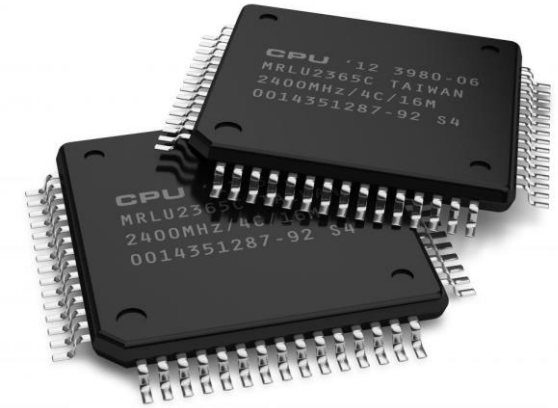
Chapter-3
MICROPROCESSOR

PART – A

MICROPROCESSOR

Microprocessor is an electronic circuit that contains the arithmetic, logic, and control circuitry necessary to perform the functions of a digital computer's central processing unit (CPU).



FUNCTIONS OF MICROPROCESSOR

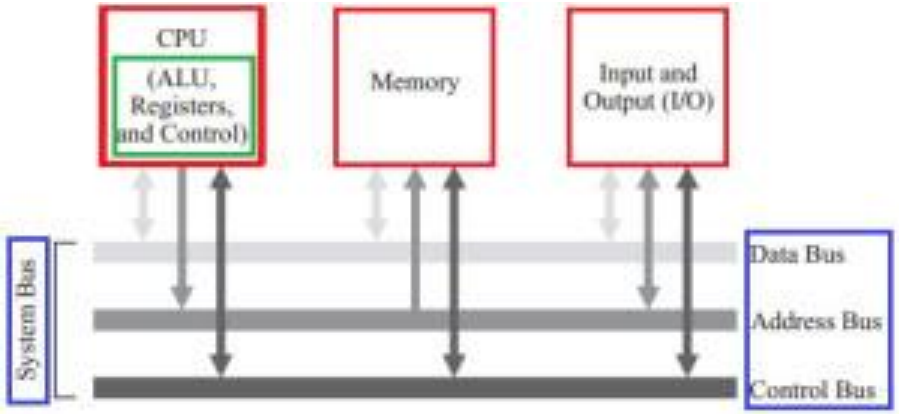
- Among various functions of microprocessor some are as follows

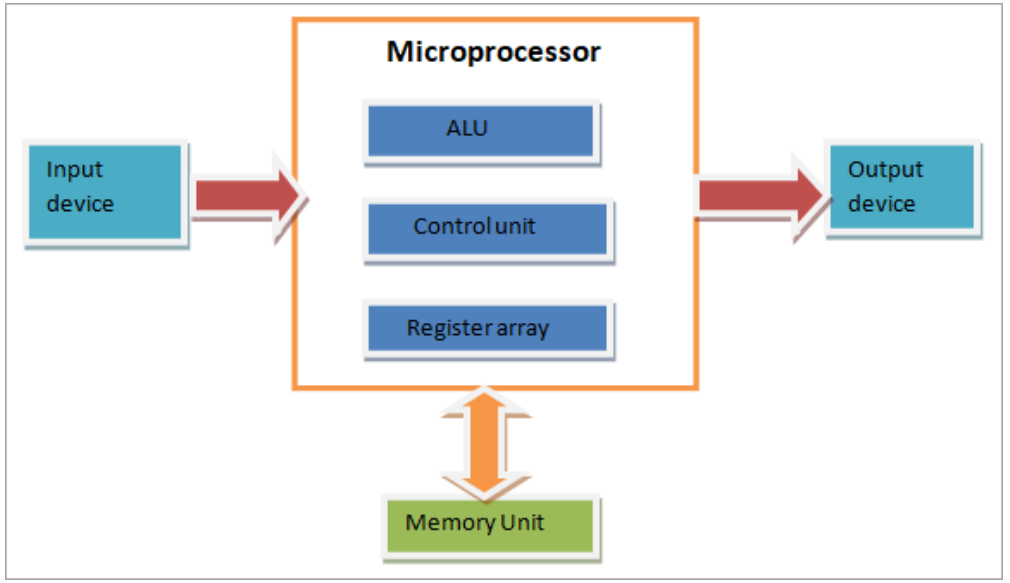
1. Controlling all other parts of the machine and sending timing signals.
2. Transferring data between memory and I/O devices
3. Fetching data and instructions from memory
4. Decoding instruction
5. Performing arithmetical and logical operations
6. Executing programs stored in memory
7. Performing communication among the I/O devices etc.

MICROPROCESSOR ARCHITECTURE

- The microprocessor is a single IC package in which several useful functions are integrated and fabricated on a single silicon semiconductor chip.
- Its architecture consists of a central processing unit, memory modules, a system bus, and an input/output unit.
- The system bus connects the various units to facilitate the exchange of information. It further consists of data, address, and control buses to perform data exchanging properly.

MICROPROCESSOR ARCHITECTURE



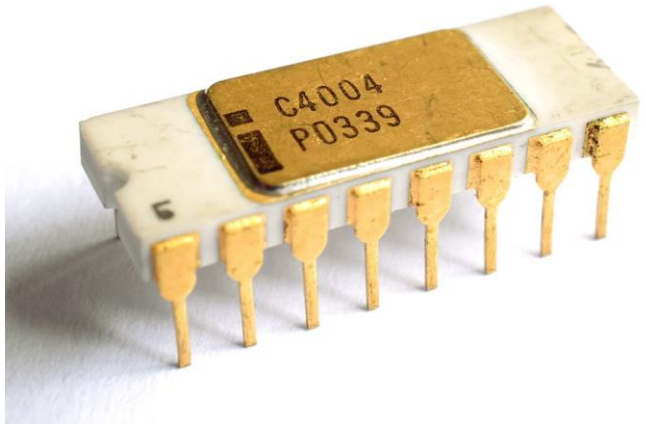


EVOLUTION OF MICROPROCESSOR

First Generation Microprocessor (1971 – 73)

Intel 4004

- The first microprocessor by Intel.
- Introduced in 1971
- 4 KB main memory
- It was 4-bit, PMOS Technology



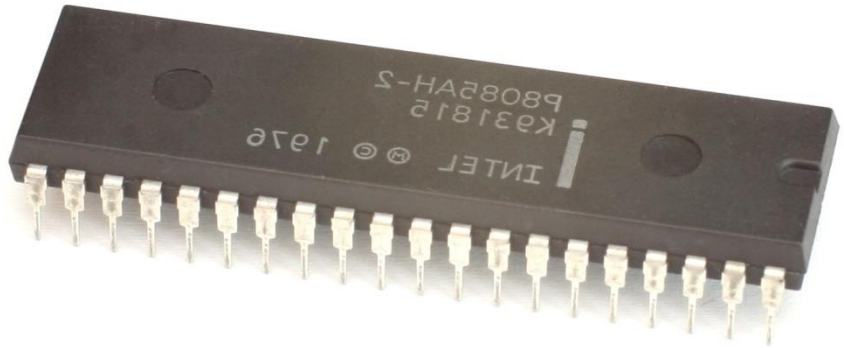
Intel 8008

- Introduced in 1972
- It was 8 -bit.
- 16 KB main memory
- PMOS Technology

EVOLUTION OF MICROPROCESSOR

Second Generation Microprocessor (1974- 78)

Intel 8085



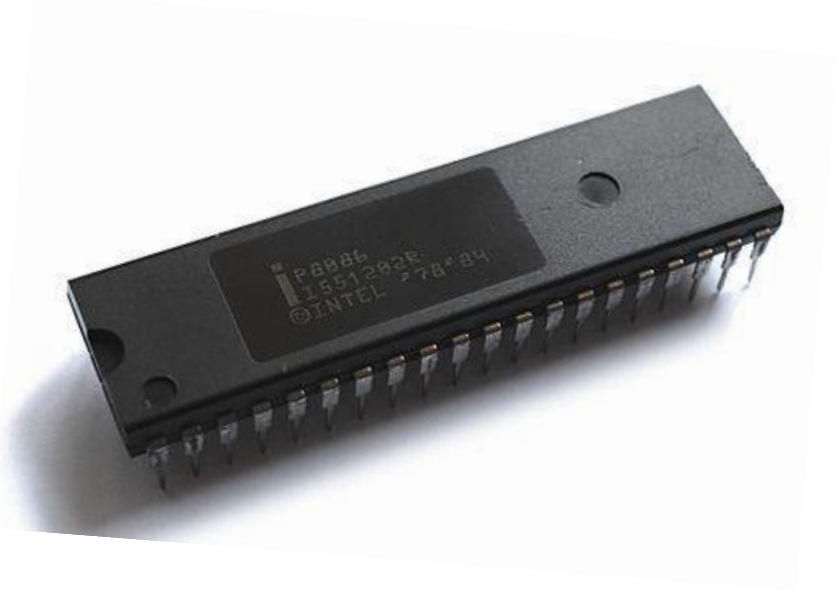
- Introduced in 1975
- It was 8 -bit.
- 64KB main memory
- Intel sold 100 million copies of this processor.

EVOLUTION OF MICROPROCESSOR

Third Generation Microprocessor (1979-80)

Intel. 8086

- Introduced in **1978**
- 16-bit
- HMOS technology
- 1 MB of memory.]



Intel. 80186

- Introduced in **1982**
- Upgraded version of **Intel. 8086**
- 16-bit
- HMOS technology
- 1 MB of memory.]

Third Generation Microprocessor (1979-83)

Intel. 80286

- Introduced in **1983**
- 16-bit high performance microprocessor with memory management & protection.
- Instruction execution time is as little as 250 ns.
- HMOS technology
- 16 MB of memory.]

EVOLUTION OF MICROPROCESSOR

Fourth Generation 32-bit Microprocessor

Intel. 80386

- Introduced in **1986**
- Intel's first practical 32-bit microprocessor
- 4 GB main memory
- Improvements include page handling in virtual environment

EVOLUTION OF MICROPROCESSOR

Fifth Generation Microprocessor (1995 – till date)

- This age the emphasis is on introducing chips that carry on-chip functionalities and
- improvements in the speed of memory and I/O devices along with introduction of 64-bitmicroprocessors.
- Intel leads the show here with Pentium, Celeron and very recently dual and quad core processors working with up to 3.5GHz speed.

EVOLUTION OF MICROPROCESSOR

Fifth Generation Microprocessor (1995 – till date)

EVOLUTION OF MICROPROCESSOR

Fifth Generation Microprocessor (1995 – till date)

Intel core 2

- The Core 2 brand was introduced on 27 July 2006
- Core 2 having a range of Intel's consumer 64-bit x86-64 single-, dual-, and quad-core microprocessors based on the Core microarchitecture

EVOLUTION OF MICROPROCESSOR

Fifth Generation Microprocessor (1995 – till date)

Core i series

- The Core i3 range is entirely dual-core.
- The i7 range are all quad-core.
- Core i3 processors don't have Turbo Boost
- The Core i7-6700, for example, has a base clock of 3.4GHz, but can 'boost' up to 4GHz.

THE INTEL FAMILY MICROPROCESSOR

Microprocessor	Year of Invention	Length	Clock	Remarks
4004	1971	4-bit	750 KHz	First Microprocessor
8085	1976	8-bit	3-6 MHz	Popular 8-bit Microprocessor
8086	1978	16-bit	5-8 MHz	Widely used in PC/X
80286	1982	16-bit	6-12.5 MHz	Widely used in PC/AT
80386	1985	32-bit	20-33 MHz	Contains MMU on chip
80486	1989	32-bit	25-100 MHz	Contains MMU, cache and FPU, 1.2 million transistors

THE INTEL FAMILY MICROPROCESSOR

Microprocessor	Year of Invention	Length	Clock	Remarks
Pentium	1993	32-bit	60-200	Contains 2 ALUs,2 Caches, FPU, 3.3 Million transistors, 3.3 V, 7.5 million transistors
Pentium Pro	1995	32-bit	150-200 MHz	It is a data flow processor. It contains second level cache also,3.3 V
Pentium II	1997	32-bit	233-400 MHz	All features Pentium pro plus MMX technology,3.3 V, 7.5 million transistors
Pentium III	1999	32-bit	600-1.3 MHz	Improved version of Pentium II; 70 new SIMD instructions
Pentium 4	2000	32-bit	600-1.3 GHz	Improved version of Pentium III
Itanium	2001	64-bit	733 MHz-1.3 GHz	64-bit EPIC Processor

QUICK BRAIN – Sample Question 1

- What is a microprocessor?
- How does it work?
- which was the first microprocessor?

PART – B

FEATURES OF MICROPROCESSOR

- Portability
- Low Cost
- Versatile
- Small in size
- Low power consumption
- Reliability

TYPES OF MICROPROCESSOR

Type of Architecture	Features	Usage
CISC (Complex Instruction Set Computer)	▪ Large instruction set ▪ Variable-length instructions ▪ Variety of addressing modes ▪ Complex & expensive to produce	Mostly used in personal computers
RISC (Reduced Instruction Set Computer)	▪ Small instruction set ▪ Fixed-length instructions ▪ Reduced references to memory to retrieve operands	Mostly used in workstations

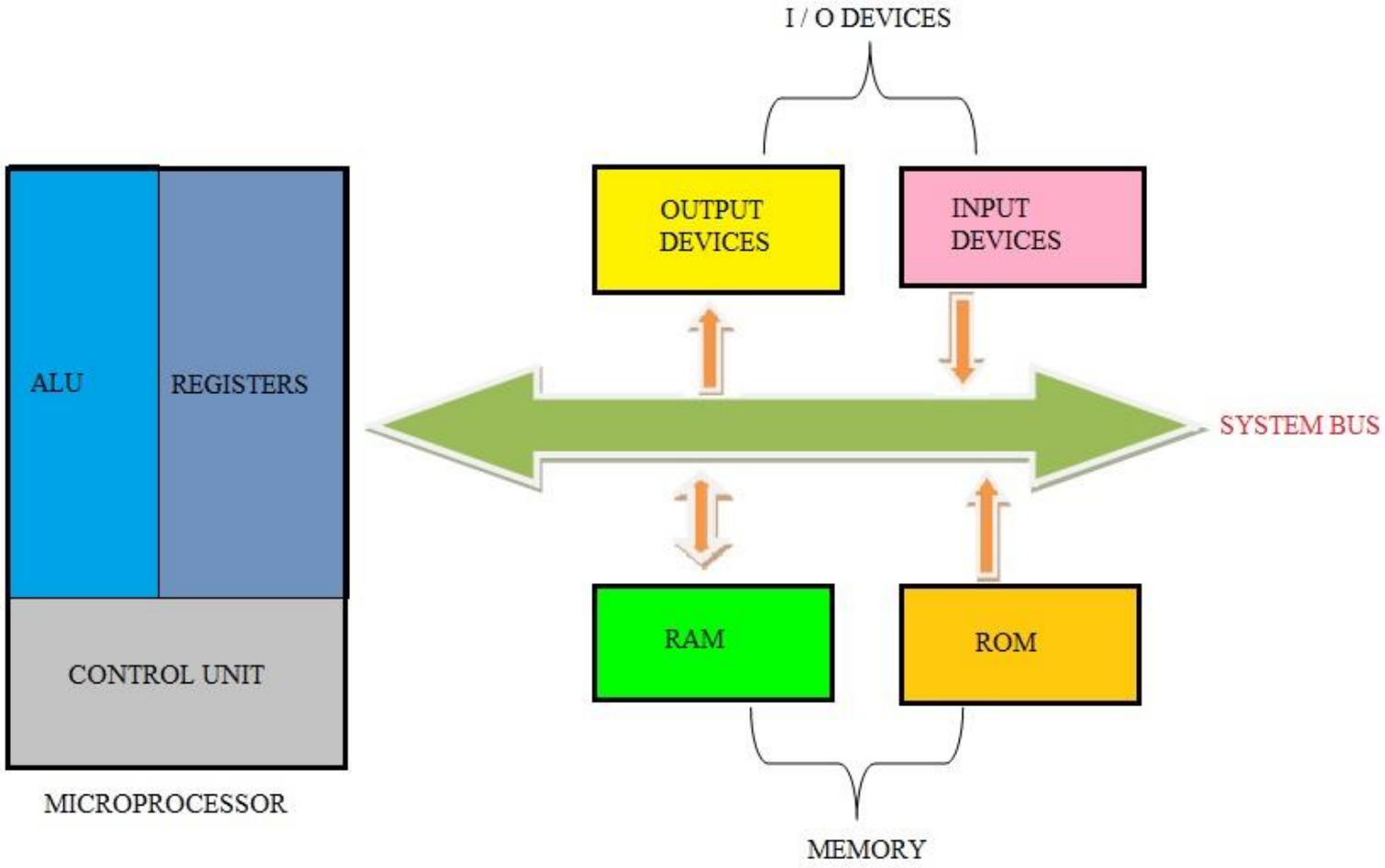
TYPES OF MICROPROCESSOR

Type of Architecture	Features	Usage
EPIC (Explicitly Parallel Instruction Computing)	▪ Allows software to communicate explicitly to the processor when operations are parallel ▪ Uses tighter coupling between the compiler and the processor ▪ Enables compiler to extract maximum parallelism in the original code, and explicitly describe it to the processor	Mostly used in high-end servers and workstations

TYPES OF MICROPROCESSOR

Type of Architecture	Features	Usage
Multi-Core Processor	▪ Processor chip has multiple cooler-running, more energy-efficient processing cores ▪ Improve overall performance by handling more work in parallel ▪ can share architectural components, such as memory elements and memory management	Mostly used in high-end servers and workstations

MICROPROCESSOR BLOCK DIAGRAM



NECESSARY COMPONENTS FOR MICROPROCESSOR

- CPU: Central Processing Unit
- I/O: Input/Output
- System Bus: Address bus, Data Bus
- CU: Timing & Control Unit
- Registers
- L1 & L2 Cache Memory

TIMING & CONTROL UNIT

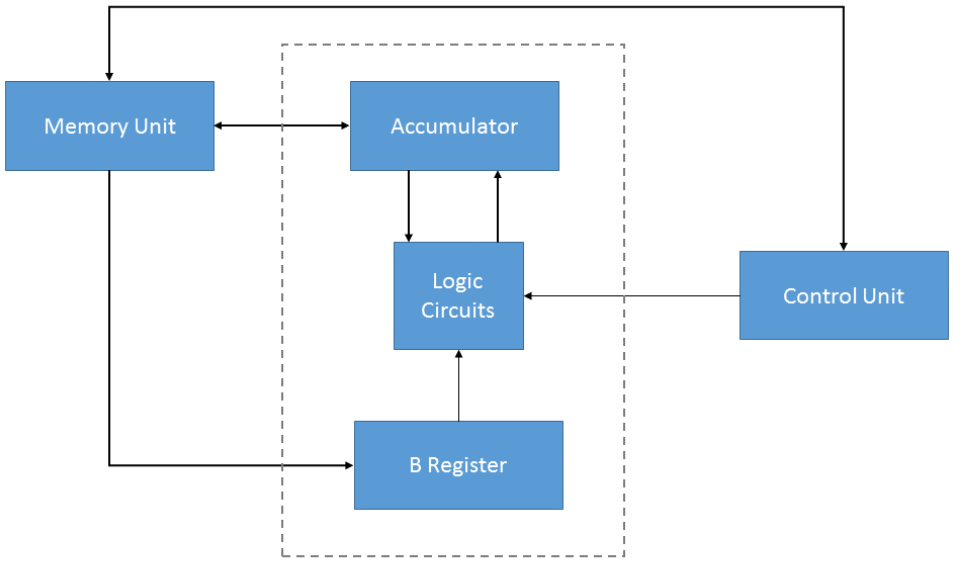
- CPU is partitioned into ALU & CU

- **Control Unit**
  - The Function of control unit is to generate the relevant timing & control signals to all operations of the in the computer.
  - It controls the flow of data between the processor & memory & peripherals.

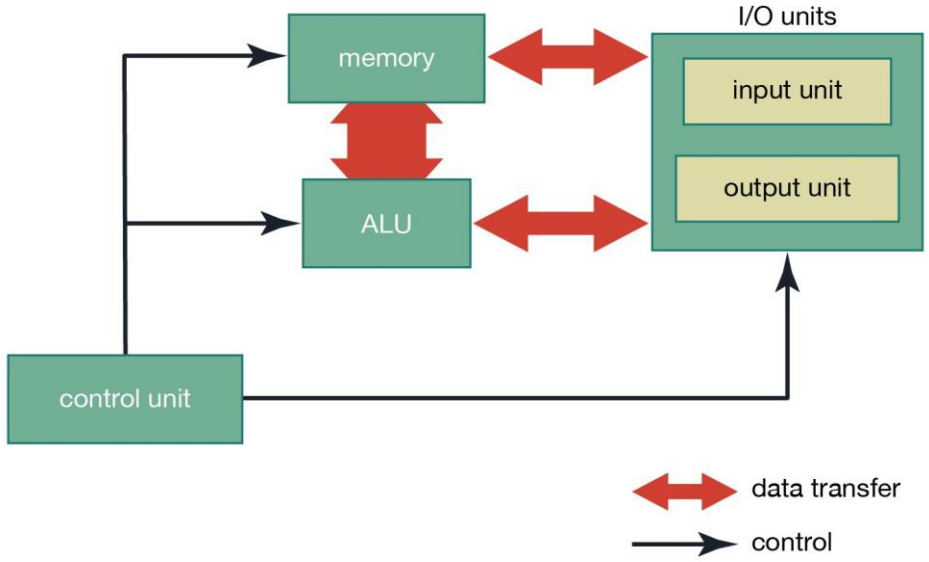
ARITHMETIC LOGIC UNIT (ALU)

- ALU Performs arithmetic and logical operations
- It includes storage places for input operands that are being added, the accumulated results (stored in an accumulator) and shifted results.
- Performs arithmetic operations (+, -, ×, ÷)
- Also Performs logical operations (AND, OR, NOT , XOR)

HOW ALU WORKS?



Organization of Arithmetic and Logic Unit



For more details:
https://www.youtube.com/watch?v=UsK5KV1FPmA&t=39s

QUICK BRAIN – Sample Question 2

- State 3 differences between **CISC, RISC**
- How does ALU work?
- Why is microprocessor called versatile?

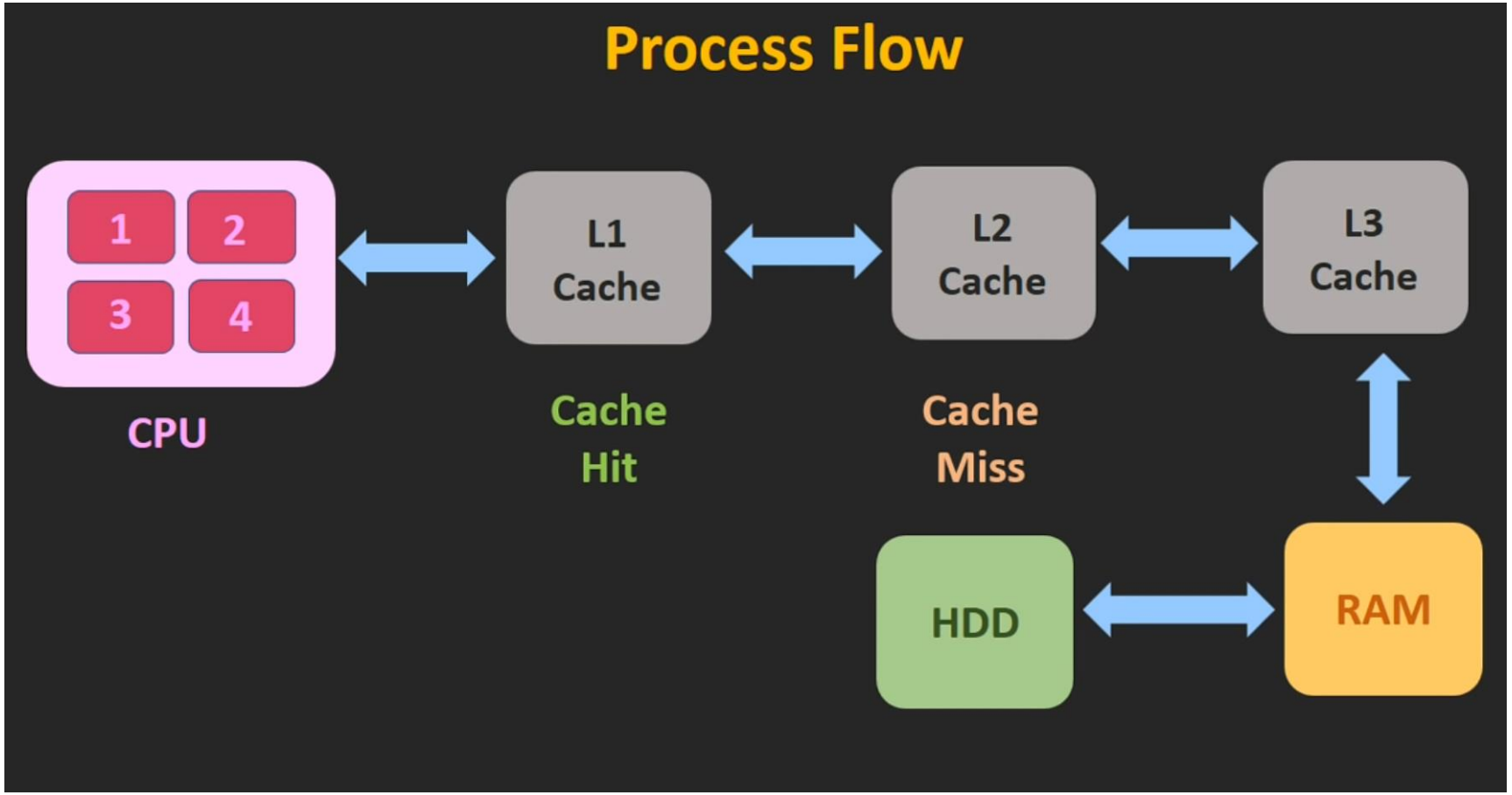
PART – C

L1 & L2 CACHE MEMORY

- L1 & L2 are levels of cache memory in a computer.

- L1 is "level-1" cache memory, usually built onto the microprocessor chip itself.
- L2 (that is, level-2) cache memory is on a separate chip (possibly on an expansion card) that can be accessed more quickly than the larger "main" memory

L1 & L2 CACHE MEMORY



SPECIAL & GENERAL PURPOSE REGISTER

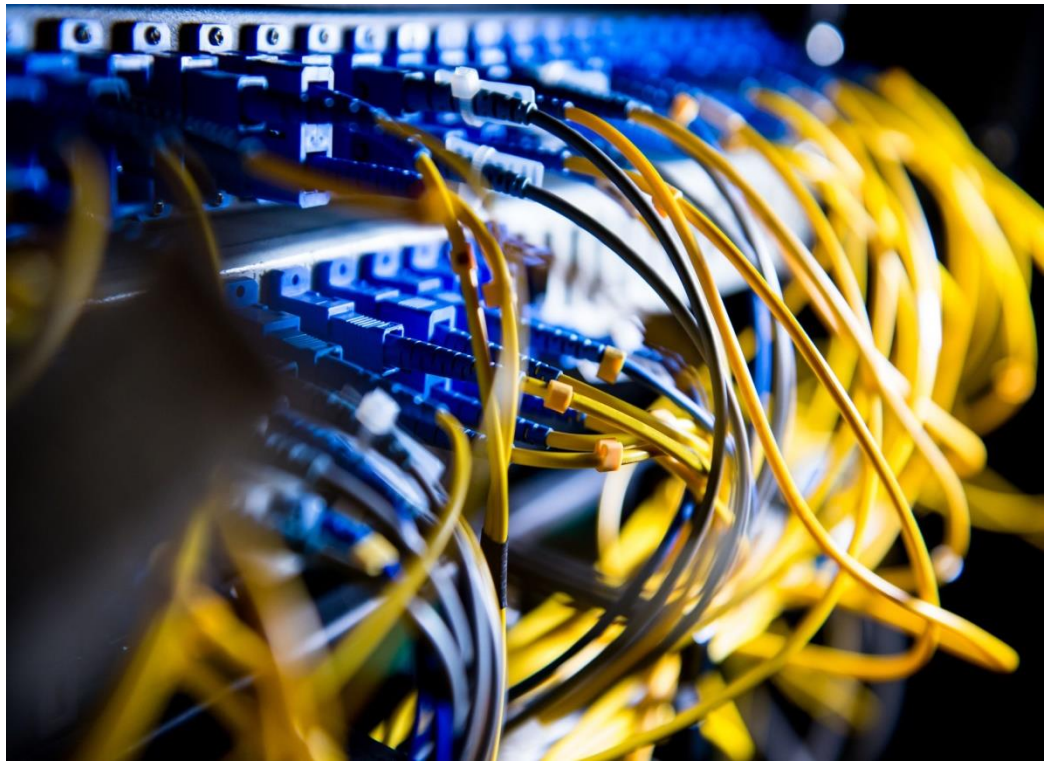
- General purpose register can be used as either data or address register.
- There are 6 general purpose registers namely B, C, D, E, H, L.
- Each of them is a 8- bit registers.
- They are used to hold data and results.
- To hold 16-bit data, combinations of two 8-bit registers can be used.

BUS INTERFACE

- The bus interface unit is the part of a processor that interface with the rest of the PC.
- It deals with moving information over the processor data bus, the primary conduit for the transfer of information to & from the CPU.
- Responsible for responding to all signals that go to the processor & generating all signals that go from the processor to other parts of the system.

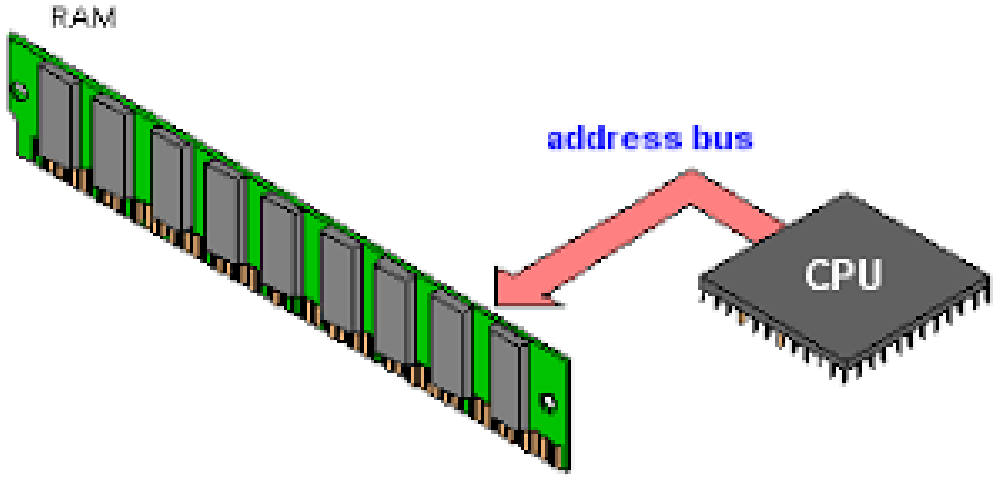
DATA BUS

- A collection of wires in which data is transmitted from one computer to another external drive.
- It carries digital information.
- It is connected to the inputs of several fates and to the outputs of several gates.
- This is also called bi-directional bus as information may flow on the bus wires in both directions.



ADDRESS BUS

- An address bus is a computer bus that is used to specify a physical address.
- The width of the address bus determines the amount of memory a system can address.
- It transfers the address of the location.
- It is called uni-directional as it transfers the address from CPU to memory only.



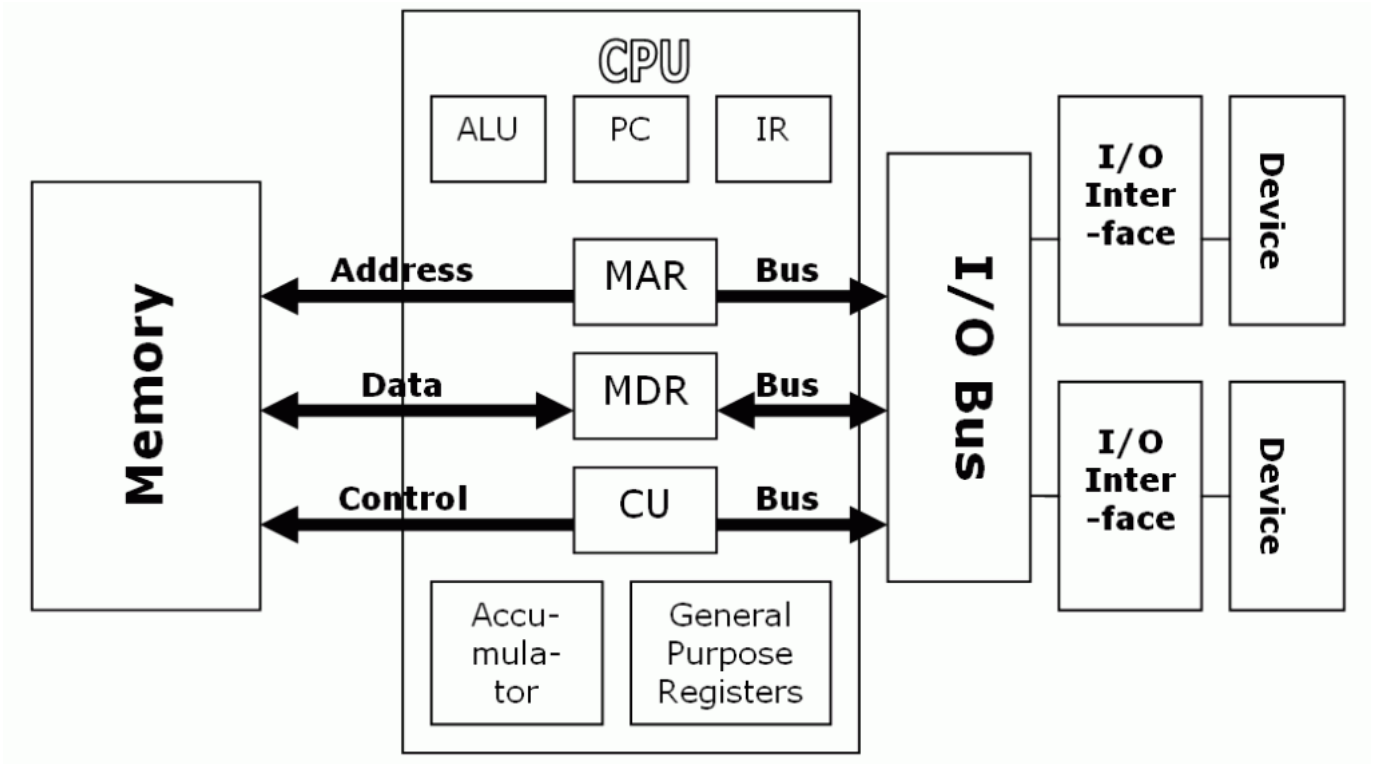
REGISTER

- Special memory units, called registers, are used to hold information on a temporary basis as the instructions are interpreted and executed by the CPU
- Registers are part of the CPU (not main memory) of a computer
- The length of a register, sometimes called its *word size*, equals the number of bits it can store
- With all other parameters being the same, a CPU with 32-bit registers can process data twice larger than one with 16-bit registers

REGISTER CLASSIFICATION

Sr. No.	Name of Register	Function
1	Memory Address (MAR)	Holds address of the active memory location
2	Memory Buffer (MBR)	Holds contents of the accessed (read/written) memory word
3	Program Control (PC)	Holds address of the next instruction to be executed
4	Accumulator (A)	Holds data to be operated upon, intermediate results, and the results
5	Instruction (IR)	Holds an instruction while it is being executed
6	Input/Output (I/O)	Used to communicate with devices the I/O

REGISTER

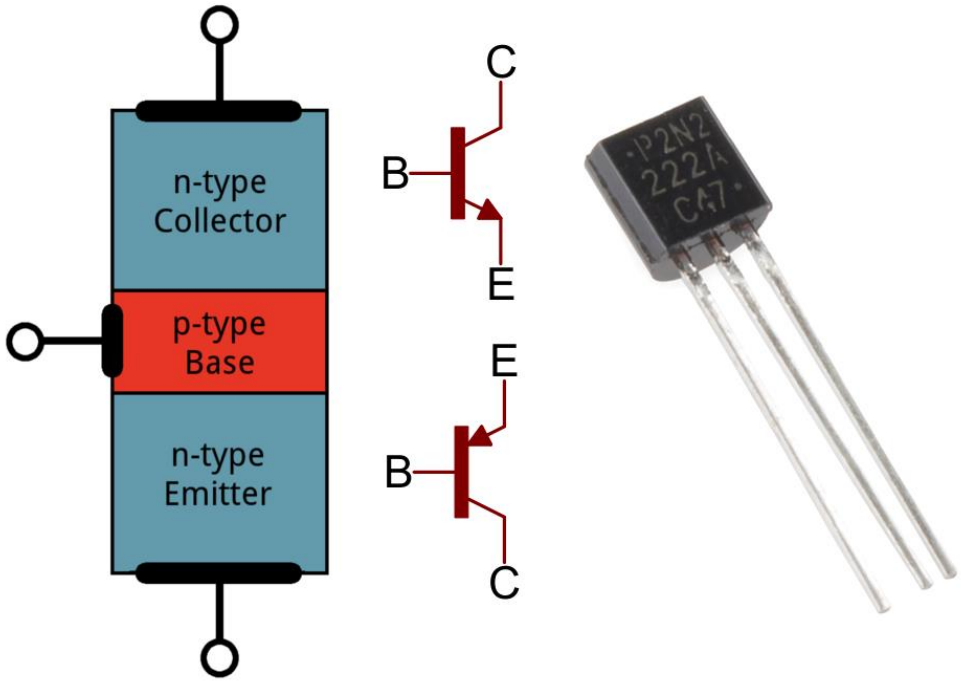


How Register works?

- https://www.youtube.com/watch?v=Z5JC9Ve1sfI&t=171s

TRANSISTOR

- Transistors are a three terminal semiconductor device used to regulate current, or to amplify an input signal into a greater output signal. Transistors are also used to switch electronic signals.



TRANSISTOR

The main functions of a transistor

- A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. Transistors are one of the basic building blocks of modern electronics. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit.

For details

- https://www.youtube.com/watch?v=P3hf2EXhQzI&t=9s

QUICK BRAIN – Sample Question 3