

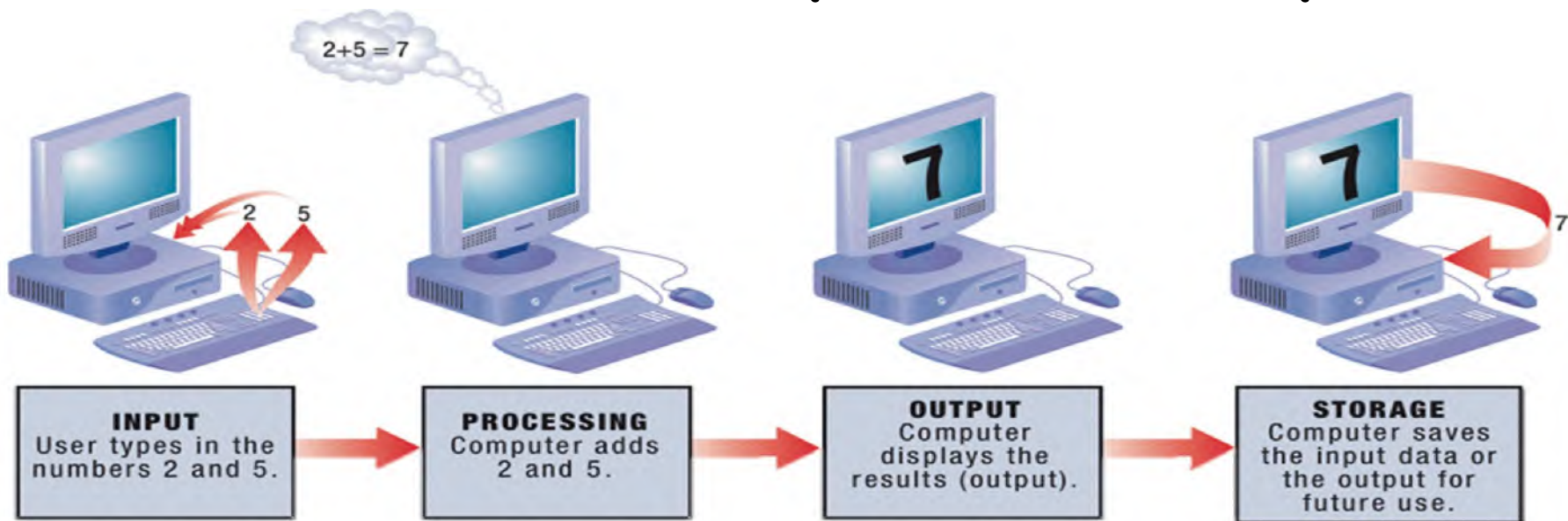
What is a computer?

A computer is a programmable, electronic device that accepts data, performs operations on that data, presents the results, and stores the data or results as needed



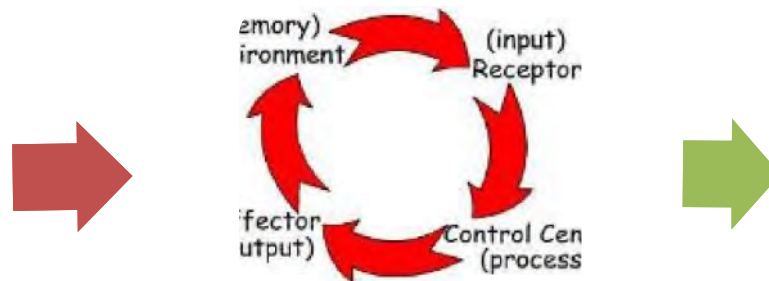
What does a computer do?

- ❑ A computer can perform four general operations:
 - ❑ Input (entering data into a computer)
 - ❑ Processing (performing operations on the data)
 - ❑ Output (presenting the results)
 - ❑ Storage (saving data, programs, or output)



Data vs. Information

- ❑ **Data:** almost any kind of fact or set of facts
- ❑ **Information Processing:** the conversion of data into information
- ❑ **Information:** processed data into a meaningful form



Data

- Raw, unorganized, unprocessed facts

Information Processing

Information

- Data that has been processed into a meaningful form

What is hardware?

☐ Hardware is the physical part of a computer, that you can touch

☐ Examples:

- ☐ Keyboard
- ☐ Mouse
- ☐ Monitor
- ☐ Printer
- ☐ Scanner
- ☐ speaker



What is software?

Software refers to the programs or instructions used to tell the computer hardware what to do



Types of software: 1. System Software

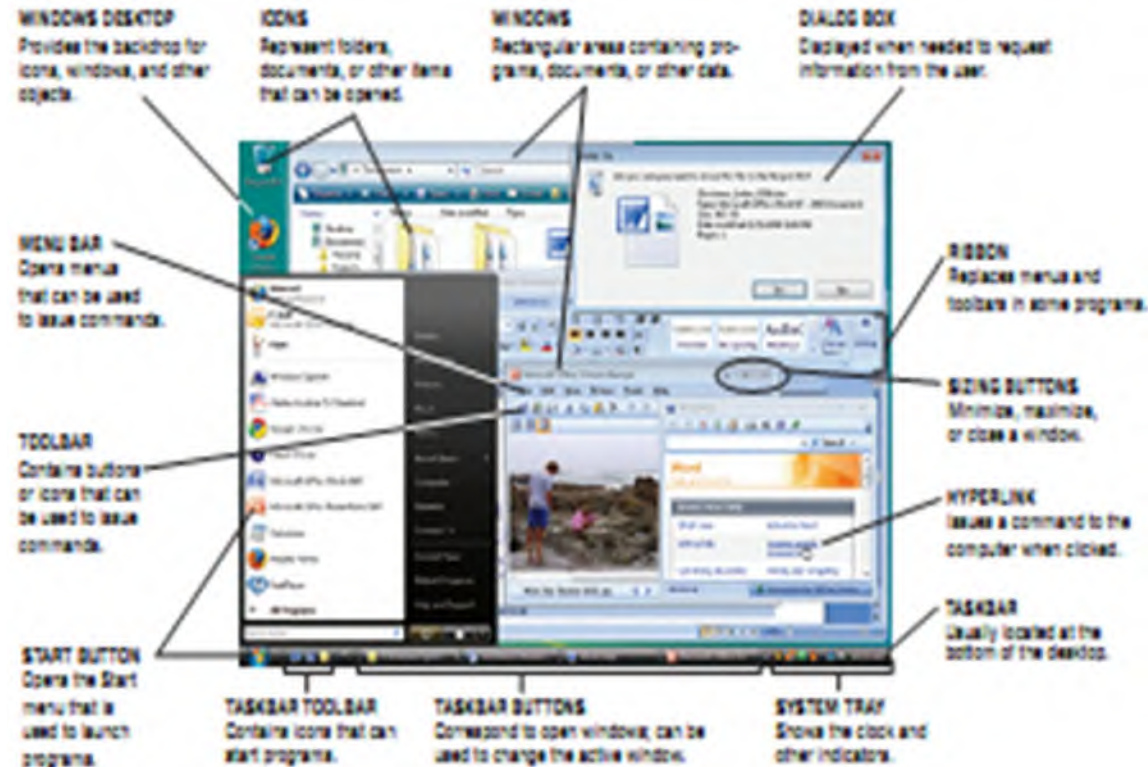
- ❑ The programs that allow a computer to operate are collectively referred to as system software.

- ❑ Examples:

- ❑ Windows, Mac

- ❑ LINUX, UNIX

- ❑ Android, Symbian



ubuntu

CentOS

debian



redhat

fedora

gentoo linux

iOS



Windows

FreeBSD

Types of software: 2. Application Software

Application software consists of programs designed to allow people to perform specific task

Examples:

- Microsoft Office (Word, Excel, PowerPoint, Access)
- Adobe Photoshop, Acrobat
- Internet explorer



WORD PROCESSING PROGRAMS

Allow users to create written documents, such as reports, letters, and memos.



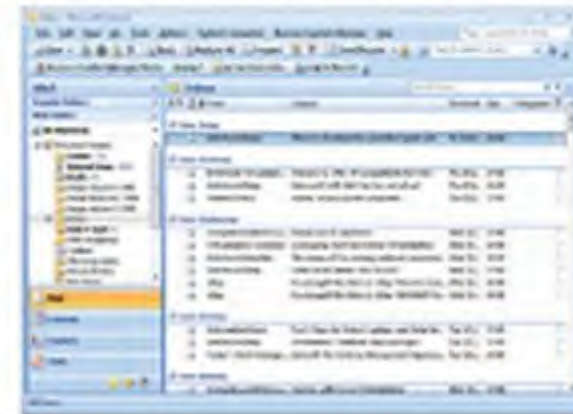
MULTIMEDIA PROGRAMS

Allow users to perform tasks, such as playing music or videos and transferring content to CDs and DVDs.



WEB BROWSERS

Allow users to view Web pages and other information located on the Internet.



E-MAIL PROGRAMS

Allow users to compose, send, receive, and manage electronic messages sent over the Internet or a private network.

Types of Users



- ❑ **Computer Users (End Users)** -- People who use computers to perform tasks or obtain information
- ❑ **Programmers** – Computer Professionals who write, test, and maintain computer programs
- ❑ **System Analysts** – Computer Professionals who analyze and design computer systems to solve business problems
- ❑ **Operations Personnel** – Computer Professionals who are responsible for the day-to-day computer operations

Types of computers: 1. Embedded Computers

- ❑ A tiny computer embedded into a product and designed to perform specific tasks or functions
- ❑ Examples:
 - ❑ Washing machine
 - ❑ Microwave
 - ❑ Televisions
 - ❑ Cars



Types of computers: 2. Mobile Devices

- ❑ A very small communication device with built-in computing or internet capability
- ❑ Examples:
 - ❑ Smart phones
 - ❑ Smart watches
 - ❑ Handheld gaming devices
 - ❑ Portable digital media players



Types of computers: 3. Personal Computers

- ❑ A computer designed to be used by one person at a time

Examples:

- ❑ Desktop Computers
- ❑ Portable Computers (Notebook/Laptop, Tablet, Netbook, Ultra-mobile PC/Handheld Computer)



tablet PCs.



NOTEBOOK COMPUTER



SLATE TABLET PC



CONVERTIBLE TABLET PC

Types of computers: 4. Midrange Server/Computer

- ❑ A medium-sized computer used to host programs and data for a small network

Example:

- ❑ Medical or dental offices
- ❑ School computer lab
- ❑ Home & small business servers



Types of computers: 5. Mainframe Computer

- ❑ A powerful computer used by many large organizations to manage large amounts of centralized data and programs

Examples:

- ❑ Hospitals
- ❑ Universities
- ❑ Banks
- ❑ Government offices

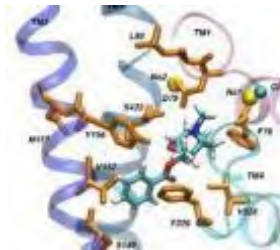
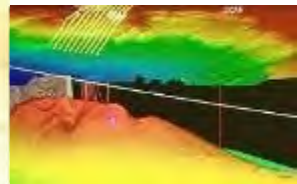
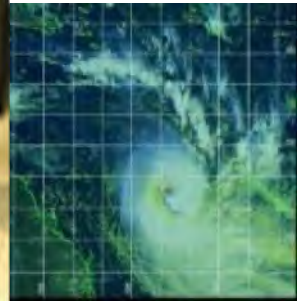
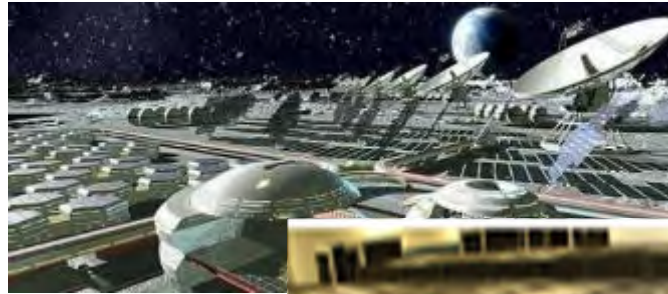


Types of computers: 6. Supercomputer

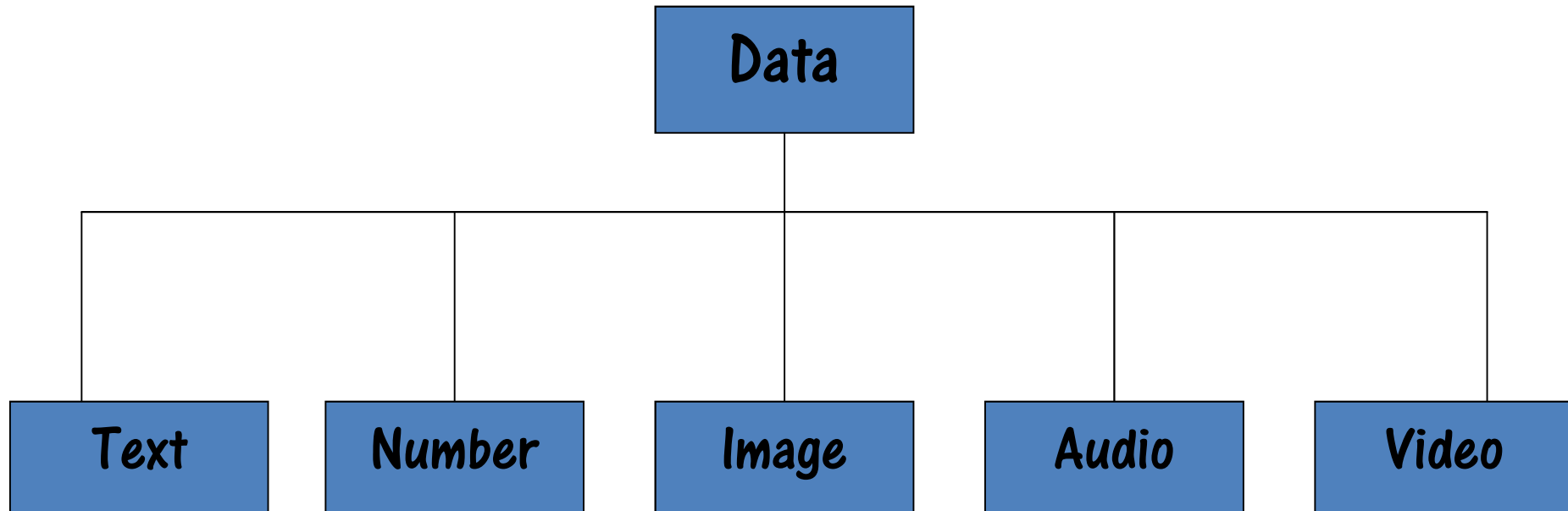
- ❑ The most powerful and most expensive computer for complex computations and processing

Examples:

- ❑ Space Missions and Satellite Controls
- ❑ Weather forecasting
- ❑ Oil exploration
- ❑ Scientific research



Basic types of data

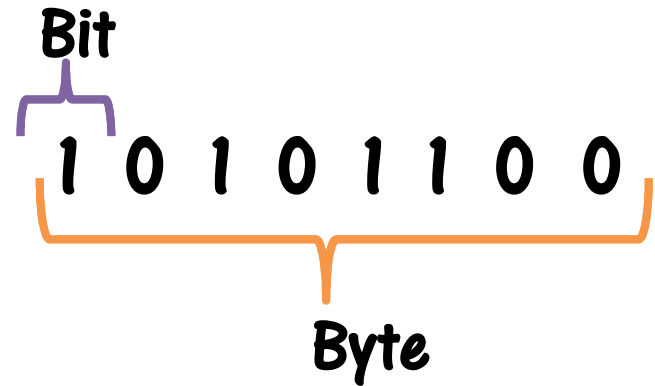


❑ Multimedia

- ❑ Integration of multiple forms of media
- ❑ Computer information represented through audio, video, animation, in addition to, text, image

Digital data representation

- Bit (Binary digit) -- the smallest unit of data that can be stored in a computer (0 or 1)
- Byte -- a group of 8 bits
- Bit Pattern -- a string of bits, example,
10011101110110001



Data Unit Conversion

1 KB (Kilobyte) \approx 1 thousand bytes
1 MB (Megabyte) \approx 1 million bytes
1 GB (Gigabyte) \approx 1 billion bytes
1 TB (Terabyte) \approx 1 trillion bytes
1 PB (Petabyte) \approx 1000 terabytes

Coding Standards for Text-based Data (Characters)

❑ ASCII (American Standard Code for Information Interchange)

- ❑ uses 7-bit code to represent each character
- ❑ Each 7-bit code can represent up to 128 characters (2^7 unique combinations)

❑ Extended ASCII

- ❑ uses 8-bit code to represent each character
- ❑ Each 8-bit code can represent up to 256 characters (2^8 unique combinations)

❑ EBCDIC (Extended Binary Coded Decimal Information Code)

- ❑ uses 8-bit code to represent each character
- ❑ Each 8-bit code can represent up to 256 characters (2^8 unique combinations)

❑ Unicode

- ❑ Universal international coding standard to represent text-based data in any language
- ❑ uses (8-bit to 32-bit) code to represent each character

❑ ISO (International Organization for Standardization)

- ❑ uses 32-bit code to represent each character
- ❑ Each 32-bit code can represent up to 2^{32} characters

ASCII value	Character	Control character	ASCII value	Character	ASCII value	Character	ASCII value	Character
000	(null)	NUL	032	(space)	064	@	096	a
001	☐	SOH	033	!	065	A	097	b
002	●	STX	034	"	066	B	098	c
003	♥	ETX	035	#	067	C	099	d
004	♠	EOT	036	\$	068	D	100	e
005	♣	ENQ	037	%	069	E	101	f
006	♠	ACK	038	&	070	F	102	g
007	(beep)	BEL	039	'	071	G	103	h
008	■	BS	040	(	072	H	104	i
009	(tab)	HT	041	)	073	I	105	j
010	(line feed)	LF	042	*	074	J	106	k
011	(home)	VT	043	+	075	K	107	l
012	(form feed)	FF	044	,	076	L	108	m
013	(carriage return)	CR	045	-	077	M	109	n
014	♪	SO	046	.	078	N	110	o
015	☼	SI	047	/	079	O	111	p
016	▶	DLE	048	0	080	P	112	q
017	▶	DC1	049	1	081	Q	113	r
018	↑	DC2	050	2	082	R	114	s
019	!!	DC3	051	3	083	S	115	t
020	π	DC4	052	4	084	T	116	u
021	\$	NAK	053	5	085	U	117	v
022	▬	SYN	054	6	086	V	118	w
023	↑	ETB	055	7	087	W	119	x
024	↑	CAN	056	8	088	X	120	y
025	↓	EM	057	9	089	Y	121	z
026	↑	SUB	058	:	090	Z	122	{
027	↑	ESC	059	;	091	[	123	|
028	(cursor right)	FS	060	<	092	\	124	}
029	(cursor left)	GS	061	=	093	]	125	~
030	(cursor up)	RS	062	>	094	^	126	☐
031	(cursor down)	US	063	?	095	_	127	☐

Some extended ASCII code examples.

CHARACTER	ASCII
0	00110000
1	00110001
2	00110010
3	00110011
4	00110100
5	00110101
A	01000001
B	01000010
C	01000011
D	01000100
E	01000101
F	01000110
+	00101011
!	00100001
*	00100011

Unicode. Many characters, such as these, can be represented by Unicode but not by ASCII or EBCDIC.

銅

CHINESE

ε

GREEK

፪

AMHARIC

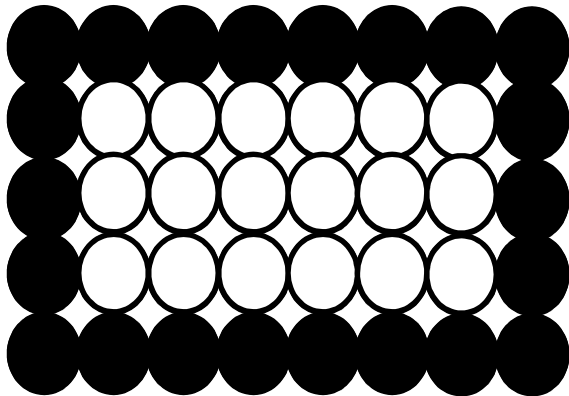
འཇུག

TIBETAN

Types of images: 1. Bitmap Graphic

- ❑ made of a grid or matrix of small dots (pixels; picture elements)
- ❑ The color at each pixel is represented by binary code/number

For monochrome (Black & White) graphic image



One sample pixel:
1110

16-COLOR IMAGE

The color of each pixel is represented using one half byte (4 bits).



One sample pixel:
01110110

256-COLOR IMAGE

The color of each pixel is represented using one byte (8 bits).



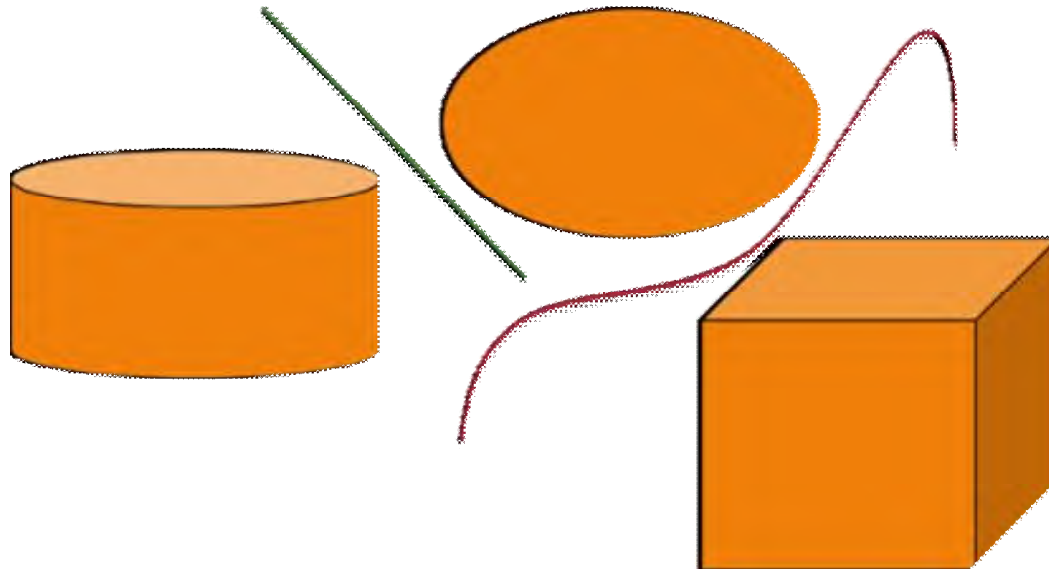
One sample pixel:
101001100100110111001011

PHOTOGRAPHIC-QUALITY (TRUE COLOR) IMAGE (16.8 million colors)

The color of each pixel is represented using three bytes (24 bits).

Types of images: 2. Vector Graphic

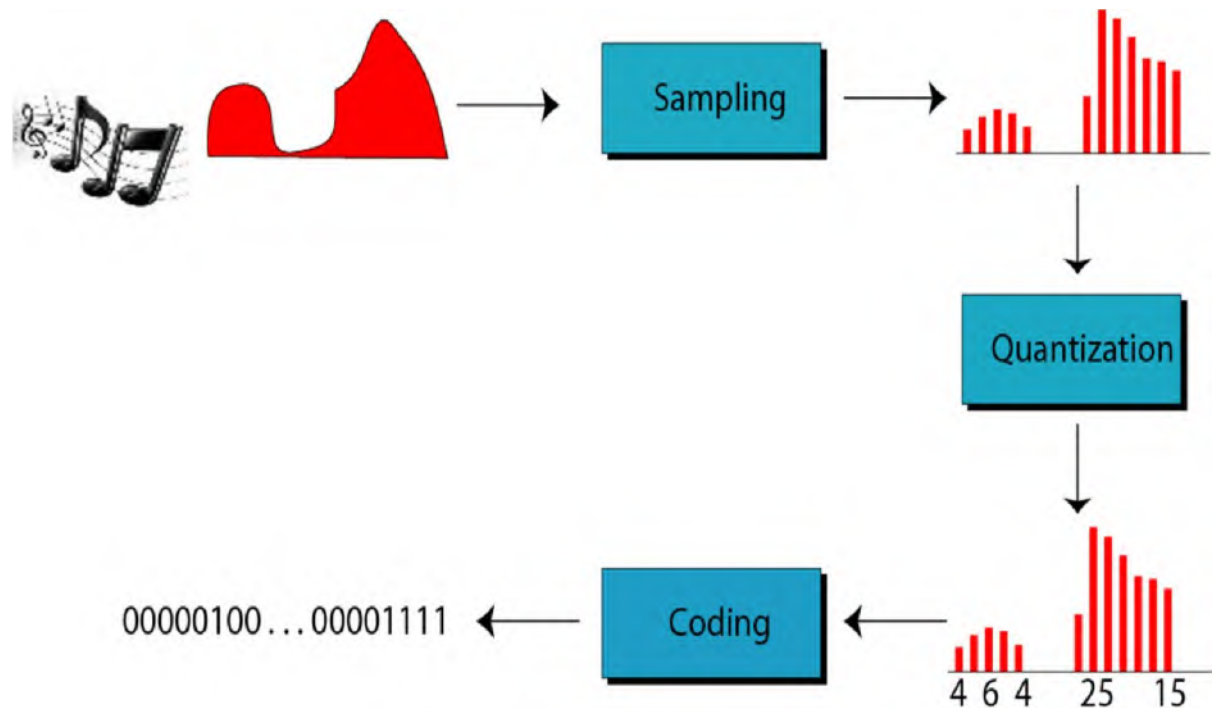
- ❑ made of lines, curves and shapes
- ❑ based on vectors (paths) that lead through locations (control points or nodes)
- ❑ all lines, curves, or shapes are represented by mathematical formulas



Audio

The procedure to convert analog sound to digital sound

- 1) analog signal is sampled
- 2) samples are quantized
- 3) The quantized values are coded into binary patterns



Video

- ❑ A collection of frames (images) that are projected in sequence dynamically
- ❑ Each image data is converted to a set of bit patterns and stored



Numerical data representation

- ❑ Decimal number system – based on 10 symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9)
- ❑ Binary number system – based 2 symbols (0, 1)
- ❑ Octal number system – based on 8 symbols (0, 1, 2, 3, 4, 5, 6, 7)

Each **octal** number is represented in **binary** form as 3-bit pattern

0	1	2	3	4	5	6	7
000	001	010	011	100	101	110	111

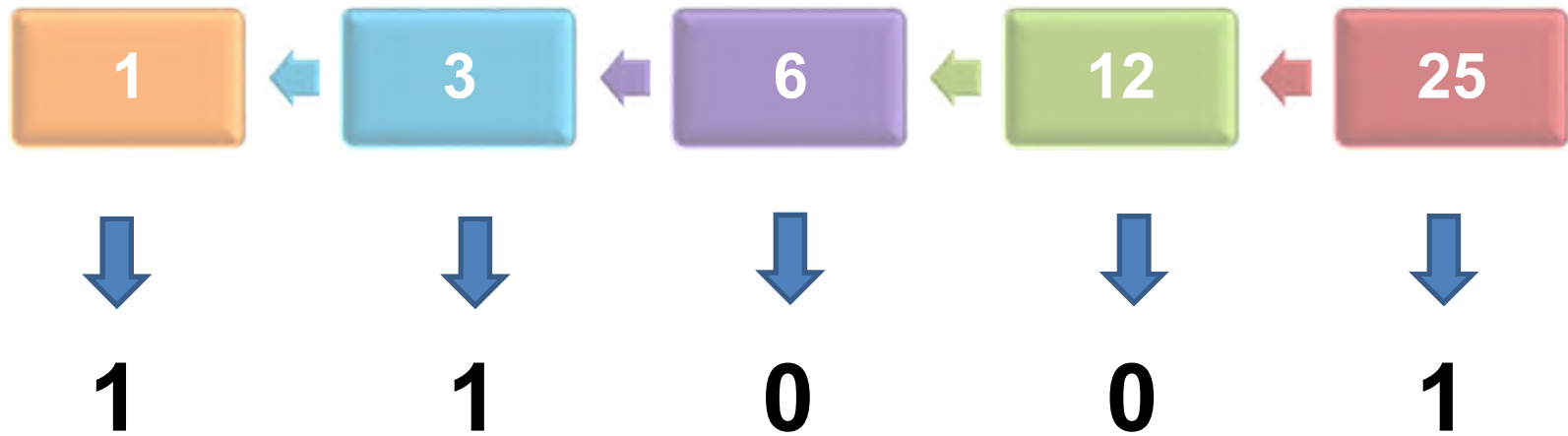
- ❑ Hexadecimal number -- based on 16 symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F)

Each **hexadecimal** number is represented in **binary** form as 4-bit pattern

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111

Conversion: Decimal to Binary

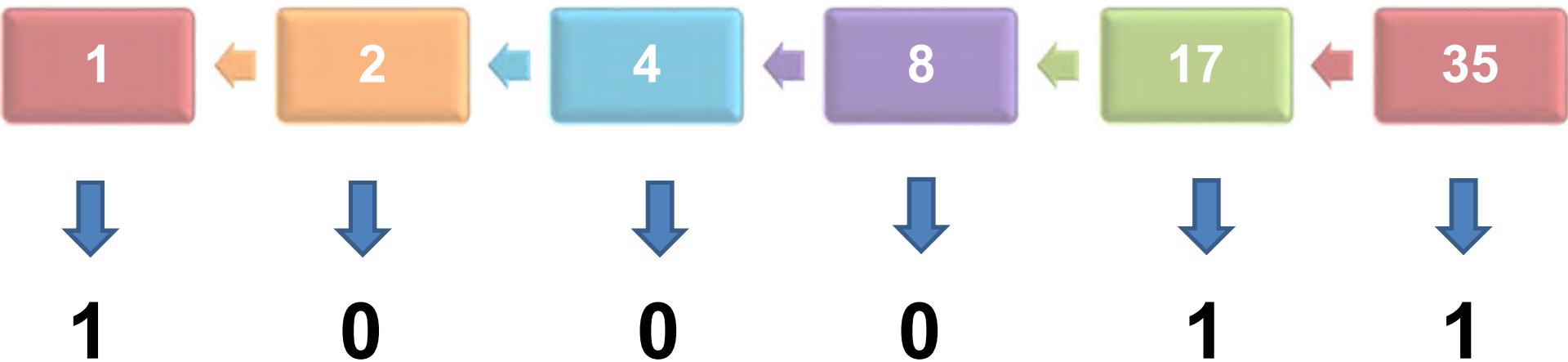
Procedure: Divide the decimal number by 2 and write down remainders successively



Decimal $(25)_{10} = \text{binary } (11001)_2$

Conversion: Decimal to Binary

Procedure: Divide the decimal number by 2 and write down remainders successively



Decimal $(35)_{10} = \text{binary } (100011)_2$

Conversion: Binary to Decimal

Procedure: Multiply the binary number by multiple of 2 respectively and add all

1	1	0	0	1
×	×	×	×	×
16	8	4	2	1

16	+	8	+	0	+	0	+	1	=	25
----	---	---	---	---	---	---	---	---	---	----

Binary $(11001)_2 = \text{Decimal } (25)_{10}$

Conversion: Binary to Decimal

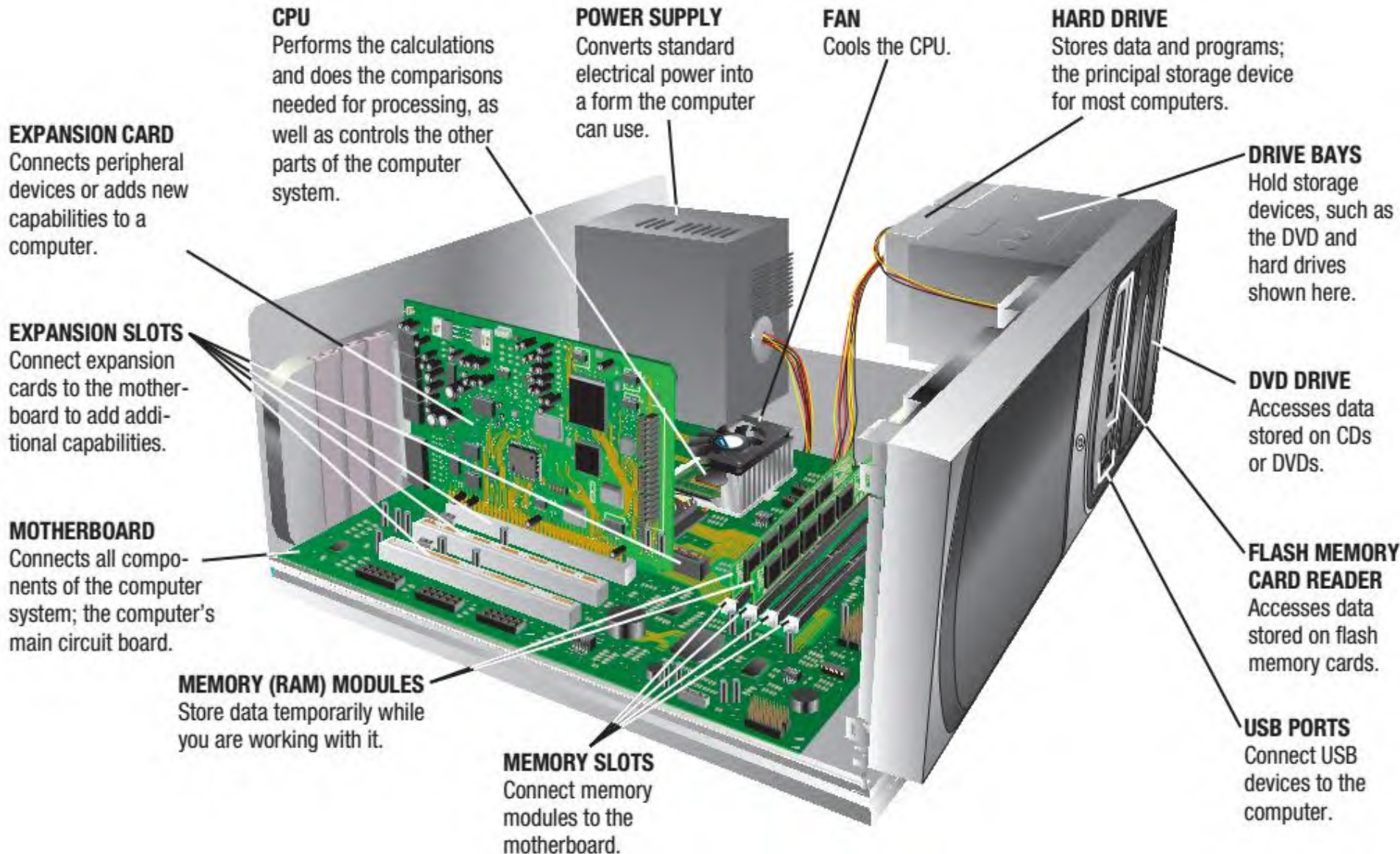
Procedure: Multiply the binary number by multiple of 2 respectively and add all

1	0	0	0	1	1
×	×	×	×	×	×
32	16	8	4	2	1

32 + 0 + 0 + 0 + 2 + 1 = 35

$$\text{Binary } (100011)_2 = \text{Decimal } (35)_{10}$$

Inside System Unit



- ❑ **Motherboard**- main electronic circuit board inside system unit that contains computer chips and other connected components
 - ❑ **Central Processing Unit (CPU)/Processor**- chip located on motherboard of computer that performs processing for the computer
-
- **Multi-core CPU**- CPU that contains processing components or core of more than one processor in a single CPU
 - **Dual-core CPU**- CPU that contains two separate processing cores
 - **Quad-core CPU**- CPU that contains four separate processing cores



Inside CPU

CONTROL UNIT

Is in charge of the entire process, making sure everything happens at the right time. It instructs the ALU, FPU, and registers what to do, based on instructions from the decode unit.

PREFETCH UNIT

Requests instructions and data from cache or RAM and makes sure they are in the proper order for processing; it attempts to fetch instructions and data ahead of time so that the other components don't have to wait.

ARITHMETIC/LOGIC UNIT AND FLOATING POINT UNIT

Performs the arithmetic and logical operations, as directed by the control unit.

REGISTERS

Hold the results of processing.

BUS INTERFACE UNIT

The place where data and instructions enter or leave the core.

CONTROL UNIT

PREFETCH UNIT

ALU/FPU

REGISTERS

DECODE UNIT

DECODE UNIT

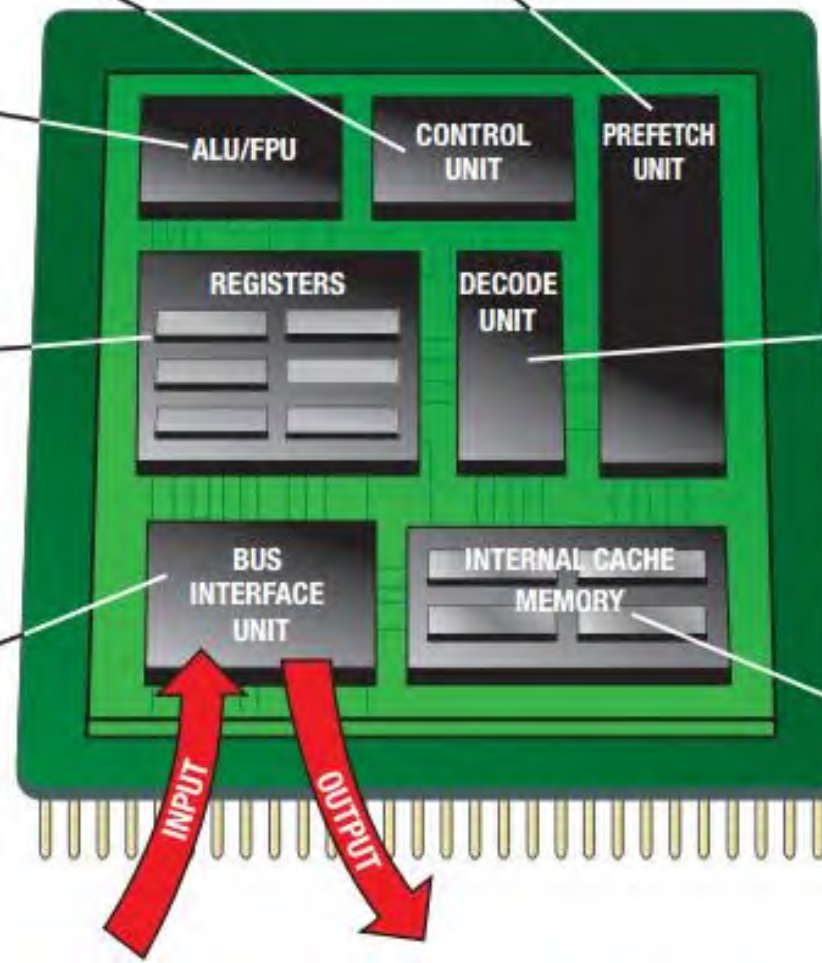
Takes instructions from the prefetch unit and translates them into a form that the control unit can understand.

BUS INTERFACE UNIT

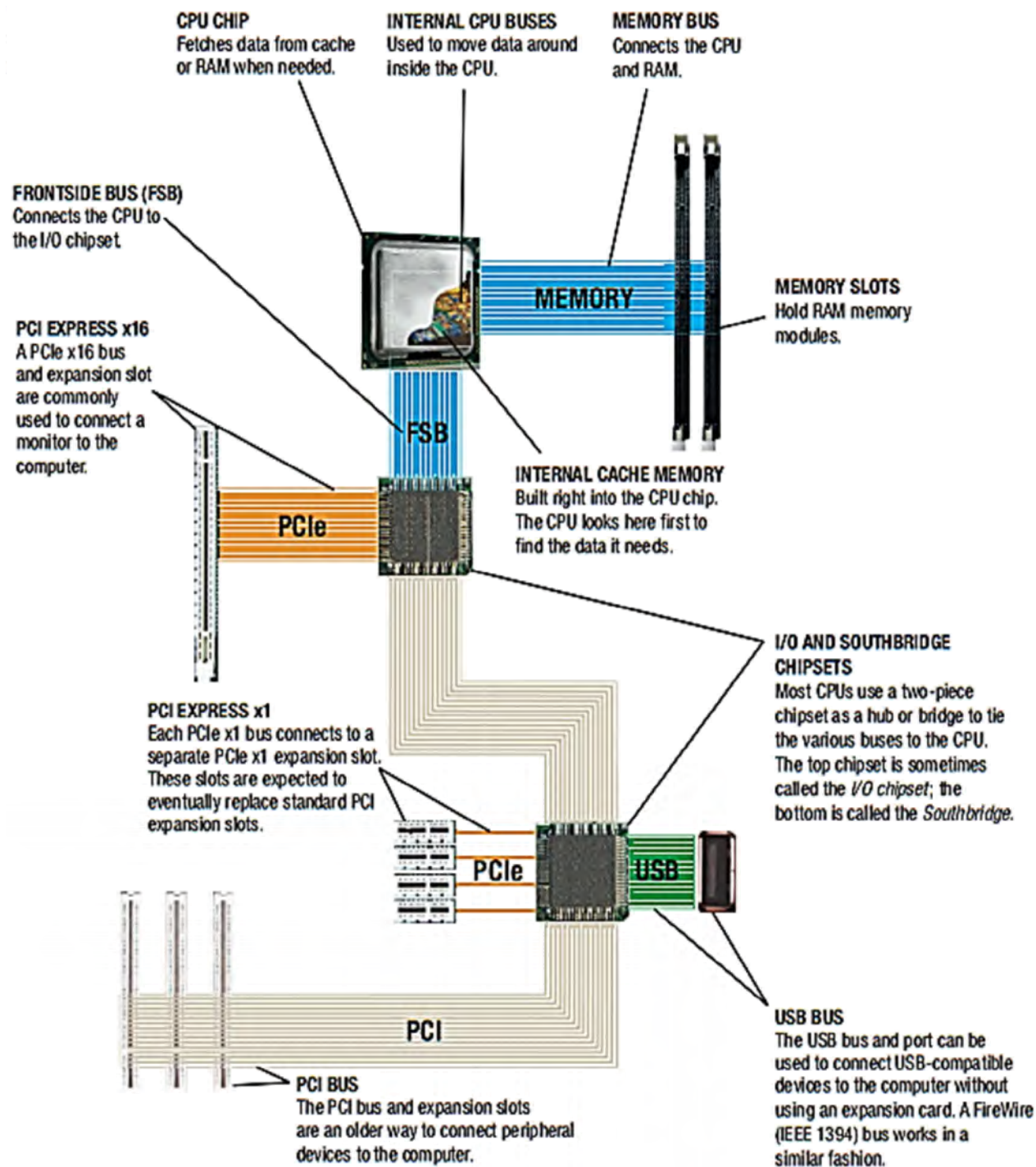
INTERNAL CACHE MEMORY

INTERNAL CACHE MEMORY

Stores data and instructions before and during processing.

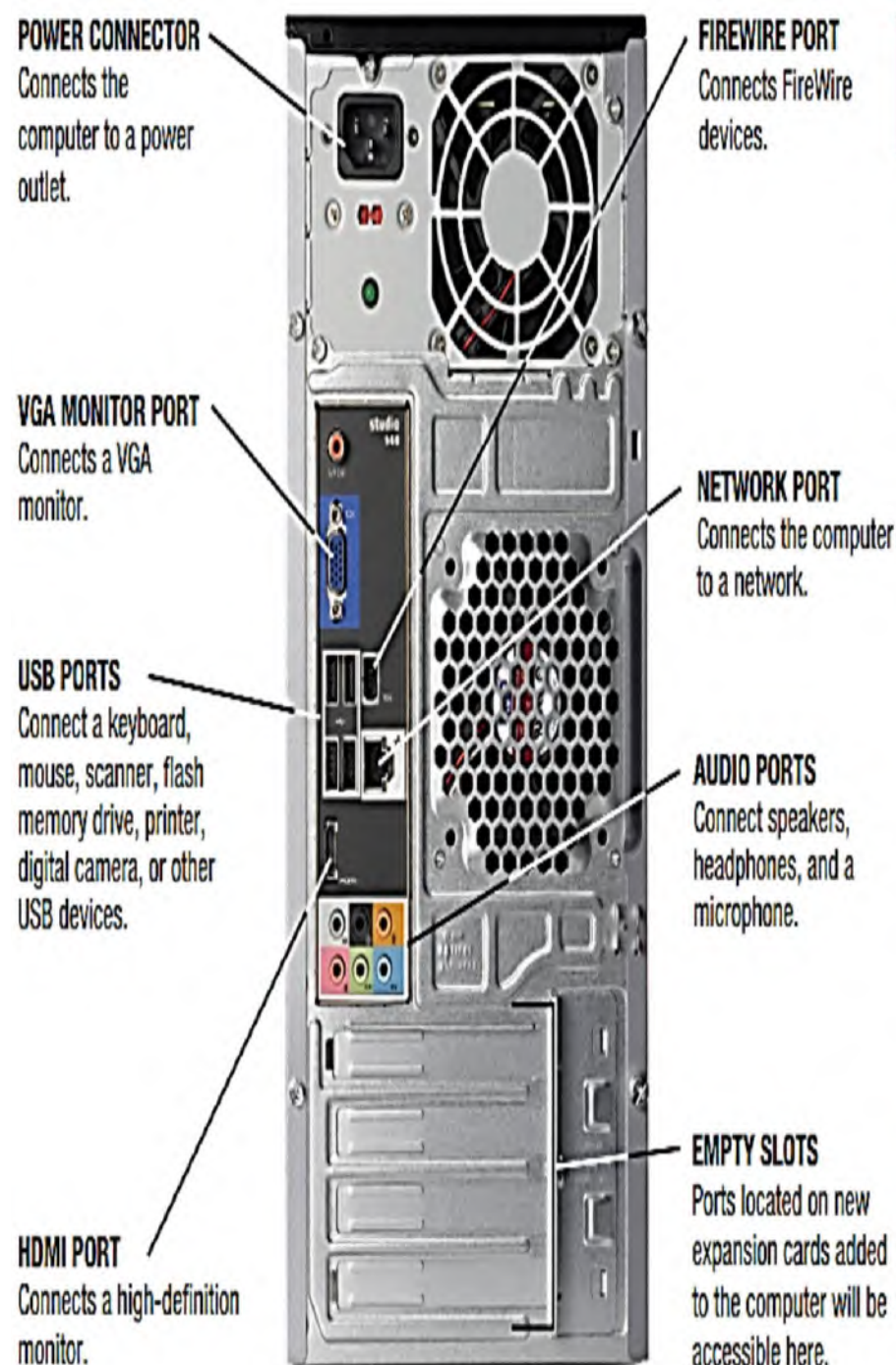


Bus - electronic path
on motherboard along
which data is transferred
Example:
Memory bus, Front-side
bus, PCI and PCI Express
bus, USB bus,
FireWire/IEEE 1394 bus



Port – the exterior of the computer to which A device may be attached using a connector

Example:
Monitor port, Network port,
Modem port, USB port,
FireWire (IEEE 1394) port,
Keyboard port, SCSI (Small Computer System Interface) port, MIDI port, Audio port, etc.



CONNECTORS



Monitor (VGA)



USB



Monitor (HDMI)



FireWire



Network (RJ-45)



Audio (3.5mm)

Volatile memory (Primary Storage)

Memory refers to chip-based storage

RAM (Random Access Memory) - This main-memory integrated-chip of computer provides temporary location to hold data and programs. Generally, it is volatile (the memory content is erased when the computer is powered down), except nonvolatile-RAM

❑ **SRAM (Static Random Access Memory)** - This volatile memory is faster but expensive. It uses electronic flip - flop gates (a gate with two states: 0 and 1) to hold data. It doesn't need memory refreshing.

❑ **DRAM (Dynamic Random Access Memory)** - This volatile memory is slower but inexpensive. It uses electronic capacitors (charged or discharged states as 1 or 0) to hold data. It needs constant memory refreshing.

Cache Memory - group of fast memory circuitry located on or near CPU to help speed up processing

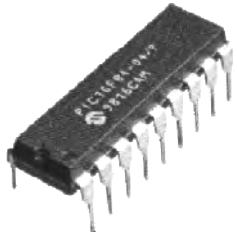
Register - high-speed memory built into CPU that temporarily stores data during processing



Non-volatile memory



ROM (Read Only Memory) -- nonvolatile memory chip that permanently stores data or programs in general.



PROM (Programmable Read Only Memory) – nonvolatile memory chip that can be programmed/written only once (one-time).



EPROM (Erasable Programmable Read Only Memory) – nonvolatile memory chip that can be erased and reprogrammed/rewritten many times.

Storage systems

Floppy Disk -- low-capacity, removable disk made of flexible plastic



Hard Drive - are used to store programs and data



Magnetic Hard Drive/Disk - contains metal hard disks that are tracked with magnetic spots representing 0s and 1s



Solid State Drive (SSD) - uses flash memory technology to store data and programs



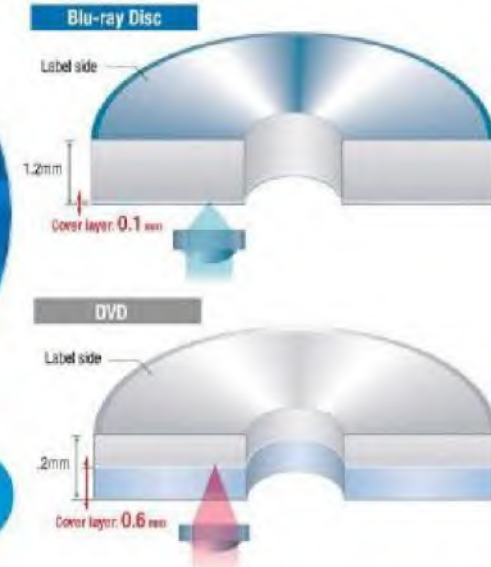
Hybrid Hard drive - a combination of magnetic hard drive and solid-state drive (contains flash memory together with magnetic hard disks)

Optical Disc – thin circular disc that stores and reads data using laser beam (optically)

❑ **CD (Compact Disc)** – low capacity (typically 650 MB) optical disc that uses infrared laser for data storage

❑ **DVD (Digital Versatile Disc)** – medium capacity (typical 4.7 GB to 8.5 GB) optical disc that uses red laser for data storage

❑ **BD (Blue-ray Disc)** – high-capacity (typically 25 GB to 50 GB) disc that uses blue-violet laser for data storage



CD-ROM, DVD-ROM, and BD-ROM discs

These discs are read-only optical discs that come prerecorded and user can not write

CD-R, DVD-R, DVD+R, and BD-R discs

These discs are recordable optical discs (write-once discs) but can not be erased afterward

CD-RW, DVD-RW, DVD+RW, and BD-RE discs

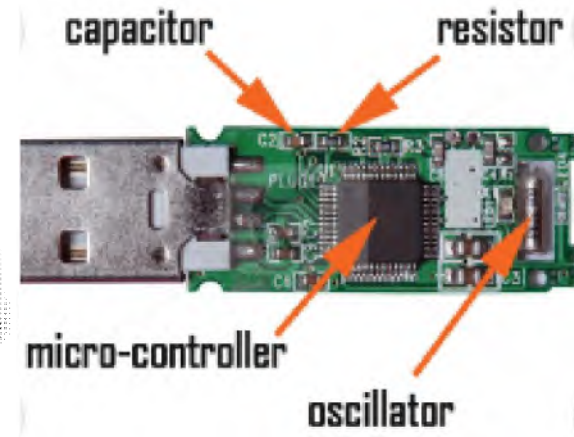
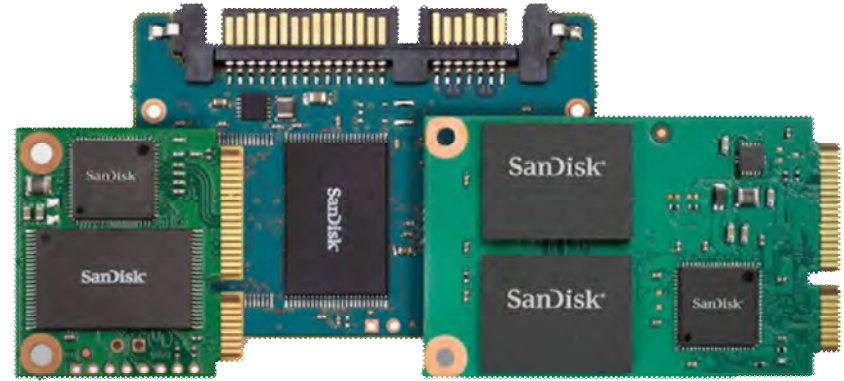
These discs are rewritable optical discs that can be written to, erased, and overwritten many times



Flash Memory

-- a chip-based storage medium that stores data using electrons (electrical charge trapped or not, i.e., 0 or 1) within flash memory cell

- ❑ Flash Memory Cards - small, rectangular flash memory medium containing chips, such as a Compact Flash (CF) or Secure Digital (SD) card
- ❑ USB Flash Drive (Universal Serial Bus Drive) -- small storage device that plugs into USB port and contains flash memory media



Input Devices

Keyboard -- input device containing numerous keys that can be used to input letters, numbers, and other symbols

Mouse -- common pointing device that user slides along a flat surface to move pointer

Electronic pen -- input device that is used to write electronically on the display screen

Scanner -- input device that reads printed text and graphics and transfers them to a computer in digital form

Examples: Flatbed Scanner, Handheld Scanner

Touch Screen -- display device that is touched with finger to issue commands



Readers – input devices that read different types of codes and marks as well as individual's biometric characteristics

1. Barcode Reader-- an input device that reads barcode (optical code)

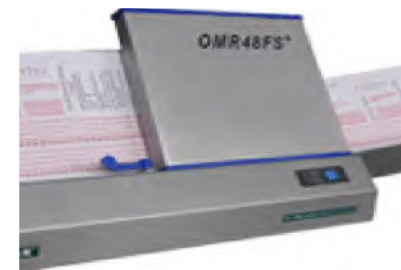
2. OMR (Optical Mark Readers) – an input device to input data from special forms to score or tally exams, questionnaires, ballots, etc.)

3. OCR (Optical Character Recognition) Reader– used to recognize scanned text characters (from monthly bills for credit cards or utilities companies, etc.) and convert into electronic form as text

4. MICR (Magnetic Ink Character Recognition) Reader– used to read and add magnetic-inked MICR characters primarily during bank check/cheque processing

5. RFID (Radio Frequency Identification) Reader— device used to read RFID tags (tiny chip with radio antenna to be identified using RFID technology)

6. Biometric Reader— device used to input biometric data, such as fingerprint, voice, face



Output Devices

- ❑ **Display device**— an output device that contains a viewing screen
- ❑ **Monitor**-- display device for desktop computer
- ❑ **Display Screen**– display device built into a notebook computer, netbook, UMPC etc.
- ❑ **Flat-panel display**– slim type of display device that uses electronically charged chemicals or gases



PORTABLE COMPUTERS



HANDHELD GAMING DEVICES



DIGITAL PHOTO FRAMES



MOBILE DEVICES



DIGITAL SIGNAGE SYSTEMS

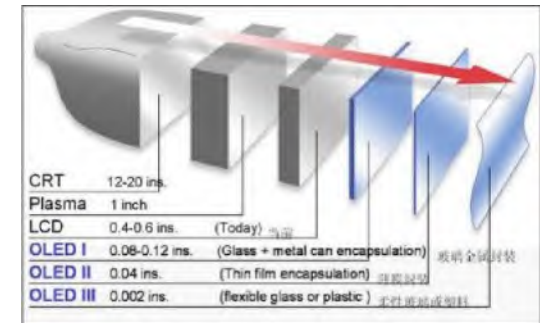
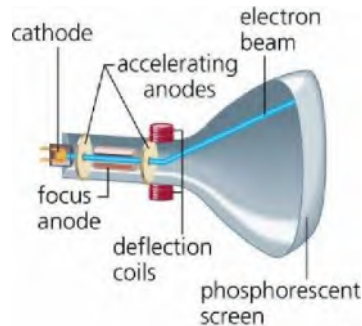
Display Device Characteristics



Color vs. Monochrome Display Devices– display devices form images by lighting up the proper configurations of pixels (the dots or the smallest colorable areas on a display device); picture elements

Color Display Device-- each pixel can display a combination of three colors (red, green, and blue)

Monochrome Display Device-- Each pixel can only be one of two colors (Black or White)



CRT Monitors vs. Flat-Panel Displays

CRT Monitor Display -- uses cathode-ray tube technology (electron gun projects an electron beam at a screen coated with red, green, and blue phosphor dots)

Flat-Panel Display-- uses electronically charged chemicals or gases filled in between thin panes of glass or other transparent material

Flat-Panel Display Technologies

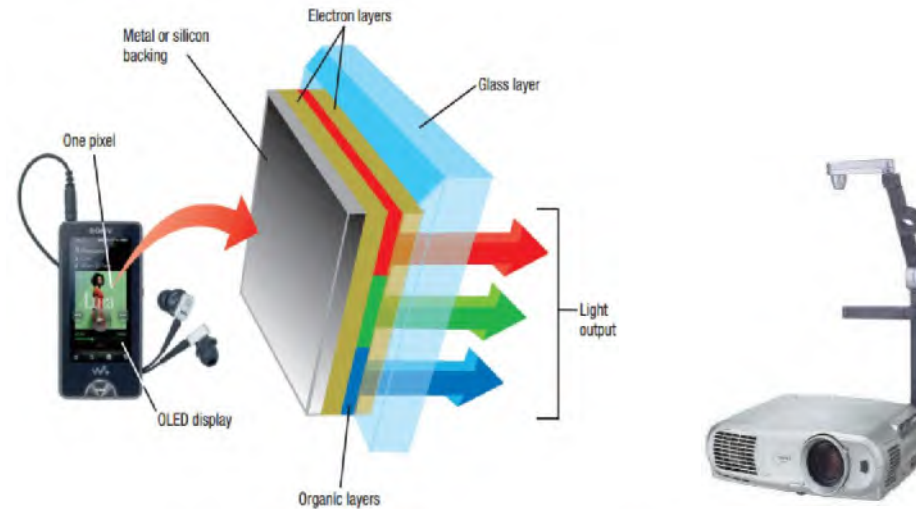
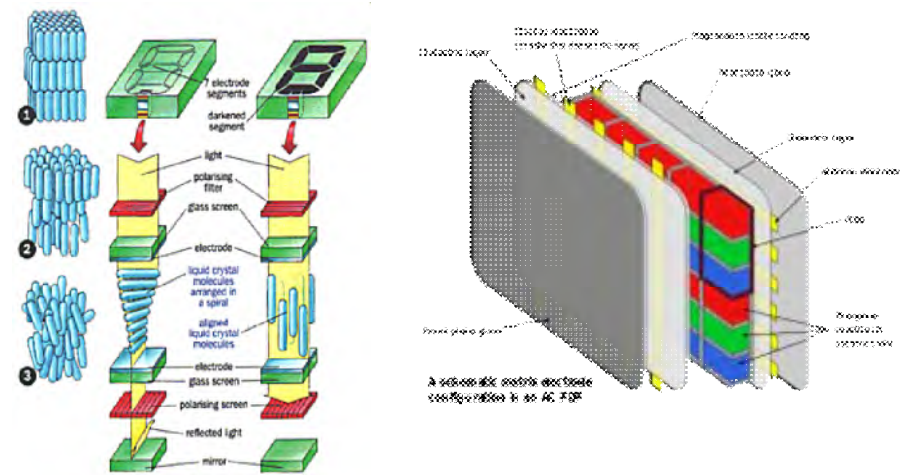
- **Liquid Crystal Display (LCD)** – uses charged liquid crystals located between two sheets of glass or plastic
- **Organic Light Emitting Diode (OLED) Display**– uses emissive organic material to display brighter and sharper images
- **Plasma Display**– uses layered technology (a layer of gas between two plates of glass) to display images
- **Data Projector**– display device that projects all computer output to a wall or projection screen

Audio Output

- includes voice, music, and other audible sounds

Types of audio output devices:

- **Computer Speaker**-- output device connected to computers that provide audio output
- **Headphone**-- personal audio output device used by an individual to hear sound
- **Headset**-- headphone with a built-in microphone



Printer

- output device that produces output on paper

Printer Characteristics- technology used, size, speed, print quality, etc.

Printing Technology- Printers produce images through either impact or nonimpact technologies

Impact Printer- have a print mechanism that actually strikes the paper to transfer ink to the paper

Example: dot-matrix printer

Nonimpact Printer- have a print mechanism that does not strike/touch the paper to transfer ink to paper

Example: Laser printer, ink-jet printer



Color vs. Black & White Printers

— Color printer uses black, blue, red, yellow ink to print a document

— often used in homes

— expensive and slow speed

— Black & White printer uses black ink to print a document

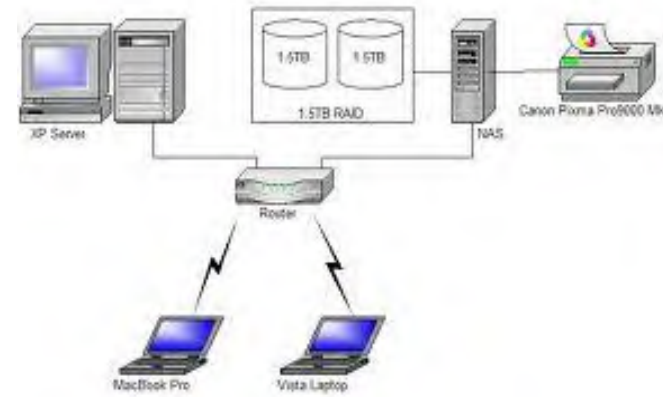
— Mostly used in business or office places

— Less expensive and faster speed



Personal vs. Network Printers

- | | |
|--|--|
| <ul style="list-style-type: none">○ Personal printer is designed to connect directly to a computer○ can not be shared | <ul style="list-style-type: none">○ Network printer is designed to connect directly to a home or office network○ can be shared over a network |
|--|--|



Print Resolution (dpi)– the number of dots (of liquid ink or toner powder flecks) per inch

Print Speed (ppm)– measured in pages per minute



Laser printer- output device that uses laser beam (to charge drum locations) and toner powder to print on paper

Ink-jet Printer- output device that sprays droplets of ink to produce images on paper

Photo Printer- output device designed for printing digital photographs

Barcode Printer- output device that print custom barcodes on price tags, shipping labels etc.

Portable Printer- small lightweight printer designed to be used while on the go

Plotter/Wide-Format Printer- used to print large documents, such as charts, drawings, maps, blueprints, posters, banners etc.

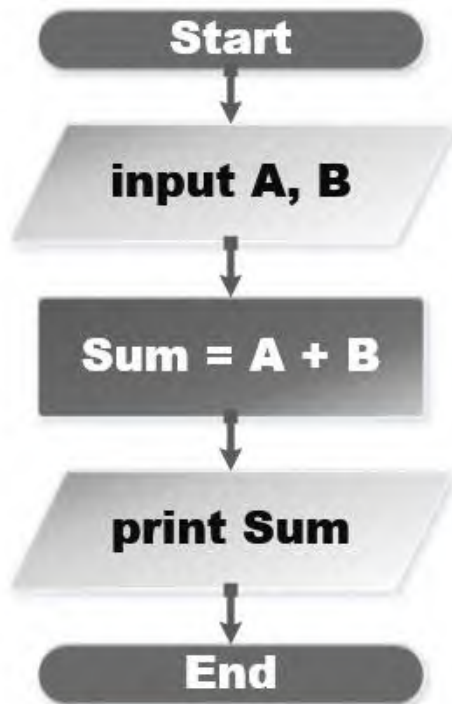
3D Printer- output device designed to print three-dimensional objects, such as product prototypes etc.



Algorithm- a step by step procedure for solving a problem

Flowchart- diagram that represents steps of an algorithm, workflow or process sequentially

Example: adding two numbers; A, B



Pseudo Code- informal description of an algorithm in plain English

Example: adding two numbers; X, Y

Begin

input X

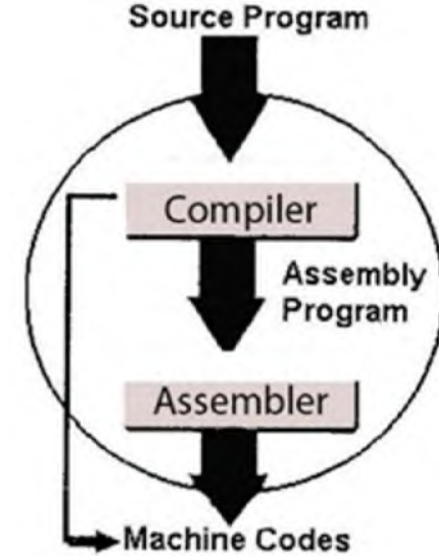
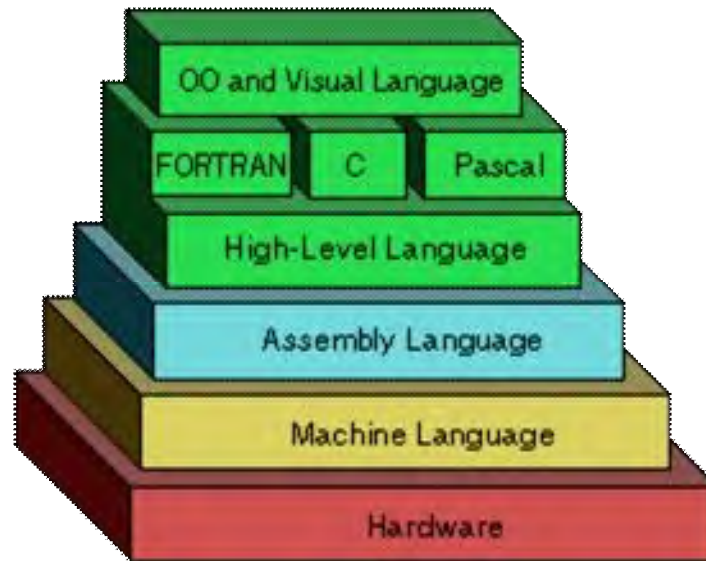
input Y

Sum = X + Y

print Sum

End

Computer Languages



Machine Language-- binary-based language for representing computer programs that the computer can execute directly

Assembly Language- a low-level programming language in which each statement produces exactly one machine instruction

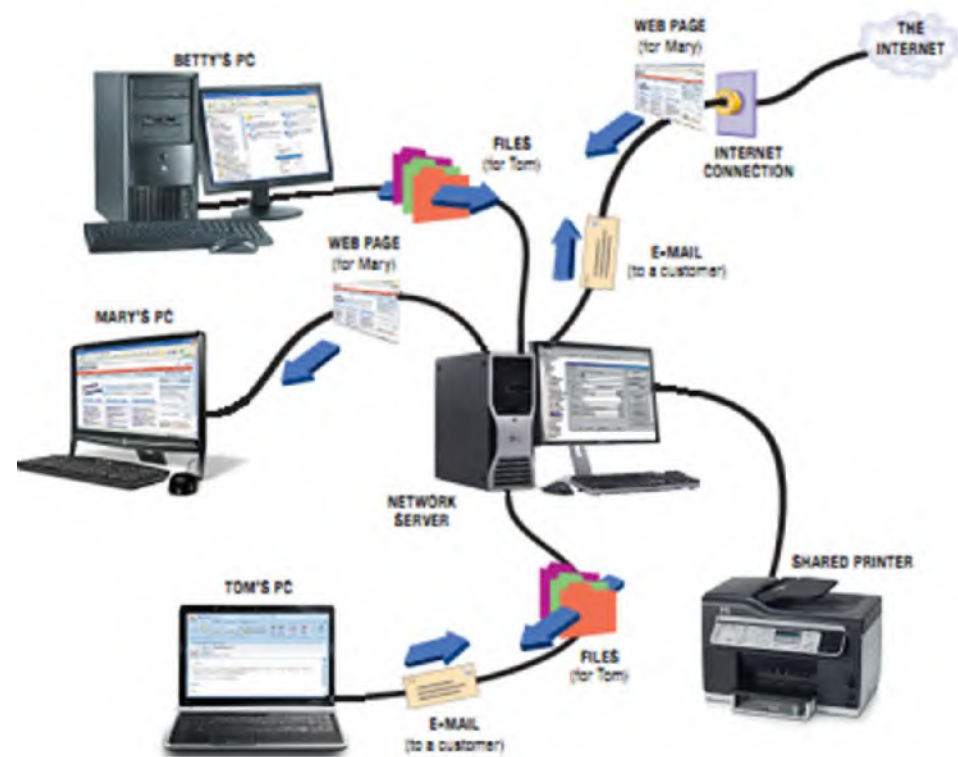
Assembler-- a program for converting Assembly language code into Machine code

High-level Language- more understandable and portable language in which each statement accomplish substantial tasks

Compiler- a program for converting High-level language code into low-level code or binary form

What is computer network?

❑ collection of computers and other hardware devices that are connected together to share hardware, software, and data, as well as to communicate electronically with one another



Internet

- ❑ the largest computer network in the world

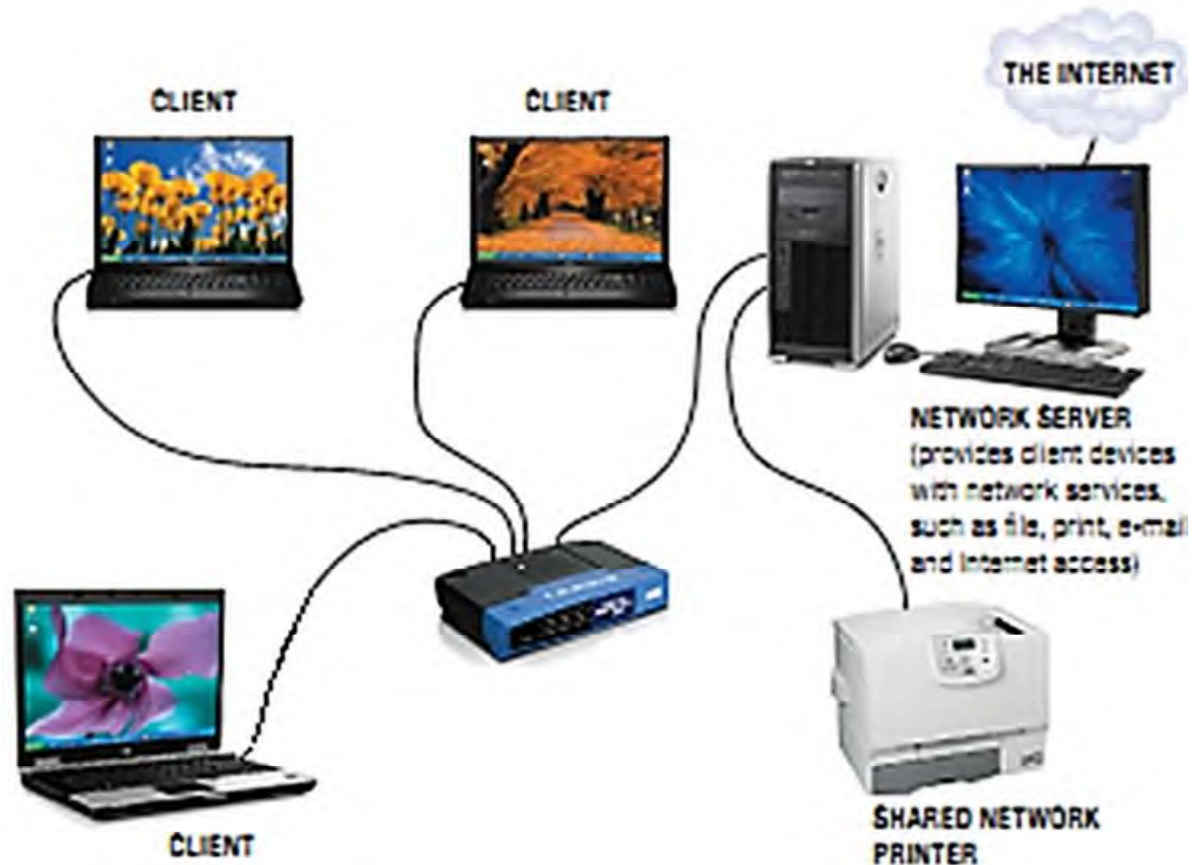
Internet benefits

- ❑ Web Browsing
- ❑ E-mail
- ❑ Chatting and Entertainment
- ❑ Communication & business
- ❑ Information sharing



Types of networks: 1. Local Area Network (LAN)

- A network that connects devices located in a small geographical area, such as within a building



Types of networks: 2. Metropolitan Area Network (MAN)

- A network designed to service a metropolitan area



Types of networks: 3. Wide Area Network (WAN)

- ❑ A network that connects devices located in a large geographical area



Operating System

- ❑ The main component of system software that enables the computer to manage its activities and the resources under its control, run application programs, and interface with the user

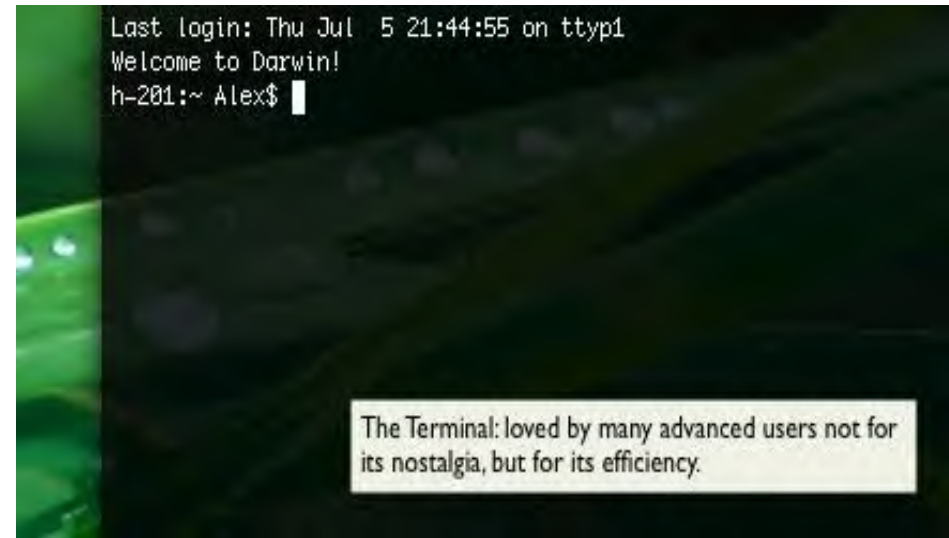
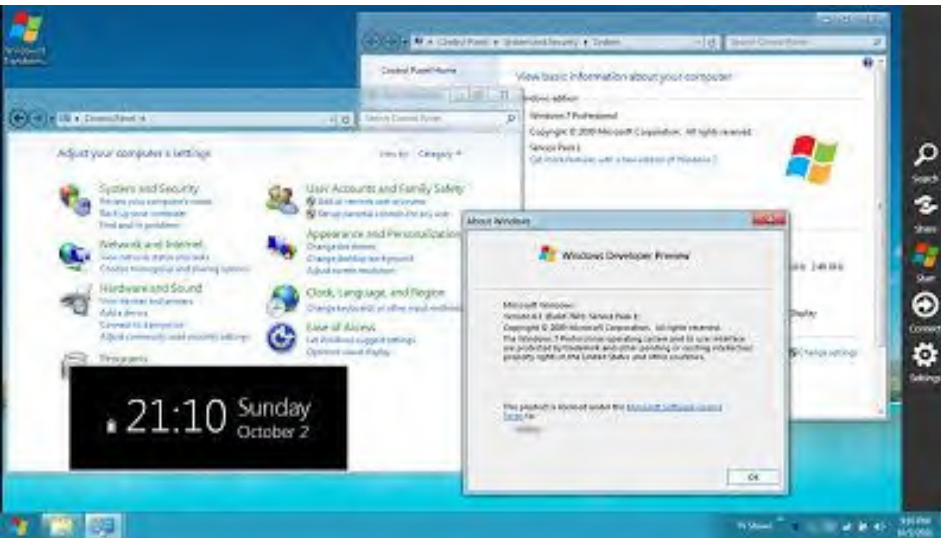


Function/Benefits of operating system

- ❑ Interfacing with Users
- ❑ Booting the Computer
- ❑ Configuring Devices
- ❑ Managing and Monitoring Resources and Jobs
- ❑ File Management
- ❑ Security



Differences among Operating Systems

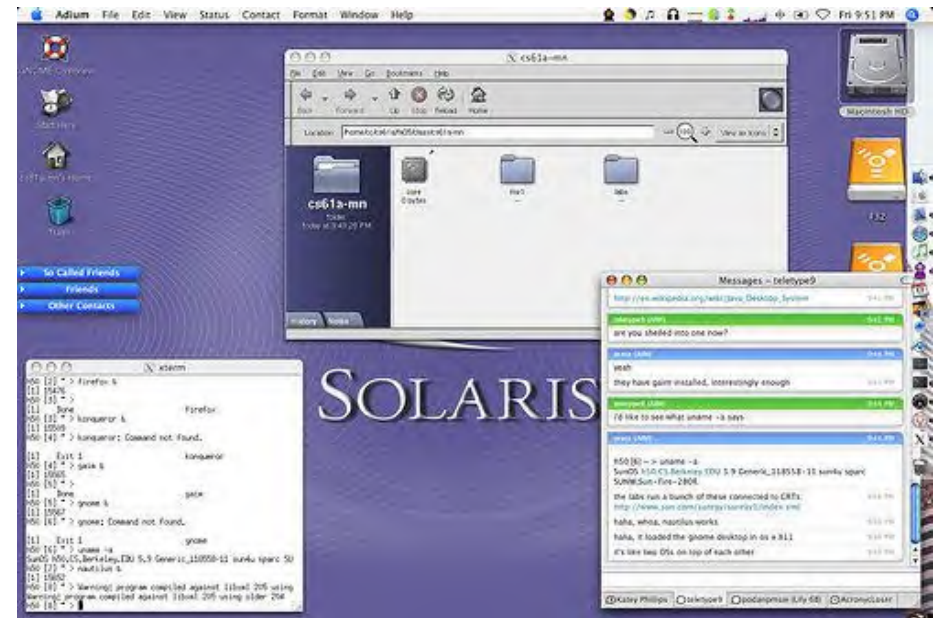
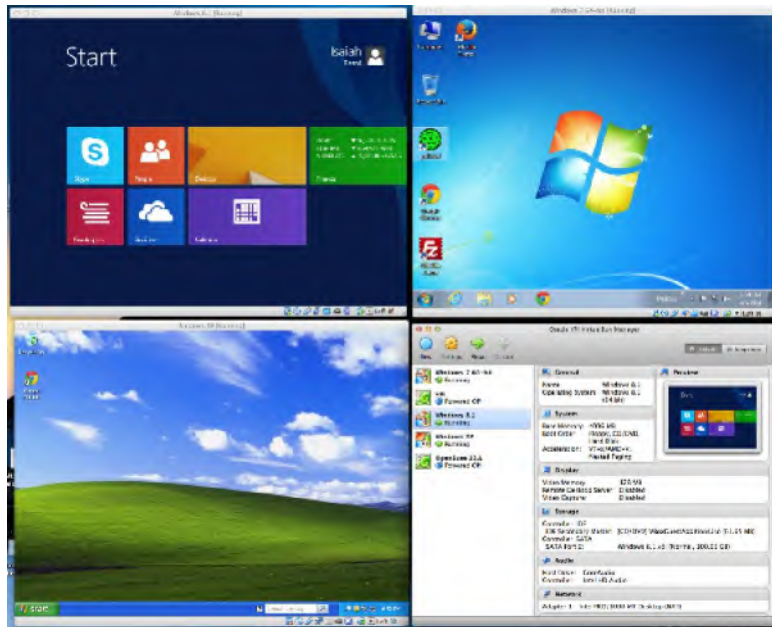


Graphical User Interface vs. Command Line

Graphical user interface (GUI) – graphics-based interface that allows a user to communicate instructions to the computer easily

Command line interface-- user interface that requires the user to communicate instructions to the computer via typed commands

Differences among Operating Systems



Types of Operating Systems

Personal operating system-- a type of operating system designed to be installed on a single personal computer

Server operating system-- a type of operating system designed to be installed on a network server