Unit 1 Tutorials: Computer Basics

INSIDE UNIT 1

Information Systems

by Sophia

WHAT'S COVERED

In today's world, information systems have an enormous impact on business, education, government, entertainment, and a myriad of other areas through which people seek to be productive. Regardless of your expertise with information systems, it is probably safe to assume that you already have experience with one of the core components of an information system: the computer. In this tutorial, we will lay the groundwork for our examination of information systems by first looking at what an information system is, as well as its requisite components.

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Our discussion breaks down as follows:

1. What Is an Information System?

An **information system** is a combination of technology, people, and processes. This combination collects, creates, distributes, and exploits useful information. Interestingly, when asked to define or describe an information system, most people will start with the ubiquitous “computers” or “databases.” However, careful inspection of our definition implies that information systems refer to both the components that make up an information system and the role that those components play within an organization.

Information systems can be incredibly complex depending on both the size and scope of the organization utilizing the system. In spite of varying levels of complexity, information systems consist of five components: hardware, software, data, people (I.T. professionals, software developers, system administrators, analysts), and process. The first three components fit under the category of technology and are what most people think of when trying to define an information system. The last two — people and process — are what separate the idea of information systems from the more technical fields, such as computer science. When thinking about information systems, it is easy to get focused on the technology components and forget that we must look beyond these tools to fully understand how they integrate into an organization. From the frontline help desk workers to systems analysts and programmers, all the way up to the chief information officer, the people involved with information systems are an essential element that must not be overlooked.

A process is a series of steps undertaken to achieve a desired outcome or goal. Information systems are becoming more and more integrated with organizational processes, bringing more productivity and better control to those processes. But, simply automating activities using technology is not enough. Using technology to manage and improve processes is the ultimate goal. Businesses hoping to gain an advantage over their competitors are highly focused on this component of information systems.

Data refers to information. The best way to think about data is as a collection of facts. For example, your street address, the city you live in, and your phone number are all pieces of data. As technology has developed, the role of the computer within an information system has increased due to its ability to take data and transform it into meaningful information that organizations can use to make decisions.

Information System

A combination of technology, people, and processes that collects, creates, distributes, and exploits useful information.

Data

Information, or a collection of facts.

2. What Is a Computer?

The computer lies at the core of modern information systems. If you have ever typed a paper, sent or received an email message, browsed the Internet, or played a video game, then you have undoubtedly experienced what a computer is capable of.

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A **computer** is an electronic device that uses a combination of hardware and software to manipulate data. **Hardware** is the part of the information system that you can touch — the physical components of the technology. Computers, keyboards, flash drives, iPads, and monitors are all examples of hardware. Computer hardware is further classified based on its overall function within the system. A **peripheral** is a hardware component that is not natively part of the system. For example, a printer is a physical component; however, it is not a native part of the computer system and it must be purchased separately.

Software is the set of instructions that tells the hardware what to do. The primary distinction between hardware and software is that software is not tangible — it cannot be touched. Examples of application software are Microsoft Excel and Microsoft Word. Virtually all tasks completed with a computer will rely on hardware and software. For example, you may be viewing this tutorial in a web browser (software) and using your mouse (hardware) to navigate from page to page through this tutorial.

In addition to the components of hardware, software, and data, another component is communication. An information system cannot exist without the ability to communicate. A **computer network** is a group of computers connected for the purpose of communication — the sharing of data and resources. The Internet is perhaps one of the most common examples of a computer network. In fact, the Internet is a global computer network comprised of smaller networks (academic, professional, personal) that are connected to each other.

DID YOU KNOW

The first personal computers were stand-alone machines that did not access networks such as the Internet. However, in today's hyper-connected world, it is extremely rare that a computer does not connect to another device or to a network.

TERMS TO KNOW

Computer

An electronic device that uses a combination of hardware and software to manipulate data.

Hardware

The part of the information system that you can touch; the physical components of the technology.

Peripheral

A hardware component that is not natively a part of the system.

Software

The set of instructions that tells the hardware what to do.

Computer Network

A group of computers connected for the purpose of communication-sharing of data and resources.

SUMMARY

In this tutorial, you learned **what an information system is**, and why people and organizations utilize them. We discussed the five key elements present in any information system: hardware, software, networks, people, and data. Additionally, you were introduced to the idea of **the computer** as the central component of an information system, due to its data manipulation capabilities.

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TERMS TO KNOW

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History of Computers

by Sophia

WHAT'S COVERED

In this tutorial, we will examine the history of computers, as well as the motivations behind their invention and continued innovation, starting in the mainframe era and gradually progressing through the development of the modern PC and the first computer network. We will take a look at the evolution of the computer and how the computer forms the technological backbone of modern information systems.

Our discussion breaks down as follows:

1. The Mainframe Era

The world's first computers were not very personal. These first business computers were room-sized monsters, with several refrigerator-sized machines linked together. Due to the enormity of these early computers, they were dubbed "mainframe computers." The period of time in which they were developed is often referred to as "The Mainframe Era." During the mainframe era, teams of engineers were required to maintain and keep computers operational.

In most cases, only large businesses, universities, and government agencies could afford computers. The primary work of these devices was to organize and store large volumes of data that were tedious to manage by hand. In fact, from the late 1950s through the 1960s, computers were seen as a way to more efficiently perform mathematical calculations. One of the first and most famous of these, the Electronic Numerical Integrator Analyzer and Computer (ENIAC), was built for the sole purpose of ballistics calculations for the U.S. military during World War II.

DID YOU KNOW

The ENIAC could solve a missile-trajectory problem in 30 seconds that would otherwise take a team of humans 12 hours to complete.

In the late 1960s, the Manufacturing Resources Planning (MRP) systems were introduced. This software, running on a mainframe computer, gave companies the ability to manage the manufacturing process, making it more efficient. From tracking inventory to creating bills of materials and scheduling production, the MRP systems (and later the MRP II systems) gave more businesses a reason to want to integrate computing into their processes. IBM became the dominant mainframe company. Continued improvement in software and the availability of cheaper hardware eventually brought mainframe computers (and their little sibling, the minicomputer) into most large businesses.

2. The Personal Computer (PC) Revolution

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The mainframe computers of the 1950s and 1960s made it clear to businesses and universities that computers, while physically enormous, were also of enormous value and worth the investment put forth by these organizations. As the mainframe computer continued to be adopted by organizations, new technologies were making the idea of a smaller, more personal, computer a reality. The invention of the integrated circuit marked the first major revolution in computing. The integrated circuit made it possible for all of a computer's electrical components to reside on one silicon chip.

The invention of the microprocessor has been regarded as the most significant and everlasting of all modern computing developments. Prior to the microprocessor, a computer would need one integrated circuit for each of its functions; thus resulting in a still fairly large and slow machine. At the size of a thumbnail, a single microprocessor could run a computer's programs, remember information, and manage data with no assistance from any other hardware component. This led the way for devices that were much smaller with much faster computation speeds.

In 1975 the first microcomputer, the Altair 8800, was announced on the cover of*Popular Electronics*. Its immediate popularity sparked the imagination of entrepreneurs everywhere, and there were quickly dozens of companies making these "personal computers." Though at first just a niche product for computer hobbyists, improvements in usability and the availability of practical software led to growing sales.

One of the more prominent of these early personal computer makers was a company known as Apple Computer, headed by Steve Jobs and Steve Wozniak, with the hugely successful "Apple II." Not wanting to be left out of the revolution, in 1981 IBM (teaming with a little company called Microsoft for their operating-system software) hurriedly released their own version of the personal computer, simply called the "PC."

Businesses that had used IBM mainframes for years finally had the permission they needed to bring personal computers into their companies, and the IBM PC took off. Due to the IBM PC's open architecture, it was easy for other companies to copy, or "clone" it. During the 1980s, many new computer companies sprang up, offering less expensive versions of the PC. This would ultimately drive prices down and spur innovation.

Microsoft further developed its Windows operating system and made the PC even easier to use. Common uses for the PC during this period included word processing, spreadsheets, and databases. Organizations now had a way — through technology — to efficiently manage information. Still, these early PCs, for the most part, stood alone as islands of innovation within the larger organization, as they had not yet been connected to any sort of network.

DID YOU KNOW

The IBM PC was named Time magazine's "Man of the Year" for 1982.

3. Networks and the World Wide Web

During the mid-1980s, as computers became more commonplace, businesses began to see the need to connect their computers together as a way to collaborate and share resources. This idea led to businesses developing computer networks. A **computer network** is a group of computers connected for the sole purpose of communication-sharing of data and resources. Initial networking architecture was referred to as **client-server,** a computer system in which a centralized computer provides data to connected computers over a network. Users would log into the centralized computer (the "server") from their PC (the "client") and join the **local area network (LAN),** a computer network that links computers within a building.

As a result of client-server networks, software companies began developing applications that allowed multiple

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users to access the same data at the same time. This evolved into software applications for communicating, with the first really popular use of electronic mail (email) appearing at this time. Networking and data sharing all stayed within the confines of each business. Computers were now seen as tools to collaborate internally, within an organization. In fact, these networks of computers were becoming so powerful that they were replacing many of the functions once performed by the larger mainframe computers, and at a fraction of the cost.

TERMS TO KNOW

Computer Network

A group of computers connected for the purpose of communication and the sharing of data and resources.

Client-Server

Computer system in which a centralized computer provides data to connected computers over a network.

Local Area Network (LAN)

Computer network that links computers within a building.

SUMMARY

Today's PC has gone through an intense **period of evolution** to arrive at the modern computers we use today. Initially motivated by the need to perform calculations more efficiently, computers were developed primarily for government and university organizations. From the **mainframe** units that housed entire rooms to the standalone, unconnected "islands" of the early 80s, computers are now able to multitask. They process data at incredibly high speeds, and are also connected through **computer networks**.

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TERMS TO KNOW

Client-Server

Computer system in which a centralized server provides data to connected computers over a network.

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Computer network that links computers within a building.

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The Primary Functions of a Computer

by Sophia

WHAT'S COVERED

Computers have had a huge impact on the manner in which society operates. Increased efficiency, through automation and organization, only scratches the surface of what computing technology has afforded humanity. In fact, technology has progressed so much that people not utilizing computing technology in their businesses are at a disadvantage, as the computer today has an almost endless array of applications and functions. With consideration to this seemingly limitless potential, at their core, ALL computers perform the same basic functions on data: input, output, processing, and storage. Here we will take a look at the basic functions of a computer.

Our discussion breaks down as follows:

1. Functions of a Computer

For the most part, all personal computers consist of the same basic components: a Central Processing Unit (CPU), memory, circuit board, storage, and input/output devices. All computer applications make use of these components in different ways and combinations. It also turns out that almost every digital device uses the same set of components, so examining the personal computer will give us insight into the structure of a variety of digital devices. Thinking about computers in terms of their basic components, and the functionality associated with each component, reveals the primary functions of the computer in general. Remember that the computer is simply an electronic device that manipulates data. There are four primary functions of a computer — input, output, processing, and storage. These functions describe what is meant by the term “manipulate” when used to describe what a computer is.

2. Input/Output

In order for a personal computer to be useful, it must have channels for receiving input from the user, and channels for delivering output to the user. Input and output are artifacts through which computers communicate and interact with their environments, be it a user, a system, or a hardware. **Input** refers to the mode by which data is put into the computer. All personal computers need components that allow the user to input data. Early computers used simply a keyboard to allow the user to enter data or select an item from a menu to run a program. With the advent of the graphical user interface, the mouse became a standard component of a computer. These two components are still the primary input devices to a personal computer, though variations of each have been introduced. For example, many new devices now use a touch screen as the primary way of entering data. Output devices are essential as well. **Output** refers to the mode by which data is delivered. The most obvious output device is a display, visually representing the state of the computer. Besides displays, other output devices include speakers for audio output and printers for printed output.

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TERMS TO KNOW

Input

Mode by which data enters the computer.

Output

Mode by which data is delivered.

3. Data Processing

The majority of all computing devices have a similar architecture. The core of this architecture is the **central processing unit (CPU).** The CPU can be thought of as the “brains” of the device. The CPU carries out the commands sent to it by the software and returns results to be acted upon. The earliest CPUs were large circuit boards with limited functionality. Today, a CPU is generally on one chip and can perform a large variety of functions. The overall effectiveness of a CPU is determined by its speed. The speed or “clock time” of a CPU is measured in hertz. A hertz is defined as one cycle per second. The CPU’s processing power is increasing at an amazing rate. Besides a faster clock time, many CPU chips now contain multiple processors per chip, working in parallel and balancing the load of instructions to be processed in a shorter time. These chips, known as dual-core (two processors) or quad-core (four processors), increase the processing power of a computer by providing the capability of multiple CPUs.

DID YOU KNOW

In 1965 Gordon Moore, one of the founders of Intel, recognized that microprocessor transistor counts had been doubling every year. His insight eventually evolved into Moore’s Law, which states that the number of transistors on a chip will double every two years. This has been generalized into the concept that computing power will double every two years for the same price point. Another way of looking at this is to think that the price for the same computing power will be cut in half every two years. Though many have predicted its demise, Moore’s Law has held true for over 40 years.

TERM TO KNOW

Central Processing Unit (CPU)

The "brains" of the device; it performs computations and logic operations sent to it by application software, and returns results to be acted upon.

4. Data Storage

A computer without an adequate amount of memory would only be able to perform limited instructions with data being output immediately. For example, a calculator provides users with fixed mathematical operations that are stored in memory. When a user performs any of the fixed operations on two or more operands, the calculator immediately displays the answer as an output on its screen. This is fine in situations where it is known beforehand that only mathematical computation is required; however, people who utilize PCs need a device that is more versatile. Remember that the CPU is what processes data by carrying out instructions. Modern computers place fast small storage options close in proximity to the CPU and slower larger storage options further away from the CPU.

When a computer starts up, it begins to load information from the hard disk into its working memory. A hard

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disk is where data is stored when the computer is turned off and where it is retrieved from when the computer is turned on. Why is it called a hard disk? A hard disk consists of a stack of disks inside a hard metal case. This working memory, called **random-access memory (RAM)**, can transfer data much faster than the hard disk. Any program that you are running on the computer is loaded into RAM for processing.

In order for a computer to work effectively, a minimal amount of RAM must be installed. In most cases, adding more RAM will allow the computer to run faster. Another characteristic of RAM is that it is **volatile.** This means that it can store data as long as it is receiving power; when the computer is turned off, any data stored in RAM is lost. Even so, the computer also needs a place to store data for the longer term. Most of today's personal computers use a hard disk for long-term data storage. Unlike RAM, the computer's hard disk is not volatile. This means that data stored on a hard disk can be stored even when the computer is turned off.

A relatively new component becoming more common in some personal computers is the**solid-state drive (SSD).** The SSD performs the same function as a hard disk: long-term storage. Instead of spinning disks, the SSD uses flash memory, which is much faster. Besides fixed storage components, removable storage media are also used in most personal computers. Removable media allows you to take your data with you. And just as with all other digital technologies, these media have gotten smaller and more powerful as the years have gone by. Early computers used floppy disks, which could be inserted into a disk drive in the computer. Around the turn of the century, a new portable storage technology was being developed: the USB flash drive. This device attaches to the universal serial bus (USB) connector, which became standard on all personal computers beginning in the late 1990s.

DID YOU KNOW

Although the terms have become interchangeable, "memory" is used to refer to the fast storage options closer to the CPU (for example RAM) and "storage" is used to refer to the slower storage options further away from the CPU (for example a hard drive).

TERMS TO KNOW

Random-Access Memory (RAM)
The working memory of a computer that transfers data from the hard disk upon starting the device.

Volatile
Computer storage that only holds data while power remains on.

Solid-State Drive (SSD)
Form of data storage that uses flash memory; all data is stored on a microchip.

SUMMARY

In this tutorial, we reviewed the primary **functions of the computer** such as **input, output**, **storage**, and **processing**. These functions are what the phrase "manipulate data" refer to when describing a computer. The primary functions of a computer can also be used to describe the functionality of various computer components. For example, a keyboard can be described as an input device.

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TERMS TO KNOW

Central Processing Unit (CPU)
The "brains" of the device; it performs computations and logic operations sent to it by application software, and returns results to be acted upon.

Input
Mode by which data enters the computer.

Output
Mode by which data is delivered.

Random-Access Memory (RAM)
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Types of Computers

by Sophia

WHAT'S COVERED

A personal computer is designed to be a general-purpose device. That is, it can be used to solve many different types of problems. As the technologies of the personal computer have become more commonplace, many of the components have been integrated into other devices that previously were purely mechanical. We have also seen an evolution in what defines a computer. Ever since the invention of the personal computer, users have clamored for a way to carry them around. Here we will examine several types of devices that represent the latest trends in personal computing.

Our discussion breaks down as follows:

1. Portable Computers

As computing technology evolved, so did the needs of businesses making use of computers. One of the major concerns for businesses in the late 1970s and early 1980s had to do with how portable a computer system could be. Information is critical to decision-making in business; therefore, companies need computers to be readily accessible to their employees at all times, during the workday, and in a wide array of locations (home, remote offices, while in transit). In 1983, Compaq Computer Corporation developed the first commercially-successful portable personal computer. By today's standards, the Compaq PC was not very portable: weighing in at 28 pounds, the computer was designed like a suitcase, to be lugged around and then laid on its side to be used. Besides portability, Compaq was successful because it was fully compatible with the software being run by the IBM PC, which was the standard for business.

In the years that followed, portable computing continued to improve, giving us laptop and notebook computers. The "luggable" computer has given way to a much lighter clamshell computer that weighs from four to six pounds and runs on batteries. In fact, the most recent advances in technology give us a new class of laptop that is quickly becoming the standard: these laptops are extremely light and portable and use less power than their larger counterparts. The MacBook Air is a good example of this: it weighs less than three pounds and is only 0.68 inches thick!

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A modern laptop

Finally, as more and more organizations and individuals are moving much of their computing to the Internet, laptops are being developed that use **cloud computing** (“the cloud”) for all of their data and application storage. These laptops are also extremely light because they have no need of a hard disk at all! A good example of this type of laptop (sometimes called a netbook) is Samsung’s Chromebook.

TERM TO KNOW

Cloud Computing

Storing and processing data over the Internet rather than on personal computer hardware.

2. Smartphones

The first modern-day mobile phone was invented in 1973. Resembling a brick and weighing in at two pounds,

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it was priced out of reach for most consumers at nearly four thousand dollars. Since then, mobile phones have become smaller and less expensive. Today, mobile phones are a modern convenience available to all levels of society. As mobile phones evolved, they became more like small computers. These **smartphones** have many of the same characteristics as a personal computer, such as an operating system and memory. The first smartphone was the IBM Simon, introduced in 1994.

In January 2007, Apple introduced the iPhone. Its ease of use and intuitive interface made it an immediate success and solidified the future of smartphones. Running on an operating system called iOS, the iPhone was really a small computer with a touchscreen interface. In 2008, the first Android phone was released, with similar functionality.

TERM TO KNOW

Smartphone

A mobile phone that incorporates the same functionality as a computer.

3. Tablet Computers

A **tablet computer** is one that uses a touchscreen as its primary input and is small enough and light enough to be carried around easily. Tablet computers generally have no keyboard and are self-contained inside a rectangular case. The first tablet computers appeared in the early 2000s and used an attached pen as a writing device for input. These tablets ranged in size from small personal digital assistants (PDAs), which were handheld, to full-sized, 14-inch devices. The primary advantage of a tablet computer lies in its ease of use. The touchscreen provides a simple yet efficient way for users to interact with and manipulate a tablet computer. In most instances, there is no need for training or advanced computer knowledge to use a tablet PC. Most early tablets used a version of an existing computer operating system, such as Windows or Linux.

These early tablet devices were, for the most part, commercial failures. Then, in January 2010, Apple introduced the iPad, which ushered in a new era of tablet computing. Instead of a pen, the iPad used the finger as the primary input device. Instead of using the operating system of their desktop and laptop computers, Apple chose to use iOS, the operating system of the iPhone. Because the iPad had a user interface that was the same as the iPhone, consumers felt comfortable and sales took off. The iPad has set the standard for tablet computing. After the success of the iPad, computer manufacturers began to develop new tablets that utilize operating systems that were designed for mobile devices, such as Android.

DID YOU KNOW

Mobile computing is having a huge impact on the business world today. The use of smartphones and tablet computers is rising at double-digit rates each year. The Gartner Group, in a report issued in April 2013, estimated that over 1.7 million mobile phones will ship in the US in 2013, compared to just over 340,000 personal computers. Over half of these mobile phones are smartphones. Almost 200,000 tablet computers were predicted to ship in 2013. According to the report, PC shipments will continue to decline as phone and tablet shipments continue to increase.

TERM TO KNOW

Tablet Computer

A computer that uses a touchscreen as its primary input.

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4. Integrated Computing

Along with advances in computers themselves, computing technology is being integrated into many everyday products. From automobiles to refrigerators to airplanes, computing technology is enhancing what these devices can do and is adding capabilities that would have been considered science fiction just a few years ago. Here are three of the latest ways that computing technologies are being integrated into everyday products:

- **The Smart House**: "Smart houses" connect home appliances and other devices to mobile phones or tablets, allowing homeowners to control these devices even when they are not home. A home security system is a common application of smart house technology. If you leave on vacation in a hurry and forget to activate your home's alarm system, you can turn it on from your smartphone while on the way to the airport. Other applications include turning on and off kitchen appliances, viewing in-home surveillance footage, or even opening and closing windows and shades.
- **The Self-Driving Car**: A growing trend in the auto industry is the idea of the self-driving car, or a car that can automatically perform functions that could previously only be done manually by the driver. A self-driving car is typically installed with cameras or sensors around the car that allow it to "see" objects that might be dangerous, such as an oncoming vehicle. This allows the car to automatically maneuver to avoid collisions. Companies are also working on auto-pilot functions that allow the car to automatically adjust its speed based on traffic conditions, and to park itself without any input from the driver.
- **The Smart Watch**: Smartwatches merge the design and functionality of a wristwatch with that of a mobile device. Simple smartwatches are able to display the weather or run calendar applications. More sophisticated smart watches integrate text and email applications, driving directions, health and fitness applications, and much more.

SUMMARY

We have reviewed some variations on the personal computer, such as the **tablet computer** and the **smartphone.** These technologies have improved quickly over the years, making today's computing devices much more powerful than devices from just a few years ago. Many devices today use **cloud computing** for data and application storage via the Internet. Finally, we discussed some examples of how **computing technology integrates** with other products, such as home applications and even cars.

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TERMS TO KNOW

Cloud Computing
Storing and processing data over the Internet rather than on personal computer hardware.

Smartphone

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A mobile phone that incorporates the same functionality as a computer.

Tablet Computer

A computer that uses a touch screen as its primary input.

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Selecting a Computer

by Sophia

WHAT'S COVERED

At some point, it may be your responsibility to make a computer purchase decision. You may be in a managerial role at your job and realize that your company needs new computers, or you will need to have a computer for personal use at home. Maybe you already own a decent computer but are now thinking about learning how to develop 3D models for electronic games. With there now being a multitude of computer types on the market, with each one designed to meet a specific user need, selecting the most appropriate computer can be a daunting task. For example, if you are interested in developing 3D models for games, then you will need a very specific system configuration requiring a fast processor (at least 3 gHZ), around 500GB of storage, a high-level video card with rendering capability (ideally with its own processor), and as much RAM as you can afford (no less than 8GB). As a computer literate person, it is important that you can very quickly assess a given situation and then make a determination as to how, or even if, a computer can solve the problems presented by said situation. Furthermore, it is equally as important that you have the knowledge to assess a given computer hardware and software for its potential long-term effectiveness. In this tutorial, we will explore some of the major factors involved with selecting computers and their related equipment.

Our discussion breaks down as follows:

1. Factors Affecting Computer Performance and Cost

The overall performance speed of a computer is determined by many elements, some related to hardware and some related to software. In hardware, speed is improved by giving the electrons shorter distances to traverse to complete a circuit. Since the first CPU was created in the early 1970s, engineers have constantly worked to figure out how to shrink these circuits and put more and more circuits onto the same chip. And this work has paid off — the speed of computing devices has been continuously improving ever since. The hardware components that most contribute to the overall performance speed of a personal computer are the CPU, the motherboard, RAM, and the hard disk (even more so if you need a high-performance computer). In most cases, these items can be replaced with newer, faster components. In the case of RAM, simply adding more RAM can also speed up the computer.

DID YOU KNOW

Not all desktop PCs have the same size and shape. Most system units are towers, sitting upright on their shortest side with drive bays perpendicular to the tower's longest side. The original desktop featured the system unit resting flat on its longest side with drive bays parallel to its longest side.

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DID YOU KNOW

The first tablet computers used an attached pen as a writing device for input.

2. Recipe for Buying a Computer

With respect to your computing needs, it may be the case that one type of computer may serve you better than another. As you are planning to purchase a computer, it is important to consider its portability, screen size, processing speed, and data input.

2a. Portability

Portability refers to how easily a type of computer can be transported. If you need to have a computer at home and at work or if you travel often, then a small, portable computer would be suitable for purchase. If you find yourself in this situation, a desktop computer is not going to meet your needs. Instead, you will probably want to purchase a netbook or laptop as these machines will give you comparable processing speed as well as portability. Depending on your processing needs, a tablet PC may also be well suited to your situation.

TERM TO KNOW

Portability

How easily a computer can be transported.

2b. Screen Size

If you will be working with video/photo data or you plan on looking at the screen for long periods of time, then **screen size** should be an important consideration. A desktop computer provides room for a screen as large as you would like but remember that a desktop computer is not portable. A tablet PC is portable, but provides a very small screen size and generally is not a good computer choice for editing video, photos, or for working in situations in which you will be viewing the screen for extended periods of time.

TERM TO KNOW

Screen Size

The length of the monitor, typically the diagonal measured in inches.

2c. Processing Speed

A computer's processing is one of the factors that has a direct impact on the speed with which the system performs. **Processing speed** refers to the amount of clock cycles a processor can perform in a second. The greater your computer's processing speed, the more instructions can be processed per second. If you run graphics-intensive or data-intensive programs, produce multimedia content, or use your computer for gaming, you will need a large processing capability. The data that you are going to primarily work with is also of great consideration when buying a computer. If you plan on working with multimedia content, you will want a computer with a large screen, graphics accelerators, HDMI inputs, thunderbolt inputs, etc.

TERM TO KNOW

Processing Speed

Amount of clock cycles a processor can perform in a second, measured in hertz.

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SUMMARY

Computers are available in many different types. Understanding what each type of computer offers, in terms of **portability**, **processing speed**, data input, and **screen size**, can provide clues into its overall effectiveness within a given situation. It is important that you carefully **assess your computing needs** before **purchasing a computer**, in order to insure that what you buy will work best for the situation you plan on using it in.

Source: Derived from Chapter 2 of “Information Systems for Business and Beyond” by David T. Bourgeois. Some sections removed for brevity.
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TERMS TO KNOW

Portability
How easily a computer can be transported.

Processing Speed
Amount of clock cycles a processor can perform in a second, measured in hertz.

Screen Size
The length of the monitor, typically the diagonal measured in inches.

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Internal Computer Hardware

by Sophia

WHAT'S COVERED

The physical parts of computing devices — those that you can actually touch — are referred to as hardware. Devices contain hardware that exist both inside and outside of the device itself. In this tutorial, we will take a look at computer hardware inside the computer, and learn a little bit about how they work.

Our discussion breaks down as follows:

1. The CPU

Most computing devices have a similar architecture. The core of this architecture is the**central processing unit (CPU)**. The CPU can be thought of as the “brains” of the device. The CPU carries out the commands sent to it by the software, and returns results to be acted upon.

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An Intel CPU

The earliest CPUs were large circuit boards with limited functionality. Today, a CPU is generally on one chip and can perform a large variety of functions. There are two primary manufacturers of CPUs for personal computers: Intel and Advanced Micro Devices (AMD).

DID YOU KNOW

The speed (“clock time”) of a CPU is measured in hertz. A hertz is defined as one cycle per second. The CPU’s processing power is increasing at an amazing rate. Besides a faster clock time, many CPU chips now contain multiple processors per chip. These chips, known as dual-core (two processors) or quad-core (four processors), increase the processing power of a computer by providing the capability of multiple CPUs.

TERM TO KNOW

Central Processing Unit (CPU)

The "brains" of the device; it performs computations and logic operations sent to it by application software, and returns results to be acted upon.

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2. Motherboard

The **motherboard** is the main circuit board on the computer. The CPU, RAM, hard disk, integrated graphics card, and sound card (if not embedded into the motherboard), among other things, all connect into the motherboard. Motherboards come in different shapes and sizes, depending upon how compact or expandable the computer is designed to be. Most modern motherboards have many integrated components, such as video and sound processing, which used to require separate components.

Motherboard

The motherboard provides much of the bus of the computer (the term bus refers to the electrical connection between different computer components). The bus is an important determiner of the computer's speed: the combination of how fast the bus can transfer data and the number of data bits that can be moved at one time determine the speed.

TERM TO KNOW

Motherboard

The main circuit board on the computer, to which the CPU, memory, and storage connect.

3. Memory

When a computer starts up, it begins to load information from the hard disk into its working memory. This working memory, called **random-access memory (RAM)**, can transfer data much faster than the hard disk. Any

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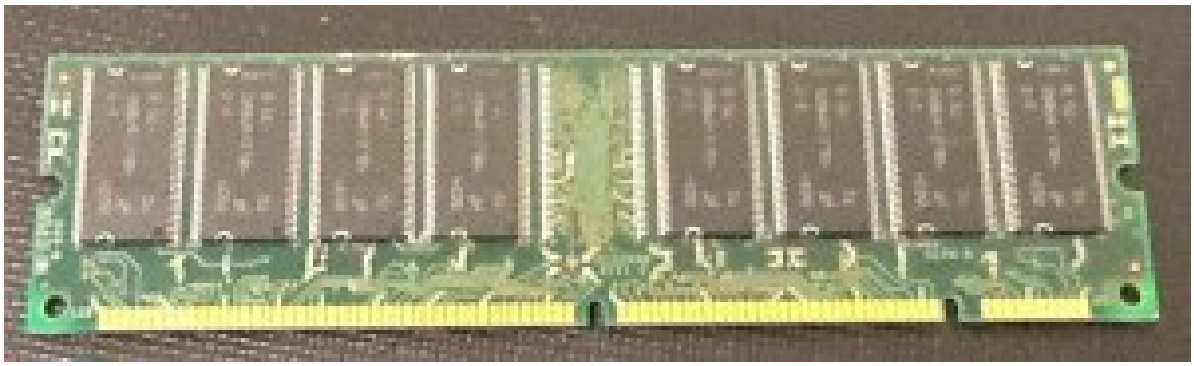
program that you are running on the computer is loaded into RAM for processing. In order for a computer to work effectively, some minimal amount of RAM must be installed. In most cases, adding more RAM will allow the computer to run faster. RAM can store data as long as it is receiving power; when the computer is turned off, any data stored in RAM is lost.

Read-only memory (ROM) is a form of memory in which the data stored on it can only be read. Typically, the data stored on ROM is meant to only be read. The boot sequence of personal computers requires ROM to initialize the operating system.



Memory DIMM

TERMS TO KNOW

Random-Access Memory (RAM)

The working memory of a computer that transfers data from the hard disk upon starting the device.

Read-Only Memory (ROM)

A form of memory in which the data stored can only be read; it cannot be changed.

4. Hard Disk

While the RAM is used as working memory, the computer also needs a place to store data for the longer term. Most of today's personal computers use a hard disk for long-term data storage. A **hard disk** is where data is stored when the computer is turned off, and where it is retrieved from when the computer is turned on. Why is it called a hard disk? A hard disk consists of a stack of disks inside a hard metal case. A floppy disk was a removable disk that, in some cases at least, was flexible, or "floppy."

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Hard disk

WATCH

Check out the components of a hard drive in the video below.

TERM TO KNOW

Hard Disk

The location for long-term data storage when the computer is turned off, and where data is retrieved from when the computer is turned on.

SUMMARY

Computing devices consist of physical components you can touch, known as hardware. In this tutorial, we reviewed important hardware components that exist inside a computer as well as their function, including the **CPU**, **motherboard**, **RAM**, **ROM**, and **hard disk**.

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TERMS TO KNOW

Central Processing Unit (CPU)

The "brains" of the device; it performs computations and logic operations sent to it by application software, and returns results to be acted upon.

Hard Disk

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The location for long-term data storage when the computer is turned off, and where data is retrieved when the computer is turned on.

Motherboard

The main circuit board on the computer, to which the CPU, memory, and storage connect.

Random-Access Memory (RAM)

The working memory of a computer that transfers data from the hard disk upon starting the device.

Read-Only Memory (ROM)

A form of memory in which the data stored can only be read; it cannot be changed.

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External Computer Hardware

by Sophia

WHAT'S COVERED

When you are working with a computer, whether you are at home, school or work, you should be able to identify all of its key external components. It is also important that you have an understanding of what each external component's function is. In this tutorial we will cover the components commonly found on the outside of a computer system.

Our discussion breaks down as follows:

1. Outside of the PC (System Unit)

Although there are many different types of computers available, on a typical computer you will always find several components. The common exterior components are: buttons, CD/DVD-ROM drive, vents, ports, and status lights.

- **Buttons**: Every computer, regardless of type, will have some way in which to turn the system on. The power button on a computer is what turns it on. Depending on the computer type, you may also see buttons that adjust sound and screen settings, as well as a button to restart the computer. You may also see a button allowing a user to eject a disk.
- **CD/DVD-ROM Drive**: Many computers will have a minimum of one **CD/DVD-ROM drive** that can be used to insert, remove, or write (burn) CDs or DVDs. Some netbooks, such as Apple's Macbook Air, do not provide users with an installed CD/DVD drive.

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CD/DVD-ROM Drive

- **Vents**: As a computer is being used, it is generating heat. To dissipate the heat generated, most computers will contain a fan and at least one externally located **vent** that cools down the electronic components of the computer.
- **Ports**: Computers provide **ports** for users to plug in cables and peripheral devices. The types of ports available depend on the age and type of the computer. Most ports are located on the back or front of a desktop PC, and on the side of a notebook PC. Typical ports include USB (keyboard, mouse, external drive), serial port, HDMI (monitor), modem or phone port, LAN or network port, and LPT port (printer).

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USB port

- **Status Lights**: Many computers will provide a **status light(s)** to let the user know that the computer is powered on. Some computers will provide indicator lights to let a user know that information is being written to a disk or incoming audio is clipping.

  WATCH

  Check out the video to learn more about these components.

  TERMS TO KNOW

  CD/DVD-ROM Drive
  Drive bay used to insert CDs and DVDs.

  Vent
  Provides external area for internally generated heat to be dissipated.

  Ports
  Areas into which device cables can be connected to the system unit.

  Status Lights
  Provide user with feedback as to the current operation of the system.

2. Peripheral Devices

A peripheral device is a system-related device that is not a native part of the computer system. Peripheral devices are typically connected to the system via a port. Peripherals can be categorized as input, output, or storage devices. Depending on the type of computer, some common peripheral devices are keyboards, pointing devices, scanners, digital cameras, monitors, and printers.

- **Keyboard**: All personal computers need components that allow the user to input data.**Keyboards** help

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the user enter text or numbers as input for documents or files. Keyboards are available in different sizes. Some keyboards are designed for ergonomics while others are designed to be small.

- **Pointing Device**: A **pointing device** is an input device that moves an on-screen pointer and gives users the ability to click to initialize applications or open files. The most common type of pointing device is a **mouse**. Users move the mouse across a flat surface and press a button to click. Another type of pointing device is a **touchpad**. A touchpad is a touch-sensitive pad that is built into a notebook computer and is designed to behave like a mouse.
- **Scanner**: **Scanners** allow users to input documents into a computer, either as images or as text. Most scanners have flat surfaces on which users place documents to be scanned. However, some scanners feed documents one page at a time. Most scanners utilize the USB interface.

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Document scanner

- **Digital Camera**: A **digital camera** is a device that captures a picture and converts it into digital information. Most digital cameras provide a local storage option until the picture can be transferred to a computer. Typically, a digital camera connects to a computer using the USB interface.
- **Monitor**: A **monitor** is a device used to display video, images, or text. With a laptop computer, the monitor is built-in. With a desktop computer, the monitor comes as a separate component connected to the system unit via cable (typically VGA). Most monitors are used only for output, but some, such as touchscreen monitors, can be used for both input and output.

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- **Printer**: A **printer** is an output device that generates a hard copy of work created on a computer. All printers do the same basic thing: they print an image on a page. A printer's resolution, cost, speed, and overall ability vary.

WATCH

Learn more about the types of peripheral devices in the video below.

TERMS TO KNOW

Keyboard

Device that provides text and/or numeric input into a computer system.

Pointing Device

Device that moves an on-screen pointer and provides buttons for input.

Mouse

A device that can be moved across a flat surface to move an on-screen pointer.

Touchpad

Touch-sensitive pad that behaves like a mouse and is built into laptop computers.

Scanner

Input device that allows users to input documents as images or text.

Digital Camera

Input device that captures a picture and converts it to digital information.

Monitor

Output device used to display video, images, and text.

Printer

Output device that generates a hard copy of work created on a computer.

SUMMARY

Computers consist of a wide array of internal and external components. In this tutorial we covered the common external components and peripheral devices utilized by a computer system.

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TERMS TO KNOW

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CD/DVD-ROM Drive
Drive bay used to insert CDs and DVDs.

Digital Camera
Input device that captures a picture and converts it to digital information.

Keyboard
Device that provides text and or numeric input into a computer system.

Monitor
Output device used to display video, images, and text.

Mouse
Device that can be moved across a flat surface to move an on-screen pointer.

Pointing Device
Device that moves an on-screen pointer and provides buttons for input.

Ports
Area into which device cables can be connected to the system unit.

Printer
Output device that generates a hard copy of work created on a computer.

Scanner
Input device that allows users to input documents as images or text.

Status Lights
Provide user with feedback as to the current operation with the system.

Touchpad
Touch sensitive pad that behaves like a mouse built into laptop computers.

Vent
Provides area for internally generated heat to be dissipated.

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Computer Software

by Sophia

WHAT'S COVERED

Computer hardware describes the physical/tangible components of an information system. However, hardware is only half of the system. The second component of an information system is software. Without software, the hardware would not be functional. In this tutorial we will discuss what computer software is and its major categories, as well as common computer software packages.

Our discussion breaks down as follows:

1. What is Software

Software is the set of instructions, written in a specific format called a computer program, that tells the hardware what to do. Software is created through the process of **computer programming**. Computer programming is the process used by computer programmers to create software that solves problems. Software can be broadly divided into two categories: operating systems and application software. Essentially, software "drives" the computer's hardware. For example, when you press a key on your computer's keyboard (hardware), a code is sent to the computer's software to display the character pressed. The software then tells the monitor (hardware) how to display the character on the screen.

TERMS TO KNOW

Software

The set of instructions that tells the hardware what to do.

Computer Programming

Process used by computer programmers to develop software that solves problems.

2. Operating Systems

The first major category of software is operating system software.**Operating systems** manage the hardware and create the interface between the hardware and the user. All computing devices run an operating system. For personal computers, the most popular operating systems are Microsoft's Windows, Apple's OS X, and different versions of Linux. Smartphones and tablets run operating systems as well, such as Apple's iOS, Google's Android, Microsoft's Windows Mobile, and Blackberry. The operating system provides several essential functions, including: managing the hardware resources of the computer, providing the user-interface components, and providing a platform for software developers to write applications. The operating system also starts and keeps the computer running. Ultimately, the operating system determines what you can do with your computer. For example, in education, network administrators will configure the operating on all computers to ensure that nobody can install software on the school system's PC.

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TERM TO KNOW

Operating System

Software that performs the task required to keep the system running, and provides the main interface for the user.

3. Application Software

The second major category of software is application software. **Application software** is, essentially, software that allows the user to accomplish some goal or purpose. For example, if you have to write a paper, you might use the application software program Microsoft Word. If you want to listen to music, you might use iTunes or Windows Media player. To surf the web, you might use Internet Explorer, Firefox, or Google Chrome. Even a computer game could be considered application software.

A "killer" application is one that becomes so essential that large numbers of people will buy a device just to run that application. For the personal computer, the killer application was the spreadsheet. Along with the spreadsheet, several other software applications have become standard tools for the workplace. These applications, called productivity software, form the first major subcategory of applications. **Productivity software** allows office employees to complete their daily work. Many times, these applications come packaged together, such as Microsoft's Office Suite. Generally, regardless of manufacturer, an office suite will be inclusive of a text editor (word processing) application, a spreadsheet application, and a presentation application. Depending on the manufacturer, other application software packages such as email, database, and information-gathering applications are included, as well as social media and communication platforms such as Skype, Windows Messenger, Google Circle, Hangout, etc.

Two other subcategories of application software worth mentioning are: utility software and programming software. **Utility software** includes system software that allows you to fix, modify, and maintain your computer in some way. Examples include antivirus software and disk defragmentation software. **Programming software** is software whose purpose is to make more software. Most of these programs provide programmers with an environment, known as an integrated development environment (IDE), in which they can write the code, test it, and convert it into the format that can then be run on a computer.

TERMS TO KNOW

Application Software

Provides user with the ability to accomplish a goal or purpose.

Productivity Software

Subcategory of application software that provides office employees the ability to complete their work.

Utility Software

Software that allows you to fix or modify your computer in some way.

Programming Software

Software whose purpose is to make more software.

SUMMARY

Software is the set of instructions that tells the computer's hardware what to do. Without software, a

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computer would be useless, as it would have no way in which to provide a relevant experience for users. Computer software is categorized according to function. There are two major categories of computer software: **application software** and **operating system** software. Several subcategories of application software exist, such as productivity software, utility software, and programming software. Common application software packages include word processing applications, spreadsheet applications, presentation applications, and database applications.

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TERMS TO KNOW

Application Software
Provides user with the ability to accomplish a goal or purpose.

Computer Programming
Process used by computer programmers to develop software that solves problems.

Operating System
Software that performs the task required to keep the system running and provides the main interface for the user.

Productivity Software
Subcategory of application software that provides office employees the ability to complete their work.

Programming Software
Software whose purpose is to make more software.

Software
The set of instructions that tells the hardware what to do.

Utility Software
Software that allows you to fix or modify your computer in some way.

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The Relationship Between Hardware and Software

by Sophia

WHAT'S COVERED

Information systems can be incredibly complex, depending on their size and scope. In spite of varying levels of complexity, information systems consist of five components: hardware, software, data, people, and process. The first three components fit under the category of technology, and place the computer square at the center of modern information systems. In this tutorial, we will take a look at the core relationship between hardware and software.

Our discussion breaks down as follows:

1. Overview of Hardware and Software

Recall that information systems contain both hardware and software.**Hardware** is the part of an information system you can touch — the physical components of the technology. Computers, keyboards, disk drives, iPads, and flash drives are all examples of information systems hardware.

Software is the set of instructions that tells the hardware what to do. When programmers create software programs, what they are really doing is simply typing out lists of instructions that tell the hardware what to do. Software can come in many forms, including the operating system and application software. There are many types of application software as well. For example, word processing or spreadsheet applications are productivity software, and antivirus programs installed on a computer are an example of utility software.

TERMS TO KNOW

Hardware

The part of the information system that you can touch; the physical components of the technology.

Software

The set of instructions that tells the hardware what to do.

---

2. Relationship Between Hardware and Software

Essentially, computer software controls computer hardware. These two components are complementary and cannot act independently of one another. In order for a computer to effectively manipulate data and produce useful output, its hardware and software must work together. Without software, computer hardware is useless. Conversely, computer software cannot be used without supporting hardware. Similarly, computer software has to first be loaded into the computer's hardware and then executed. There are several categories of

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software, with the two main categories being operating-system software, which makes the hardware usable, and application software, which does something useful. Examples of operating systems include Microsoft Windows on a personal computer and Google's Android on a mobile phone. Examples of application software are Microsoft Excel and Angry Birds.

IN CONTEXT

Consider the following analogy: an iPod is used to play recorded music in the form of an MP3. In order to listen to the recorded music, you need three things: an iPod, a speaker, and the MP3 file. In this analogy, both the iPod and the speaker are examples of hardware. The MP3 file, in this case, would represent software. Without the iPod or the speaker, you would not be able to listen to the MP3. By the same token, the iPod and the speaker would be worthless without the MP3 files to play.

SUMMARY

Information systems such as geographic information systems, search engines, and data warehouses rely on both **hardware and software** working in concert to achieve the goal of data manipulation. Computer software drives computer hardware by providing the instructions that tell the hardware what to do. Hardware will not function without software and software will not run without the appropriate hardware.

Source: Derived from Chapters 2 and 3 of "Information Systems for Business and Beyond" by David T. Bourgeois. Some sections removed for brevity.
https://www.saylor.org/site/textbooks/Information%20Systems%20for%20Business%20and%20Beyond/Textbook.html

TERMS TO KNOW

Hardware
The part of the information system that you can touch; the physical components of the technology.

Software
The set of instructions that tells the hardware what to do.

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Computer Components and Roles

by Sophia

WHAT'S COVERED

At their core, all personal computers consist of the same basic components: a CPU, memory, circuit board, storage, and input/output devices. Each of these basic components performs a specified function that ultimately works to aid users in performing useful tasks, such as typing a paper, or sending an email message. In this tutorial we will discuss computing systems and their core components. We will also take a look at the role each component plays within the system.

Our discussion breaks down as follows:

1. Computing Systems

Simply put: a system is a combination of parts that work together to achieve a goal. Based on this definition, we can easily see how a computer fits the description of what a system is. All computers have a way to accept user input and receive instructions from users, a way of delivering data back to the user, a central processing unit, basic hardware, and software.

---

2. Data Processing Components

After a computer receives data from an input device, the data must be processed before it is sent to an output device such as a monitor. In a computer, a data processing device is any device that is responsible for the storage and retrieval of data. Listed below are the data processing devices located in a computer.

Data Processing Devices	Description
Central Processing Unit (CPU)	Most computing devices have a similar architecture. The core of this architecture is the **central processing unit (CPU)**. The CPU can be thought of as the “brains” of the device. The CPU carries out the commands sent to it by the software and returns results to be acted upon.
Graphics Processing Unit (GPU)	The **graphics processing unit or GPU** is essentially what generates the image(s) on the monitor. It is located internally and typically connects directly to the motherboard. The GPU is more widely referred to as a “video card.”
Motherboard	The **motherboard** is the main circuit board on the computer. The CPU, memory, and storage components, among other things, all connect into the motherboard. Motherboards come in different shapes and sizes, depending upon how compact or expandable the computer is designed to be. Most modern motherboards have many integrated components, such as

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	video and sound processing, which used to require separate components.
Network Interface Card (NIC)	Commonly referred to as an ethernet card, the **network interface card (NIC)** is an expansion card that provides a computer with the ability to connect to a network. Most newer model computers have their network interface card built into the motherboard.
Sound Card	The **sound card** is an expansion card that produces sound through the speakers or headphone. The sound card is also sometimes referred to as the audio card. Sound cards are included with every computer system; however, they are not required by the computer to operate.

WATCH

Learn more about the data processing components in the video below.

TERMS TO KNOW

Central Processing Unit (CPU)
The "brains" of the device; it performs computations and logic operations sent to it by application software, and returns results to be acted upon.

Graphics Processing Unit (GPU)
Generates images on the monitor; also referred to as the video card.

Motherboard
The main circuit board on the computer to which the CPU, memory, and storage connect.

Network Interface Card
Expansion card that provides a computer with the ability to connect to a network.

Sound Card
Expansion card that produces sound through the speakers or headphone.

3. Data Storage Components

In a computer, data storage is handled by several components. Generally, a data storage component is any hardware that can store information temporarily or permanently. Data storage devices are classified as either primary storage or secondary storage. Primary storage refers to internal storage, such as random access memory (RAM). Secondary storage is not readily accessible by the computer and can be internal or external, such as a hard drive or flash drive. Listed below are the data storage components located in a computer.

Data Storage Components	Description
Hard Disk	Most of today's personal computers use a hard disk for long-term data storage. A **hard disk** is where data is stored when the computer is turned off and where it is retrieved from when the computer is turned on. Maximum capacity is currently around 2TB.
Solid-State	The solid-state drive (SSD) performs the same function as a hard disk: long-term storage. Instead of spinning disks, the SSD uses flash memory, which is much faster. Solid-state drives are currently quite a bit more expensive than hard disks. However, the use of flash memory

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Drives (SSD)	instead of disks makes them much lighter and faster than hard disks. Maximum capacity is currently around 1TB.
Flash Drives	Around the turn of the century, a new portable storage technology was being developed: the USB flash drive. This device attaches to the universal serial bus (USB) connector, which became standard on all personal computers beginning in the late 1990s. Maximum capacity is currently around 256GB.
Random-Access Memory (RAM)	When a computer starts up, it begins to load information from the hard disk into its working memory. This working memory, called **random-access memory (RAM)**, can transfer data much faster than the hard disk. Any program that you are running on the computer is loaded into RAM for processing. In order for a computer to work effectively, some minimal amount of RAM must be installed. In most cases, adding more RAM will allow the computer to run faster. Another characteristic of RAM is that it is "volatile." This means that it can store data as long as it is receiving power. When the computer is turned off, any data stored in RAM is lost.
Optical Disc	An optical disc is a form of removable storage media that stores data on the surface of the disc. Compact Disc (CD) and Digital Video Disc (DVD) are examples of optical discs. Maximum capacity is currently 900MB for CDs and 50GB for DVDs.

WATCH

Learn more about the data storage components in the video below.

TERMS TO KNOW

Hard Disk

The location for long-term data storage when the computer is turned off, and where data is retrieved when the computer is turned on.

Random-Access Memory (RAM)

The working memory of a computer that transfers data from the hard disk upon starting the device.

4. Input/Output Components

All computers accept input from the keyboard or mouse (or other designated input device), process it, and output it to a monitor (or other designated output device). An **input device** is any hardware component that sends data into a computer. An **output device** is any hardware component that sends data out of a computer.

TERMS TO KNOW

Input Device

Any hardware component that sends data into the computer.

Output Device

Any hardware component that sends data out from the computer.

Below are the common input and output devices utilized by most computer systems.

4a. Input Devices

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- **Keyboard**: All personal computers need components that allow the user to input data. Keyboards help the user enter text or numbers as input for documents or files. Keyboards are available in different sizes. Some keyboards are designed for ergonomics, while others are designed to be small.
- **Pointing Device**: A pointing device is an input device that moves an on-screen pointer and gives users the ability to click to initialize applications, or to open files. The most common type of pointing device is a mouse. Users move the mouse across a flat surface and press a button to click. Another type of pointing device is a touchpad. A touchpad is a touch-sensitive pad that is built into a notebook computer and is designed to behave like a mouse.
- **Scanner**: Scanners allow users to input documents into a computer, either as images or as text. Most scanners have flat surfaces for users to place documents to be scanned on. However, some scanners feed documents one page at a time. Most scanners utilize the USB interface.
- **Digital Camera**: A digital camera is a device that captures a picture and converts it into digital information. Most digital cameras provide a local storage option until the picture can be transferred to a computer. Typically, a digital camera connects to a computer using the USB interface.

4b. Output Devices

- **Monitor**: A monitor is a device used to display video, images, or text. With a laptop computer, the monitor is built in, and with a desktop computer, the monitor comes as a separate component connected to the system unit via cable (typically VGA). Most monitors are used only for output, but some, such as touchscreen monitors, can be used for both input and output.
- **Printer**: A printer is an output device that generates a hard copy of work created on a computer. All printers do the same basic thing: they print an image on a page. A printer's quality, cost, speed, and overall ability vary.

HINT

Some devices can be both input and output devices if they are allowed to get information into the computing system, and also send information back out of the system. For example, a printer that has a scanner is both an input and an output device. A touchscreen is another example. The output is the monitor display, and the input is the touch interactions to click, zoom in, and zoom out.

SUMMARY

Computers are systems with multiple components all designed to work in concert for the purpose of **data manipulation**. In this tutorial, we examined what a**computing system** is, along with its **data processing**, **data storage components**, and its various **input/output** components.

Source: Derived from Chapters 2 and 3 of “Information Systems for Business and Beyond” by David T. Bourgeois. Some sections removed for brevity.
https://www.saylor.org/site/textbooks/Information%20Systems%20for%20Business%20and%20Beyond/Textbook.html

TERMS TO KNOW

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Central Processing Unit (CPU)

The "brains" of the device; it performs computations and logic operations sent to it by application software, and returns results to be acted upon.

Graphics Processing Unit (GPU)

Generates images on the monitor; also referred to as the video card.

Hard Disk

The location for long-term data storage when the computer is turned off, and where data is retrieved when the computer is turned on.

Input Device

Any hardware component that sends data into the computer.

Motherboard

The main circuit board on the computer to which the CPU, memory, and storage connect.

Network Interface Card

Expansion card that provides a computer with the ability to connect to a network.

Output Device

Any hardware component that sends data out from the computer.

Random-Access Memory (RAM)

The working memory of a computer that transfers data from the hard disk upon starting the device.

Sound Card

Expansion card that produces sound through the speakers or headphone.

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Data Storage

by Sophia

WHAT'S COVERED

When data enters a computer it is immediately routed and stored in memory. If the data needs to be kept for future use, it must be saved to a storage device. Numerous options for storage are available for computers, each with their own set of advantages and disadvantages. In this tutorial, we will take a look at computer memory, the various storage options, and the capacities for each storage option.

Our discussion breaks down as follows:

1. How Data is Stored

In a computer, data sent to and read from the hard disk is initially read by the hard disk controller. The**hard disk controller** gives the processor access to read, write, and modify data on the hard disk, CD-ROM, flash drive, and any other storage device. If the operating system needs to read or write data to a storage device, it examines the storage device to determine where to read from (file location) or where to write to. After a read/write location is obtained, the hard disk controller tells the drive to read or write.

All data stored on a hard disk is done magnetically. If the computer needs to read data from the hard disk, it reads magnetic polarities from the hard disk. One side of the polarity is 0 (off) and the other side is 1 (on). The computer reads the 0 or 1 as binary data. Each 0 or 1 is referred to as a **bit** (a contraction of binary digit). This means that the computer reads data from its storage location as a binary number. For the computer to write information to the hard disk, the magnetic polarities are aligned with the hard disk's read/write head. The read/write head then writes 0s and 1s that can be read by the computer at a later time. This means that the computer writes information to the hard disk as a binary number.

TERMS TO KNOW

Hard Disk Controller

A hard disk component that enables the CPU to access, modify, read, and write data to and from the hard disk, CD-ROM, and any other drive.

Bit

A contraction of "binary digit" — a digit containing either a 0 or 1.

2. Bits and Bytes

As mentioned above, a bit is a unit of digital data, containing a single value of either a 0 or a 1. Digital information can be very large, and thus can result in incredibly lengthy strings of 0s and 1s. A string of eight bits is known as a byte. So a **byte** is also a unit of digital information, and it contains eight bits.

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TERM TO KNOW

Byte

A unit of digital data, containing a string of eight binary units (0s or 1s).

3. Units of Measurement for Storage

Similar to RAM, storage space is measured in bytes. As the capacities of digital devices grew, new terms were developed to identify the capacities of processors, memory, and disk storage space. Prefixes were applied to the word byte to represent different orders of magnitude. Since these are digital specifications, the prefixes were originally meant to represent multiples of 1024 (which is two raised to the 10th power), but have more recently been rounded to mean multiples of 1000. The table below shows various storage sizes, how they are related to bytes, and an example of media with an approximate storage size.

Prefix	Represents	Example	Storage Device	Value Contained
B	Byte	Byte = Eight Bits		1 Character; e.g. the letter “t” is 1 byte
KB	Kilobyte	1 KB = 1,000 Bytes		Two or three paragraphs of text
MB	Megabyte	1 MB = 1 Million Bytes	Floppy Disk	One-minute MP3 file One digital picture (four megapixel) Four books (200 pages each)
GB	Gigabyte	1 GB = 1 Billion Bytes	DVD-R Blu Ray Disc Hard Disk USB Flash Drive	One 650MB CD of data 256 MP3 songs 340 digital pictures 600 web pages 4,470 books (200 pages each)
TB	Terabyte	1 TB = 1 Trillion Bytes	Hard Disk	1600 CDs of data 230 DVDs 40 Blu-Ray Discs 262,100 MP3 songs 349,500 digital pictures 655,300 web pages 4,500,000 books (200 pages each)

4. Common Storage Media

Various storage media have their own storage capacity limitations.

Storage Media	Description
Hard Drive/Hard Disk	Most of today’s personal computers use a **hard disk** for long-term data storage. Maximum capacity is currently around 2TB.
Solid-State Drives	The **solid-state drive (SSD)** performs the same function as a hard disk: long-term storage. Maximum capacity is currently around 1 TB.

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Flash Drives	The USB **flash drive** serves as a portable and removable storage solution. Maximum capacity is currently around 256GB.
Optical Disc (CD/DVD-ROM)	An **optical disc** is another form of portable and removable storage. Maximum capacity is currently 900MB for CDs and 50GB for DVDs.

TERMS TO KNOW

Hard Disk
The location for long-term data storage when the computer is turned off, and where data is retrieved from when the computer is turned on.

Solid-State Drive (SSD)
Form of data storage that uses flash memory; all data is stored on a microchip.

Flash Drive
Form of data storage that attaches to the USB connector on PCs.

Optical Disc
A form of removable storage media that stores data on the surface of the disc.

SUMMARY

As data is generated by a computer, there must be sufficient **space** in which to **store** it. Various types of **storage media** are available, each with their own **storage capacities**, pros, and cons.

Source: Derived from Chapter 2 of “Information Systems for Business and Beyond” by David T. Bourgeois. Some sections removed for brevity.
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TERMS TO KNOW

Bit
A contraction of "binary digit;" a digit containing either a 0 or 1.

Byte
A unit of digital data, containing a string of eight binary units (0s or 1s).

Flash Drive
Form of data storage that attaches to the USB connector on PCs.

Hard Disk
The location for long-term data storage when the computer is turned off, and where data is retrieved when the computer is turned on.

Hard Disk Controller
A hard disk component that enables the CPU to access, modify, read, and write data to and from the hard disk, CD-ROM, and any other drive.

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Optical Disc

A form of removable storage media that stores data on the surface of the disc.

Solid-State Drive (SSD)

Form of data storage that uses flash memory; all data is stored on a microchip.

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Unit Prefixes

by Sophia

WHAT'S COVERED

As the capacities of digital devices grew, new terms were developed to identify the capacities of processors, memory, and disk storage space. Prefixes were applied to measurements — such as byte — to represent different orders of magnitude. Since bits and bytes are binary numbers, the prefixes were originally meant to represent multiples of 1024 (which is two to the 10th power), but have more recently been rounded to mean multiples of 1000. In this tutorial, we will examine the most common prefixes, and apply them to measurements of storage and processing speed.

Our discussion will break down like this:

1. Unit Prefixes

A **unit prefix** is a group of letters attached to the beginning of a unit of measurement. You're probably familiar with unit prefixes for measurements, such as the meter. For example, the prefix "kilo" can be added to the meter to form a kilometer, a unit of length equivalent to 1000 meters. A kilogram is a unit of weight equivalent to 1000 grams.

In these examples, the prefix multiplies the base unit by a power of 10 ($1000 = 10^3$). With units of digital information, such as the byte, these prefixes actually multiply the base by a power of two. This is because the byte is made of binary digits (binary meaning two).

↱ EXAMPLE When adding the prefix kilo to byte, we get the kilobyte. A kilobyte is defined as 2^{10} or 1024 bytes. This can be confusing, especially since we are familiar with multiplying other measurements by 1000, not 1024, when applying the prefix kilo. Due to this confusion, it has become common and acceptable to round 1024 to 1000 when applying prefixes to bytes.

HINT

Technically, binary prefixes apply a multiplier of 2^{10} (or 1024). However, because it is easier to multiply by 1000 instead of 1024, it is acceptable to interpret the prefixes as multiples of 1000. For example, 1 gigabyte can be expressed as 1,000,000,000 bytes (1000*1000*1000), rather than 1,073,741,824 bytes (1024*1024*1024).

TERM TO KNOW

Unit Prefix

A group of letters attached to the beginning of a unit; common prefixes include kilo, mega, giga, and tera.

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2. Bytes

Recall that a **byte** is a unit of digital data, consisting of binary digits made of 0s and 1s. When dealing with millions and billions of bytes, it is easier to express the size of the data using binary prefixes. The most common binary prefixes are kilobyte, megabyte, and gigabyte. In today's society, the terabyte is also becoming more popular to describe machines with very large storage capacities.

Below is a table of common prefixes and their application on the byte.

Prefix	Notation	Represents	Example
kilo	KB	1 thousand	1 KB = 1,000 bytes
mega	MB	1 million	1 MB = 1,000,000 bytes
giga	GB	1 billion	1 GB = 1,000,000,000 bytes
tera	TB	1 trillion	1 TB = 1,000,000,000,000 bytes

↱ EXAMPLE A brief email of text would be one to two kilobytes. A larger file, such as a minute-long video clip, would be 15 to 20 megabytes. Today's smartphones can have capacities of 64 gigabytes or more. A professional videographer might need a hard drive with one terabyte to store the multimedia files and software programs she needs to do her job.

TRY IT

Rank the following storage sizes from smallest to largest: 5KB, 1TB, 6MB, 3GB.

What did you come up with? To solve this, it is helpful to write each measurement in one unit, such as bytes, and then compare:

5KB= 5,000 bytes
1TB= 1,000,000,000,000 bytes
6MB= 6,000,000 bytes
3GB= 3,000,000,000 bytes

So, the correct ordering of these, from smallest to largest, would be 5KB, 6MB, 3GB, 1TB

TERM TO KNOW

Byte
A unit of digital data, containing a string of eight binary units (0s or 1s).

3. Hertz

Hertz is a unit of frequency named after German physicist Heinrich Hertz. This unit of frequency is defined as one cycle per second, and is used to describe the processing speed of computing devices. Hertz is abbreviated Hz, and can also be used with the prefixes mentioned above.

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The same prefixes that were used with bytes can be applied to hertz. The most common prefix associated with processing speed is giga. All of the prefixes applied to hertz are multipliers of a power of 10. This differs from the prefixes applied to bits and bytes, as those prefixes are multipliers of two.

Prefix	Notation	Represents	Example
kilo	KHz	1 thousand	1 KHz = 1,000 hertz
mega	MHz	1 million	1 MHz = 1,000,000 hertz
giga	GHz	1 billion	1 GHz = 1,000,000,000 hertz
tera	THz	1 trillion	1 THz = 1,000,000,000,000 hertz

↱ EXAMPLE The speed of today's desktop and mobile processors are measured in gigahertz (GHz) and can range from two to four GHz.

TERM TO KNOW

Hertz

A unit of frequency used to describe the speed of computing devices; abbreviated Hz.

SUMMARY

Several **prefixes** can be applied to the beginning of measures to represent much larger quantities. In computing, common measurements include the byte, a unit of data, and the **hertz**, a unit of frequency or speed. The most common prefixes applied to the byte are kilo, mega, giga, and tera, which represent multiples of 1000 from one prefix to the next. For example, 1 kilobyte equals 1000 **bytes**, 1 megabyte equals 1000 kilobytes, 1 gigabyte equals 1000 megabytes, and so on. These same prefixes can be used with the hertz; however, the most common unit of processing speed is the gigahertz (GHz), which is 1 million hertz.

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TERMS TO KNOW

Byte

A unit of digital data, containing a string of eight binary units (0s or 1s).

Hertz

A unit of frequency used to describe the speed of computing devices; abbreviated Hz.

Unit Prefix

A group of letters attached to the beginning of a unit; common prefixes include kilo, mega, giga, and tera.

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Understanding Numbering Systems

by Sophia

WHAT'S COVERED

A numbering system is a way to represent numbers of a certain type, and to have as their root base the same number of digits in the system. The system of numbering we are most familiar with is base-10 numbering. This means that there are 10 digits in the numbering system, zero through nine. If we count these digits in numerical order, we stop at nine, and then have to use two digits to express the next number, 10.

The decimal numbering system is not the only numbering system. In fact, computers primarily use the binary numbering system to represent data. As you will learn below, this system uses only two digits — zero and one. Because there are only two digits in this system, representing data in this system can require an incredibly long string of digits. When making computations or processing data, it can be quicker and easier to manage if data is expressed in fewer digits. To make this possible, other numbering systems were developed that contain more digits in their system. This allows the same information to be expressed using fewer digits.

Our discussion will break down as follows:

1. Decimal Numbering System

We are most familiar with the **decimal number system**, which is a base-10 system. This system is natural to us because we have 10 fingers on our hands, and we use our fingers for counting. This system is based in 10 digits, zero to nine. In this system, each digit in the number represents a power of 10. The far-right digit represents the “1s” which can be thought of as 10^0. The next digit to the left represents the “10s,” which can be thought of as 10^1. As we continue to the left, the next digits represent the “hundreds” (10^2), the “thousands” (10^3), and so on.

↱ EXAMPLE In the decimal numbering system, the number 1010 contains four digits, and each digit corresponds to a power of 10. We can break down 1010 into four digits — 1, 0, 1, 0 — and associate each digit with its corresponding power of 10: (1 x 1000) + (0 x 100) + (1 x 10) + (0 x 1). If we add these numbers, we get the value 1010.

TERM TO KNOW

Decimal Number System

Base-10 numbering in which each column in the number represents a power of 10; includes the digits zero through nine.

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2. Binary Numbering System

Computers primarily use the base-two numbering system, also known as the**binary number system**. This system is based on two digits: 0 and 1. In this system, each digit in the number represents a power of two. The far-right digit represents the “1s” which can be thought of as 2^0. The next digit to the left represents the “2s” which can be thought of as 2^1. As we continue to the left, the next digits represent the “fours” (2^2), the “eights” (2^3), and so on.

> ↱ EXAMPLE In the binary number system, the number 1010 contains four digits, and each digit corresponds to a power of two. We can break down 1010 into the four digits — 1, 0, 1, 0 — and associate each digit with its corresponding power of two: (1 x 8) + (0 x 4) + (1 x 2) + (0 x 1). In base-10, this evaluates to 10.

TERM TO KNOW

Binary Number System

Base two numbering system used by computers to work with data; includes the digits 0 and 1.

---

3. Octal Numbering System

The **octal number system** is based on eight digits (zero through seven). In this system, each digit in the number represents a power of eight. The far-right digit represents the “1s” (8^0). The next digit to the left represents the “eights” (8^1). As we continue to the left, the next digits represent 8^2 (which is 64), 8^3 (which is 512), and so on.

> ↱ EXAMPLE In the octal numbering system, the number 1010 contains four digits, and each digit corresponds to a power of eight. We can break down 1010 into the four digits — 1, 0, 1, 0 — and associate each digit with its corresponding power of eight: (1 x 512) + (0 x 64) + (1 x 8) + (0 x 1). In base-10, this evaluates to 520.

TERM TO KNOW

Octal Number System

Numbering system based on eight digits; includes the digits zero through seven.

---

4. Hexadecimal Numbering System

Computers also use a **hexadecimal number system** for some tasks, such as defining color. Hexadecimal is a numbering system based on 16 digits (hex meaning six, and decimal meaning 10). The first 10 digits are the numbers zero through nine, and because we don’t have any single digit numbers to represent 10 through 16, we use the first six letters of the alphabet, A through F. In this system, each digit in the number represents a power of 16. The far-right digit represents the “1s” (16^0). The next digit to the left represents the “16s” (16^1). As we continue to the left, the next digits represent 16^2 (which is 256), 16^3, (which is 4096), and so on.

> ↱ EXAMPLE In the hexadecimal numbering system, the number 1010 contains four digits, and each digit corresponds to a power of 16. We can break down 1010 into the four digits — 1, 0, 1, 0 — and

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associate each digit with its corresponding power of 16: (1 x 4096) + (0 x 256) + (1 x 16) + (0 x 1). In base-10, this evaluates to 4112.

TERM TO KNOW

Hexadecimal Number System

A numbering system based on 16 digits; includes the digits zero through nine and A through F.

SUMMARY

Numbering systems define how numbers are represented, and they can be used to define how data is processed. Computers represent data primarily using the **binary numbering system**. However, other number systems can also be used to represent data. Common number systems, such as **octal** and **hexadecimal**, can make it easier and quicker to write and manage data by using a smaller number of digits.

Source: Derived from “Information Systems for Business and Beyond” by David T. Bourgeois. Some sections removed for brevity.
https://www.saylor.org/site/textbooks/Information%20Systems%20for%20Business%20and%20Beyond/Textbook.html#_Chapter2:_What

TERMS TO KNOW

Binary Number System

Base-two numbering system used by computers to work with data; includes the digits 0 and 1.

Decimal Number System

Base-ten numbering in which each column in the number represents a power of ten; includes the digits 0-9.

Hexadecimal Number System

A numbering system based on sixteen digits; includes the digits 0-9 and A-F.

Numbering System

Method of representing numbers of a certain type.

Octal Number System

Numbering system based on eight digits; includes the digits 0-7.

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Terms to Know

Application Software

Provides user with the ability to accomplish a goal or purpose.

Binary Number System

Base-two numbering system used by computers to work with data; includes the digits 0 and 1.

Bit

A contraction of "binary digit;" a digit containing either a 0 or 1.

Byte

A unit of digital data, containing a string of eight binary units (0s or 1s).

CD/DVD-ROM Drive

Drive bay used to insert CDs and DVDs.

Central Processing Unit (CPU)

The "brains" of the device; it performs computations and logic operations sent to it by application software, and returns results to be acted upon.

Client-Server

Computer system in which a centralized server provides data to connected computers over a network.

Cloud Computing

Storing and processing data over the Internet rather than on personal computer hardware.

Computer

An electronic device that use a combination of hardware and software to manipulate data.

Computer Network

A group of computers connected for the purpose of communication-sharing of data and resources.

Computer Programming

Process used by computer programmers to develop software that solves problems.

Data

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Information, or a collection of facts.

Decimal Number System

Base-ten numbering in which each column in the number represents a power of ten; includes the digits 0-9.

Digital Camera

Input device that captures a picture and converts it to digital information.

Flash Drive

Form of data storage that attaches to the USB connector on PCs.

Graphics Processing Unit (GPU)

Generates images on the monitor; also referred to as the video card.

Hard Disk

The location for long-term data storage when the computer is turned off, and where data is retrieved when the computer is turned on.

Hard Disk Controller

A hard disk component that enables the CPU to access, modify, read, and write data to and from the hard disk, CD-ROM, and any other drive.

Hardware

The part of the information system that you can touch; the physical components of the technology.

Hertz

A unit of frequency used to describe the speed of computing devices; abbreviated Hz.

Hexadecimal Number System

A numbering system based on sixteen digits; includes the digits 0-9 and A-F.

Information System

A combination of technology, people, and processes that collect, create, distribute, and exploit useful information.

Input

Mode by which data enters the computer.

Input Device

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Any hardware component that sends data into the computer.

Keyboard

Device that provides text and or numeric input into a computer system.

Local Area Network (LAN)

Computer network that links computers within a building.

Monitor

Output device used to display video, images, and text.

Motherboard

The main circuit board on the computer, to which the CPU, memory, and storage connect.

Mouse

Device that can be moved across a flat surface to move an on-screen pointer.

Network Interface Card

Expansion card that provides a computer with the ability to connect to a network.

Numbering System

Method of representing numbers of a certain type.

Octal Number System

Numbering system based on eight digits; includes the digits 0-7.

Operating System

Software that performs the task required to keep the system running and provides the main interface for the user.

Optical Disc

A form of removable storage media that stores data on the surface of the disc.

Output

Mode by which data is delivered.

Output Device

Any hardware component that sends data out from the computer.

Peripheral

A hardware component that is not natively a part of the system.

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Pointing Device

Device that moves an on-screen pointer and provides buttons for input.

Portability

How easily a computer can be transported.

Ports

Area into which device cables can be connected to the system unit.

Printer

Output device that generates a hard copy of work created on a computer.

Processing Speed

Amount of clock cycles a processor can perform in a second, measured in hertz.

Productivity Software

Subcategory of application software that provides office employees the ability to complete their work.

Programming Software

Software whose purpose is to make more software.

Random-Access Memory (RAM)

The working memory of a computer that transfers data from the hard disk upon starting the device.

Read-Only Memory (ROM)

A form of memory in which the data stored can only be read; it cannot be changed.

Scanner

Input device that allows users to input documents as images or text.

Screen Size

The length of the monitor, typically the diagonal measured in inches.

Smartphone

A mobile phone that incorporates the same functionality as a computer.

Software

The set of instructions that tells the hardware what to do.

Solid-State Drive (SSD)

Form of data storage that uses flash memory; all data is stored on a microchip.

Sound Card

Expansion card that produces sound through the speakers or headphone.

Status Lights

Provide user with feedback as to the current operation with the system.

Tablet Computer

A computer that uses a touch screen as its primary input.

Touchpad

Touch sensitive pad that behaves like a mouse built into laptop computers.

Unit Prefix

A group of letters attached to the beginning of a unit; common prefixes include kilo, mega, giga, and tera.

Utility Software

Software that allows you to fix or modify your computer in some way.

Vent

Provides area for internally generated heat to be dissipated.

Volatile

Computer storage that only holds data while power remains on.