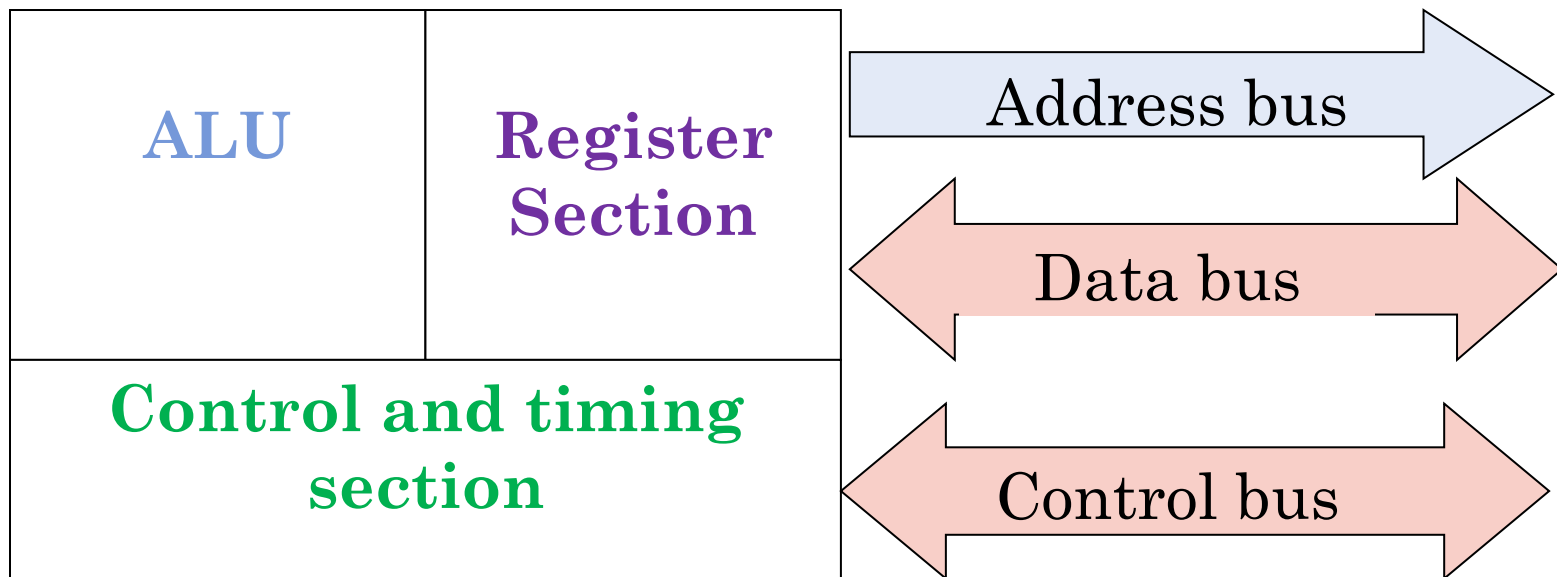# Introduction to microprocessor (Continued)
Unit 1
Lecture 2

Dronacharya Group of Institutions

INTERNAL STRUCTURE AND BASIC OPERATION OF MICROPROCESSOR

| ALU	Register Section
Control and timing section	

Address bus

Data bus

Control bus

Block diagram of a microprocessor

CONTROL UNIT

o The circuitry that controls the flow of information through the processor, and coordinates the activities of the other units within it.

o In a way, it is the "brain within the brain", as it controls what happens inside the processor, which in turn controls the rest of the PC.

o On a regular processor, the control unit performs the tasks of fetching, decoding, managing execution and then storing results.

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INTERNAL STRUCTURE OF CONTROL UNIT
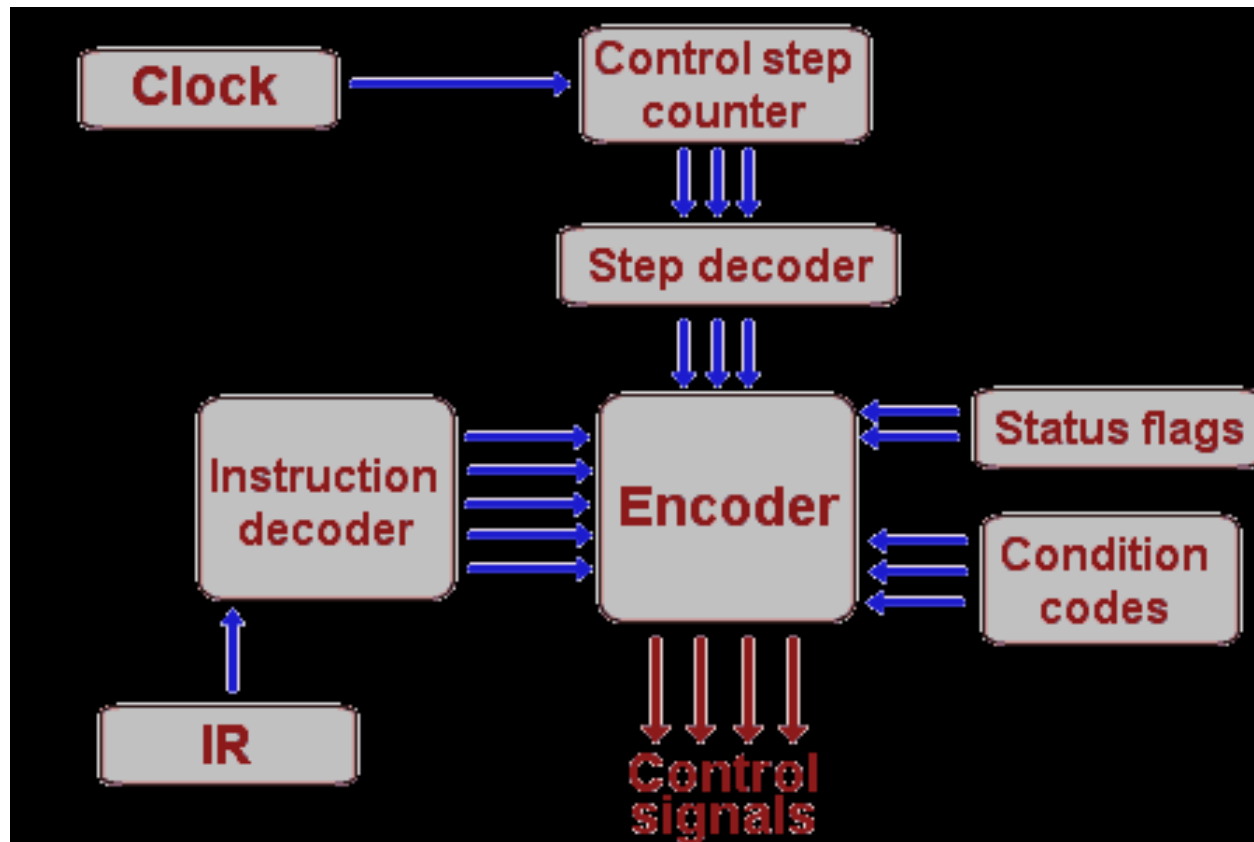
ACCUMULATOR

- A register in which intermediate arithmetic and logic results are stored.

- example for accumulator use is summing a list of numbers.
  - The accumulator is initially set to zero, then each number in turn is added to the value in the accumulator.
  - Only when all numbers have been added is the result held in the accumulator written to main memory or to another, non-accumulator, CPU register.

Flag	Name	Description
Z	Zero flag	Indicates that the result of a mathematical or logical operation was zero.
C	Carry flag	Indicates that the result of an operation produced an answer greater than the number of available bits. (This flag may also be set before a mathematical operation as an extra operand to certain instructions, e.g. "add with carry".)
X	Extend flag	*Masks the XIRQ request when set. It is set by the hardware and cleared by the software as well is set by unmaskable XIRQ.*
N	Negative/ Sign flag	Indicates that the result of a mathematical operation is negative. In some processors, the N and S flags have different meanings: the S flag indicates whether a subtraction or addition has taken place, whereas the N flag indicates whether the last operation result is positive or negative.
V	Overflow Flag	Indicates that the result of an operation has overflowed according to the CPU's word representation, similar to the carry flag but for signed operations.
I	interrupts	Interrupts can be enabled or disabled by respectively setting or clearing this flag. Modifying this flag may be restricted to programs executing in supervisor mode

PROGRAM COUNTER (PC)

- a 16 bit register, used to store the next address of the operation code to be fetched by the CPU.
- Not much use in programming, but as an indicator to user only.
- Purpose of PC in a Microprocessor
  - to store address of tos (top of stack)
  - to store address of next instruction to be executed.
  - count the number of instructions.
  - to store base address of the stack.

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INTERNAL STRUCTURE OF PC
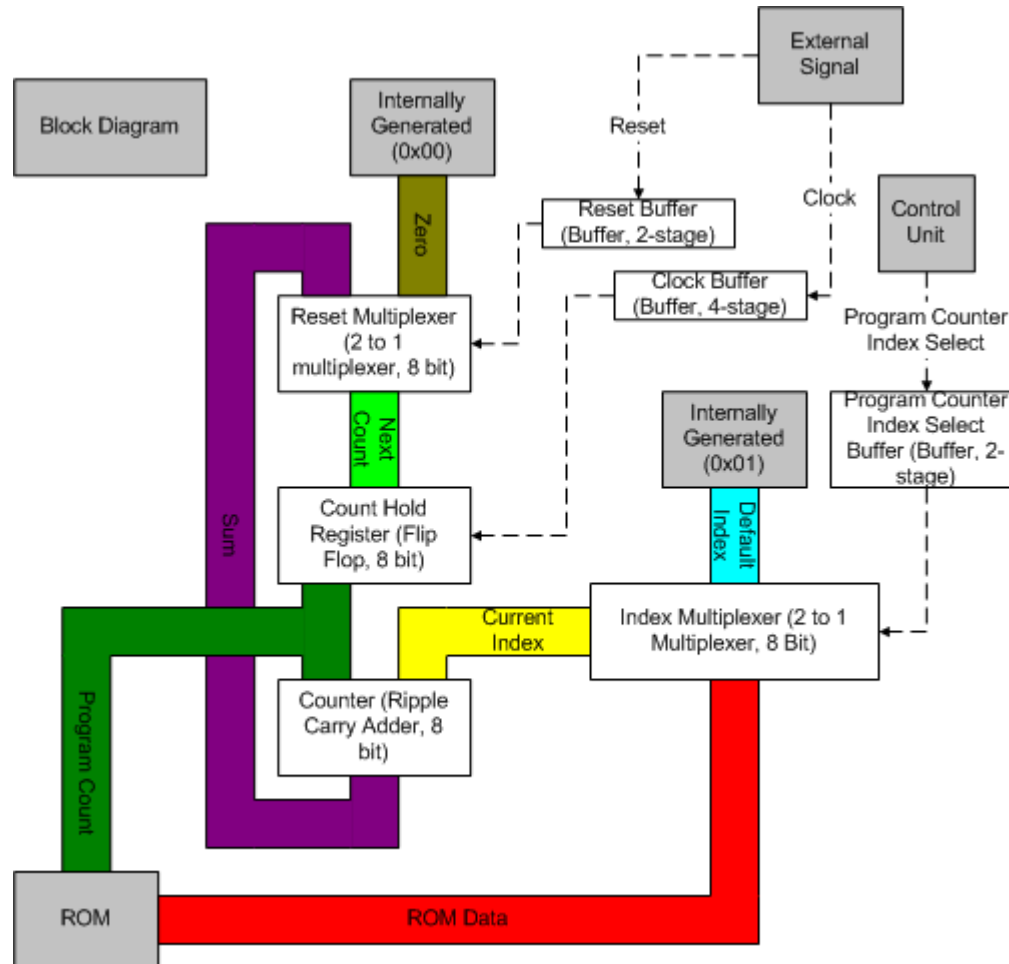
STACK POINTER (SP)

- The stack is configured as a data structure that grows downward from high memory to low memory.

- At any given time, the SP holds the 16-bit address of the next free location in the stack.

- The stack acts like any other stack when there is a subroutine call or on an interrupt. ie. pushing the return address on a jump, and retrieving it after the operation is complete to come back to its original location.
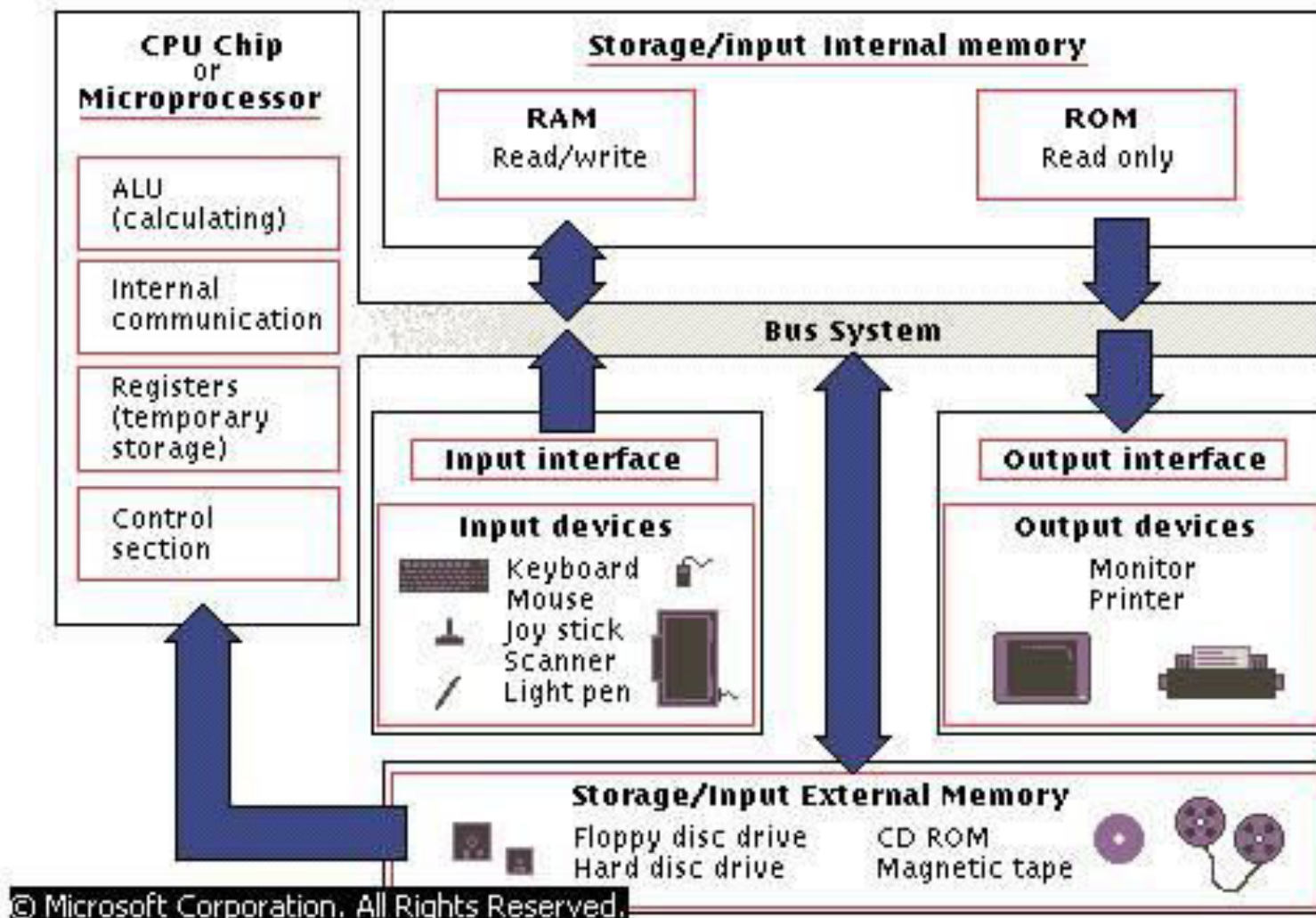
BUS SYSTEM

- a subsystem that transfers data between computer components inside a computer or between computers.
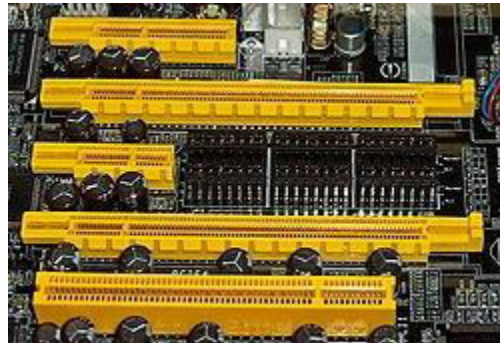
4 PCI Express bus card slots (from top to bottom: x4, x16, x1 and x16), compared to a traditional 32-bit PCI bus card slot (very bottom).

BUS SYSTEM CONNECTION

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DATA BUS

- The data bus is 'bi-directional'
  - data or instruction codes from memory or input/output are transferred into the microprocessor
  - the result of an operation or computation is sent out from the microprocessor to the memory or input/output.
- Depending on the particular microprocessor, the data bus can handle 8 bit or 16 bit data.

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ADDRESS BUS

- The address bus is '**unidirectional**', over which the microprocessor sends an address code to the memory or input/output.
- The size (width) of the address bus is specified by the number of bits it can handle.
- The more bits there are in the address bus, the more memory locations a microprocessor can access.
- A 16 bit address bus is capable of addressing 65,536 (64K) addresses.

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CONTROL BUS

- The control bus is used by the microprocessor to send out or receive timing and control signals in order to coordinate and regulate its operation and to communicate with other devices, i.e. memory or input/output.
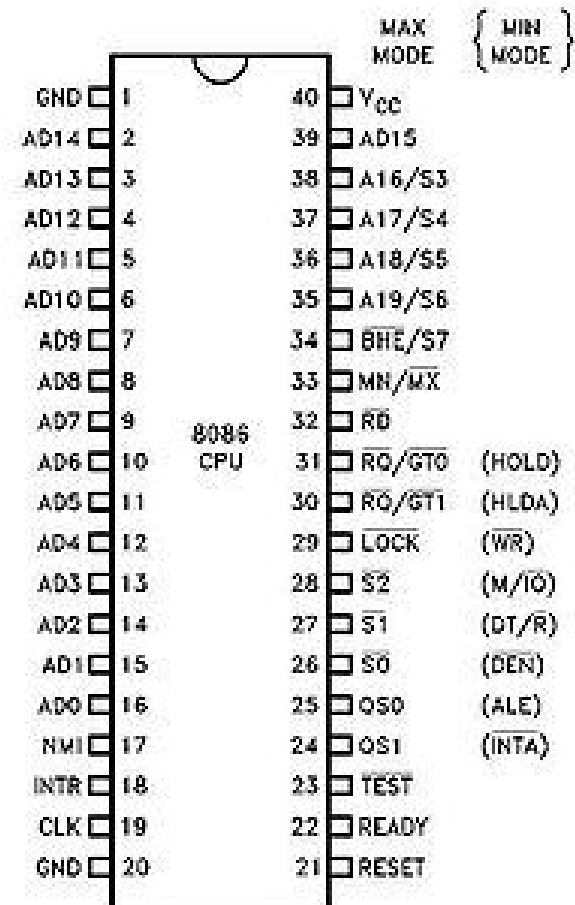
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Micro processor clock

- Also called clock rate, the speed at which a microprocessor executes instructions. Every computer contains an internal clock that regulates the rate at which instructions are executed and synchronizes all the various computer components.

- The CPU requires a fixed number of clock ticks (or clock cycles) to execute each instruction. The faster the clock, the more instructions the CPU can execute per second. Clock speeds are expressed in megahertz (MHz) or gigahertz (GHz).

- Some microprocessors are superscalar, which means that they can execute more than one instruction per clock cycle.

- Like CPUs, expansion buses also have clock speeds. Ideally, the CPU clock speed and the bus clock speed should be the same so that neither component slows down the other. In practice, the bus clock speed is often slower than the CPU clock speed, which creates a bottleneck. This is why new local buses, such as AGP, have been developed.

EXAMPLES OF MICROPROCESSOR

- Intel 8085
- Intel 8086

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8086

- The 8086 is a 16-bit microprocessor chip designed by Intel, which gave rise to the x86 architecture; development work on the 8086 design started in the spring of 1976 and the chip was introduced to the market in the summer of 1978.

- The Intel 8088, released in 1979, was a slightly modified chip with an external 8-bit data bus (allowing the use of cheaper and fewer supporting logic chips and is notable as the processor used in the original IBM PC.

MAX MODE { MIN MODE }

```
GND   1        40   Vcc
AD14  2        39   AD15
AD13  3        38   A16/S3
AD12  4        37   A17/S4
AD11  5        36   A18/S5
AD10  6        35   A19/S6
AD9   7        34   BHE/S7
AD8   8        33   MN/MX
AD7   9  8086  32   RD
AD6   10 CPU   31   RQ/GT0  (HOLD)
AD5   11       30   RQ/GT1  (HLDA)
AD4   12       29   LOCK    (WR)
AD3   13       28   S2      (M/IO)
AD2   14       27   S1      (DT/R)
AD1   15       26   S0      (DEN)
AD0   16       25   QS0     (ALE)
NMI   17       24   QS1     (INTA)
INTR  18       23   TEST
CLK   19       22   READY
GND   20       21   RESET
```

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8085

- The Intel 8085 is an 8-bit microprocessor introduced by Intel in 1977.

- It was binary-compatible with the more-famous Intel 8080 but required less supporting hardware, thus allowing simpler and less expensive microcomputer systems to be built.

An Intel 8085AH processor.	
Produced	From 1977 to 1990s
Common manufacturer(s)	•Intel and several others
Max. CPU clock rate	3,5 and 6 MHz
Instruction set	pre x86
Package(s)	•40 pin DIP