

1.

ECE 405 LECTURES
MICROCOMPUTER &
MICROPROCESSOR
WEEK ONE LECTURES

INTRODUCTION TO COMPUTER

DEFINITION OF COMPUTER : A device that accepts input, processes data, stores data, and produces output.

A computer is a machine that can be programmed to manipulate symbols. Its principal characteristics are:

- It responds to a specific set of instructions in a well-defined manner.
- It can execute a prerecorded list of instructions (a program).
- It can quickly store and retrieve large amounts of data

TYPES OF COMPUTER

- **Mainframe computers** are large-sized, powerful multi-user computers that can support concurrent programs. That means, they can perform different actions or ‘processes’ at the same time. such as processing the organisation’s payroll.
- **Mini-computers** are mid-sized multi-processing computers. Again, they can perform several actions at the same time and can support from 4 to 200 users simultaneously.
- **Workstations** are powerful, single-user computers. They have the capacity to store and process large quantities of data, but they are only used by one person at a time.
- **Personal computers (PCs)**, also called microcomputers, are the most popular type of computer in use today. The PC is a small-sized, relatively inexpensive computer
- designed for an individual user.

TYPES OF COMPUTER

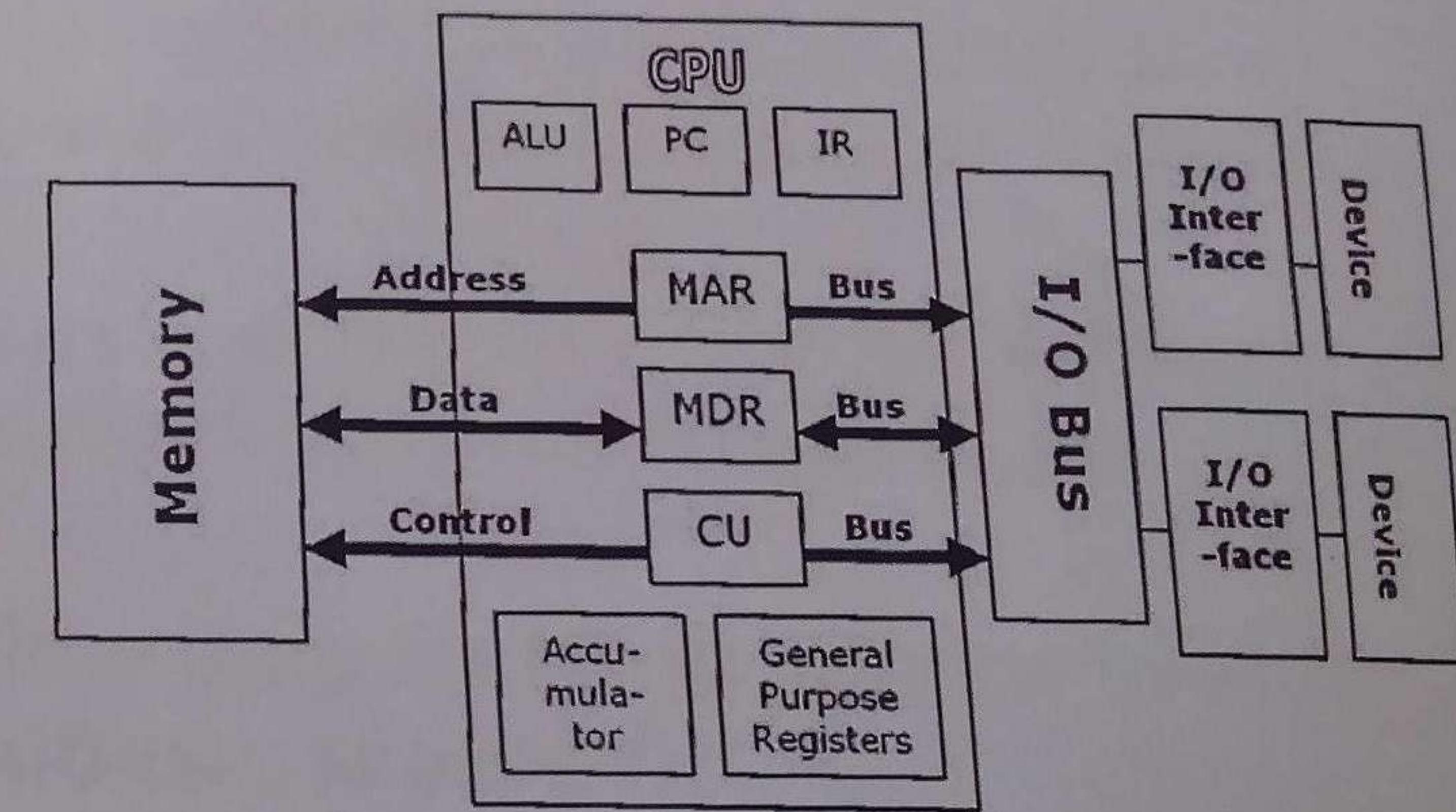
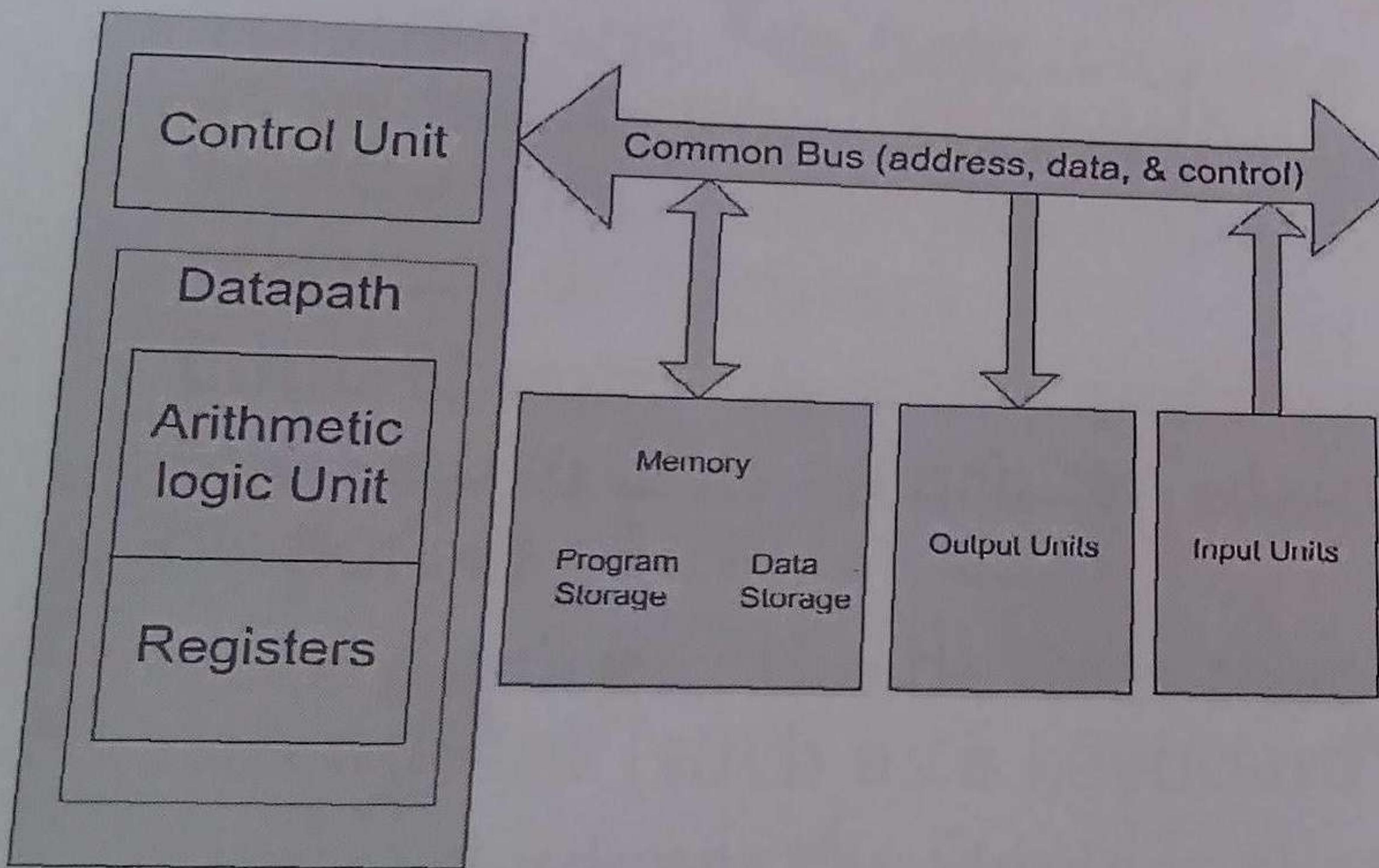
- ***Supercomputers-super large computers:*** supercomputers are high- capacity machines with hundreds of thousands of processors that can perform more than 1 trillion calculations per second..
- ***Desktop PCs:*** are those in which the case or main housing sits on a desk, with keyboard in front and monitor (screen) often on top.
- ***Tower PCs:*** are those Microcomputer in which the case sits as a "tower," often on the floor beside a desk, thus freeing up desk surface space.
- ***Laptop computers*** (also called *notebook computers*): are lightweight portable computers with built-in monitor..
- ***Personal digital assistants (PDAs)*** (also called handheld computers or palmtops) combine personal organization tools-schedule planners, address books, to-do lists Some are able to send e-mail and faxes.
- ***Microcontrollers-tiny computers:*** Microcontrollers, also called embedded computers, are the tiny, specialized microprocessors installed in "smart" appliances and automobiles. These microcontrollers enable PDAs microwave ovens, for example, to store data about how long to cook your potatoes and at what temperature.

PARTS OF A COMPUTER

Computers are made up of two parts: the hardware and the software.

- ***Hardware:*** The physical equipment required to create, use, manipulate and store electronic data.
- ***Software:*** The computerised instructions that operate a computer, manipulate the data and execute particular functions or tasks.

COMPUTER HARDWARE ARCHITECTURE



COMPUTER HARDWARE ARCHITECTURE CONT'

- **Central Processing Unit:** The two main parts of the CPU are the control unit and the arithmetic logic unit
 - **Datapath** - consists of register file and ALU , Register is a storage location. Used to hold data or a memory address during execution of an instruction. ALU receives data from main memory and/or register file, performs computations and writes result back to main memory or registers
 - **Control unit** – decodes and monitors the execution of instructions and also acts as an arbiter while various systems compete for resources of CPU.
- **input devices** : the devices that allow data and instructions to enter a computer (such as a keyboard, mouse, scanner).
- **output devices**: the devices that allow information to be represented (that is,given out) to the user, such as a display screen or printer)

COMPUTER HARDWARE ARCHITECTURE CONT'

- **Data bus** - data pathway on which signals are sent between system components. Data is sent back and forth between the memory, RAM, and the microprocessor, CPU.(Bidirectional) . The size of data stored in a memory depends on the size of processor, size of cell and type of processor. And 8bit processor will decode 8bit data
- **Address bus:** The address bus is used to identify the memory location or I/O device the processor intends to communicate with. The width of the Address Bus ranges from 20 bits (8086) to 36 bits for (Pentium II). The number of memory locations that can be accessed is given by 2^n . Where n is no of address lines ($2^{16} = 65536$) also an 8bit processor will decode 8bit data and access 2^8 memory locations.
- **Control bus:** carries the control unit's signal.
- The control unit contains program instructions and emits signals to carry them out. Each time the processor outputs an address it also activates one of the four control bus signals: Memory Read, Memory Write, I/O Read and I/O Write

COMPUTER MEMORY

PRIMARY MEMOERY

- **RAM** is temporary (volatile) memory that stores information while the software is used. It is the primary memory component in most computers.
- **ROM** is for permanent storage and cannot be overwritten. Important central processing unit (CPU) instructions for system operation are stored in ROM.
- **Cache** memory provides transitional memory storage and is often built into CPU chips to provide a buffer between RAM and disc memory.
- **CMOS** - (complimentary metal oxide semiconductor) - memory which allows the computer to store configuration/boot data so there is always a place where essential data is stored. CMOS needs to be updated if a new hard drive is installed - more permanent than RAM - less permanent than ROM

COMPUTER MEMORY cont'

PRIMARY MEMOERY

- PROM (programmable read-only memory): a PROM is a memory chip on which you can store a program. Once the PROM has been used, you cannot wipe it clean and use it to store something else. Like ROMs, PROMs are non-volatile.
- EPROM (erasable programmable read-only memory): an EPROM is a special type of PROM that can be erased by exposing it to ultraviolet light.
- EEPROM (electrically erasable programmable read-only memory): an EEPROM is a special type of PROM that can be erased by exposing it to an electrical charge

COMPUTER MEMORY cont'

Secondary Memory

- **Hard Disk Drive**-Data can be read or write, Speed of disk rotation usually 7200 rpm - usually labelled the **C** drive.
- 3.5" Floppy Disk Data can be read or write Data capacity: 1.44 MB.
- CD-RW, CD-R, DVD-RW , USB flash memory, Memory Cards e.g. Secure Digital **Card**(SD card), CompactFlash(CF card), Extreme Digital (XD card)

COMPUTER MEMORY CONT'

PRIMARY MEMORY

- Has less storage capacity.
- Are semiconductor memories..
- Are directly accessed by the cpu (speeed, solid devices).
- Do not have movable parts.
- Smaller in size, lighter in weight.
- Comsumes less power.
- Are more expensive.
- Has more speed(Faster).
- Lesser access time

SECONDARY MEMORY

- Has higher storage capacity
- Are magnetic memories.
- Are accessed by CPU via an interface .
- Have movable part (drives)
- Bigger in size, heavier in weight.
- Consumes more power.
- Less expensive.
- Slower.
- More access time needed

Computer system unit component

- **CMOS** - (complimentary metal oxide semiconductor) - memory which allows the computer to store configuration/boot data so there is always a place where essential data is stored. CMOS needs to be updated if a new hard drive is installed - more permanent than RAM - less permanent than ROM.
- **port** - The serial and parallel ports on a personal computer are external sockets to plug in communications lines, modems, printers, etc. to a computer via cables. The Macintosh uses the serial port to attach a printer, whereas the PC uses the parallel port.
- **CPU** - central processing unit, the brain of the compute.
- **Hard Disk /Drive** - The mechanism (drive) that reads and writes data on a hard disk.
- **Motherboard** - The main printed circuit board in a computer. It contains sockets that accept additional boards. It contains the bus, CPU and coprocessor sockets, memory sockets, keyboard controller and supporting chips

Computer system unit component cont'

- **CD-RW drive** :Compact disc Read/Write drives support the creation of CD-R and CD-RW discs, and also function as CD-ROM drives. These drives use low-powered lasers to 'burn' data into the active layer of the disc.
- **USB Flash drive**:Memory sticks or Flash drives are solid-state NAND flash chips packaged to provide additional memory storage.
- **Expansion cards and slots**: An appropriate expansion card can be added to increase the functionality of a specific computer. E.g graphic cards, network cards and sound cards.

Computer software

Software - Instructions to the computer - includes system and utility programs in computer-readable language e.g Application, system software and firmware.

System software (Operating System): The primary functions of the operating system are to manage the hardware resources (disk space, memory, CPU and so on) and provide facilities to manage and run programs.

- Examples of operating systems are Windows (for IBM personal computers), UNIX (for SUN computers and others), and VMS (for many mainframe computers). Macintosh computers use a proprietary operating system.
- **CISC** - complex instruction set computer - can recognize 100 or more instructions
- **RISC** - reduced instruction set computer - runs 50 - 75 % faster than a CISC instruction set computer. Cheaper to design, debug and manufacture because they are less complex. The instructions used the most are emphasized for the fastest possible execution

Computer software CONT'

- **Applications software:** These are special purpose software and user friendly. They includes programs that users access to carry out work. E'g Msword, etc
- include applications for the following functions.
Firmware - the system software permanently stored in the computers ROM (read-only memory) or elsewhere in the circuitry. Is not modified by the user.
- **Virus:** A computer program that is planted in one computer and then transferred, hidden in useful information, to one or more other computers with the intention of corrupting or wiping out information in the recipient computer.

Computer software CONT'

PROGRAMMING LANGUAGES.

- Most computer programs are written using high-level languages such as C, Pascal, COBOL, dBase, FORTRAN, or Basic.
- Object code, or machine language, is the machine-specific binary code instructions used by the CPU.
- High-level machine-independent languages are called source code.
- A compiler is a software program used to convert high-level language (source code) to machine language (object code).
- Assembly languages (low level languages) are very similar to machine languages and are used a lot with programs that have to relate to hardware

COMPUTER BOOTSTRAPPING

- **Bootstrapping** - When the computer is turned on, the permanent instructions stored in ROM tell the computer how to find the disk containing the operating system. The operating system is then copied from the disk into RAM for quick access. Hardware diagnostics are run and the system may check itself for viruses.
- **Bootstrap process:**
 1. Turn the machine on - power goes to the internal fan and otherboard. The light comes on when this process is started.
 2. The CPU (microprocessor) executes the instructions stored in ROM (read only memory). The programs stored in ROM are activated.
 3. The computer performs self test - diagnostics of critical system components.
Checks graphics card -> tests RAM->checks keyboard-> tests drives. Throughout this process on most computers you will see lights flash on keyboard and various drives.

COMPUTER BOOTSTRAPPING

4. The OS (operating system) is copied from a disk to RAM. Computer locates the default drive -> Command.com
 5. The CPU (microprocessor) reads configuration data and performs start up routines residing in Autoexec.bat or Windows startup group. Customized routines can be set by the computer user - for example a virus check, a utilities program to check performance.
 6. The computer is ready to accept commands from the user and let the user enter data. The interface (Windows or other desktop configuration) appears, from which the user can access applications.
- pipelining - a strategy for optimizing processor speed by beginning the next operation before the last is completed
 - parallel processing - using multiple processors to perform a task. Parallel processing enables the computer user to have more than one program running at the same time - ie, using a wordprocessor while a spreadsheet program is calculating data and a database is sorting data. A windows environment enables multitasking; DOS does not.
 - Serial processing refers to performing tasks sequentially

COMPUTER WORD LENGTH

- Word length is the number of bits that a digital computer can process in parallel at a time.
- The word length is given as n-bit, where n=8,16,32, 64 etc.
- An 8-bit computer/processor can process on 8 bit data at a time; while it will take two cycles to process a 16bit data and 4 cycles to process 32 bit data.
- The word length of a computer/processor depends on its data bus size. An 16 bit process has a word length of 16, etc
- An 16 bit data can be stored in two 8bit cells while 32 bit data will be stored in four 8bit cells.

NUMBER SYSTEM

- BINARY, OCTAL, HEXADECIMAL ETC NUMBER SYSTEMS.
- ***Binary digit (bit):*** A digit within the binary number system. A bit is the smallest unit of information held in a computer.
- ***Byte: A combination of bits that represent one character.*** A byte is usually composed of 8 bits.
- ***Converting from decimal to binary:***
- Example: Convert 25₁₀ to binary:
 - Remainder
 - $25/2 = 12 \text{ } 1$ LSB (least significant bit)
 - $12/2 = 6 \text{ } 0$
 - $6/2 = 3 \text{ } 0$
 - $3/2 = 1 \text{ } 1$
 - $1/2 = 0 \text{ } 1$ MSB (most significant bit)
 - Therefore, $25_{10} = 11001_2$

NUMBER SYSTEM cont

Hexadecimal	Binary	Decimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

- **Converting from binary to decimal:**
- Example: Convert 1101012 to decimal:
- $110101_2 = \text{Decimal}$
- $1 \times 2^0 = 1 \times 1 = 1$
- $0 \times 2^1 = 0 \times 2 = 0$
- $1 \times 2^2 = 1 \times 4 = 4$
- $0 \times 2^3 = 0 \times 8 = 0$
- $1 \times 2^4 = 1 \times 16 = 16$
- $1 \times 2^5 = 1 \times 32 = + 32$

$$53 \quad 110101_2 = 53_{10}$$

- **Converting from binary to hex (hexadecimal):**

- Example: Convert 1001111101012 to hex:
- 1001 1111 0101
- = 9 F 5

• Therefore, $100111110101_2 = 9F5$ Hex

- **Converting from hex to binary:**

- Example: Convert hex 29B to binary:

• 2 9 B

• = 0010 1001 1011 Dropping zeros, 29B = 1010011011