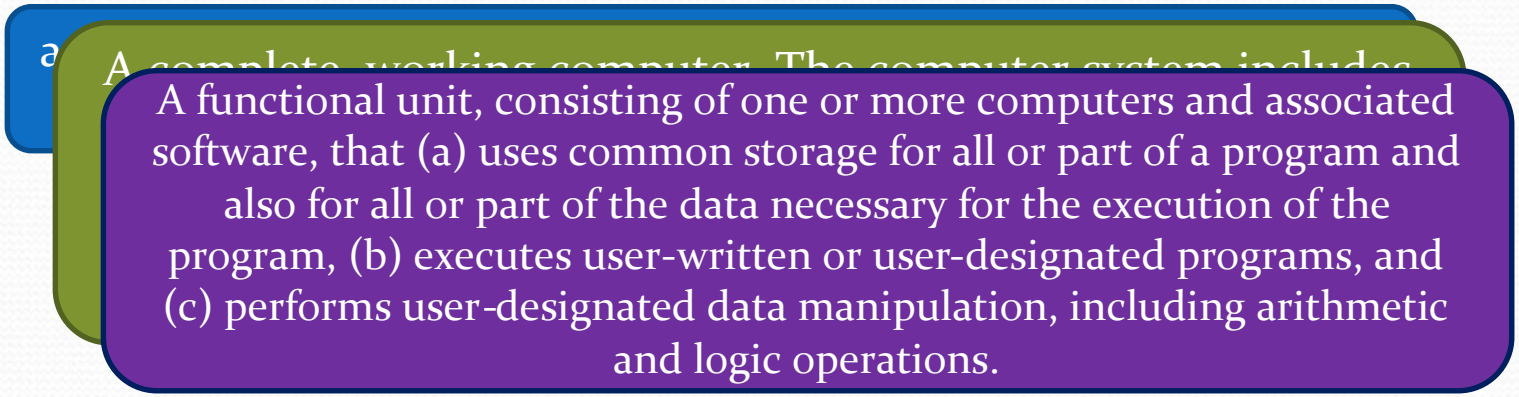
REVIEW COMPUTER SYSTEM

Understanding Computer System

Content:

- Defining a computer system
- History of computers
- Different types of computers
- Components of a personal computer
  - Functions of components

What do you understand by the term computer system?



Definition:

- A system consisting of interconnected computers that share a central storage system and various peripheral devices such as a printer, scanner, or router. Each computer connected to the system can operate independently, but has the ability to communicate with other external devices and computers.

HISTORY OF COMPUTERS

First Generation (1940-1956) Vacuum Tubes

- Used vacuum tubes for circuitry and magnetic drums for memory
- Often enormous, taking up entire rooms.
- They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions.
- Relied on machine language, the lowest-level programming language understood by computers, to perform operations, and they could only solve one problem at a time.
- Input was based on punched cards and paper tape, and output was displayed on printouts.
- The UNIVAC and ENIAC computers are examples of first-generation computing devices.

Second Generation (1956-1963) Transistors

- Transistors replaced vacuum tubes.
- The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube.
- Second-generation computers still relied on punched cards for input and printouts for output.
- Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words.
- The first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology.

Third Generation (1964-1971) Integrated Circuits

- The development of the integrated circuit was the hallmark of the third generation of computers.
- Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers.
- Instead of punched cards and printouts, users interacted through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory.
- Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

Fourth Generation (1971-Present) Microprocessors

- The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip. What in the first generation filled an entire room could now fit in the palm of the hand.
- The Intel 4004 chip, developed in 1971, located all the components of the computer—from the central processing unit and memory to input/output controls—on a single chip.
  - In 1981 IBM introduced its first computer for the home user, and in 1984 Apple introduced the Macintosh.
- Microprocessors also moved out of the realm of desktop computers and into many areas of life as more and more everyday products began to use microprocessors.
- As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet.
- Fourth generation computers also saw the development of GUIs, the mouse and handheld devices.

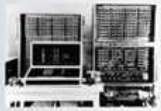
Fifth Generation (Present and Beyond) Artificial Intelligence

- Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today.
- Used in parallel processing
- Used superconductors
- Used in speech recognition
- Used in intelligent robots
- Used in artificial intelligence

1940s FIRST GENERATION

1939 | Hewlett-Packard is founded in California
Their first product was the popular HP 200A Audio Oscillator, used as sound effects generators for Walt Disney Pictures movie "Fantasia."

1940 | Complex Number Calculator (CNC)
Designed by researcher George Stibitz and completed by Bell Telephone Laboratories.



1941 | Z3 computer / Bombe
The Z3 was built by German engineer Konrad Zuse in complete isolation from developments elsewhere.
The Bombe was used to decrypt Nazi Military communications

1942 | Atanasoff-Berry Computer (ABC)
The ABC was designed and built by Professor John Vincent Atanasoff and graduate student Cliff Berry at Iowa State College

1943 | Project Whirlwind / Relay Interpolator
Project Whirlwind was a simulator to train bomber crews.
The Relay Interceptor assisted in testing its M-9 Gun Director.

1944 | Harvard Mark-1 / Colossus
The Harvard Mark-1 was a room-sized, relay-based calculator.
The Colossus was designed to break the complex Lorenz ciphers used by the Nazis during WWII.

1945 | "First Draft of a Report on the EDVAC"
Outlined the architecture of a stored-program computer, which would lead to the mainstream computers we know today.

1946 | ENIAC / AVIDAC
The ENIAC improved by 1,000 times on the speed of its contemporaries.

1948 | IBM SSEC
The Selective Sequence Electronic Calculator produced the moon-position tables used for plotting the course of the 1969 Apollo flight to the moon.

1949 | EDSAC / Manchester Mark I
The first practical stored-program computer.
The Manchester Mark I computer functioned as a complete system using the Williams tube for memory.

1950s 2ND GEN: TRANSISTORS

1950 | ERA 1101 / SEAC / Pilot ACE
ERA 1101 was the first commercially produced computer.
SEAC was the first computer to use all-diode logic.
Alan Turing´s philosophy directed design of Britain´s Pilot ACE

1951 | MIT Whirlwind
The first computer with a reliable OS, running 35 hours a week at 90-percent utility using an electrostatic tube memory.

1951 | LEO / UNIVAC I
Leo, England´s first commercial computer, solved clerical problems.
UNIVAC I, used by U.S. Census Bureau, was the first commercial computer to attract widespread public attention.

1952 | MANIAC
Based on John von Neumann´s IAS computer at the Institute for Advanced Studies in Princeton, N.J.

1953 | IBM 701
IBM shipped its first electronic computer, the 701.

1954 | IBM 650
The IBM 650 magnetic drum calculator established itself as the first mass-produced computer, selling 450 in one year.

1956 | MIT TX0
The first general-purpose, programmable computer built at MIT with transistors.

1958 | SAGE
Semi-Automatic Ground Environment — linked hundreds of radar stations in the United States and Canada in the first large-scale computer communications network.

1958 | NEAC 1101
Japan´s NEC builds the country´s first electronic computer

1959 | IBM STRETCH
IBM´s 7000 series mainframes were the company´s first transistorized computers.

1960s 3RD GEN: MICROPROCESSOR

1960 | DEC PDP-1
The precursor to the minicomputer.

1961 | IBM 1401
The 1401 mainframe replaced the vacuum tube with smaller, more reliable transistors and used a magnetic core memory.

1962 | LINC (Laboratory Instrumentation Computer)
The first real time laboratory data processing machine.

1964 | IBM System 360
A family of six mutually compatible computers and 40 peripherals that could work together.

1964 | CDC 6600
The fastest computer of its time performed up to 3 million instructions per second - three times faster than the IBM Stretch.

1965 | DEC PDP-8
The first commercially successful minicomputer.

1966 | ILLIAC IV
The first large-scale array computer.

1966 | HP-2115
Hewlett-Packard entered the general purpose computer business with its HP-2115.

1968 | Nova
The Nova is introduced, with 32 kilobytes of memory, for $8,000.

1968 | Apollo Guidance Computer
The Apollo Guidance Computer made its debut orbiting the Earth on Apollo 7.

1970s 4TH GEN: MICROCOMPUTER

1971 | Kenback 1
The first personal computer, advertised for $750 in Scientific American.

1972 | HP-35
The HP-35 was a fast, extremely accurate electronic slide rule with a solid-state memory similar to that of a computer.

1973 | TV Typewriter / Micral
The first display of alphanumeric text on an ordinary television set.
The Micral was the earliest commercial, non-kit personal computer based on a micro-processor.

1974 | Xerox Alto / Scelbi 8H
The first work station with a built-in mouse for input.
The first commercially advertised U.S. computer based on a microprocessor

1975 | MITS Altair / Tandem-16
The Altair was based on Intel´s 8080 microprocessor, and ran on BASIC.
The Tandem was the first fault-tolerant computer, for online transaction processing.

1976 | Apple I / Cray I
Steve Wozniak designed the Apple I, later selling it with Steve Jobs.
The Cray I was the first commercially successful vector processor.

1977 | Commodore PET
The Commodore Personal Electronic Transactor was the first of several personal computers released in 1977.

1977 | Apple II / TRS-80
The Apple II became an instant success when released in 1977.
The TRS-80 was Tandy Radio Shack´s first desktop computer.

1978 | VAX 11/780
The VAX 11/780 had the ability to address up to 4.3 gigabytes of virtual memory, 100 times the capacity of most minicomputers.

1979 | Atari 400 and 800
Atari introduces the Model 400 and 800 Computers with gaming abilities.

1980s RISE OF MICROCOMPUTERS

1981 | IBM PC / Osborne I
IBM introduced its PC, igniting a fast growth of the PC market. Adam Osborne releases the first portable computer, the Osborne I, which weighed 24 pounds and cost $1,795.

1982 | Cray XMP / Commodore 64
The Cray XMP almost doubled the OS of competing machines. The C64 sold for $595 came with 64KB of RAM and featured impressive graphics, it eventually sold for 22 million units by 1993.

1983 | Apple Lisa
The first personal computer with a graphical user interface.

1983 | Compaq PC
Compaq introduced first PC clone that used the same software as the IBM PC.

1984 | Apple Macintosh
Apple launches the first successful mouse-driven computer with a graphic user interface.

1984 | IBM PC Jr.
IBM released its PC Jr. and PC-AT. The PC Jr. failed but the PC-AT proved to be several times faster than original PC.

SYSTEM1.0

1985 | Amiga 1000
Commodore's Amiga 1000 sold for $1,295 dollars (without monitor) and had surpassed audio and video capabilities of other PCs.

WINDOWS 1.0

1986 | Connection Machine
Daniel Hillis of Thinking Machines Corp. develops the concept of massive parallelism in the Connection Machine.

SYSTEM 5.0

1987 | IBM PS/2
IBM introduced its PS/2 machines, which made the 3 1/2-inch floppy disk drive and video graphics array standard for IBM computers.

SYSTEM 6.0

1988 | NeXT
The first personal computer to incorporate a drive for an optical storage disk and object-oriented languages to simplify programming.

1990s PERSONAL COMPUTERS

3.0

SYSTEM 7.0

NT

95

OS 8.0

98

OS 9.0

1990 | Macintosh IIfx / Amiga 3000
Based on a 40 MHz version of the 68030 the IIfx achieved 10 MIPS. Commodore releases the Amiga 3000, the first 32-bit Amiga.

1991 | CDTV
Commodore release the CDTV, an Amiga multimedia appliance with CD-ROM drive but no floppy drive.`

1992 | PowerPC 601
The PowerPC 601was the first generation of PowerPC processors.

1993 | P5 Pentium
Intel releases the P5-based Pentium processor, with 60 and 66 MHz versions.

1994 | Pentium Processor 100 MHz
Intel releases the 100 MHz version of the Pentium Processor.

1995 | Sony Playstation
Sony releases its first PlayStation – To date, over 100 million have been sold.

1996 | Toshiba Libretto
Toshiba's Libretto was the smallest PC compatible computer to be released.

1997 | Pentium 2 / Deep Blue
The Pentium II featured a larger on-chip cache as well as an expanded instruction set.
IBM's Deep Blue is the first computer to beat Garry Kasparov at chess.

1998 | iMac
Apple announces the iMac.

1999 | PowerMac G4 / AMD Athlon 750 MHz
The PowerMac G4 by Apple is powered by Motorola's G4 chip. AMD releases an Athlon clocked at 750 MHz.

2000s MOBILE COMPUTING

ME /2000
OS X 10.0
XP
Jaguar 10.1
Panther 10.3
Tiger 10.4
Leopard 10.5
Vista
Snow Leopard 10.6
7

2000 | 1 GHz Pentium and Athlon / Playstation 2
AMD and Intel release chips clocked at 1 GHz.
Sony releases the PlayStation 2.

OS

2001 | Mac OS X / Windows XP / Linux 2.4.0
New versions of the three major operating systems are released.

2002 | Blackberry
RIM releases the first BlackBerry smartphone.

2003 | PowerPC G5 / Athlon 64
Apple releases the PowerPC G5.
AMD releases the Athlon 64.

2004 | NVIDIA GeForce 6800
NVIDIA releases GeForce 6800, showing more than 100% increase in productivity compared with the fastest card on the market.

2005 | Pentium D / Athlon 64 X2 / Microsoft XBOX 360
Intel and AMD release their first dual-core 64-bit desktop processors.
Microsoft releases the Xbox 360.

2006 | Macbook Pro / Intel Core 2 / Playstation 3 / Wii
The MacBook Pro, their first dual-core Intel based mobile computer.
Sony and Nintendo release the PS3 and Wii, respectively.

2007 | iPhone / ASUS Eee PC
The first iPhone was introduced by Apple.
The first ASUS Eee PC introduces the netbook category of laptops.

2008 | HTC Dream / Google Android
The HTC Dream is released - the first commercially available phone to run the newly released Android operating system by Google.

2010 | iPad
Apple releases the iPad, a tablet computer that bridges the gap between smartphones and laptops.

Types of Computers

Based on operational principles:

- Analog
- Digital
- Hybrid

Analog

- A type of computer in which continuously variable physical quantities, such as electrical potential, fluid pressure, or mechanical motion, are used to represent the quantities in the problem to be solved.
- Analog computers are especially well suited to simulating dynamic systems; such simulations may be conducted in real time or at greatly accelerated rates, allowing experimentation by performing many runs with different variables.
- They have been widely used in simulating the operation of aircraft, nuclear power plants, and industrial chemical processes.
- A thermometer is a simple analog computer. As the temperature varies, the mercury moves correspondingly.
- Analog computers do not have the ability of digital computers to store data in large quantities, nor do they have the comprehensive logical facilities afforded by programming digital machines.

Digital

- A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system.
- Digital computers come in a wide variety of types, ranging from tiny, special-purpose devices embedded in cars and other devices to the familiar desktop computer, the minicomputer, the mainframe, and the supercomputer.

Hybrid

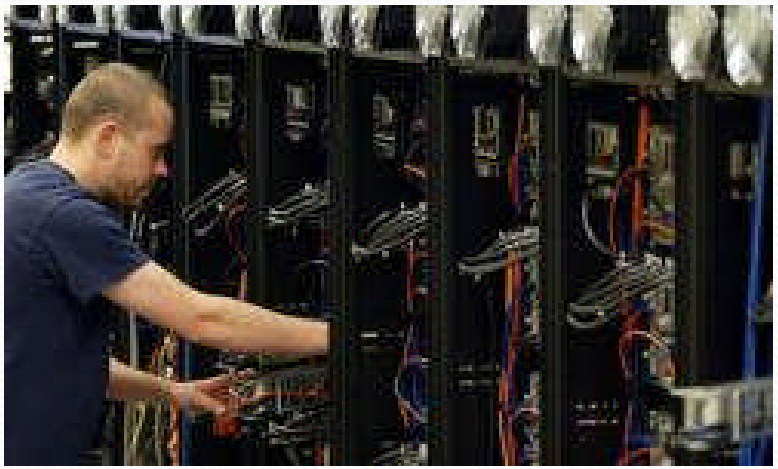
- These types of computers are, as the name suggests, a combination of both Analog and Digital computers.
- The Digital computers which work on the principle of binary digit system of “0” and “1” can give very precise results. But the problem is that they are too slow and incapable of large scale mathematical operation.
- In the hybrid types of computers, the digital computer accepts the analog signals, converts them to digital and processes them in digital form.
- It is used in process control and robotics.

Types of computer based on size and power are as follows:

- Supercomputer
- Personal computer
  - Desktop
  - Laptop
  - Notebook
  - Hand-held
  - PDA
  - Palmtop
- Workstation
- Minicomputer
- Mainframe
- Server
- Wearable

Mainframe

- A mainframe is simply a very large computer.
- It is an industry term for a large computer. The name comes from the way the machine is build up: all units (processing, communication etc.) were hung into a frame. Thus the maincomputer is build into a frame, therefore: **Mainframe**
- Used by large organizations like meteorological surveys and statistical institutes for performing bulk mathematical computations.
- They are core computers which are used for desktop functions of over one hundred people simultaneously.



Whether it's a desktop PC or a massive supercomputer, computing power all comes down to the processor.

Operating systems

- UNIX
- Linux
- VMS
- Z/OS
- Z/VM
- VSE/ESA

Microcomputer (Personal Computers)

- These are the most frequently used computers better known by the name of “Personal computers”. This is the type of computer meant for public use.
- The personal computer (PC) defines a computer designed for general use by a single person.
- PCs were first known as **microcomputers** because they were a complete computer but built on a smaller scale than the huge systems in use by most businesses.

Personal computers come in many forms, including the new Apple iPad.

- **Desktop**

  A PC that is not designed for portability is a desktop computer. The expectation with desktop systems are that you will set the computer up in a permanent location. Most desktops offer more power, storage and versatility for less cost than their portable brethren.

Desktop computers are usually less expensive than laptops.

- A **desktop computer** is a personal computer (PC) in a form intended for regular use at a single location, as opposed to a mobile laptop or portable computer.
- Desktop computers come in a variety of types ranging from large vertical tower cases to small form factor models that can be tucked behind an LCD monitor. Most modern desktop computers have separate screens and keyboards.

Operating systems

- An operating system is the program that after being initially loaded into the computer by a boot program, manages all the other programs in a computer.
- Most of today's desktop computers have one of the two major operating systems available: Microsoft Windows and Mac OS X. Microsoft Windows and Linux can be used for almost any desktop computers. Mac OS is only available for Apple computers.
- New versions of each of these operating systems are released on a semi-regular basis.
- The newest version of Microsoft Windows is called Windows 7 and is widely regarded as a marked improvement over the previous Windows Vista.
- The newest version of Mac OS is Mac OS X Snow Leopard.

- **Laptop**

  Also called **notebooks**, laptops are portable computers that integrate the display, keyboard, a pointing device or trackball, processor, memory and hard drive all in a battery-operated package slightly larger than an average hardcover book.

- Laptops were originally considered to be a small niche market and were thought suitable mostly for specialized field applications such as the military, accountants and sales representatives. But today, laptops are becoming more popular for student and general uses.

Macbook air

Advantages

- Portability - can be used in many place
- Productivity
- Connectivity
- Immediacy - instant access

Disadvantages

- Ergonomics and health
- Durability - subject to more wear and physical damage than desktops
- Security

Operating systems

- Windows
- Linux
- Android
- Chrome OS
- Mac OS X

- **Netbook**

  Netbooks are ultra-portable computers that are even smaller than traditional laptops. The extreme cost-effectiveness of netbooks (roughly $300 to $500) means they're cheaper than almost any brand-new laptop you'll find at retail outlets. However, netbooks' internal components are less powerful than those in regular laptops.

Netbooks are smaller and cheaper than laptops.

- **Personal Digital Assistant (PDA)**
  - Also known as a **palmtop computer**, or **personal data assistant**
  - Tightly integrated computers that often use flash memory instead of a hard drive for storage.
  - Functions as a personal information manager. Current PDAs often have the ability to connect to the Internet.
  - Has an electronic visual display which enables it to include a web browser
  - Employ touch screen technology for user input.

    PDAs are typically smaller than a paperback novel, very lightweight with a reasonable battery life. A slightly larger and heavier version of the PDA is the handheld computer.

Palm Pilot

Typical applications include:

- Military: Notably Army
- package delivery
- medical treatment and recordkeeping in hospitals
- facilities maintenance and management
- parking enforcement
- meter reading by utilities
- "wireless waitress" applications in restaurants and hospitality venues

Minicomputer

- A class of multi-user computers that lies in the middle range of the computing spectrum, in between the largest multi-user systems (mainframe computers) and the smallest single-user systems (microcomputers or personal computers).

- **Workstation**
  - High-end microcomputer designed for technical or scientific applications.
  - It is simply a desktop computer that has a more powerful processor, additional memory and enhanced capabilities for performing a special group of task, such as 3D Graphics or game development.
  - Commonly connected to a local area network and run multi-user operating systems.
  - The term *workstation* has also been used to refer to a mainframe computer terminal or a PC connected to a network.

- **Super Computers**
  - A supercomputer is a computer that is at the frontline of current processing capacity, particularly speed of calculation.
  - It is somewhat similar to mainframe computers but unlike mainframes, supercomputers are used for the heavy stuff like weather maps, construction of atom bombs, finding oil, earthquake prediction, and sciences where a lot of calculations must be done. Military and scientific agencies are heavy users.
  - They are also used to help governments eavesdrop on anything passing through telephone, data lines, e-mail, or radio waves; and anything that is written, etc.

An employee of the Korea Institute of Science and Technology Information checks the supercomputers at the research institute.

- This type of computer usually costs hundreds of thousands or even millions of dollars.
- Although some supercomputers are single computer systems, most are comprised of multiple high performance computers working in parallel as a single system.

- The chief difference between a supercomputer and a mainframe is that a supercomputer channels all its power into executing a few programs as fast as possible, whereas a mainframe uses its power to execute many programs concurrently.

Operating Systems

- Operating systems are specifically designed for each type of supercomputer. Sometimes a redesign of an existing OS will do the job if the super's CPUs belong to the same family. But mostly, since the new computer really is something new, a new OS is needed.

Example:

Pleiades, located at NASA's Ames Research Center in Moffett Field, California, allows over 1,000 active users around the country advance knowledge about the Earth, solar system and the universe. Pleiades helps meet computing needs of NASA's aeronautics projects and other space operations. It has a performance at 1.09 petaflop/s.

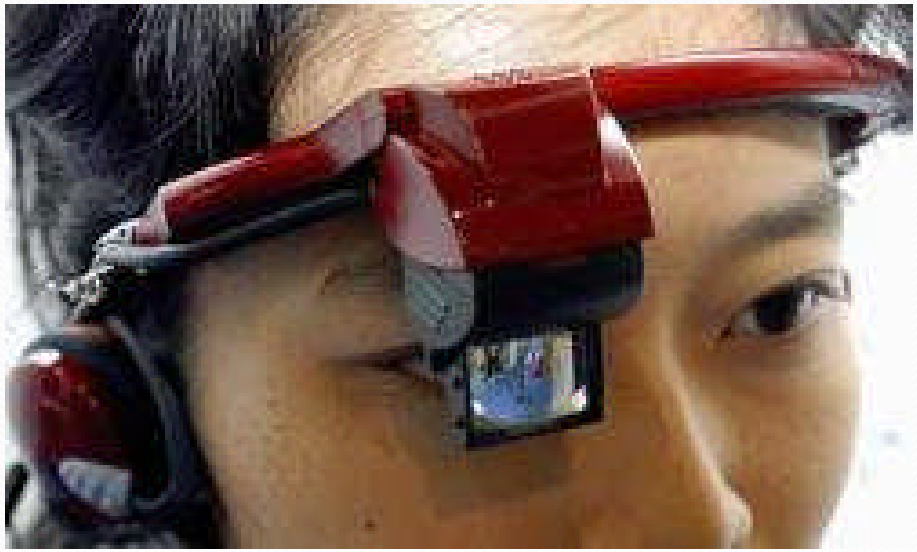
- **Server**

  A computer, or series of computers, that link other computers or electronic devices together. They often provide essential services across a network, either to private users inside a large organization or to public users via the internet.

Web server racks

- As servers need stable power supply, good Internet access, increased security and are also noisy, it is usual to store them in dedicated server centers or special rooms.
- This requires to reduce power consumption as extra energy used generates more heat and the temperature in the room could exceed the acceptable limits.
- Normally server rooms are equipped with air conditioning devices. Server casings are usually flat and wide, adapted to store many devices next to each other in server rack.
- Unlike ordinary computers, servers usually can be configured, powered up and down or rebooted remotely, using out-of-management.

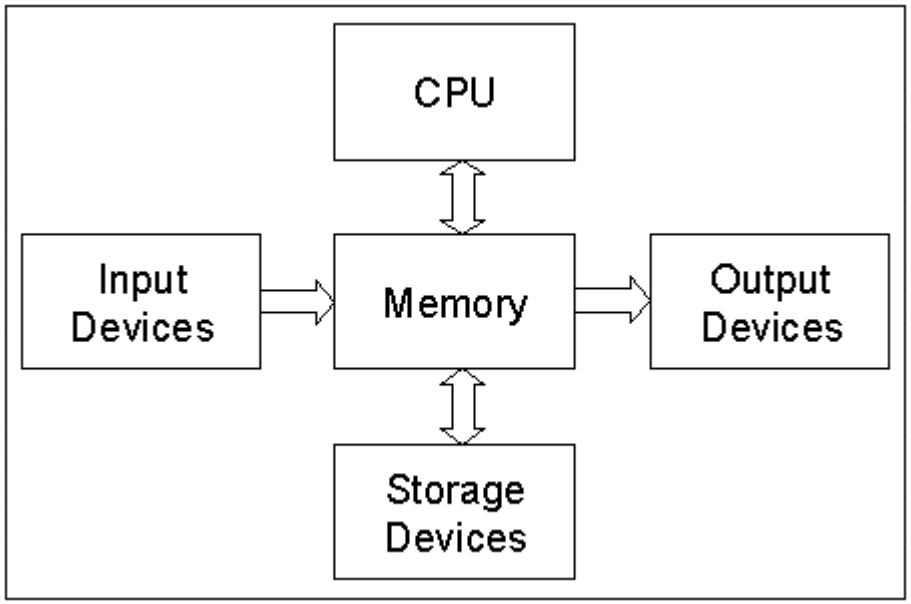
- **Wearable Computer**
  - The latest trend in computing is wearable computers. **Wearable computers** are computers that are worn on the body. This type of wearable technology has been used in behavioral modeling, health monitoring systems, information technologies and media development.
  - Wearable computers are especially useful for applications that require computational support while the user's hands, voice, eyes, arms or attention are actively engaged with the physical environment. Essentially, common computer applications (e-mail, database, multimedia, calendar/scheduler) are integrated into watches, cell phones, visors and even clothing.



A woman wears Team Tsukamoto's prototype of a wearable PC.

Components of a computer

Components of a personal computer



- Computer systems ranging from a controller in a microwave oven to a large supercomputer contain components providing five functions.
- A typical personal computer has hard, floppy and CD-ROM disks for storage, memory and CPU chips inside the system unit, a keyboard and mouse for input, and a display, printer and speakers for output. The arrows represent the direction information flows between the functional units.

- If you use a desktop computer, you might already know that there isn't any single part called the "computer." A computer is really a system of many parts working together. The physical parts, which you can see and touch, are collectively called ***hardware***.
- ***Software***, on the other hand, refers to the instructions, or programs, that tell the hardware what to do.

A typical personal computer should have the following main components:

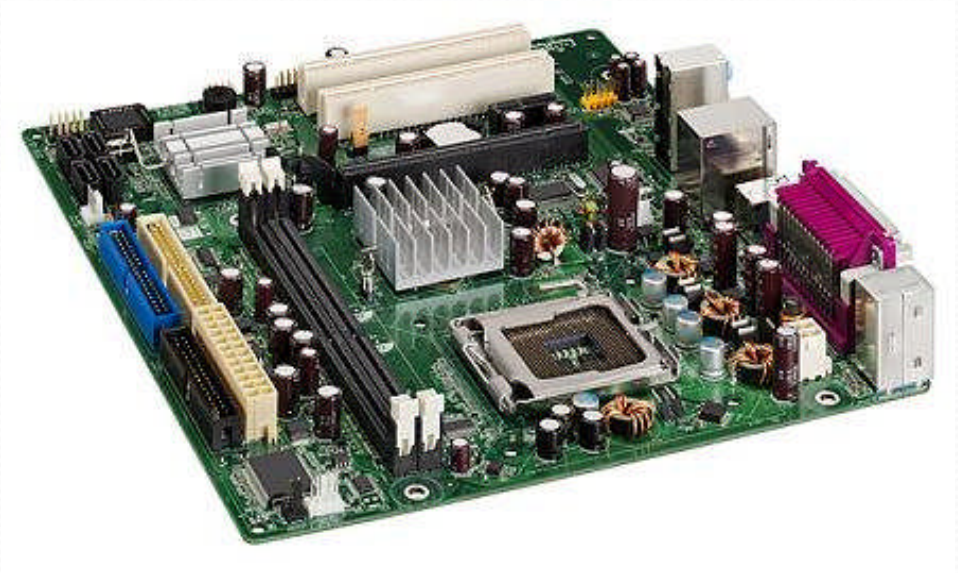
- Monitor
- Motherboard
- Central processing unit or CPU
- Memory
- Cables and connectors
- Peripherals

Monitor

- Displays information in visual form, using text and graphics.
- The portion of the monitor that displays the information is called the screen. Like a television screen, a computer screen can show still or moving pictures.
- There are two basic types of monitors: CRT (cathode ray tube) monitors and LCD (liquid crystal display) monitors.
- Both types produce sharp images, but LCD monitors have the advantage of being much thinner and lighter. CRT monitors, however, are generally more affordable.

Motherboard

- Also known as mainboard, mobo (abbreviation), MB (abbreviation), system board, logic board
- Serves to connect all of the parts of a computer together. The CPU, memory, hard drives, optical drives, video card, sound card and other ports and expansion cards all connected to the motherboard directly or via cables.



Central Processing Unit

What is the central processing unit (CPU) ?

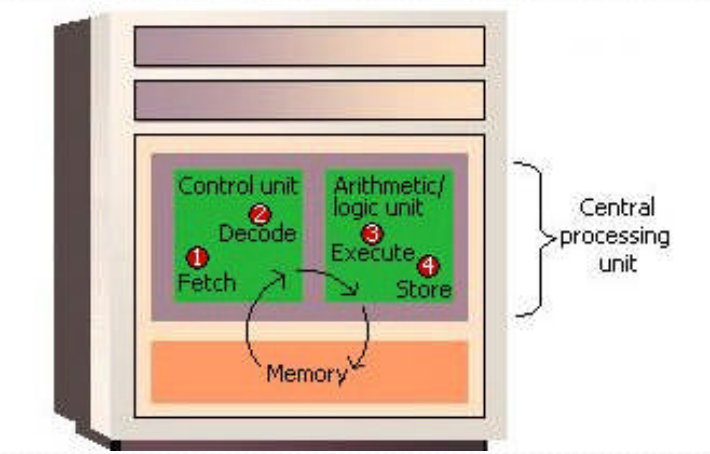
- Also called as a processor, microprocessor, central processor, "the brains of the computer", the CPU is the heart of any computer system. It interprets and carries out basic instructions that operate a computer.

- Central Processing Unit itself consists of three main subsystems; first is the Control Unit, the second is Registers, and the third is Arithmetic and Logic Unit(ALU).

How the CPU Executes Program Instructions

- Before an instruction can be executed, program instructions and data must be placed into memory from an input device or a secondary storage device. Once the necessary data and instruction are in memory, the central processing unit performs the following four steps for each instruction:

1. The control unit fetches (gets) the instruction from memory.
2. The control unit decodes the instruction (decides what it means) and directs that the necessary data be moved from memory to the arithmetic/logic unit. These first two steps together are called instruction time, or I-time.
3. The arithmetic/logic unit executes the arithmetic or logical instruction. That is, the ALU is given control and performs the actual operation on the data.
4. The arithmetic/logic unit stores the result of this operation in memory or in a register. Steps 3 and 4 together are called execution time, or E-time.



Control Unit

- The control unit of the CPU contains circuitry that uses electrical signals to direct the entire computer system to carry out, or execute, stored program instructions.
- The control unit does not execute program instructions; rather, it directs other parts of the system to do so. The control unit must communicate with both the arithmetic/logic unit and memory.

Arithmetic Logic Unit (ALU)

- Arithmetic logic unit (ALU) is a digital circuit that performs arithmetic and logical operations.
- An ALU loads data from input registers, an external Control Unit then tells the ALU what operation to perform on that data, and then the ALU stores its result into an output register. The Control Unit is responsible for moving the processed data between these registers, ALU and memory.
- Arithmetic/logic unit (ALU) performs execution part of the machine cycle. The execution consists of Arithmetic (addition, subtraction, multiplication, and division), Comparison (greater than, equal to, or less than) and Logical (AND, OR, NOT).

Registers: Temporary Storage Areas

- Registers are temporary storage areas for instructions or data. They are not a part of memory; rather they are special additional storage locations that offer the advantage of speed.

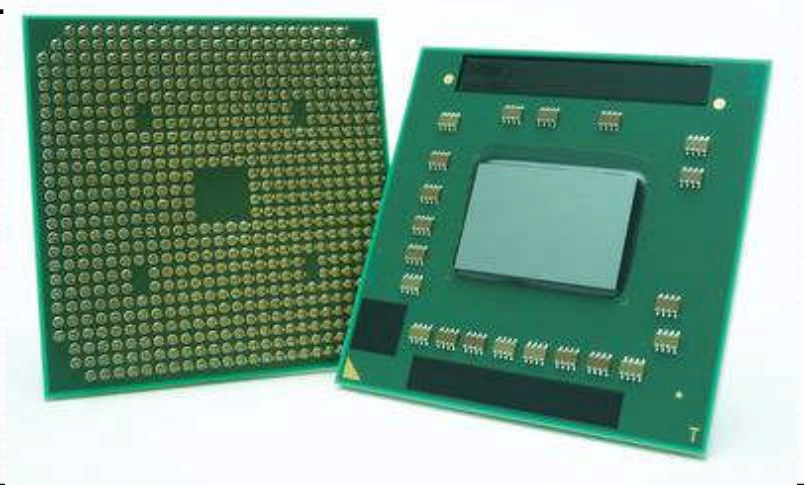
- Registers work under the direction of the control unit to accept, hold, and transfer instructions or data and perform arithmetic or logical comparisons at high speed. The control unit uses a data storage register the way a store owner uses a cash register-as a temporary, convenient place to store what is used in transactions.

Memory

- Memory is also known as primary storage, primary memory, main storage, internal storage, main memory, and RAM (Random Access Memory); all these terms are used interchangeably by people in computer circles.
- Memory is the part of the computer that holds data and instructions for processing. Although closely associated with the central processing unit, memory is separate from it. Memory stores program instructions or data for only as long as the program they pertain to is in operation.

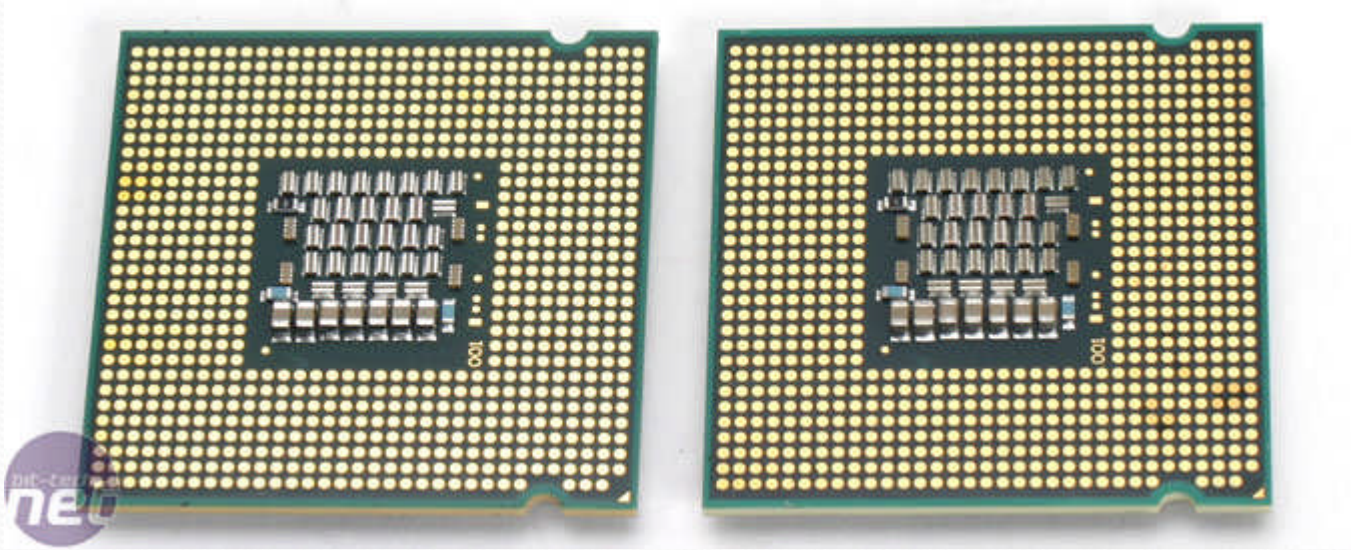
L1 cache

- L1 cache is a small, fast memory cache that is built in to a CPU and helps speed access to important and frequently-used data.
- L1 cache is typically smaller and faster than L2 cache.
- L1 cache is an abbreviation of *Level 1 cache*.



L2 Cache

- L2 cache is a set of memory circuits designed to speed access to important and frequently used data.
- Early L2 cache designs involved fast static RAM memory chips placed near the CPU. Modern L2 caches involve RAM built directly into the CPU.
- L2 cache is typically larger but slower than L1 cache.
- L2 cache is an abbreviation of *Level 2 cache*.



RAM (Random Access Memory)

- Random-access, commonly known as RAM or simply memory, provides space for your computer to read and write data to be accessed by the CPU (central processing unit). When people refer to a computer's memory, they usually mean its RAM.
- The strength of the RAM determines, at random, how fast a piece of data can be pulled and returned.
- Regardless of where the data is on a drive or whether it is at all related to any previous bit of data is irrelevant; RAM pulls it back at a constant time.
- RAM is volatile, so data stored in RAM stays there only as long as the computer is running. As soon as the computer is switched off, the data stored in RAM disappears.

- There are two different types of RAM: DRAM (Dynamic Random Access Memory) and SRAM (Static Random Access Memory).

- There are two types of RAM:

  SRAM (Static Random Access Memory)

  - SRAM is a type of memory that is faster and more reliable than the more common DRAM (dynamic RAM). The term static is derived from the fact that it doesn't need to be refreshed like dynamic RAM.
  - Uses multiple transistors, typically four to six, for each memory cell but doesn't have a capacitor in each cell.
  - It is volatile i.e. they lose their contents when the power is turned off
  - It is used primarily for cache.

  DRAM (Dynamic Random Access Memory)

  - It has memory cells with a paired transistor and capacitor requiring constant refreshing.
  - The advantage of DRAM is its structural simplicity: only one transistor and a capacitor are required per bit, compared to six transistors in SRAM. This allows DRAM to reach very high densities.
  - It is volatile i.e. they lose their contents when the power is turned off
  - DRAM is used in main memory .

ROM (Read-Only Memory)

- Read-Only Memory or ROM is an integrated-circuit memory chip that contains configuration data.
- ROM is commonly called firmware because its programming is fully embedded into the ROM chip. As such, ROM is a hardware and software in one.
- Because data is fully incorporated at the ROM chip's manufacture, data stored can neither be erased nor replaced. This means permanent and secure data storage.
- Data stored in ROM is nonvolatile - it is not lost when your computer is turned off.
- Data stored in ROM is either unchangeable or requires a special operation to change.
- Examples of ROM are: Programmable ROM (PROM), Erasable Programmable ROM (EPROM) and Electrically Erasable Programmable ROM (EEPROM).

Ports

- A port serves as an interface between the computer and other computers or peripheral devices through which data is sent and received.
- Physically, a port is a specialized outlet on a piece of equipment to which a plug or cable connects.
- Electronically, the several conductors making up the outlet provide a signal transfer between devices.
- Hardware ports can almost always be divided into two groups based on the signal transfer:
    - A **serial port** transmits one bit of data at a time and is used to connect slow-speed devices, such as mouse, keyboard, mode.
    - A **parallel port** connects devices that can transfer more than one bit at a time, such as a printer.

Parallel Port

- A parallel port is a type of interface found on computers (personal and otherwise) for connecting various peripherals.
- In computing, a parallel port is a parallel communication physical interface.
  - Printers
  - Scanners
  - CD burners
  - External hard drives
  - Iomega Zip removable drives
  - Network adapters
  - Tape backup drives

- When using a parallel port, the computer sends the data 1 byte at a time (8 bits in parallel, as opposed to 8 bits serially as in a serial port). With each byte sent out, it sends a handshaking signal so the printer can latch the byte.
- If you want to accept data from a parallel port, all you really need is an 8-bit latch and a little glue logic.

Serial Port

- A serial port is a serial communication physical interface through which information transfers in or out one bit at a time.
- Data transfer through serial ports connected the computer to devices such as terminals and various peripherals.
- While such interfaces as Ethernet, FireWire, and USB all send data as a serial stream, the term "serial port" usually identifies hardware more or less compliant to the RS-232 standard, intended to interface with a modem or with a similar communication device.

Cables and Connectors

1. Computer and Monitor Power Cable

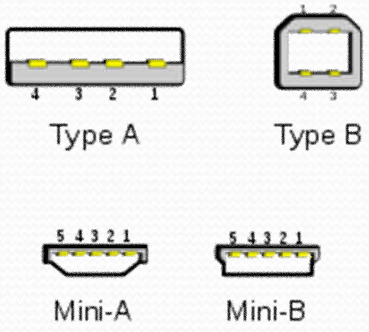
- This is the power cable that connects the computer with the wall socket. Computer monitors also use this cable.
- Computer power cable connects to the back of your computer on the power supply unit.

2. USB (Universal Serial Bus) Cables

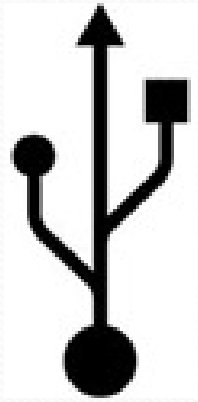
What are USB cables used for?

- A “plug and play” technology, a USB can be “hot-plugged” (connected or disconnected) while the computer is on.
- It is the most common interface for connecting external and peripheral devices to your computer including flash memory sticks, portable media players, internet modems and digital cameras.

- USB has effectively replaced a variety of interfaces such as serial and parallel ports.



- Additionally, USB cables are also used for charging a variety of gadgets including mobile phones or for transferring data from one computer to another.



3. VGA (Video Graphic Array) Cable

- VGA cable is one of the most common video connectors which connect computers with monitors or television sets.
- A standard VGA connector has 15-pins and other than connecting a computer to a monitor, a VGA cable can also be used to connect a laptop to a TV screen or a projector.
- It transmit analog video data that supports standard 640 x 480 resolution and wide screen displays.
- A VGA only transfers video signals, not audio signals.

4. DVI (Digital Visual Interface) Monitor Port

- A DVI cable implement the DVI video interface standard in order to enable high visual quality displays on LCD flat panel and digital projector displays.
- It supports both analog and digital data transfer of video signals. Digital video resolutions range from 1920 x 1200 and higher when using DVI cables.
- It uses pins to send DVI-native digital video signals to display devices. It has 29 pins, though some connectors may have less pins depending on their configuration.
- DVI's video signal is compatible with HDMI, so a simple converter can allow a DVI monitor to receive input from an HDMI cable.
- Additionally, DVI to VGA converters are also available for connect your new graphics card to old monitor that supports only VGA mode.
- The letter that follows the DVI label indicates the type of connection it is, for example, DVI-D (digital connections), DVI-A (Analog connections), DVI-I (Integrate digital and analog connections).

5. HDMI (High Definition Multimedia Interface) Cables

- HDMI is the new standard that provide both audio and video transmission through a single cable.
- It is a compact 19-pin plug and cable for connecting High-Definition video and multi-channel audio-capable
- HDMI is an uncompressed, all-digital signal audio/video interface with 5 Gbps of available bandwidth.

- The primary use of the HDMI wire is to transmit digital signals from a compatible digital audio/video source such as a cable set top box, DVD player, A/V receiver or satellite receiver to a compatible digital audio and/or video monitor such as a high definition television.
- In addition to carrying uncompressed video, HDMI carry 8-channels, of 192kHz, 24-bit uncompressed audio.

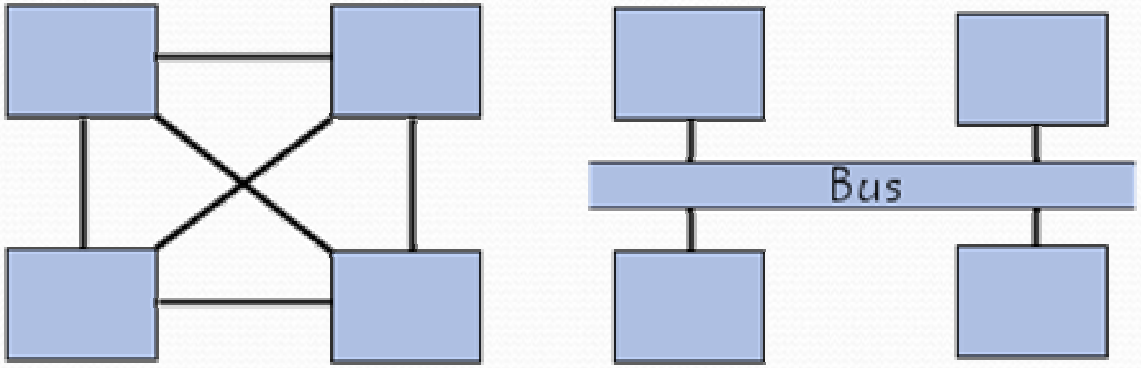
- HDMI eliminates the complexity of using several multiple cables since it combines audio and video onto a single cable.

6. Firewire

- Firewire, also known as IEEE 1394 and i.Link, is a high speed serial bus.
- It is a faster alternate to USB and is commonly used for connecting digital camcorders and external hard drives to a computer.
- Digital camcorders and external hard drives often have firewire ports.
- Firewire typically has 6 pins in its connector, though a 4 pin variety is common as well.

Bus

- In order for multiple hardware components to communicate with one another, a bus is used to transmit the data from one part of a computer to another.
- A bus is a collection of wires through which data is transmitted from one part of a computer to another.
- The purpose of buses is to reduce the number of "pathways" needed for communication between the components, by carrying out all communications over a single data channel.



Characteristics of a bus

- The size of a bus, known as its *width,* is important because it determines how much data can be transmitted at one time.
- For example, a 16-bit bus can transmit 16 bits of data, whereas a 32-bit bus can transmit 32 bits of data.
- Additionally, the bus speed is also defined by its **frequency** (expressed in Hertz), the number of data packets sent or received per second.
- Each time that data is sent or received is called a **cycle**.
- To find the maximum **transfer speed** of the bus, the amount of data which it can transport per unit of time, by multiplying its width by its frequency.
- Example: A bus with a width of 16 bits and a frequency of 133 MHz, therefore, has a transfer speed equal to:

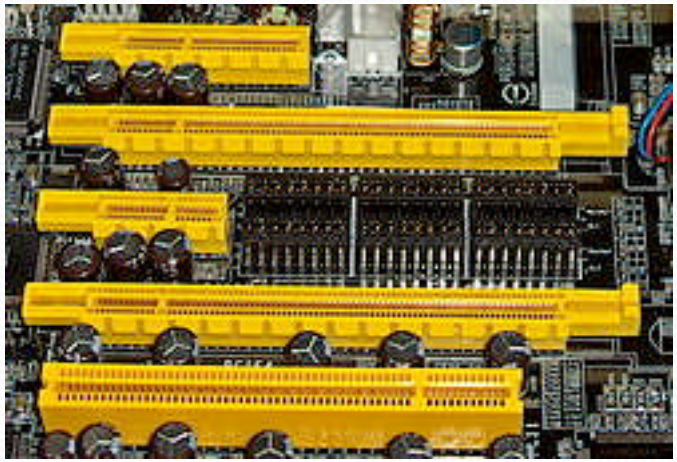
$16 * 133.10^6 = 2128*10^6$ bit/s,

or $2128*10^6/8 = 266*10^6$ bytes/s or

$266*10^6 /1000 = 266*10^3$ KB/s

or $259.7*10^3 /1000 = 266$ MB/s

- A bus is generally constituted of 50 to 100 distinct physical lines, divided into three subassemblies:
- The **address bus** (sometimes called the *memory bus*) transports memory addresses which the processor wants to access in order to read or write data. It is a unidirectional bus.
- The **data bus** transfers instructions coming from or going to the processor. It is a bidirectional bus.
- The **control bus** (or *command bus*) transports orders and synchronisation signals coming from the control unit and travelling to all other hardware components. It is a bidirectional bus, as it also transmits response signals from the hardware.



- There are generally two buses within a computer:
  - **Internal bus** (sometimes called the *front-side bus*, or *FSB* for short). The internal bus operates only within the internal circuitry of the CPU, allowing the processor to communicate with the system's central memory (the RAM).

  - **External bus** (sometimes called the *input/output bus*) allows various motherboard components (USB, serial, and parallel ports, cards inserted in PCI connectors, hard drives, CD-ROM and CD-RW drives, etc.) to communicate with one another.

Peripheral Devices

- Peripheral devices are computer devices that are connected to the computer externally such as printer, scanner, keyboard, mouse, tape device, microphone and external modem or internally such as CD-ROM or internal modem and external as the scanner, printer and Zip drive.
- Peripheral devices can be classified according to their functions.

  - **Input**
    - Input devices are the type of the computer devices that are used to provide the control signals to the computer. Keyboard and the Mouse are the examples of the input devices.
  - **Output**
    - Output devices are the devices that are used to display the results. Printer, scanner, speaker and the monitor are the examples of the output devices.
  - **Storage**
    - A storage device is a device that is used to store the information such as hard disk drive, flash drive, floppy disk and the tape drive.

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