



Computer Maintenance

Introduction to PCs:
How Computers Work

Topics of Discussion

- Basic Functions of an Operating System
- Bootstrap
- Power-On Self Test (POST)
- Motherboards
- Central Processing Unit
- Control Unit
- Processor Speed
- Expansion Slots



Topics of Discussion (cont.)



- Monitors
- I/O Ports
- Serial Ports
- Parallel Ports
- PS/2 Ports
- EIDE and SCSI Controllers
- Hard Disk Drive
- Interrupt Request
- I/O Address

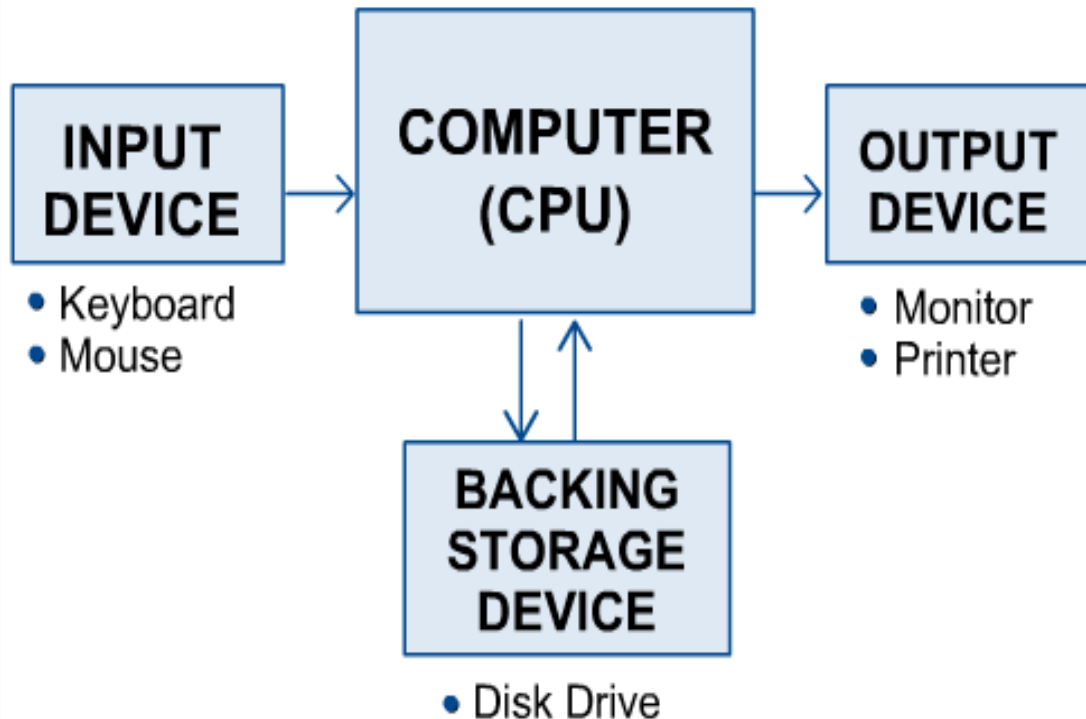


Basic Functions of an Operating System



- Input – Recognizing entries from the keyboard or mouse
- Processing – Manipulating data according to the user's instructions
- Output – Sending output to the video screen or printer
- Storage – Keeping track of files for use later. Examples of storage devices include floppy disks and hard drives.

Basic Functions of an Operating System (Cont.)





Bootstrap

- For an operating system to run, it must be loaded into the computer's Random Access Memory (RAM).
- When a computer is first turned on, it launches a small program, called the **bootstrap loader**, that is built into the computer's hardware.
- Specifically, the bootstrap is located on the BIOS chip, which resides on the system board
- The bootstrap's primary functions are to test the computer's hardware and to locate and load the operating system into RAM

Power-On Self Test (POST)



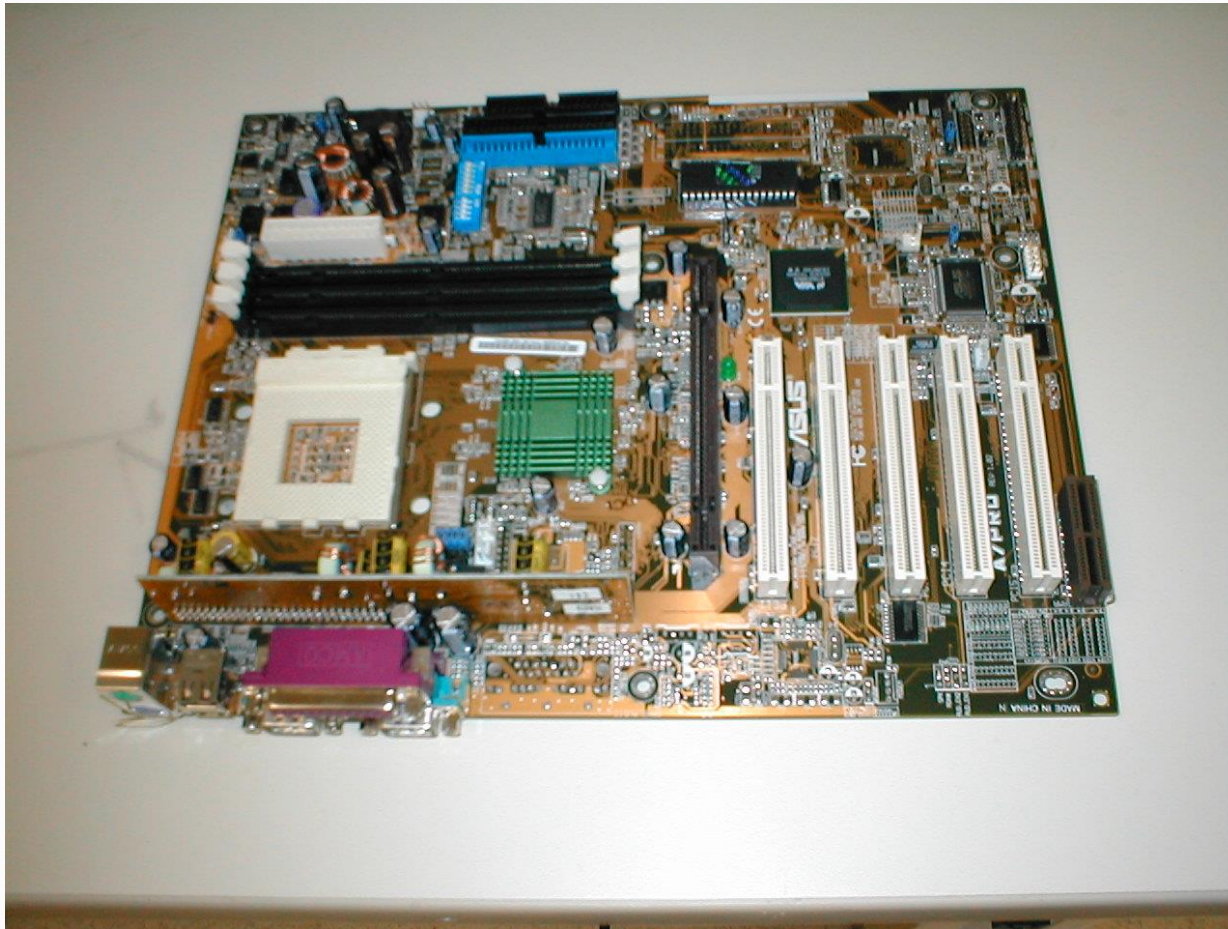
- To test the computer's hardware, the bootstrap program runs a program called power-on-self-test or POST.
- The computer's CPU checks itself first and then checks the computer's system timer.
- The POST checks the RAM by writing data to each RAM chip and then reading that data (any difference indicates a problem).
- If POST finds errors, it sends a message to the computer monitor. If it can't send to the monitor – it sends “beeps.”
- The POST sends one beep, and the screen begins to display OS loading messages, once the computer has determined that the computer has passed the POST.



Motherboards

- The motherboard, also called the system board or main board, is the nerve center of the computer system.
- Everything else in the system plugs into it, is controlled by it, and depends on it to communicate with other devices on the system.
- It houses the CPU, controller circuitry, the bus, RAM, expansion slots for additional boards, and ports for external devices.
- In addition, it contains the CMOS, other ROM BIOS, and support chips providing varied functionality.

Motherboards



Motherboard Form Factors



- Motherboards are usually described by their form factors which describe their physical dimensions.
- The two most common form factors used today are:
 - Baby AT motherboards
 - ATX motherboards
- The ATX is similar to the Baby AT except for a number of important enhancements.
- Most new systems come with the ATX motherboard form factor.

Motherboard Form Factors (Cont.)



Form factor	Dimensions(inches)	Notes
Baby AT	8.5 X 10-13	Used by older PCs, are becoming outdated.
ATX	12 X 9.6	Most common form factor in use today.

AT



ATX



Motherboard Components



- Chipset
- CPU socket
- Expansion sockets
- I/O support
- BIOS
- RAM sockets
- Power supply socket
- CMOS chip
- Dipswitches/jumpers
- Memory cache



Central Processing Unit

- The CPU is one of the most important elements of a personal computer.
- On the motherboard, the CPU is contained on a single integrated circuit called the microprocessor.
- The computer will not run without a CPU.
- Often referred to as the brains of a computer, the CPU contains two basic components:
 - Control unit
 - Arithmetic/Logic Unit (ALU)





Control Unit

- Instructs the rest of the computer system on how to follow a program's instructions
- It directs the movement of data to and from processor memory.
- The control unit temporarily holds data, instructions, and processed information in its arithmetic/logic unit.
- In addition, it directs control signals between the CPU and the external devices such as hard disks, main memory, I/O ports, etc.



Processor Speed

- CPU descriptions such as Intel i5, AMD Zen, Pentium 133, Pentium 166, or Pentium 200 are well known.
- These numbers are specifications that indicate the maximum reliable operating speed at which the CPU can execute instructions.
- On older chips, the CPU speed is **NOT** controlled by the microprocessor itself, but by an external clock located on the motherboard.
- Modern CPUs are controlled onboard the same chip and the BIOS “suggests an overclock”
- The speed of the processor is determined by the frequency of the clock signal.
 - It is typically expressed in megahertz (MHz) / gigahertz (GHZ), and the higher the number, the faster the processor.

Expansion Slots

- Expansion slots (sockets) are receptacles on the motherboard that accept printed circuit boards.
- All computers have expansion slots that allow additional devices to be added.
- Video cards, I/O cards, and sound cards are examples of components that are located in expansion slots.
- The common expansion slots that are likely to be encountered include the following:
 - Industry Standard Architecture (ISA)
 - Peripheral Component Interconnect (PCI)
 - Accelerated Graphics Port (AGP)
 - Next Generation Form Factor (NGFF) M.2
 - Peripheral Component Interconnect Express (PCIE)
- PCI is most commonly used on new motherboards



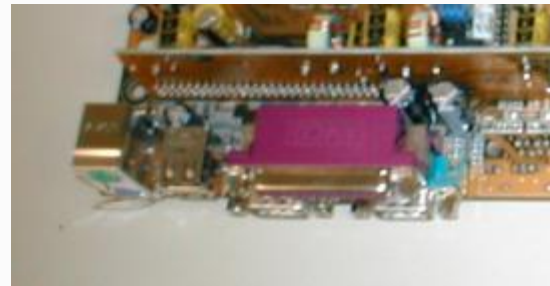


Monitors

- Computers are usually connected to a display, also called a monitor.
- Some key monitor-related terms are pixels, refresh rate, resolution, and size.
 - Pixels – picture elements.
 - the screen image is made of pixels (tiny dots)
 - which are arranged in rows across the screen
 - each pixel consists of three colors: red, green, and blue (RGB)
 - Dot pitch – A measurement of how close together the phosphor dots are on the screen. The finer the dot pitch, the better the image quality (measured in millimeters).

I/O Ports

- All peripheral devices that connect physically to the computer such as printers, scanners, and so on, use a connector on the back of the computer known as a port.
- There are different types of ports on the computer that serve different purposes. Some of the common ports are
 - Serial Ports
 - Parallel Ports
 - PS/2 Ports
 - USB Ports
 - ESATA Ports



Serial Ports

- A serial port can be used to connect devices that use a serial interface, such as a modem, scanner, mouse, etc.
- Generally, a PC can identify up to four serial ports, but the typical computer contains only two, referred to as COM1 and COM2.
- A serial port transmits data bits one after the other (serially) over a single line.



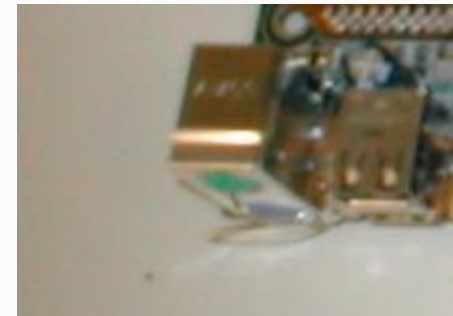
Parallel Ports

- A parallel port is a socket on the computer that is used to connect a printer or other peripheral device, such as a portable hard disk, tape backup, scanner, or a CD-ROM.
- The parallel port contains eight lines for transmitting an entire byte (8 bits) across the eight data lines simultaneously.
- Parallel ports can be configured as LPT1, LPT2, or LPT3.



PS/2 Ports

- PS/2 keyboard or PS/2 mouse ports are used to connect your PC to its keyboard and mouse.
- Though both ports look identical, the mouse (green) and keyboard (purple), the ports are not interchangeable.
- Usually both ports are color-coded or labeled to avoid any confusion.



USB Ports

- Now the modern standard to connect peripherals along with keyboards and mice.
- Though ports look identical, the colors and internal wiring are different.
- Usually both ports are color-coded or labeled to avoid any confusion.
 - USB 1
 - USB 2
 - USB 3
 - USB 3.1
 - USB Type C



ESATA Ports

- Used to connect external hard drives directly to the SATA controller
 - Also known as Power over ESATA
- Hybrid Port exist that are compatible with USB



EIDE and SCSI Controllers



- The internal hard drive is connected to a disk controller with a cable.
- The hard drive and other devices can use one of four types of interface controllers to work with the computer.
 - Enhanced Integrated Drive Electronics (EIDE).
 - Serial Advanced Technology Attachment (SATA)
 - Small Computer System Interface (SCSI).
 - Pronounced “scuzzy.”
 - Serial Attached Small Computer System Interface (SAS)

EIDE Controllers

- Enhanced IDE (EIDE) is the “new and improved” Integrated Drive Electronics (IDE) drive interface.
- Not confined to IDE’s 528 MB of data, the EIDE interface can handle up to 8.4 GB or more.
- While IDE can support only two drives, EIDE can support up to four devices using two IDE cables.



SCSI Controllers

- The Small Computer Systems Interface (SCSI) controller evolved from the Shugart Associates Standard Interface (SASI).
- Like EIDE, SCSI devices have the controlling electronics on each of the drives.
- A standard SCSI interface will allow up to seven devices to be connected.
- Such devices may include hard drives, CD-ROM drives, taped drives, scanners, and removable drives.
- Each SCSI device in the chain is given a SCSI ID number from 0 to 7.
 - #0 for the primary boot device (hard drive)
 - #7 for the SCSI controller card



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SAS Controllers

- Operates Point – to – Point
 - No terminators needed
- Performs very similar to SATA
- Runs Full Duplex
- Faster mechanical drives (15000 rpms)
- Transfer speeds of 12 Gbits/s
- Up to 65636 devices allowed



SATA Controllers

- Operates Point – to – Point
- Transfer Speeds from 1.5 to 6 Gbits/s (revision 3.2 16Gbit/s)
- Runs Half Duplex
- Drives up to 10000 rpms





Hard Disk Drive

- The HDD has a much larger storage capacity than the floppy for long-term storage.
- It stores your programs and files, as well as the operating system.
- Typically, the HDD is an internal drive that is not removed from the computer.

Hard Disk Drive Components



- All hard disk drives share a common set of components. These components include: disk platters, read/write heads, head actuator assembly, spindle motor, logic/circuit board, configuration jumpers, and interface connectors.
 - Disk platters are the actual media on which data is stored on the hard disk drive.
 - Read/write heads are used to access the media. The disk platters require a read/write head for each side.
 - The spindle motor spins the platters.



Solid Disk Drive

- Works off of flash memory
- No moving parts
- Faster and more reliable than Hard Drives
- More expensive
- SATA, SAS, and PCIE interfaces
- NVMe Standard optimized for SSD use



Interrupt Request

- Modern computers and operating systems owe their reliability to the organized ways in which they handle internal transactions.
- Various hardware devices, for example, may want to tell the CPU that they have some information available that is ready for transfer.
- The devices indicate this by making an interrupt request, or IRQ.
- It is a general rule that IRQs **CANNOT** be shared.

Interrupt Request



IRQ	Common Device or Port Assignment
0	System Timer
1	Keyboard
2	Programmable Interrupt Controller (Cascade IRQs 8-15)
3	COM2 and COM4
4	COM1 and COM3
5	Parallel port 2 (LPT2), or Sound Card, or Network Card
6	Floppy Disk Controller
7	Parallel port 1 (LPT1), or Sound Card (Shared)
8	Real Time Clock
9	Cascade IRQ2
10	Available
11	Available
12	PS/2 Mouse (Available if not used)
13	Numerical Processing Unit
14	Primary IDE Controller
15	Secondary IDE Controller



Interrupt Request

- Direct Memory Access (DMA) channels allow devices to bypass the processor and directly access the computer memory.
- Devices with a DMA channel assignment, as a result, gain the advantage of faster data transfers.
- DMA channels are typically used by high-speed communications devices for transferring large amounts of data at high speeds.
- Examples of such devices include sound cards, some network cards, some SCSI cards, some disk drives, and some tape backup drives.



I/O Address

- In addition to an IRQ, computer components also need to be assigned an I/O port number.
- An I/O port number is a memory address where data is temporarily stored as it moves in and out of the devices.
- The I/O address is very similar to a Post Office box.



I/O Address

Frequently referred to I / O Addresses:

- 3F8 = COM1
- 2F8 = COM2
- 3E8 = COM3
- 2E8 = COM4
- 378 = LPT1
- 278 = LPT2

Summary

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