INTRODUCTION TO COMPUTER SYSTEMS

By:

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Introduction to Computer Systems

By: Khalid Essam Mahmud

Computer:
- Any device capable of <u>processing information</u> to <u>produce a desired result.</u>
- No matter how large or small they are, computers typically perform their work <u>in three well-defined steps</u>:
  - (1) <u>Accepting</u> input.
  - (2) <u>Processing</u> the input according to predefined rules (programs).
  - (3) <u>Producing</u> output.
- There are several ways to categorize computers, including <u>class</u> (ranging from microcomputers to supercomputers) and <u>generation</u> (first through fifth generation).

Mainframe computer:
- A high-level, typically large and expensive computer designed <u>to handle intensive computational tasks.</u>
- Mainframe computers are characterized by their <u>ability to simultaneously support many users connected to the computer by terminals.</u>

Minicomputer:
- A mid-level computer built <u>to perform complex computations while dealing efficiently with a high level of input and output</u> from users connected via terminals.
- A computer of medium power, more than a microcomputer but less than a mainframe.

Microcomputer:
- A computer built around <u>a single-chip microprocessor.</u>
- Less powerful than minicomputers and mainframes, microcomputers have nevertheless evolved into very powerful machines capable of complex tasks.

Personal Computer (PC):
- <u>A microcomputer designed for individual use</u>, as by a person in an office or at home or school, for such applications as word processing, data management, financial analysis, or computer games.

Workstation:
- <u>A powerful stand-alone computer</u> of the sort used in computer-aided design and other applications requiring a high-end, usually expensive, machine with considerable calculating or graphics capability.

Laptop:
- <u>A small, portable personal computer</u> that runs on either batteries or AC power, designed for use during travel. Laptops have flat LCD or plasma screens and small keyboards.
- Most can run the same software as their desktop counterparts and can accept similar peripherals, such as sound cards, internal or external modems, floppy disks, and CD-ROM drives.
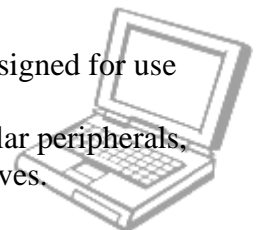
Notebook:
- <u>A portable microcomputer</u> that is similar to but <u>usually smaller than a laptop computer.</u>

Personal Digital Assistant (PDA):
- A lightweight palmtop computer <u>designed to provide specific functions</u> like personal organization (calendar, note taking, database, calculator, and so on) as well as communications.
- More advanced models also offer multimedia features.
- Many PDA devices <u>rely on a pen or other pointing device</u> for input instead of a keyboard or mouse.

System:
- Any <u>collection of component elements</u> that work together to perform a task.

✤ Computer system:
- ✍ The <u>configuration</u> that includes all functional components of a computer and its associated hardware.

✤ Central Processing Unit (CPU):
- ✍ The <u>computational and control unit</u> of a computer.
- ✍ The CPU is the device that <u>interprets and executes instructions</u>.

Central Processing Unit (CPU)
Arithmetic Logic Unit (ALU)
Control Unit (CU)
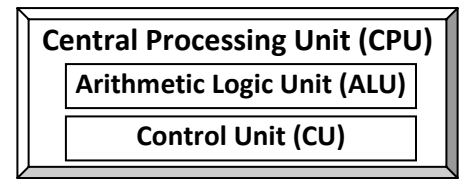
✤ Arithmetic Logic Unit (ALU):
- ✍ A component of a CPU <u>used for arithmetic</u> (addition, subtraction, multiplication, and division), <u>comparative, and logical functions.</u>

✤ Control Unit (CU):
- ✍ The part of a CPU that <u>interprets the instructions in programs and directs the operation of the entire system.</u>

✤ Storage device:
- ✍ An apparatus <u>for recording computer data</u> in permanent or temporary form.

✤ Register:
- ✍ A set of bits of <u>high-speed memory</u> <u>within a microprocessor (CPU on a single chip)</u> or other electronic device, <u>used to hold data for a particular purpose.</u>

✤ Operating system (OS):
- ✍ The operating system has three major functions:
  1) It <u>coordinates and manipulates</u> computer hardware, such as computer memory, printers, disks, keyboard, mouse, and monitor.
  2) It <u>organizes</u> files on a variety of storage media, such as floppy disk, hard drive, compact disc, digital video disc, and tape.
  3) It <u>manages</u> hardware errors and the loss of data.
- ✍ Popular operating systems include <u>Windows 98, Windows NT, Mac OS, and UNIX.</u>

> **Talk about the functions of the operating system.**

✤ UNIX:
- ✍ A widely used <u>multiuser, multitasking</u> operating system.

✤ Linux:
- ✍ An operating system <u>modeled on UNIX,</u> whose <u>source code is publicly available at no charge.</u>

✤ Hardware:
- ✍ <u>The physical components of a computer system,</u> including any peripheral equipment such as printers, modems, and mouse devices.

> **Define: Hardware, Software, and Peripheral**

✤ Peripheral:
- ✍ <u>A device,</u> such as a disk drive, printer, modem, or joystick, that is connected to a computer and is controlled by the computer's microprocessor.

✤ Software:
- ✍ <u>Computer programs; instructions that make hardware work.</u>
- ✍ Two main types of software are <u>system software</u> (<u>operating systems</u>), and <u>applications.</u>

✤ Program:
- ✍ <u>A sequence of instructions</u> that can be executed by a computer.

> **We must distinguish (the difference) between Application and Program**

✤ Application:
- ✍ A program <u>designed to assist in the performance of a specific task,</u> such as word processing, accounting, or inventory management.

↳ **GUI (Graphical User Interface):**
  - ✎ <u>A display format</u> that <u>enables the user to choose</u> commands, start programs, and see lists of files and other options <u>by pointing to pictorial representations (icons) and lists of menu items on the screen.</u>

↳ **Binary Digit (Bit):**
  - ✎ <u>The smallest unit</u> of information handled by a computer.
  - ✎ One bit expresses <u>a 1 or a 0</u> in a binary numeral.

↳ **Binary Term (Byte):**
  - ✎ A group of binary digits or bits <u>(usually eight)</u> operated on as a unit.

↳ **Kilobyte (K, KB, or Kbyte):**
  - ✎ A data unit of <u>1024 bytes.</u>

↳ **Megabyte (MB):**
  - ✎ A unit of information equal to <u>one million</u> or (strictly) 1,048,576 <u>bytes.</u>

↳ **Gigabyte (GB):**
  - ✎ A unit of information equal to <u>one thousand million</u> (10^9) or (strictly) 2^{30} <u>bytes.</u>
  - ✎ <u>1024 megabytes.</u>

↳ **Terabyte (TB):**
  - ✎ A unit of information equal to <u>one trillion</u> (million million) (10^{12}) or (strictly) 2^{40} <u>bytes.</u>

↳ **Random Access Memory (RAM):**
  - ✎ Computer memory <u>where data is temporarily stored for quick retrieval</u> (once the computer is turned off all data in RAM is lost).
  - ✎ A type of <u>volatile memory.</u>

↳ **Read Only Memory (ROM):**
  - ✎ Computer memory that can be easily accessed but <u>does not allow alteration of its data</u>
  - ✎ A type of <u>nonvolatile memory.</u>

↳ **Flash memory:**
  - ✎ A type of <u>nonvolatile memory</u> that retains data in the absence of a power supply.

↳ **Volatile memory:**
  - ✎ Memory, such as RAM, that <u>loses its data</u> when the power is shut off.

↳ **Nonvolatile memory:**
  - ✎ Memory, such as ROM, that <u>does not lose data</u> when power is removed from it.

↳ **Input device:**
  - ✎ A device, such as a keyboard or a mouse, that is <u>used to enter information into a computer.</u>

↳ **Output device:**
  - ✎ A device, such as a printer, video display, or speaker, <u>that presents data from a computer to a user.</u>

↳ **Input/output device (I/O device):**
  - ✎ A piece of hardware that can be <u>used both for providing data to a computer and for receiving data from it,</u> depending on the current situation.
  - ✎ <u>A disk drive is an example of an input/output device.</u>

⌨ *Keyboard:*
- ✍ <u>A hardware unit</u> with a set of switches that resembles a typewriter keyboard and that <u>conveys information from a user to a computer (Input device).</u>

✥ *Pointing device:*
- ✍ <u>An input device used to move the cursor around on the screen.</u>

🖱 *Mouse:*
- ✍ <u>A hand-held input device</u> that is moved about on a flat surface <u>to direct the cursor on a computer screen.</u>
- ✍ It also has buttons for activating computer functions.
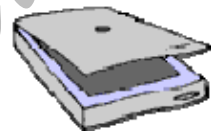
✥ *Trackball:*
- ✍ <u>A small ball set in a holder</u> that can be rotated by hand to move a cursor on a computer screen.

✥ *Joystick:*
- ✍ <u>A pointing device used</u> mainly but not exclusively <u>for computer games.</u>

✥ *Scanner:*
- ✍ <u>An optical input device</u> that uses light-sensing equipment <u>to capture an image on paper</u> or some other subject.

✥ *Magnetic tape:*
- ✍ A tape used in <u>recording sound, pictures, or computer data.</u>

✥ *Disk drive:*
- ✍ <u>An electromechanical device</u> that <u>reads from and writes to disks.</u>
- ✍ Two types of disk drives are in common use: floppy disk drives and hard disk drives.

💾 *Floppy disk (diskette):*
- ✍ A thin, flexible plastic disk coated with magnetic material, <u>on which data and programs can be stored for later retrieval</u>: used mainly with microcomputers (PC).

✥ *Zip drive:*
- ✍ A disk drive that uses 3.5-inch removable disks (Zip disks) <u>capable of storing 100 megabytes of data.</u>

✥ *Hard Disk Drive (HDD):*
- ✍ A rigid <u>non-removable magnetic disk</u> with a large data storage capacity.
- ✍ <u>The main drive on a computer</u> that <u>reads and writes information by magnetic means.</u>

✥ *Compact Disc (CD):*
- ✍ <u>An optical storage medium</u> for digital data, usually audio.
- ✍ A small plastic disc on which music or other digital information is stored in the form of a pattern of metal-coated pits from <u>which it can be read using laser light reflected off the disc.</u>

✥ *Digital Video Disc (DVD):*
- ✍ <u>The next generation of optical disc storage technology.</u>
- ✍ With digital video disc technology, video, audio, and computer data can be encoded onto a compact disc (CD).
- ✍ <u>A digital video disc can store greater amounts of data than a traditional CD.</u>
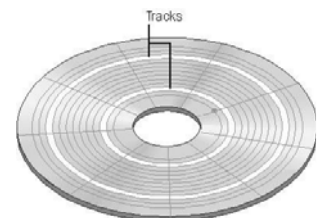
✥ *Voice input:*
- ✍ <u>Spoken instructions</u> that <u>a computer translates into executable commands</u> using speech recognition technology or that are embedded into documents <u>with the aid of a microphone.</u>

✥ *Voice output (Speech synthesis):*
- ✍ The ability of a computer to <u>produce "spoken" words</u> which resembles human speech.

✥ *Video card (video adapter):*
- ✍ The <u>electronic components</u> that <u>generate the video signal sent through a cable to a video display.</u>

✥ *<u>Visual Display Unit (VDU):</u>*
- ✍ <u>A device for displaying input signals</u> as characters on a screen, typically incorporating a keyboard.

✥ *Touch screen:*
- ✍ <u>A display device</u> which allows the user to interact with a computer <u>by touching areas on the screen.</u>
- ✍ By touching the screen, the user can make a selection or move a cursor.

✥ *CRT (<u>Cathode Ray Tube</u>):*
- ✍ The <u>basis</u> of <u>the television screen</u> and the <u>standard microcomputer display screen</u>.

✥ *Monitor:*
- ✍ <u>The device on which images generated by the computer's video adapter are displayed.</u>
- ✍ The monitor is attached to the video adapter by a cable.
- ✍ A monitor is one type of computer display, defined by its CRT screen. Other types of displays include flat, laptop computer screens that often use <u>liquid-crystal displays</u> (LCDs).
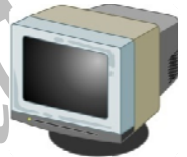
➲ *Size:*
- ✍ The screen size of monitors is measured by <u>the distance from one corner of the display to the diagonally opposite corner.</u>
- ✍ A typical size is 38 cm (15 in), with most monitors ranging in size from 22.9 cm (9 in) to 53 cm (21 in).

➲ *Resolution:*
- ✍ The number of pixels is determined by the graphics mode and video adapter, but the size of the display depends on the size and adjustment of the monitor; hence the resolution of a video display is taken as <u>the total number of pixels displayed horizontally and vertically.</u>

➲ *<u>Electromagnetic Radiation (EMR):</u>*
- ✍ EMR is generated by the coils on the CRT (Cathode-ray Tube).
- ✍ <u>The only safe thing to do is buying a low radiation monitor.</u>
- ✍ Liquid crystal display (LCD) and plasma display monitors emit little EMR.

> **Your brother needs to know how to choose a computer monitor. Explain its common features to him.**

➲ *Dot pitch:*
- ✍ <u>A measure of image clarity.</u>
- ✍ A video display's dot pitch is <u>the vertical distance</u>, expressed in millimeters, between like-colored pixels.
- ✍ <u>A smaller dot pitch generally means a crisper image.</u>

➲ *Color depth:*
- ✍ <u>The number of color values</u> that can be assigned to <u>a single pixel</u> in an image.
- ✍ Color depth can range from 1 bit (black and white) to 32 bits (over 16.7 million colors).

✥ *Plotter:*
- ✍ Any device used to <u>draw charts, diagrams, and other line-based graphics.</u>
- ✍ Plotters use either pens or electrostatic charges and toner.

> **As an engineer, which do you prefer Plotter or Printer? Why?**

✥ *Printer:*
- ✍ <u>An output device</u> that <u>prints text or graphics</u> on paper.

✍ *Impact printer:*
- ✎ A printing device in which a printing element <u>directly strikes a surface</u> (as in <u>a typewriter</u>).
- ✎ Such as a wire-pin dot-matrix printer or a daisy-wheel printer.

★ *Dot-matrix printer:*
- ✎ Any printer that produces characters made up of dots using a wire-pin print head.
- ✎ Printer which prints graphics and text by pressing pins against an inked ribbon.

✍ *Nonimpact printer:*
- ✎ Any printer that makes marks on the paper <u>without striking it</u> mechanically.
- ✎ The most common types are ink-jet, thermal, and laser printers.

✍ *Laser printer:*
- ✎ A <u>high-speed</u> printer <u>for computer output</u> in which <u>a laser is used</u> to form a pattern of electrostatically charged dots on a light-sensitive drum, which attracts toner.

✍ *Modulator/demodulator (Modem):*
- ✎ <u>A communications device</u> that <u>converts between</u> **digital data** from a computer or terminal and **analog audio signals** that can pass through a standard <u>telephone line</u>.
- ✎ Because the telephone system was designed to handle voice and other audio signals and a computer processes signals as discrete units of digital information, <u>a modem is necessary at both ends of the telephone line to exchange data between computers.</u>
- ✎ At the transmit end, <u>the modem converts from digital to analog audio</u>; at the receiving end, a second modem <u>converts the analog audio back to its original digital form</u>.

> **What will you say if your friend asks you what's the importance of using the modem?**

✍ *BUS:*
- ✎ A set of hardware lines (conductors) <u>used for data transfer among the components of a computer system.</u>
- ✎ A bus is essentially a shared highway that <u>connects different parts of the system</u>—including the processor, memory, and input/output ports—<u>and enables them to transfer information.</u>
- ✎ The bus consists of specialized groups of lines that carry different types of information.
- ✎ <u>One group of lines carries data; another carries memory addresses (locations) where data items are to be found; yet another carries control signals.</u>

✍ *BIOS (Basic Input/output System):*
- ✎ <u>A set of routines</u> that work closely with the computer hardware <u>to support the transfer of information between elements of the system</u>, such as memory, disks, and the monitor.

✍ *USB (Universal Serial Bus):*
- ✎ A serial bus with a data transfer rate of **<u>12 megabits per second</u>** <u>(Mbps) for connecting peripherals to a microcomputer.</u>

✍ *Parallel port:*
- ✎ <u>An input/output connector</u> that sends and receives data **8 bits at a time**, in parallel, between a computer and a peripheral device such as a printer, scanner, CD-ROM, or other storage device.

Parallel port
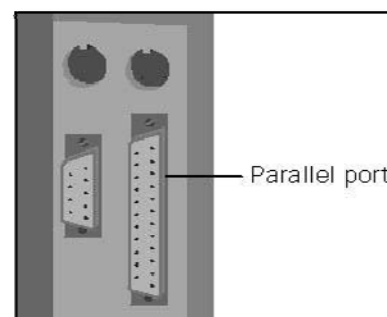
✍ *Serial port:*
- ✎ <u>An input/output location (channel)</u> that sends and receives data to and from a computer's central processing unit or a communications device **one bit at a time**.

✥ Network:

- ✎ A group of computers and associated devices that are connected by communications facilities.
- ✎ A network can involve permanent connections, such as cables, or temporary connections made through telephone or other communication links.

• Network Interface Card (NIC):

- ✎ An expansion card or other device used to provide network access to a computer or other device, such as a printer.
- ✎ *Also called:* Network Adapter, Network Card.

• Network Operating System (NOS):

- ✎ An operating system specifically designed to support networking.

• File Server:

- ✎ A file-storage device on a local area network that is accessible to all users on the network.
- ✎ On local area networks, a file server is often a computer with a large hard disk that is dedicated only to the task of managing shared files.

• Network Administrator:

- ✎ The person in charge of operations on a computer network.
- ✎ The duties of a network administrator can be broad and might include such tasks as installing new workstations and other devices, adding and removing individuals from the list of authorized users, archiving files, overseeing password protection and other security measures, monitoring usage of shared resources, and handling malfunctioning equipment.

✥ Local Area Network (LAN):

- ✎ A group of computers and other devices dispersed over a relatively limited area and connected by a communications link that enables any device to interact with any other on the network.

✥ Metropolitan Area Network (MAN):

- ✎ A high-speed network that can carry voice, data, and images at up to 200 Mbps or faster over distances of up to 75 km.

✥ Wide Area Network (WAN):

- ✎ A geographically widespread network, one that relies on communications capabilities to link the various network segments.
- ✎ A WAN can be one large network, or it can consist of a number of linked LANs (local area networks).

✥ Client/server architecture (or network):

- ✎ Client/server networks consist of two kinds of computer.
- ✎ The clients are usually computer workstations sitting on the desks of employees in an organization.
- ✎ The servers are usually more powerful computers and are held in a central location or locations within an organization.

✥ Peer-to-peer architecture (or network):

- ✎ Peer-to-peer networks have workstations connected to each other but do not have servers.
- ✎ Files can be shared between workstations, and a printer connected to one workstation can be accessed by another workstation.
- ✎ Peer-to peer networks are often much simpler to set up than client/server networks.

☞ Remarks:

- ★ **A Client/Server network may be a LAN or WAN, however a peer-to-peer network can only be a LAN.**
- ★ **The most famous and widely used Wide Area Network is the Internet which contains many thousands of servers and many millions of clients all over the world.**
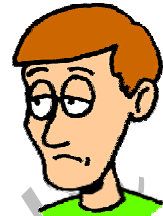
✥ *Topology:*
- The configuration or layout of a network formed by the connections between devices on a LAN (local area network) or between two or more LANs.

➲ *Bus network:*
- A topology (configuration) for a LAN (local area network) in which all nodes are connected to a main communications line (bus).
- On a bus network, each node monitors activity on the line.

Bus Network

➲ *Ring network:*
- A LAN (local area network) in which devices (nodes) are connected in a closed loop, or ring.
- A ring network covers larger distances than star and bus networks.
- Because of the closed loop, however, adding new nodes can be difficult.
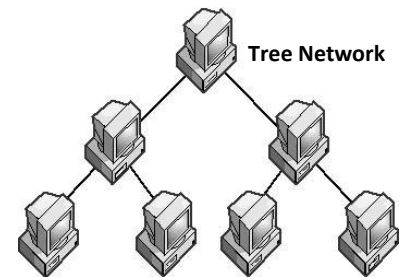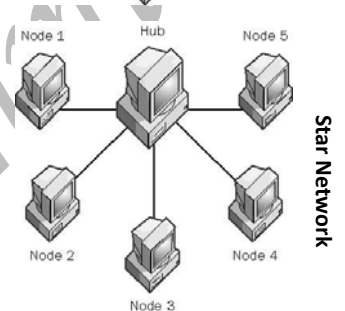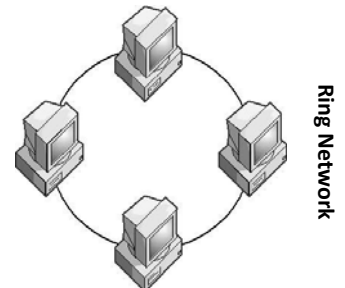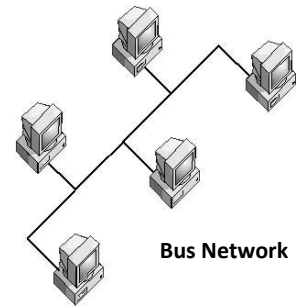
Ring Network

➲ *Star network:*
- A LAN (local area network) in which each device (node) is connected to a central computer in a star-shaped configuration (topology); commonly, a network consisting of a central computer (the hub) surrounded by terminals.

Node 1   Hub   Node 5

Star Network

Node 2   Node 4

Node 3

➲ *Tree network:*
- A topology for a local area network (LAN) in which one machine is connected to one or more other machines, each of which is connected to one or more others, and so on, so that the structure formed by the network resembles that of a tree.

Tree Network

➲ *Mesh network:*
- A communications network having two or more paths to any node.
- Each computer includes everything it needs to serve as a relay point for sending information to any other computer on the network.
- In other words, each node has a connection to every other node on the network.

✥ *Internet:*
- The worldwide collection of networks and gateways that use the TCP/IP suite of protocols to communicate with one another.

✥ *Internet Protocol address (IP address):*
- The identifying number that enables any computer on the Internet to find any other computer on the network.
- It consists of four sets of numbers separated by periods—for example, 123.456.78.90.

✥ *Domain Name Service (DNS):*
- A method of translating Internet addresses so that computers connected in the Internet can find each other.
- A DNS server translates a numerical address assigned to a computer (such as 207.46.228.91) into a sequence of words, and vice versa (the opposite).
- A DNS name, written in lowercase letters with words separated by periods, takes the form of username@computer.zonename (for example: khalid@delta.edu). *Username* is the name or account number used to log on. The *hostname* (Delta in the example above) is the name of the computer or Internet provider; it may consist of several parts. *Zonename* indicates the type of organization. Common zone names include **com (commercial organization), edu (educational), gov (government), and net (networking organization).**

⇩ *World Wide Web (WWW):*
  - ✎ An extensive information system on the Internet providing facilities for documents to be connected to other documents by hypertext links.

⇩ *Hypertext Markup Language (HTML):*
  - ✎ The markup language used for documents on the World Wide Web.

⇩ *Transmission Control Protocol/Internet Protocol (TCP/IP):*
  - ✎ A protocol suite (or set of protocols) developed by the U.S. Department of Defense for communications over interconnected, sometimes dissimilar, networks.

⇩ *Advanced Research Projects Agency net (ARPANET):*
  - ✎ A large wide area network created in the 1960s by the U.S. Department of Defense Advanced Research Projects Agency for the free exchange of information between universities and research organizations, although the military also used this network for communications.

⇩ *National Science Foundation Network (NSFnet):*
  - ✎ A WAN (wide area network), developed by the National Science Foundation to replace ARPANET for civilian purposes.

⇩ *Internet Service Provider (ISP):*
  - ✎ A company that sells access to the Internet, allowing computer users to send electronic mail (e-mail) and browse the World Wide Web (WWW), among other tasks.

⇩ *Communications Protocol:*
  - ✎ A set of rules or standards designed to enable computers to connect with one another and to exchange information with as little error as possible.

⇩ *Hypertext Transfer Protocol (HTTP):*
  - ✎ The protocol used to carry requests from a browser to a Web server and to transport pages from Web servers back to the requesting browser.

⇩ *File Transfer Protocol (FTP):*
  - ✎ A fast, application-level protocol widely used for copying files to and from remote computer systems on a network using TCP/IP, such as the Internet.

⇩ *Uniform Resource Locator (URL):*
  - ✎ An address for a resource on the Internet.
  - ✎ URLs are used by Web browsers to locate Internet resources.

⇩ *Electronic mail (E-mail):*
  - ✎ Messages sent electronically from one computer user to one or more recipients via a network.

⇩ *Dial-up:*
  - ✎ A connection that uses the public switched telephone network rather than a dedicated circuit or some other type of private network.

⇩ *Digital Subscriber Line (DSL):*
  - ✎ A recently developed (late 1990s) digital communications technology that can provide high-speed transmissions over standard copper telephone wiring.
  - ✎ There are two main categories.
  - ✎ **Asymmetric DSL (ADSL)** is for Internet access, where fast downstream is required, but slow upstream is acceptable.
  - ✎ **Symmetric DSL (SDSL, HDSL, etc.)** is designed for connections that require high speed in both directions.
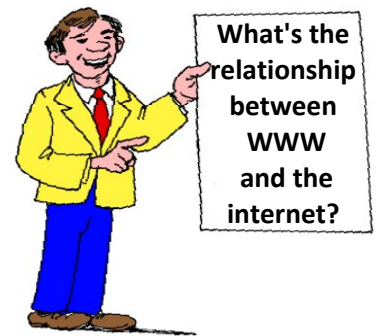
✦ Integrated Services Digital Network (ISDN):

- ✑ A high-speed digital communications network evolving from existing telephone services.
- ✑ The goal in developing ISDN was to replace the current telephone network, which requires digital-to-analog conversions.

✦ Programming language:

- ✑ Any artificial language that can be used to define a sequence of instructions that can ultimately be processed and executed by the computer.
- ✑ Defining what is or is not a programming language can be tricky, but general usage implies that the translation process—from the source code expressed using the programming language to the machine code that the computer needs to work with—be automated by means of another program, such as a compiler.

┌─────────────────────┐
What's the function of the compiler?
└─────────────────────┘

✦ Compiler:

- ✑ A computer program (or set of programs) that translates text written in a computer language (the source language) into another computer language (the target language).
- ✑ The original sequence is usually called the source code and the output called object code.
- ✑ The name "compiler" is primarily used for programs that translate source code from a high-level programming language to a lower level language (e.g., machine language).

✦ Machine code (Machine language):

- ✑ In machine languages, instructions are written as sequences of 1s and 0s, called bits, that a computer can understand directly.
- ✑ While all executable programs are eventually read by the computer in machine language, they are not all programmed in machine language.
- ✑ It is extremely difficult to program directly in machine language because the instructions are sequences of 1s and 0s.

How to translate a high-level language into lower level language?

✦ Low-level language:

- ✑ A language that provides little or no abstraction from a computer's microprocessor.
- ✑ The word "low" does not imply that the language is inferior to high-level programming languages but rather refers to the small or nonexistent amount of abstraction between the language and machine language; because of this, low-level languages are sometimes described as being "close to the hardware."

✦ High-level Language (HLL):

- ✑ A programming language that, in comparison to low-level programming languages, may be more abstract and easier to use.
- ✑ Statements in a high-level language generally use keywords similar to English and translate into more than one machine-language instruction.
- ✑ For example, Pascal, Visual Basic, C++, and java.

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If you have any comments or suggestions, please let me know ☺.
If there's anything you don't understand, I'll be happy to explain ☺.

Many Thanks To:

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