Introduction to Computers

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Introduction

- Today, computers are virtually everywhere in our society.
- People encounter and use computers and computing technology many times during the average day.
- Individuals use personal computers and mobile devices both at home and while on the go to perform a variety of important daily tasks, such as to pay bills, shop, manage investments, communicate with others, research products, make travel arrangements, check current news and weather, look up phone numbers, and view maps of locations.

Introduction (Contd.)

- They also use these devices for a growing number of entertainment purposes, such as playing games, downloading and listening to music, viewing friends' Facebook pages, and watching TV shows and movies.
- Businesses, schools, government agencies, and other organizations use computers and related technologies to facilitate day-to-day transactions, provide better services to customers, communicate with others, retrieve and disseminate information, and assist managers in making good decisions.
- Because they are so embedded in our society today, it is essential for everyone to know something about computers and what they can do.

Digital and Analog Computers

Analog	Digital
Analog computer works with continuous values.	Digital computers works with discrete value **(0,1).** It can work only with digits.
It has very limited memory.	It can store large amount of data.
It has no state.	It has two states ***on*** and ***off***.
It can perform certain types of calculations.	It's speed of calculation is very high.
It is difficult to use.	It is easy to use.
Analog computers is used in engineering and scientific applications.	Digital computer is widely used in almost all fields of life.
Analog computer is used for calculations and measurement of physical quantities such as weight, height, temperature and speed.	Digital computer is used to calculate mathematical and logical operations.
It's accuracy is low.	It's accuracy is comparatively high.
It's readability is low.	It's readability is high.
Examples: Analog Thermometer, analog clock, older weighing machines, car speedometer, voice, radio/tv signal etc.	**Examples:** Digital Thermometer, Digital watches, digital weighing machines, mini computers, micro computers, mainframe computers, super computers etc.

Fig: Digital and Analog Computers

Analog Computer

Vs.

Digital Computer

Computers In Your Life

Why Learn About Computers?

- Fifty years ago, computers were used primarily by researchers and scientists.
- Today, computers are an integral part of our lives. Experts call this trend ***pervasive computing***, in which few aspects of daily life remain untouched by computers and computing technology.
- With ***pervasive computing***—also referred to ***as ubiquitous computing***—computers are found virtually everywhere and computing technology is integrated into an ever-increasing number of devices to give those devices additional functionality, such as enabling them to communicate with other devices on an ongoing basis.

Why Learn About Computers? (Contd.)

- Because of the prominence of computers in our society, it is important to understand what a computer is, a little about how a computer works, and the implications of living in a computer-oriented society:
  - Prior to about 1980, computers were large and expensive, and few people had access to them. Most computers used in organizations were equipped to do little more than carry out high-volume processing tasks, such as issuing bills and keeping track of inventories.
  - Furthermore, the use of computers generally required a lot of technical knowledge and the use of the Internet was reserved primarily for researchers and educational institutions.

Why Learn About Computers? (Contd.)

- Beginning in the early 1980s, things began to change. ***Microcomputers***—inexpensive personal computers were invented and computer use increased dramatically.
- The creation of the **W**orld **W**ide **W**eb **(WWW)** in the late 1980s and the graphical Web browser in the early 1990s started the trend of individuals buying and using computers for personal use.
- Today, portable computers and mobile phones have brought personal computing to a whole new level—nearly 90% of all U.S. households have a computer or mobile phone, and most individuals use some type of computer on the job.

Why Learn About Computers? (Contd.)

- Whether you become a teacher, attorney, doctor, engineer, restaurant manager, salesperson, professional athlete, musician, executive, or skilled tradesperson, you will likely use a computer to obtain and evaluate information, to facilitate necessary on-the-job tasks, and to communicate with others.
- Today’s computers are very useful tools for these purposes; they are also taking on new roles in our society, such as delivering entertainment on demand.
- Hence, basic computer literacy— knowing about and understanding computers and their uses—is an essential skill today for everyone.

Computers In Home

- **Reference:**

  Retrieving information, obtaining news, viewing recipes, shopping online, and exchanging e-mail are popular home computer activities.

- **Productivity:**

  Home computers are frequently used for editing and managing digital photos and home videos, creating and editing work-related documents, paying bills, and other productivity tasks.

- **Entertainment:**

  Home computers and gaming consoles are becoming a central hub for entertainment, such as the delivery of photos, videos, music, games, TV shows, instant messages, and social networking updates.

Computers In Education

- **Computer Labs and Classrooms:**

  Many schools today have computers and Internet access available in the classroom and/or a computer lab for student use.

- **Campus Wireless and Hotspots:**

  Many students can access the Internet from anywhere on campus to do research, check e-mail, and more, via a campus hotspot.

- **Distance Learning:**

  With distance learning, students—such as Nepal army soldiers—can take classes from home or wherever they happen to be at the moment.

Computers on the Job

- **Decision Making:**

  Many individuals today use a computer to help them make on-the-job decisions.
- **Productivity:**

  Many individuals today use a computer to perform on-the-job tasks efficiently and accurately.
- **Off-site Communications:**

  Many individuals use portable computers or mobile devices to record data, access data, or communicate with others when they are out of the office.
- **Authentication:**

  Many individuals are required to use authentication systems to punch in and out of work, access facilities, or log on to company computers.

Computers on the Go

- **Portable Devices:**

  Many people today carry a portable computer or smartphone with them at all times or when they travel in order to remain in touch with others and to access internet resources.

- **Consumer Kiosks:**

  Electronic kiosks are widely available to view conference or gift registry information, print photographs, order products or services, and more.

- **Mobile Payment Systems:**

  Allow individuals to pay for purchases using a smartphone or other device.

- **Consumer Authentication Systems:**

  Allow only authorized members, such as theme park annual pass holders as shown here, access to facilities.

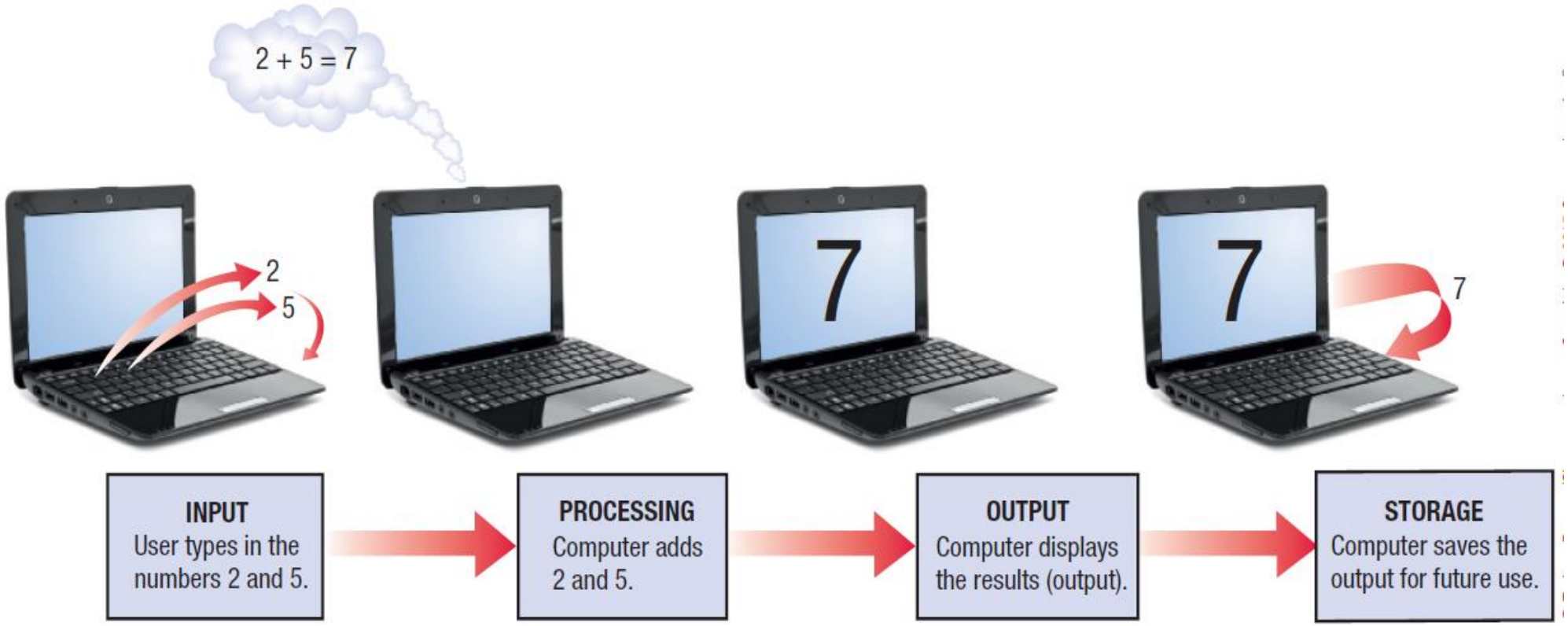
What is a Computer and What does it do?

- A computer can be defined as a programmable, electronic device that ***accepts data***, ***performs operations on that data***, ***presents the results***, and ***stores the data*** or ***results as needed***.
- The fact that a computer is ***programmable*** means that a computer will do whatever the instructions—called the ***program***—tell it to do. The programs used with a computer determine the tasks the computer is able to perform.
- The four operations described in this definition are more technically referred to as ***input***, ***processing***, ***output***, and ***storage***.

What is a Computer and What does it do? (Contd.)

- These four primary operations of a computer can be defined as follows:
  - **Input**: The process of entering data into a computer; can also refer to the data itself.
  - **Processing**: Performing operations on data that has been input into a computer to convert that input to output.
  - **Output**: The process of presenting the results of processing; can also refer to the results themselves.
  - **Storage**: The operation of saving data, programs, or output for future use.

Figure: The Information Processing Cycle (or IPOS Cycle)



What is a Computer and What does it do? (Contd.)

- For an example, look at a supermarket barcode reader to see how it fits this definition of a computer.
  - **First,** the grocery item being purchased is passed over the barcode reader—***input***.
  - **Next,** the description and price of the item are looked up—***processing***.
  - **Then,** the item description and price are displayed on the cash register and printed on the receipt—***output***.
  - **Finally,** the inventory, ordering, and sales records are updated—***storage***.

What is a Computer and What does it do? (Contd.)

- In addition to these four primary computer operations, today's computers almost always perform **communications functions**, such as:
  - Sending or retrieving data via the Internet, accessing information located in a shared company database, or exchanging data or e-mail messages with others.
  - Therefore, ***communications***—technically an input or output operation, depending on which direction the information is going—is often considered the **fifth primary computer operation**.

Characteristics of Computer

Characteristics of Computer

- The invention of modern computers has changed human life dramatically due to the following characteristics processed by it:
  - **Speed:**

    The computer can process data very fast, at the rate of millions of instructions per second. Some calculations that would have taken hours and days to complete otherwise, can be completed in a few seconds using the computer. The speed of computers is measured in Millions Instruction Per Second (MIPS).
  - **Accuracy:**

    Computer provides a high degree of accuracy. The calculations are 100% error-free. Computers perform all jobs with 100% accuracy provided that correct input has been given. It gives false results only when wrong data is entered. This behavior of computer is known as ***GIGO*** (Garbage-in-Garbage-Out).

Characteristics of Computer (Contd.)

- **Storage Capacity:**

  Large volumes of data and information can be stored in the computer and also retrieved whenever required. A limited amount of data can be stored, temporarily, in the primary memory. Secondary storage devices like floppy disk and compact disk can store a large amount of data permanently. It can also store any type of data such as images, videos, text, audio and many others.

- **Diligence:**

  When used for a longer period of time, the computer does not get tired or fatigued. It can perform long and complex calculations with the same speed and accuracy from the start till the end.

Characteristics of Computer (Contd.)

- **Versatility:**

  Computer is versatile in nature. It can perform different types of tasks with the same ease. At one moment you can use the computer to prepare a letter document and in the next moment you may play music or print a document.

- **Automatic:**

  A computer is an automatic machine. Automation means the ability to perform the given task automatically. Once data and programs are given to the computer and stored in computer memory, the program instructions can control the program execution without human interaction. It does not require any help from the user to process it.

Characteristics of Computer (Contd.)

- **No Intelligence:**

  A computer is a machine that has no intelligence to perform any task. A computer cannot take any decision on its own. It performs tasks specified in the instructions given to it. However, nowadays, machine learning algorithms are available that enable computers to processes some degree of intelligence.

- **No Feeling:**

  A computer does not have feelings or emotions. It cannot be sad or happy. However, modern development in machine intelligence enables computers to possess some degree of feelings too.

Data Vs Information

- A user inputs **data** into a computer, and then the computer processes it. Almost any kind of fact or set of facts can become computer data, such as the words in a letter to a friend, the numbers in a monthly budget, the images in a photograph, the notes in a song, or the facts stored in an employee record.
- When data is processed into a meaningful form, it becomes **information**.
- ***Information processing*** (the conversion of data into information) is a vital activity today for all computer users, as well as for businesses and other organizations.

History of Computer

Computers Then (History) and Now

- The basic ideas of computing and calculating are very old, going back thousands of years. However, the computer in the form in which it is recognized today is a fairly recent invention.
- In fact, personal computers have only been around since the late 1970s.
- The history of computers is often referred to in terms of **generations**, with each new generation characterized by a major technological development.
- The next sections summarize some early calculating devices and the different computer generations.

Generations of Computer

Pre-computers and Early Computers (before approximately 1946)

- Based on archeological finds, such as notched bones, knotted twine, and hieroglyphics, experts have concluded that ancient civilizations had the ability to count and compute.
- The ***abacus*** is considered by many to be the earliest recorded calculating device; it was used primarily as an aid for basic arithmetic calculations.
- Other early computing devices include the ***slide rule***, the ***mechanical calculator***, and Dr. Herman Hollerith's ***Punch Card Tabulating Machine and Sorter***.

Pre-computers and Early Computers (before approximately 1946)

- Hollerith’s machine was used to process the 1890 U.S. Census data and it was able to complete the task in two and one half years, instead of the decade it usually took to process the data manually.

- Consequently, this is considered to be the first successful case of an information processing system replacing a paper-and-pen-based system. Hollerith’s company eventually became ***International Business Machines (IBM)***.

First-Generation Computers (approximately 1946–1957)

- The first computers were enormous, often taking up entire rooms. They were powered by thousands of vacuum tubes—glass tubes that look similar to large light bulbs—which needed replacing constantly, required a great deal of electricity, and generated a lot of heat.
- First-generation computers could solve only one problem at a time because they needed to be physically rewired with cables to be reprogrammed, which typically took several days (sometimes even weeks) to complete and several more days to check before the computer could be used. Usually paper punch cards and paper tape were used for input, and output was printed on paper.

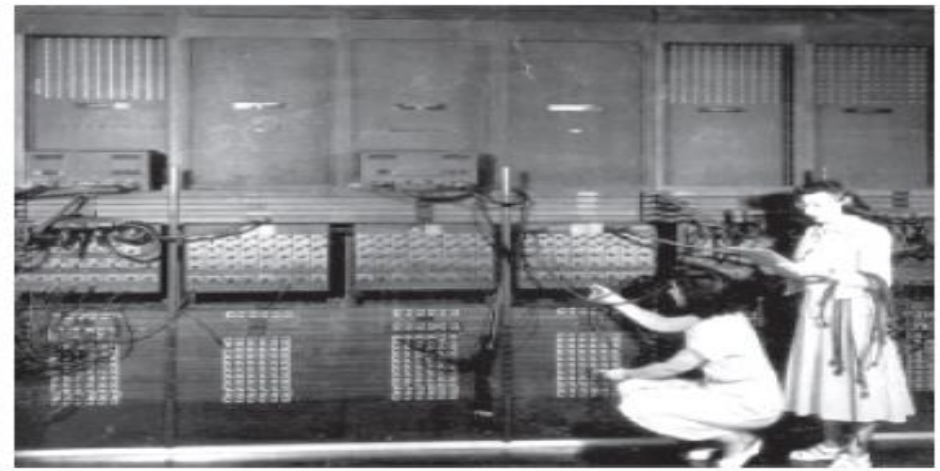
First-Generation Computers (approximately 1946–1957)

- Two of the most significant examples of first-generation computers were ***ENIAC*** and ***UNIVAC***.
- **ENIAC (Electronic Numerical Interrogator and Calculator),** was the world's first large-scale, general purpose computer. Although it was not completed until 1946, ENIAC was developed during World War II to compute artillery firing tables for the U.S. Army.
- Instead of the 40 hours required for a person to compute the optimal settings for a single weapon under a single set of conditions using manual calculations, **ENIAC** could complete the same calculations in less than two minutes.

First-Generation Computers (approximately 1946–1957)

- **UNIVAC (Universal Automatic Computer)**, released in 1951, was initially built for the U.S. Census Bureau and was used to analyze votes in the 1952 U.S. presidential election.
- Interestingly, its correct prediction of an Eisenhower victory only 45 minutes after the polls closed was not publicly aired because the results were not trusted.
- However, UNIVAC became the first computer to be mass produced for general commercial use.

PRECOMPUTERS AND EARLY COMPUTERS
Dr. Herman Hollerith's Punch Card Tabulating Machine and Sorter is an example of an early computing device. It was used to process the 1890 U.S. Census data.



FIRST-GENERATION COMPUTERS
First-generation computers, such as ENIAC shown here, were large and bulky, used vacuum tubes, and had to be physically wired and reset to run programs.

Second-Generation Computers (approximately 1958–1963)

- The second generation of computers began when the ***transistor***—a small device made of ***semiconductor*** material that acts like a switch to ***open or close electronic circuits***—started to replace the vacuum tube.
- ***Transistors*** allowed ***second-generation computers*** to be smaller, less expensive, more powerful, more energy-efficient, and more reliable than first-generation computers.
- Typically, programs and data were input on punch cards and magnetic tape, output was on punch cards and paper printouts, and magnetic tape was used for storage.
- Hard drives and programming languages (such as **FORTRAN** and **COBOL**) were developed and implemented during this generation.

Third-Generation Computers (approximately 1964–1970)

- The replacement of the transistor with ***integrated circuits (ICs)*** marked the beginning of the third generation of computers.
- Integrated circuits incorporate many transistors and electronic circuits on a single tiny silicon ***chip***, allowing ***third-generation computers*** to be even smaller and more reliable than computers in the earlier computer generations.
- Instead of punch cards and paper printouts, ***keyboards*** and ***monitors*** were introduced for input and output; hard drives were typically used for storage.
- An example of a widely used third generation computer is shown in Figure.

SECOND-GENERATION COMPUTERS
Second-generation computers, such as the IBM 1401 mainframe shown here, used transistors instead of vacuum tubes so they were smaller, faster, and more reliable than first-generation computers.

THIRD-GENERATION COMPUTERS
Third-generation computers used integrated circuits, which allowed the introduction of smaller computers such as the IBM System/360 mainframe shown here.

Fourth-Generation Computers (approximately 1971–present)

- A technological breakthrough in the early 1970s made it possible to place an increasing number of transistors on a single chip. This led to the invention of the ***microprocessor*** in 1971, which ushered in the fourth generation of computers.
- In essence, a microprocessor contains the core processing capabilities of an entire computer on one single chip.
- The original ***IBM PC*** and ***Apple Macintosh computers,*** and most of today's traditional computers, fall into this category.
- ***Fourth-generation computers*** typically use a ***keyboard*** and ***mouse*** for input, a ***monitor*** and ***printer*** for output, and ***hard drives***, ***flash memory media***, and ***optical discs*** for storage. This generation also witnessed the development of ***computer networks***, ***wireless technologies***, and the ***Internet***.

Fifth-Generation Computers (now and the future)

- ***Fifth-generation computers*** are most commonly defined as those that are based on ***artificial intelligence***, allowing them to think, reason, and learn.
- Some aspects of fifth-generation computers—such as voice and touch input and ***speech recognition***—are being used today.
- In the future, fifth-generation computers are expected to be constructed differently than they are today, such as in the form of ***optical computers*** that process data using light instead of electrons, tiny computers that utilize ***nanotechnology***, or as entire general-purpose computers built into desks, home appliances, and other everyday devices.

FOURTH-GENERATION COMPUTERS
Fourth-generation computers, such as the original IBM PC shown here, are based on microprocessors. Most of today's computers fall into this category.

FIFTH-GENERATION COMPUTERS
Some aspects of fifth-generation computers, such as the natural language input and artificial intelligence used by the IBM Watson computer shown competing on *Jeopardy!* here, already exist.

Classification of Computer

COMPUTERS TO FIT EVERY NEED

- The types of computers available today vary from the tiny computers embedded in consumer products, to the mobile devices that do a limited number of computing tasks, to the powerful and versatile desktop and portable computers found in homes and businesses, to the super powerful computers used to control the country’s defense systems.

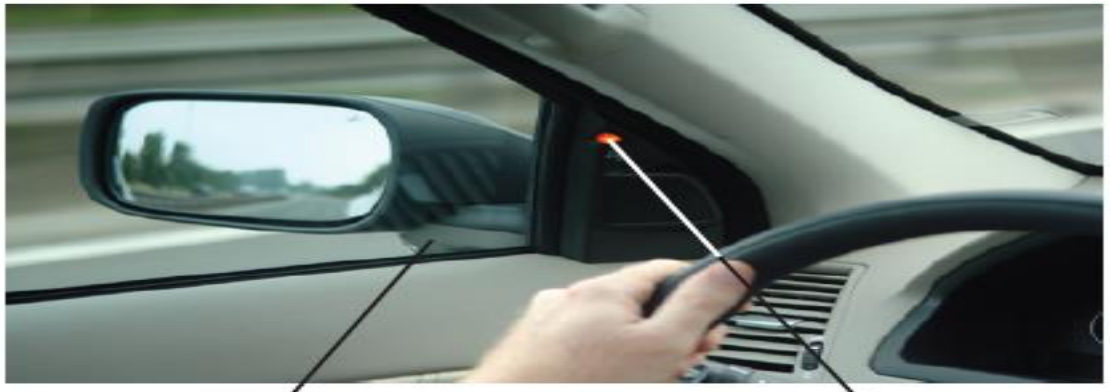
- Computers are generally classified in one of six categories, based on size, capability, and price.

COMPUTERS TO FIT EVERY NEED (Contd.)

- ***Embedded computers***—tiny computers embedded into products to perform specific functions or tasks for that product.
- ***Mobile devices***—mobile phones, small tablets, and other small personal devices that contain built-in computing or Internet capabilities.
- ***Personal computers***—fully functioning portable or desktop computers that are designed to be used by a single individual at a time.
- ***Servers***—computers that host data and programs available to a small group of users.
- ***Mainframe computers***—powerful computers used to host a large amount of data and programs available to a wide group of users.
- ***Supercomputers***—extremely powerful computers used for complex computations and processing.

Embedded Computers

- An embedded computer is a tiny computer embedded into a product designed to perform specific tasks or functions for that product.
- For example, computers are often embedded into household appliances (such as dishwashers, microwaves, ovens, coffeemakers, and so forth), as well as into other everyday objects (such as thermostats, answering machines, treadmills, sewing machines, DVD players, and televisions), to help those appliances and objects perform their designated tasks.



Mobile Devices

- A ***mobile device*** is loosely defined as a very small (typically pocket-sized) device that has built-in computing or Internet capability.
- Mobile phones are the most common type of mobile device and can typically be used to make telephone calls, send text messages (short text-based messages), view Web pages, take digital photos, play games, download and play music, watch TV shows, and access calendars and other personal productivity features. Mobile phones that include computing and Internet capabilities are called ***smartphones*** (less capable mobile phones are sometimes referred to as feature phones).
- Handheld gaming devices (such as the Nintendo 3DS), portable digital media players (such as the iPod Touch), smart watches, and other personal devices that include Internet capabilities can also be referred to as mobile devices.

Personal Computers (PCs)

- A personal computer (PC) or microcomputer is a small computer designed to be used by one person at a time. Personal computers are widely used by individuals and businesses today and are available in a variety of shapes and sizes.
- Personal computer can be classified as under:
  - ***Desktop Computers:*** Conventional personal computers that are designed to fit on or next to a desk are often referred to as desktop computers.
  - ***Portable Computers:*** Portable computers are fully functioning computers designed to be carried around easily. This portability makes them very flexible. They can be used at home or in the office; they can also be used at school, while on vacation, at off-site meetings, and other locations. E.g. Notebook computers (laptop computers), Tablet computers, Hybrid Notebook-Tablets etc.

Servers

- A ***server***—also sometimes called a midrange server, minicomputer, or midrange computer— is a computer used to host programs and data for a small network.
- Typically larger, more powerful, and more expensive than a desktop computer, a server is usually located in an out-of-the-way place and can serve many users at one time.
- Users connect to the server through a network, using their desktop computer, portable computer, consisting of just a monitor and keyboard.
- Servers are often used in small- to medium-sized businesses (such as medical or dental offices), as well as in school computer labs.
- There are also special home servers designed for home use, which are often used to back up (make duplicate copies of) the content located on all the computers in the home automatically and to host music, photos, movies, and other media to be shared via a home network.

Mainframe Computers

- A mainframe computer is a powerful computer used by many large organizations—such as hospitals, universities, large businesses, banks, and government offices—that need to manage large amounts of centralized data.
- Larger, more expensive, and more powerful than servers, mainframes can serve thousands of users connected to the mainframe via personal computers in a manner similar to the way users connect to servers.
- Mainframe computers are typically located in climate controlled data centers and are connected to the rest of the company computers via a computer network.
- During regular business hours, a mainframe typically runs the programs needed to meet the different needs of its wide variety of users. At night, it commonly performs large processing tasks, such as payroll and billing.
- Today's mainframes are sometimes referred to as ***high-end servers*** or ***enterprise-class servers*** and they usually cost at least several hundred thousand dollars each.

Mainframe Computers (Contd.)

- One issue facing businesses today is the high cost of electricity to power and cool the mainframes, servers, and personal computers used in an organization.
- Virtualization is often used today to utilize a company's mainframes more efficiently.

Super Computers

- Some applications require extraordinary speed, accuracy, and processing capabilities—for example, sending astronauts into space, controlling missile guidance systems and satellites, forecasting the weather, exploring for oil, breaking codes, and designing and testing new products.
- Supercomputers—the most powerful and most expensive type of computer available—were developed to fill this need.
- Some relatively new supercomputing applications include hosting extremely complex Web sites (such as search sites and social networking sites) and three-dimensional applications (such as 3D medical imaging, 3D image projections, and 3D architectural modeling).
- Unlike mainframe computers, which typically run multiple applications simultaneously to serve a wide variety of users, supercomputers generally run one program at a time, as fast as possible.

Super Computers (Contd.)

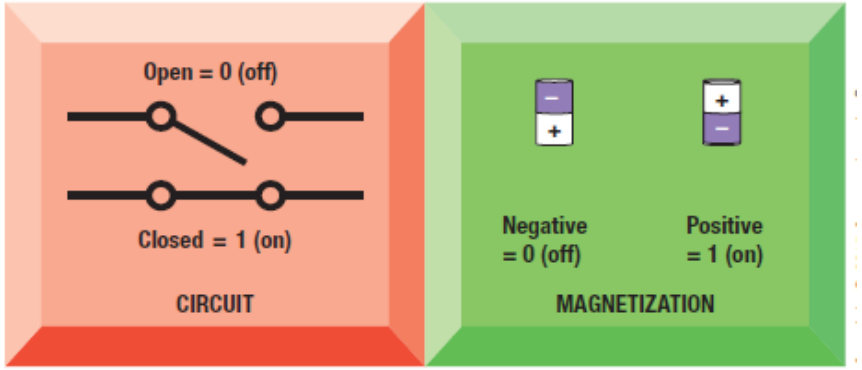
- Conventional supercomputers can cost several million dollars each. They tend to be very large and contain a large number of CPUs. For example, the Titan supercomputer shown in Figure occupies 4,352 square feet of floor space and contains 299,008 CPUs.

- This supercomputer is being installed at the U.S. Department of Energy Oak Ridge National Laboratory and is expected to be used for a variety of scientific research, including climate change and astrophysics. Titan is one of the fastest computers in the world.

DATA AND PROGRAM REPRESENTATION

Digital Data Representation

- In order to be understood by a computer, data and software programs need to be represented appropriately. Consequently, coding systems are used to represent data and programs in a manner that can be understood by the computer.
- Virtually all computers today—such as the embedded computers, mobile devices, personal computers, servers, mainframes, and supercomputers discussed earlier—are digital computers. Most digital computers are binary computers, which can understand only two states, usually thought of as off and on and represented by the digits 0 and 1. Consequently, all data processed by a binary computer must be in binary form (0s and 1s).



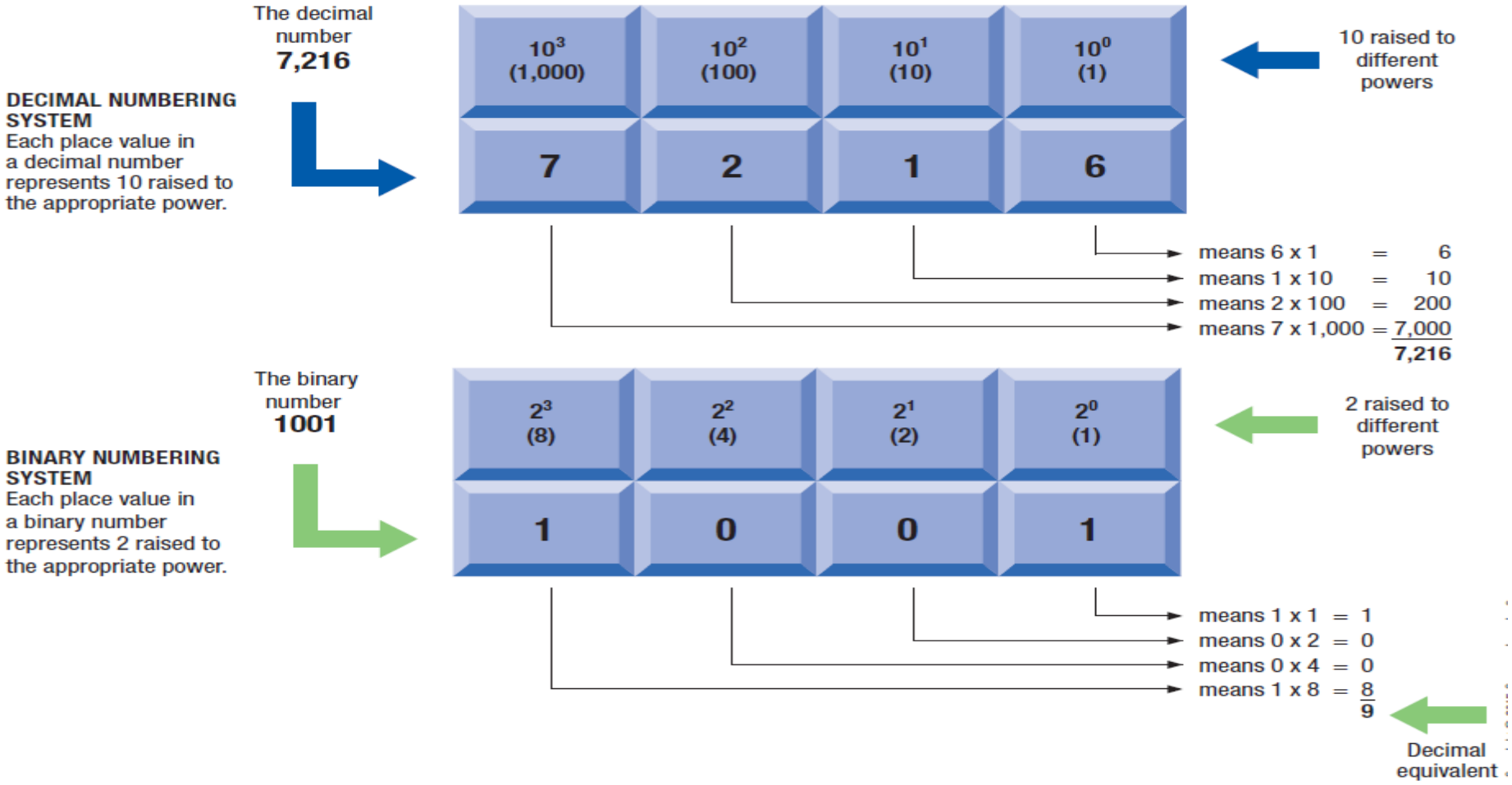
Bits and Bytes

- A bit is the smallest unit of data that a binary computer can recognize. Therefore, the input you enter via a keyboard, the software program you use to play your music collection, the term paper stored on your USB flash drive, and the digital photos located on your mobile phone are all just groups of bits.
- Representing data in a form that can be understood by a digital computer is called digital data representation.
- For instance, a **kilobyte (KB)** is equal to 1,024 bytes, but is usually thought of as approximately 1,000 bytes; a **megabyte (MB)** is about 1 million bytes; a **gigabyte (GB)** is about 1 billion bytes; a **terabyte (TB)** is about 1 trillion bytes; a **petabyte (PB)** is about 1,000 **terabytes (2^{50} bytes)**; an **exabyte (EB)** is about 1,000 **petabytes (2^{60} bytes);** a **zettabyte (ZB)** is about 1,000 **exabytes (2^{70} bytes)**; and a **yottabyte (YB)** is about 1,000 **zettabytes (2^{80} bytes)**.

Representing Numerical Data: The Binary Numbering System

- A numbering system is a way of representing numbers.
- The numbering system we commonly use is called the decimal numbering system because it uses 10 symbols—the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9—to represent all possible numbers.
- Numbers greater than nine, such as 21 and 683, are represented using combinations of these 10 symbols.
- The binary numbering system uses only two symbols—the digits 0 and 1—to represent all possible numbers.
- Consequently, binary computers use the binary numbering system to represent numbers and to perform math computations.

Examples of using the decimal and binary numbering systems.



Coding Systems for Text-Based Data

- While numeric data is represented by the binary numbering system, text-based data is represented by binary coding systems specifically developed for text-based data—namely,
  - **ASCII**
  - **EBCDIC**
  - **Unicode**
- These codes are used to represent all characters that can appear in text data—such as numbers, letters, and special characters and symbols like the dollar sign, comma, percent symbol, and mathematical symbols.

ASCII and EBCDIC

- **ASCII** (**American Standard Code for Information Interchange**) is the coding system traditionally used with personal computers. **EBCDIC** (**Extended Binary-Coded Decimal Interchange Code**) was developed by IBM, primarily for use with mainframes.
- **ASCII** is a 7-digit (7-bit) code, although there are several different 8-bit extended versions of ASCII that contain additional symbols not included in the 7-bit ASCII code. The ***extended ASCII*** character sets (see some examples of 8-bit ASCII codes in Figure) and ***EBCDIC*** represent each character as a unique combination of 8 bits (1 byte), which allows 256 (2^8) unique combinations.
- Therefore, an 8-bit code can represent up to 256 characters (twice as many as a 7-bit code)—enough to include the characters used in the English alphabet, as well as some non-English characters, the 10 digits used in the decimal numbering system, the other characters usually found on a keyboard, and many special characters not included on a keyboard such as mathematical symbols, graphic symbols, and additional punctuation marks.

ASCII and EBCDIC (Representation)

Character	ASCII Code (Decimal)	ASCII Code (Binary)
0	48	00110000
1	49	00110001
2	50	00110010
A	65	01000001
B	66	01000010
a	97	01100001
b	98	01100010
#	35	00100011
+	43	00101011

Character	EBCDIC (Decimal)	EBCDIC Code (Binary)
0	240	11110000
1	241	11110001
2	242	11110010
A	193	11000001
B	194	11000010
a	129	10000001
b	130	10000010
#	123	01111011
+	78	01001110

ASCII (Representation)

ASCII – Binary Character Table

Letter	ASCII Code	Binary	Letter	ASCII Code	Binary
a	097	01100001	A	065	01000001
b	098	01100010	B	066	01000010
c	099	01100011	C	067	01000011
d	100	01100100	D	068	01000100
e	101	01100101	E	069	01000101
f	102	01100110	F	070	01000110
g	103	01100111	G	071	01000111
h	104	01101000	H	072	01001000
i	105	01101001	I	073	01001001
j	106	01101010	J	074	01001010
k	107	01101011	K	075	01001011
l	108	01101100	L	076	01001100
m	109	01101101	M	077	01001101
n	110	01101110	N	078	01001110
o	111	01101111	O	079	01001111
p	112	01110000	P	080	01010000
q	113	01110001	Q	081	01010001
r	114	01110010	R	082	01010010
s	115	01110011	S	083	01010011
t	116	01110100	T	084	01010100
u	117	01110101	U	085	01010101
v	118	01110110	V	086	01010110
w	119	01110111	W	087	01010111
x	120	01111000	X	088	01011000
y	121	01111001	Y	089	01011001
z	122	01111010	Z	090	01011010

EBCDIC (Representation)

Each code is shown in decimal, hexadecimal, and character form

129	81	a	193	C1	A	240	F0	0
130	82	b	194	C2	B	241	F1	1
131	83	c	195	C3	C	242	F2	2
132	84	d	196	C4	D	243	F3	3
133	85	e	197	C5	E	244	F4	4
134	86	f	198	C6	F	245	F5	5
135	87	g	199	C7	G	246	F6	6
136	88	h	200	C8	H	247	F7	7
137	89	i	201	C9	I	248	F8	8
						249	F9	9
145	91	j	209	D1	J			
146	92	k	210	D2	K	64	40	blank
147	93	l	211	D3	L	76	4C	<
148	94	m	212	D4	M	77	4D	(
149	95	n	213	D5	N	78	4E	+
150	96	o	214	D6	O	79	45	|
151	97	p	215	D7	P	80	50	&
152	98	q	216	D8	Q	90	5A	!
153	99	r	217	D9	R	91	5B	$
						92	5C	*
162	A2	s	226	E2	S	93	5D	)
163	A3	t	227	E3	T	94	5E	;
164	A4	u	228	E4	U	96	60	-
165	A5	v	229	E5	V	97	61	/
166	A6	w	230	E6	W	107	6B	,
167	A7	x	231	E7	X	108	6C	%
168	A8	y	232	E8	Y	109	6D	_
169	A9	z	233	E9	Z	110	6E	>
						111	6F	?
122	7A	:	125	7D	'			
123	7B	#	126	7E	=			
124	7C	@	127	7F	"			

Unicode

- Unlike ASCII and EBCDIC, which are limited to only the Latin alphabet used with the English language, Unicode is a **universal international coding standard** designed to represent text-based data written in any ancient or modern language, including those with different alphabets, such as Chinese, Greek, Hebrew, Amharic, Tibetan, and Russian (see Figure).
- Unicode uniquely identifies each character using 0s and 1s, no matter which language, program, or computer platform is being used.
- Unicode is quickly replacing ASCII as the primary text-coding system. In fact, Unicode includes the ASCII character set so ASCII data can be converted easily to Unicode when needed. Unicode is used by most Web browsers and is widely used for Web pages and Web applications (Google data, for instance, is stored exclusively in Unicode).
- Most recent software programs, including the latest versions of Microsoft Windows, Mac OS, and Microsoft Office, also use Unicode, as do modern programming languages, such as Java and Python. Unicode is updated regularly to add new characters and new languages not originally encoded—the most recent version is Unicode 15.0.0.

Unicode (Figure)

Coding Systems for Other Types of Data

- Multimedia data, such as graphics, audio, and video data, must also be represented in binary form in order to be used with a computer, as discussed next.
- **Graphics Data:**

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).

Coding Systems for Other Types of Data (Contd.)

- **Audio:**
  - Like graphics data, audio data—such as a song or the sound of someone speaking—must be in digital form in order to be stored on a storage medium or processed by a computer. To convert analog sound to digital sound, several thousand samples—digital representations of the sound at particular moments—are taken every second. When the samples are played back in the proper order, they re-create the sound of the voice or music.
  - For example, audio CDs record sound using 2-byte samples, which are sampled at a rate of 44,100 times per second.
  - For example, files that are MP3-encoded—that is, compressed with the MP3 compression algorithm developed by the Motion Pictures Expert Group (MPEG)—are about 10 times smaller than their uncompressed digital versions, so they download 10 times faster and take up one-tenth of the storage space second.

Coding Systems for Other Types of Data (Contd.)

- **Video Data:**
  - Video data—such as home movies, feature films, video clips, and television shows—is displayed using a collection of frames; each frame contains a still image. When the frames are projected one after the other (typically at a rate of 24 frames per second (fps) for film based video and 30 or 60 fps for video taken with digital video cameras), the illusion of movement is created.
  - With so many frames, the amount of data involved in showing a two-hour feature film can be substantial. Fortunately, like audio data, video data can be compressed to reduce it to a manageable size.
  - For example, a two-hour movie can be compressed to fit on a single DVD disc; it can be compressed even further to be delivered over the Web.

Representing Software Programs: Machine Language

- Just as numbers, text, and multimedia data must be represented by 0s and 1s, software programs must also be represented by 0s and 1s.
- Before a computer can execute any program instruction, such as requesting input from the user, moving a file from one storage device to another, or opening a new window on the screen, it must convert the instruction into a binary code known as **machine language**.
- An example of a typical machine language instruction is as follows:

01011000011100000000000100000010

- A machine language instruction might look like a meaningless string of 0s and 1s, but it actually represents specific operations and storage locations.
- Early computers required programs to be written in machine language, but today's computers allow programs to be written in a programming language, which is then translated by the computer into machine language in order to be understood by the computer.

Applications of Computers (Uses)

- Science and Engineering
- Education and Research
- Businesses and Research
- Entertainment
- Banking
- Insurance
- Health Care
- Military

Applications of Computers (Uses)

- **Science and Engineering**

  Computers are widely used in scientific calculations and for engineering purposes. One of the major areas is CAD (Computer-aided design), which provides the creation and modification of maps and sketches of buildings, cars etc.

- **Education and Research**

  The computer has provided a lot of facilities for education and research. Computer-based education involves control, delivery, and evaluation of learning. It is used to prepare manuals, prepare a database about the performance of student and analysis is carried out on this basis. Even distance learning is made productive and effective through internet and video-based classes. Researchers have massive usage of computers in their work from the starting till the end of their scholarly work. They use computers for doing analysis, preparing research reports etc.

Applications of Computers (Uses)

- **Business and Industries**

  A computer has high speed of calculation, diligence, accuracy, reliability, or versatility which makes it useful in all business organizations. The computer is used in business organizations for payroll calculations, budgeting, sales analysis, Financial forecasting, managing employee's databases, maintenance of stocks etc.

- **Entertainment**

  Computers are now the major entertainers and the primary time pass machines. We can use computers for playing games, watching movies, listening to music, drawing pictures etc.

Applications of Computers (Uses)

- **Banking**

  Today banking totally dependent on computers. We know well that computers are being used by financial institutions like banks for different purposes. The foremost important thing is to store information about different account holders in database so that it will be available at any time and is accessible from anywhere. Besides these, computers are used for keeping records of the cash flow, giving the information regarding your account etc.

- **Insurance**

  Insurance companies are keeping all records up-to-date with the help of computers. Insurance companies are maintaining a database of all clients with information showing procedure to continue with policies, starting date of the policies, next due installment of a policy, maturity date, calculating bonus etc.

Applications of Computers (Uses)

- **Health Care**

  Computers have become an important part of hospitals and labs. The computers are being used in hospitals to keep the record of patients and medicines. It is also used in scanning and diagnosing different diseases. ECG, ultrasounds, CT Scans, etc. are also done by computerized machines.

- **Military**

  Computers are largely used in defence. Modern tanks, missiles, weapons etc. also employ computerized control systems. Some military areas where a computer has been used are: missile control, military communication, smart weapons, etc.

THANK YOU!