دانشگاه آزاد اسلامی واحد رودهن

English for Computer Students

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Computer

The NASA Columbia Supercomputer.

A computer in a wristwatch.

A **computer** is a machine which manipulates data according to a list of instructions.

Computers take numerous physical forms. The first devices that resemble modern computers date to the mid-٢٠th century (around ١٩٤٠ - ١٩٤١), although the computer concept and various machines similar to computers existed earlier. Early electronic computers were the size of a large room, consuming as much power as several hundred modern personal computers. Modern computers are based on comparatively tiny integrated circuits and are millions to billions of times more capable while occupying a fraction of the space. Today, simple computers may be made small enough to fit into a wrist watch and be powered from a watch battery. Personal computers in various forms are icons of the information age and are what most people think of as "a computer". However, the most common form of computer in use today is by far the embedded computer. Embedded computers are small, simple devices that are often used to control other devices. For example, they may be found in machines ranging from fighter aircraft to industrial robots, digital cameras, and even children's toys.

How computers work

A general purpose computer has four main sections: the arithmetic and logic unit (ALU), the control unit, the memory, and the input and output devices (collectively termed I/O). These parts are interconnected by busses, often made of groups of wires.

The control unit, ALU, registers, and basic I/O (and often other hardware closely linked with these) are collectively known as a central processing unit (CPU). Early CPUs were composed of many separate components but since the mid-١٩٧٠s CPUs have typically been constructed on a single integrated circuit called a microprocessor.

Control unit

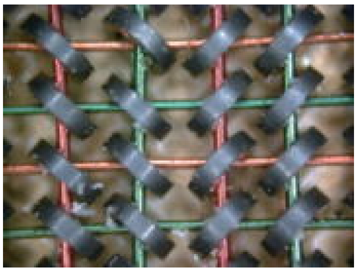
The control unit (often called a control system or central controller) directs the various components of a computer. It reads and interprets (decodes) instructions in the program one by one. The control system decodes each instruction and turns it into a series of control signals that operate the other parts of the computer.. Control systems in advanced computers may change the order of some instructions so as to improve performance.

Arithmetic/logic unit (ALU)

The ALU is capable of performing two classes of operations: arithmetic and logic.

The set of arithmetic operations that a particular ALU supports may be limited to adding and subtracting or might include multiplying or dividing, trigonometry functions (sine, cosine, etc) and square roots. Some can only operate on whole numbers (integers) whilst others use floating point to represent real numbers, albeit with limited precision. However, any computer that is capable of performing just the simplest operations can be programmed to break down the more complex operations into simple steps that it can perform. Therefore, any computer can be programmed to perform any arithmetic operation—although it will take more time to do so if its ALU does not directly support the operation. An ALU may also compare numbers and return boolean truth values (true or false) depending on whether one is equal to, greater than or less than the other ("is ٦٤ greater than ٦٥?").

Memory



Magnetic core memory was popular main memory for computers through the ١٩٦٠s until it was completely replaced by semiconductor memory.

A computer's memory can be viewed as a list of cells into which numbers can be placed or read. Each cell has a numbered "address" and can store a single number. The computer can be instructed to "put the number ١٢٣ into the cell numbered ١٣٥٧" or to "add the number that is in cell ١٣٥٧ to the number that is in cell ٢٤٦٨ and put the answer into cell ١٥٩٥". The information stored in memory may represent practically anything. Letters, numbers, even computer instructions can be placed into memory with equal ease. Since the CPU does not differentiate between different types of information, it is up to the software to give significance to what the memory sees as nothing but a series of numbers.

In almost all modern computers, each memory cell is set up to store binary numbers in groups of eight bits (called a byte). Each byte is able to represent ٢٥٦ different numbers; either from ٠ to ٢٥٥ or -١٢٨ to +١٢٧. To store larger numbers, several consecutive bytes may be used (typically, two, four or eight). When negative numbers are required, they are usually stored in two's complement notation. Other arrangements are possible, but are usually not seen outside of specialized applications or historical contexts. A computer can store any kind of information in memory as long as it can be somehow represented in numerical form. Modern computers have billions or even trillions of bytes of memory.

The CPU contains a special set of memory cells called registers that can be read and written to, much more rapidly than the main memory area. There are typically between two and one hundred registers depending on the type of CPU. Registers are used for the most frequently needed data items to avoid having to access main memory every time data is needed. Since data is constantly being worked on, reducing the need to access main memory (which is often slow compared to the ALU and control units) greatly increases the computer's speed.

Computer main memory comes in two principal varieties: random access memory or RAM and read-only memory or ROM. RAM can be read and written to anytime the CPU commands it, but ROM is pre-loaded with data and software that never changes, so the CPU can only read from it. ROM is typically used to store the computer's initial start-up instructions. In general, the contents of RAM is erased when the power to the computer is turned off while ROM retains its data indefinitely. In a PC, the ROM contains a specialized program called the BIOS that orchestrates loading the computer's operating system from the hard disk drive into RAM whenever the computer is turned on or reset. In embedded computers, which frequently do not have disk drives, all of the software required to perform the task may be stored in ROM. Software that is stored in ROM is often called firmware because it is notionally more like hardware than software. Flash memory blurs the distinction between ROM and RAM by retaining data when turned off but being rewritable like RAM. However, flash memory is typically much slower than conventional ROM and RAM so its use is restricted to applications where high speeds are not required.

In more sophisticated computers there may be one or more RAM cache memories which are slower than registers but faster than main memory. Generally computers with this sort of cache are designed to move frequently needed data into the cache automatically, often without the need for any intervention on the programmer's part.

Input/output (I/O)

Hard disks are common I/O devices used with computers.

I/O is the means by which a computer receives information from the outside world and sends results back. Devices that provide input or output to the computer are called peripherals. On a typical personal computer, peripherals include input devices like the keyboard and mouse, and output devices such as the display and printer. Hard disk drives, floppy disk drives and optical disc drives serve as both input and output devices. Computer networking is another form of I/O.

Often, I/O devices are complex computers in their own right with their own CPU and memory. A graphics processing unit might contain fifty or more tiny computers that perform the calculations necessary to display ٣D graphics. Modern desktop computers contain many smaller computers that assist the main CPU in performing I/O.

Multitasking

While a computer may be viewed as running one gigantic program stored in its main memory, in some systems it is necessary to give the appearance of running several programs simultaneously. This is achieved by having the computer switch rapidly between running each program in turn. One means by which this is done is with a special signal called an interrupt which can periodically cause the computer to stop executing instructions where it was and do something else instead. By remembering where it was executing prior to the interrupt, the computer can return to that task later. If several programs are running "at the same time", then the interrupt generator might be causing several hundred interrupts per second, causing a program switch each time. Since modern computers typically execute instructions several orders of magnitude faster than human perception, it may appear that many programs are running at the same time even though only one is ever executing in any given instant. This method of multitasking is sometimes termed "time-sharing" since each program is allocated a "slice" of time in turn.

Before the era of cheap computers, the principle use for multitasking was to allow many people to share the same computer.

Seemingly, multitasking would cause a computer that is switching between several programs to run more slowly, in direct proportion to the number of programs it is running. However, most programs spend much of their time waiting for slow input/output devices to complete their tasks. If a program is waiting for the user to click on the mouse or press a key on the keyboard, then it will not take a "time slice" until the event it is waiting for has occurred. This frees up time for other programs to execute so that many programs may be run at the same time without unacceptable speed loss.

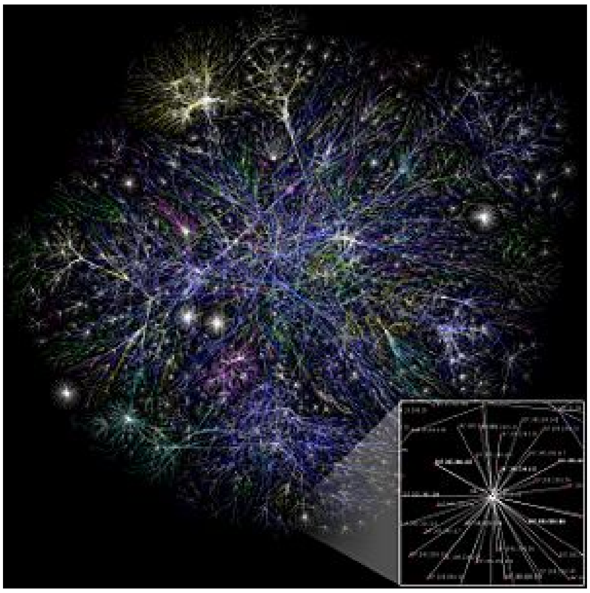
Multiprocessing

Cray designed many supercomputers that used multiprocessing heavily.

Some computers may divide their work between one or more separate CPUs, creating a multiprocessing configuration. Traditionally, this technique was utilized only in large and powerful computers such as supercomputers, mainframe computers and servers. However, multiprocessor and multi-core (multiple CPUs on a single integrated circuit) personal and laptop computers have become widely available and are beginning to see increased usage in lower-end markets as a result.

Supercomputers in particular often have highly unique architectures that differ significantly from the basic stored-program architecture and from general purpose computers. They often feature thousands of CPUs, customized high-speed interconnects, and specialized computing hardware. Such designs tend to be useful only for specialized tasks due to the large scale of program organization required to successfully utilize most of a the available resources at once. Supercomputers usually see usage in large-scale simulation, graphics rendering, and cryptography applications, as well as with other so-called "embarrassingly parallel" tasks.

Networking and the Internet



Visualization of a portion of the routes on the Internet.

Computers have been used to coordinate information in multiple locations since the ١٩٥٠s, with the U.S. military's SAGE system the first large-scale example of such a system, which led to a number of special-purpose commercial systems like Sabre.

In the ١٩٧٠s, computer engineers at research institutions throughout the United States began to link their computers together using telecommunications technology. This effort was funded by ARPA (now DARPA), and the computer network that it produced was called the ARPANET. The technologies that made the Arpanet possible spread and evolved. In time, the network spread beyond academic and military institutions and became known as the Internet. The emergence of networking involved a redefinition of the nature and boundaries of the computer. Computer operating systems and applications were modified to include the ability to define and access the resources of other computers on the network, such as peripheral devices, stored information, and the like, as extensions of the resources of an individual computer. Initially these facilities were available primarily to people working in high-tech environments, but in the ١٩٩٠s the spread of applications like e-mail and the World Wide Web, combined with the development of cheap, fast networking technologies like Ethernet and ADSL saw computer networking become almost ubiquitous. In fact, the number of computers that are networked is growing phenomenally. A very large proportion of personal computers regularly connect to the Internet to communicate and receive information. "Wireless" networking, often utilizing mobile phone networks, has meant networking is becoming increasingly ubiquitous even in mobile computing environments.

Programming languages

Programming languages provide various ways of specifying programs for computers to run. Unlike natural languages, programming languages are designed to permit no ambiguity and to be concise. They are purely written languages and are often difficult to read aloud. They are generally either translated into machine language by a compiler or an assembler before being run, or translated directly at run time by an interpreter. Sometimes programs are executed by a hybrid method of the two techniques. There are thousands of different programming languages, some intended to be general purpose, others useful only for highly specialized applications.

Operating system

An **operating system** (**OS**) is the software that manages the sharing of the resources of a computer and provides programmers with an interface used to access those resources. An operating system processes system data and user input, and responds by allocating and managing tasks and internal system resources as a service to users and programs of the system. At the foundation of all system software, an operating system performs basic tasks such as controlling and allocating memory, prioritizing system requests, controlling input and output devices, facilitating networking and managing file systems. Most operating systems come with an application that provides a user interface for managing the operating system, such as a command line interpreter or graphical user interface. The operating system forms a platform for other system software and for application software.

The most commonly used contemporary desktop and laptop (notebook) OS is Microsoft Windows. More powerful servers often employ Linux, FreeBSD, and other UNIX-like systems. However, these operating systems, especially Mac OS X, are also used on personal computers.

Services

Process management

Every program running on a computer, be it a service or an application, is a process. As long as a Von Neumann architecture is used to build computers, only one process per CPU can be run at a time. Older microcomputer OSes such as MS-DOS did not attempt to bypass this limit, with the exception of interrupt processing, and only one process could be run under them (although DOS itself featured TSR as a very partial and not too easy to use solution).

Most operating systems enable concurrent execution of many processes and programs at once via multitasking, even with one CPU. The mechanism was used in mainframes since the early ١٩٦٠s, but in the personal computers it became available in ١٩٩٠s. Process management is an operating system's way of dealing with running those multiple processes. On the most fundamental of computers (those containing one processor with one core) multitasking is done by simply switching processes quickly. Depending on the operating system, as more processes run, either each time slice will become smaller or there will be a longer delay before each process is given a chance to run. Process management involves computing and distributing CPU time as well as other resources. Most operating systems allow a process to be assigned a priority which affects its allocation of CPU time. Interactive operating systems also employ some level of feedback in which the task with which the user is working receives higher priority. Interrupt driven processes will normally run at a very high priority. In many systems there is a background process, such as the System Idle Process in Windows, which will run when no other process is waiting for the CPU.

Memory management

Current computer architectures arrange the computer's memory in a hierarchical manner, starting from the fastest registers, CPU cache, random access memory and disk storage. An operating system's memory manager coordinates the use of these various types of memory by tracking which one is available, which is to be allocated or deallocated and how to move data between them. This activity, usually referred to as virtual memory management, increases the amount of memory available for each process by making the disk storage seem like main memory. There is a speed penalty associated with using disks or other slower storage as memory. If running processes require significantly more RAM than is available, the system may start thrashing. This can happen either because one process requires a large amount of RAM or because two or more processes compete for a larger amount of memory than is available. This then leads to constant transfer of each process's data to slower storage.

Another important part of memory management is managing virtual addresses. If multiple processes are in memory at once, they must be prevented from interfering with each other's memory (unless there is an explicit request to utilize shared memory). This is achieved by having separate address spaces. Each process sees the whole virtual address space, typically from address ٠ up to the maximum size of virtual memory, as uniquely assigned to it. The operating system maintains a page table that match virtual addresses to physical addresses.

The operating system can also write inactive memory pages to secondary storage. This process is called "paging" or "swapping", the terminology varies between operating systems.

It is also typical for operating systems to employ otherwise unused physical memory as a page cache; requests for data from a slower device can be retained in memory to improve performance. The operating system can also preload the in-memory cache with data that may be requested by the user in the near future; SuperFetch is an example of this.

Disk and file systems

Generally, operating systems include support for file systems.

Modern file systems comprise a hierarchy of directories. While the idea is conceptually similar across all general-purpose file systems, some differences in implementation exist. Two noticeable examples of this are the character used to separate directories, and case sensitivity.

UNIX demarcates its path components with a slash (/), a convention followed by operating systems that emulated it or at least its concept of hierarchical directories, such as Linux, Amiga OS and Mac OS X.

UNIX and UNIX-like operating systems allow for any character in file names other than the slash and NULL characters (including line feed (LF) and other control characters). UNIX file names are case sensitive, which allows multiple files to be created with names that differ only in case. By contrast, Microsoft Windows file names are not case sensitive by default. Windows also has a larger set of punctuation characters that are not allowed in file names.

Computer networking

Computer networking is the engineering discipline concerned with communication between computer systems or devices. Networking, routers, routing protocols, and networking over the public Internet have their specifications defined in documents called RFCs. Computer networking is sometimes considered a sub-discipline of telecommunications, computer science, information technology and computer engineering. Computer networks rely heavily upon the theoretical and practical application of these scientific and engineering disciplines.

A computer network is any set of computers or devices connected to each other with the ability to exchange data. Examples of networks are:

- local area network (LAN), which is usually a small network constrained to a small geographic area.
- wide area network (WAN) that is usually a larger network that covers a large geographic area.
- wireless LANs and WANs (WLAN & WWAN) is the wireless equivalent of the LAN and WAN

All networks are interconnected to allow communication with a variety of different kinds of media, which including twisted-pair copper wire cable, coaxial cable, optical fiber, and various wireless technologies. The devices can be separated by a few meters (e.g. via Bluetooth) or nearly unlimited distances (e.g. via the interconnections of the Internet).

Local area network (LAN)

A local area network is a network that spans a relatively small space and provides services to a small number of people. Depending on the number of people that use a Local Area Network, a peer to peer or client server method of networking may be used. A peer to peer network is where each client shares their resources with other workstations in the network. Examples of peer to peer networks are: Small office networks where resource use is minimal and a home network. A client server network is where every client is connected to the server and each other. Client server networks use servers in different capacities. These can be classified into two types: Single service servers, where the server performs one task such as file server, print server, etc.; while other servers can not only perform in the capacity of file servers and print servers, but they also conduct calculations and use these to provide information to clients (Web/Intranet Server). Computers are linked via Ethernet Cable, can be joined either directly (one computer to another), or via a network hub that allows multiple connections.

Wide area network (WAN)

A wide area network is a network where a wide variety of resources are deployed across a large domestic area or internationally. An example of this is a multinational business that uses a WAN to interconnect their offices in different countries.

Wireless networks (WLAN, WWAN)

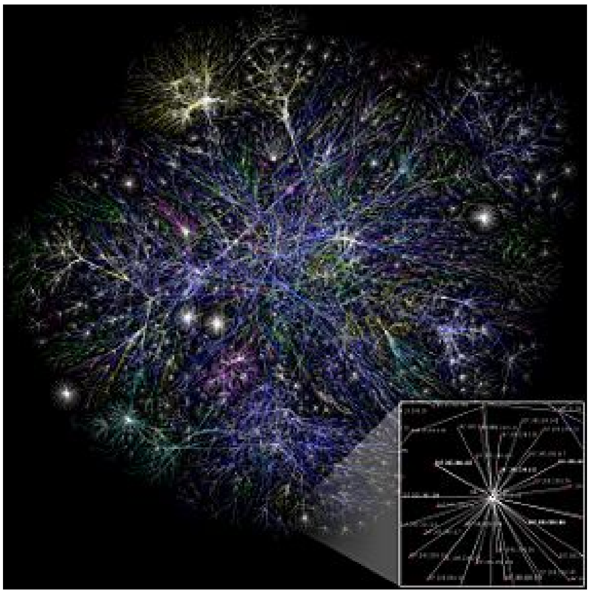
A wireless network is basically the same as a LAN or a WAN but there are no wires between hosts and servers. The data is transferred over sets of radio transceivers. These types of networks are beneficial when it is too costly or inconvenient to run the necessary cables.

Network topology

The network topology defines the way in which computers, printers, and other devices are connected, physically and logically. A network topology describes the layout of the wire and devices as well as the paths used by data transmissions. Commonly used topologies include:

- Bus
- Star
- Tree (hierarchical)
- Linear
- Ring
- Mesh

Internet



Visualization of the various routes through a portion of the Internet.

The **Internet** is a worldwide, publicly accessible series of interconnected computer networks that transmit data by packet switching using the standard Internet Protocol (IP). It is a "network of networks" that consists of millions of smaller domestic, academic, business, and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked web pages and other resources of the World Wide Web (WWW).

Terminology

The Internet protocol suite is a collection of standards and protocols organized into layers so that each layer provides the foundation and the services required by the layer above. In this scheme, the Internet consists of the computers and networks that handle Internet Protocol (IP) data packets. Transmission Control Protocol (TCP) depends on IP and solves problems like data packets arriving out of order or not at all. Next comes Hypertext Transfer Protocol (HTTP), which is an application layer protocol. It runs on top of TCP/IP and provides user agents, such as web browsers, with access to the files, documents and other resources of the World Wide Web (WWW). More generally, the Internet is the worldwide network holding most data communications together, while the World-Wide Web is just one of many applications that the Internet can be used for.

ICANN

ICANN headquarters in Marina Del Rey, California, United States

The Internet Corporation for Assigned Names and Numbers (ICANN) is the authority that coordinates the assignment of unique identifiers on the Internet, including domain names, Internet Protocol (IP) addresses, and protocol port and parameter numbers. A globally unified namespace (i.e., a system of names in which there is at most one holder for each possible name) is essential for the Internet to function. ICANN is headquartered in Marina Del Rey, California, but is overseen by an international board of directors drawn from across the Internet technical, business, academic, and noncommercial communities.

Common uses of the Internet

E-mail

The concept of sending electronic text messages between parties in a way analogous to mailing letters or memos predates the creation of the Internet. Even today it can be important to distinguish between Internet and internal e-mail systems. Internet e-mail may travel and be stored unencrypted on many other networks and machines out of both the sender's and the recipient's control. During this time it is quite possible for the content to be read and even tampered with by third parties, if anyone considers it important enough. Purely internal or intranet mail systems, where the information never leaves the corporate or organization's network, are much more secure, although in any organization there will be IT and other personnel whose job may involve monitoring, and occasionally accessing, the email of other employees not addressed to them.

File sharing

A computer file can be e-mailed to customers, colleagues and friends as an attachment. It can be uploaded to a Web site or FTP server for easy download by others. It can be put into a "shared location" or onto a file server for instant use by colleagues.

Programming language

A **programming language** is an artificial language that can be used to control the behavior of a machine, particularly a computer. Programming languages, like natural languages, are defined by syntactic and semantic rules which describe their structure and meaning respectively. Many programming languages have some form of written specification of their syntax and semantics; some are defined only by an official implementation.

Elements

Syntax

A programming language's surface form is known as its syntax. Most programming languages are purely textual; they use sequences of text including words, numbers, and punctuation, much like written natural languages. On the other hand, there are some programming languages which are more graphical in nature, using spatial relationships between symbols to specify a program.

The syntax of a language describes the possible combinations of symbols that form a syntactically correct program. The meaning given to a combination of symbols is handled by semantics.