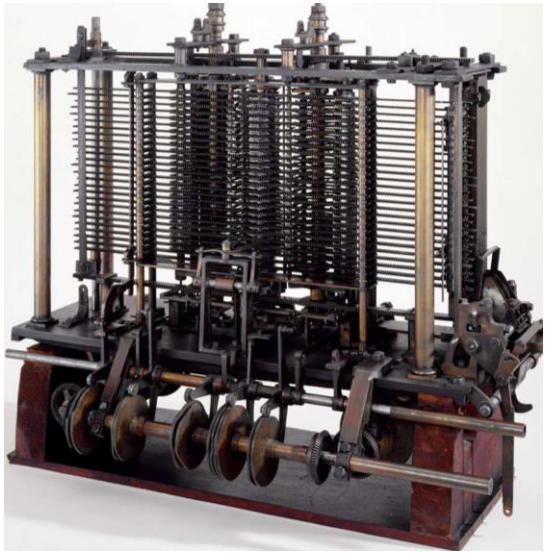


Abacus (Babylonians, the ancestors of the present-day Iraqis, 500 BC).

A mechanical calculator was constructed of gears and wheels (Blaise Pascal, 1642)



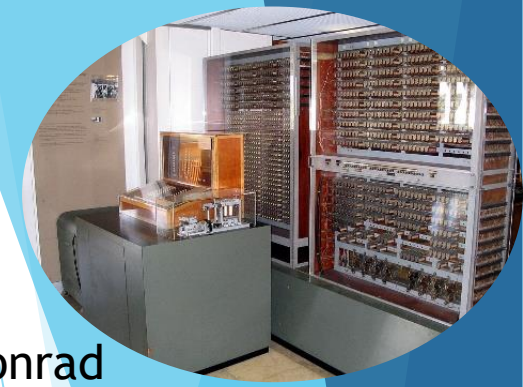
Analytical Engine was a steam-powered mechanical computer (Charles Babbage, 1823).



The Analytical Engine required more than 50,000 machined parts, which could not be made with enough precision to allow his engine to function reliably.

Electrical Age

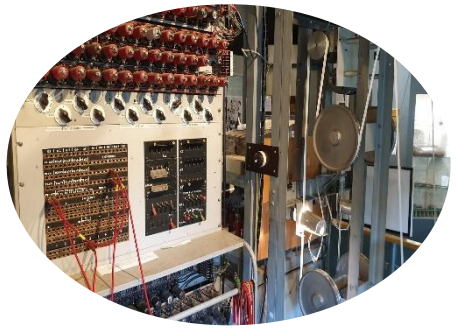
The advent of the **electric motor** (Michael Faraday, 1800s).



First modern electromechanical computer (Konrad Zuse, 1941).

Colossus was the first electronic computer based on vacuum tubes placed to break secret German military codes (Alan Turing, 1943).

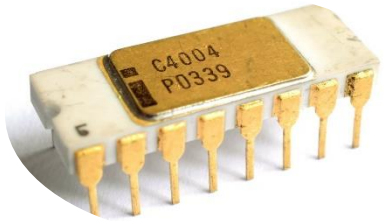
Problem: the program was fixed and could not be changed.



ENIAC (Electronics Numerical Integrator and Calculator) was the first **general-purpose, programmable electronic** computer system (at the University of Pennsylvania, 1946).

Transistors (at Bell Labs, 23 DEC 1947)

IC or integrated circuits (Jack Kilby, 1958)



First microprocessor 4004 (at Intel Corporation, 1971).

Microprocessor Age

4004 — a 4-bit-wide memory locations

4040 — an updated version of the earlier 4004

8008 — an extended 8-bit version of the 4004 microprocessor.

- 8080 microprocessor in 1973.
- After six months, Motorola Corporation introduced its MC6800 microprocessor.

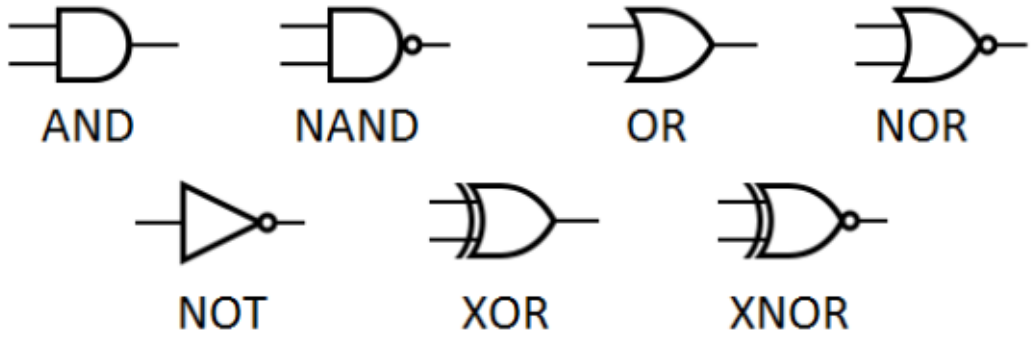
8085- an updated version of the 8080 (1977).

- 8086 and 8088 are 16-bit microprocessors that execute instructions in as little as 400 ns (1978).

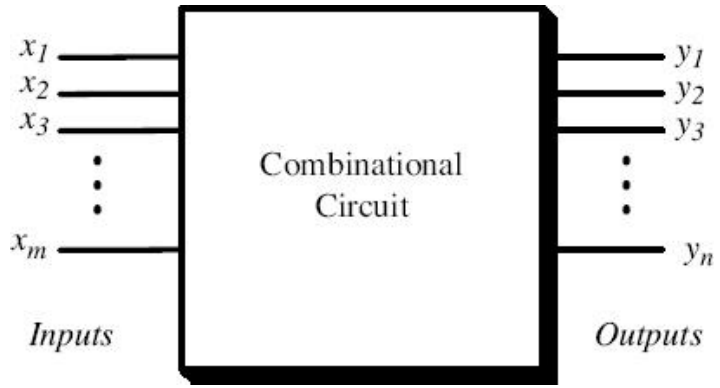
Improvements in speed and memory size continued until we reached what microprocessors are now

Digital Circuits

- Logic gates(AND, OR,NOT,...etc.).

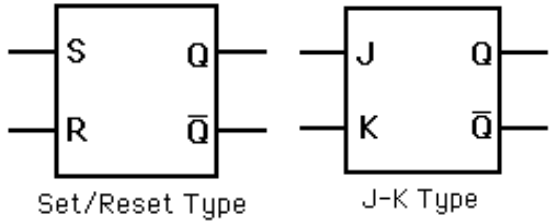


- Combinational Circuits like decoders, encoders, multiplexers, adders, subtractors, … etc.

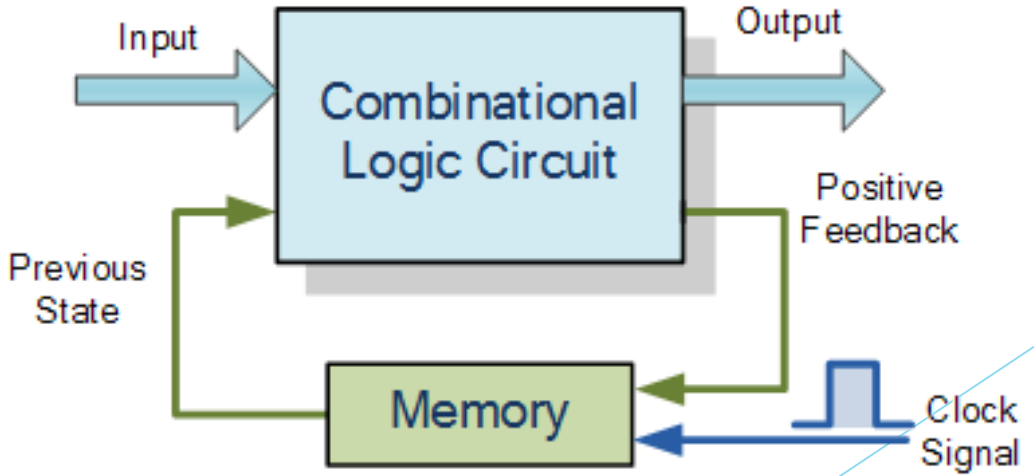


Digital Circuits

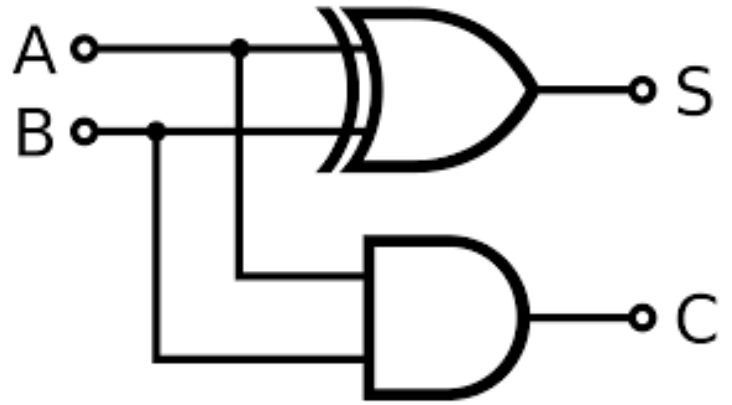
- Flip Flops(SR type, D type, JK type and T type).



- Sequential Circuits like counters, shift registers, serial adders,…etc.



Digital Circuits

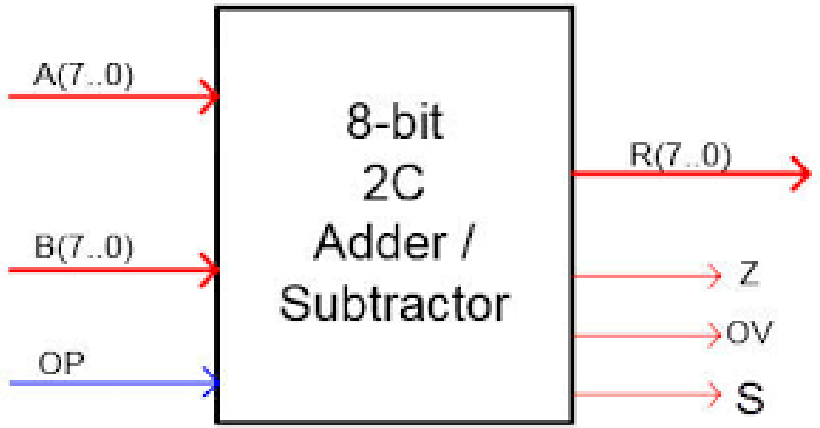


- Example 1: design a circuit that adds 0 to 1.

Solution: design a half-adder circuit with two inputs (A, B) and two outputs (S, C).

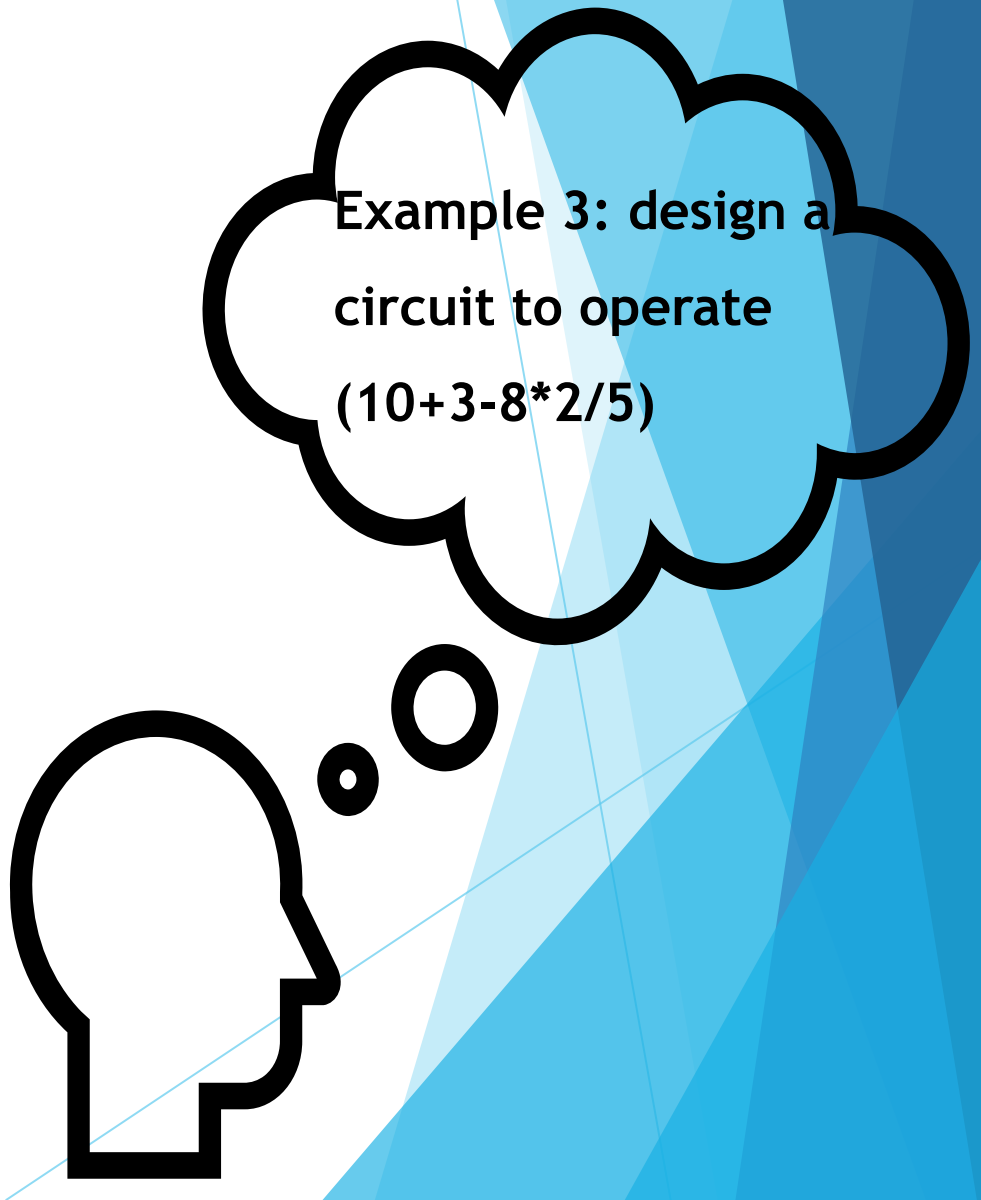
- Example 2: design a circuit that adds/subtracts two 8-bit numbers (like 8,5).

Solution: design an adder-subtractor circuit or **Arithmetic unit.**



Why Microprocessor?

- There is a need in this example to design an **arithmetic unit more complex than the previous example that can perform addition, subtraction, multiplication, and division.**
- We need, in those states and in more complex states, to design a circuit able to perform all arithmetic operations as well as logic operations, this circuit or device is what so-called ***Microprocessor*** with small code written in assembly language.

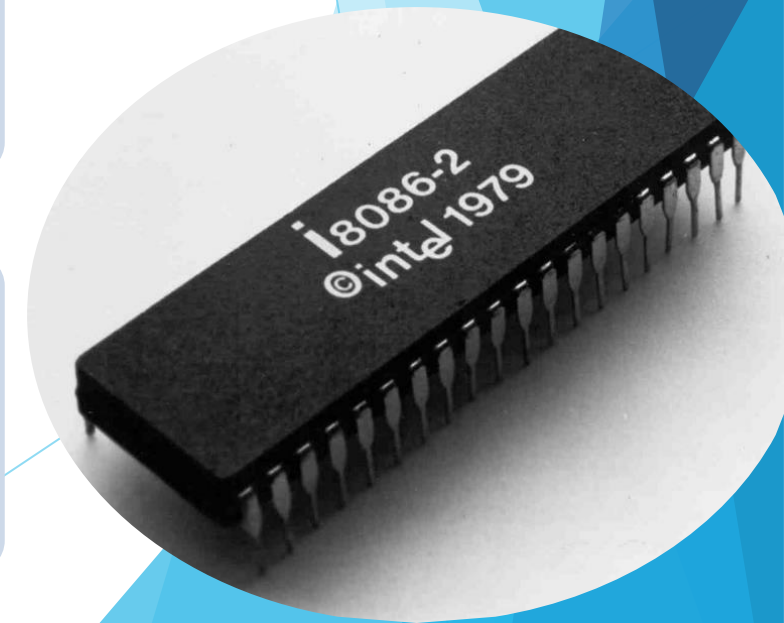


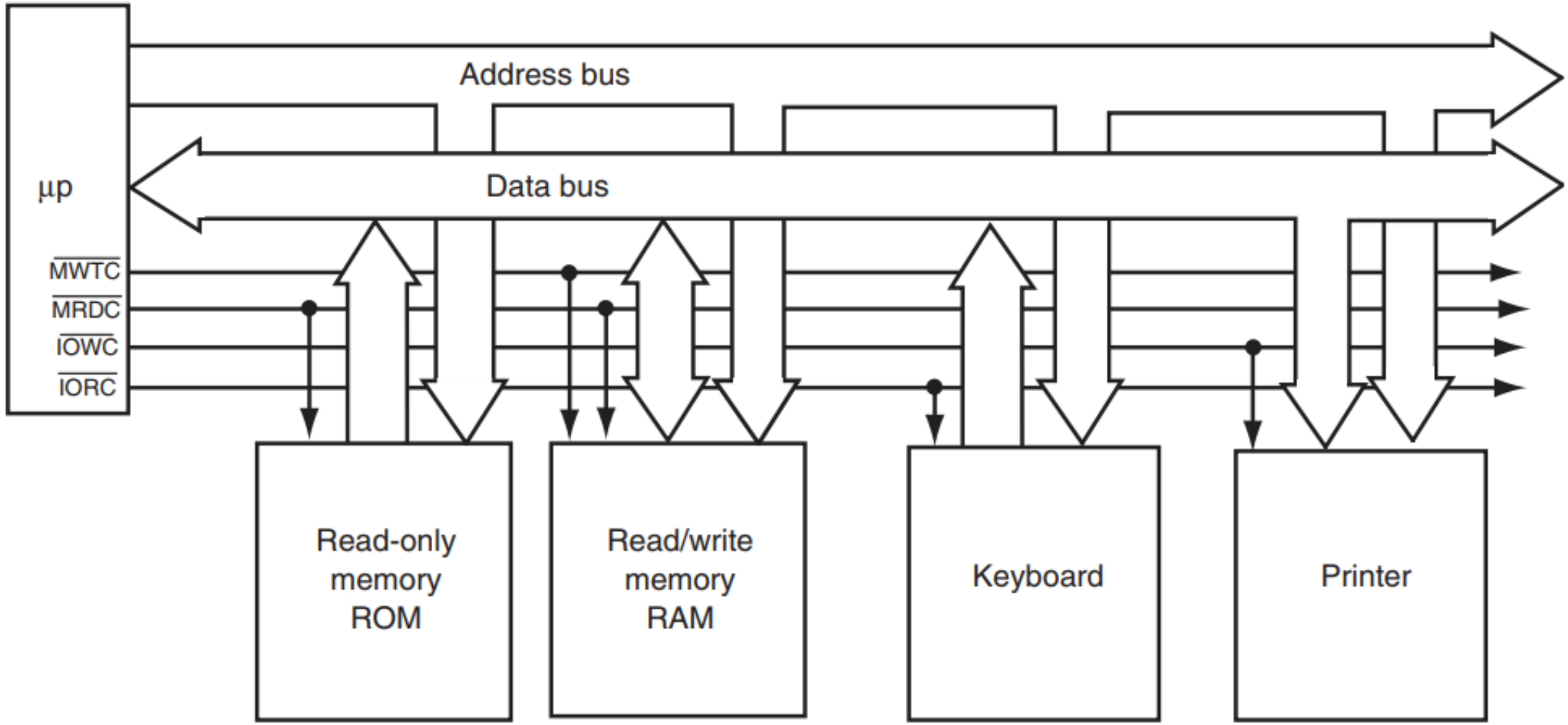
What is a Microprocessor?

A microprocessor is a controlling element in a computer system on a single integrated circuit (IC) or microchip.

The microprocessor performs data transfers, does simple arithmetic and logic operations, and makes simple decisions.

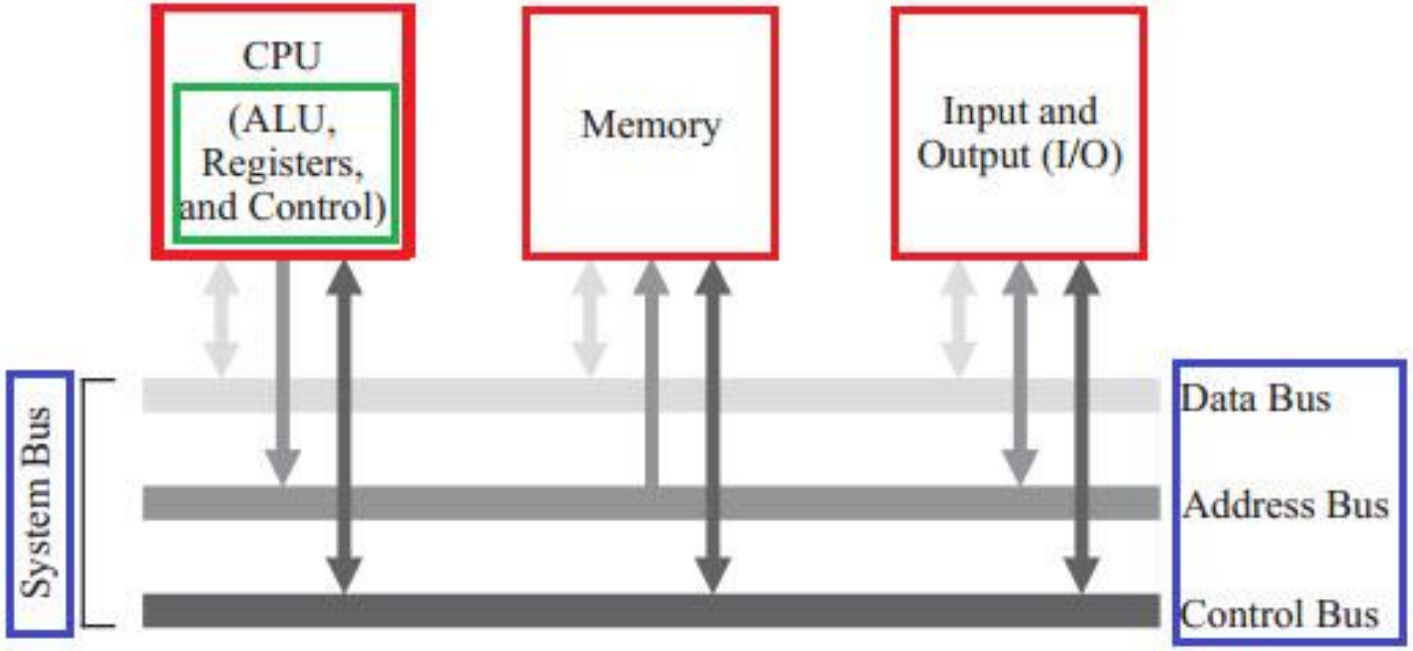
The microprocessor executes programs stored in the memory system to perform complex operations in short periods of time.



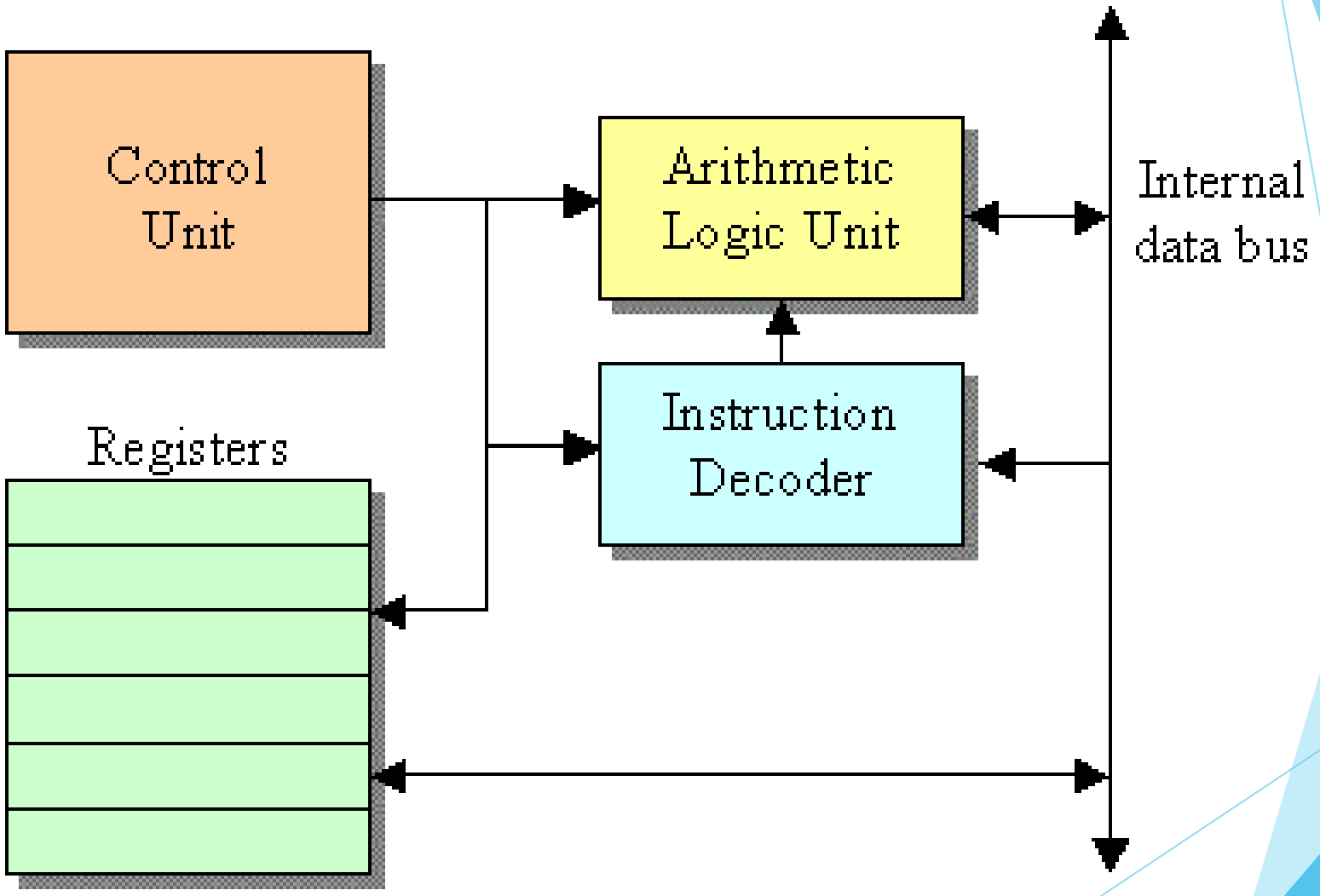

µp
Address bus
Data bus
MWTC
MRDC
IOWC
IORC
Read-only memory ROM
Read/write memory RAM
Keyboard
Printer

Microprocessor System

- All computer systems contain **three buses** to control memory and I/O: *address bus, data bus, and control bus*.
- The address bus is used to request a memory location or I/O device.
- The data bus transfers data between the microprocessor and memory or I/O.
- The control bus controls the memory and I/O and requests reading or writing of data. Control is accomplished with (I/O read control), (I/O write control), (memory read control), and (memory write control).

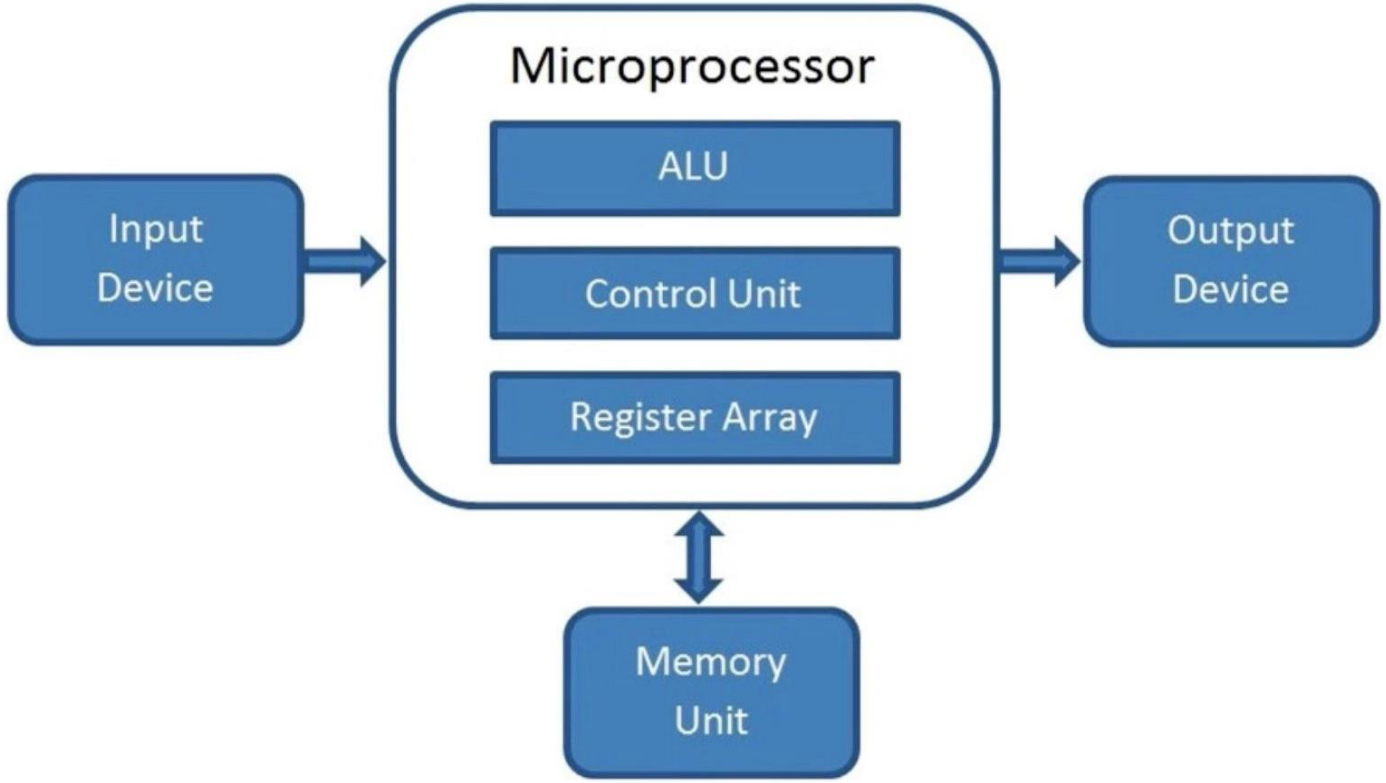


Architecture of Microprocessor



Advantages of Microprocessor

- Low cost.
- High speed.
- Low power consumption.
- Versatile.
- Small size.



No.	Register	Memory
1	Registers hold operands or instructions that the CPU would be currently processing.	Memory holds instructions and the data about the currently executing program required by the CPU.
2	Small amounts of data– 32 bits to 64 bits.	Memory can range from some Gigabytes (GB) to Tera bytes (TB).
3	CPU can operate on the contents of the register at the rate of more than **one operation during one clock cycle.**	CPU accesses memory at a slower rate in comparison to access the registers.
4	There are many types of registers– Accumulator register, Program counter, and Instruction register.	There are different types of memory– RAM, and ROM.
5	It is **quick** in comparison to memory.	RAM is slow in comparison to registers.