

## Chapter 5

### The System Unit

#### Lecture Guide

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- **Learning Objectives**

- Differentiate between the four basic types of system units.
- Describe system boards, including sockets, slots, and bus lines.
- Recognize different microprocessors, including microprocessor chips and specialty processors.
- Compare different types of computer memory including RAM, ROM, and flash memory.
- Explain expansion slots and cards.
- Describe bus lines, bus widths, and expansion buses.
- Describe ports including standard and specialized ports.
- Identify power supplies for desktop, laptop, tablets, and mobile devices.
- Explain how a computer can represent numbers and encode characters electronically.

#### Chapter Outline

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- **The System Unit**

- Also known as the system chassis, the system unit houses most of the electronic components that make up a computer system.
- There are four basic types of personal computers:
  - **Desktops** - This is the most powerful type of personal computer. Many desktops have their system unit in a separate case. This case contains the system's electronic components and selected secondary storage devices. Input and output devices such as a mouse, keyboard, and monitor, are located outside the system unit.
    - Desktop system unit that are placed vertically are sometimes referred to as a tower unit or tower computer. Some desktop computers, like Apple's iMac, have their monitor and system unit housed together in the same case. These computers are known as all-in-one.
  - **Laptops**, also called laptops, are portable and much smaller. These system units are housed with, selected secondary storage devices and input devices. The monitor is attached by hinges.
    - **Ultrabooks**, or mini notebooks are a type of a very portable laptop. They are lighter, smaller and generally have a longer battery life than a laptop.
  - **Tablets** - are the newest and one of the most popular types of computer. They are effectively a thin slab that is all monitor with the system unit located behind the monitor. Tablets are smaller, lighter, and generally less powerful than laptop computers. Tablets typically use a virtual keyboard that appears on the screen and is touch sensitive.

- **Mobile devices** – mobile devices are the smallest and are designed to fit comfortably into the palm of one hand. These systems contain an entire computer system, including the electronic components, secondary storage, and input and output devices.
  - Most popular is the smartphone.
  - Smartphones extend the capabilities of a cell phone by providing computing power. In addition to capturing and sending audio and video, smartphones run apps, connect to the Internet, and more. Their system unit is located behind the display screen.
- **Components**
  - Personal computers come in a variety of different sizes, shapes, and capabilities.
  - Each type of system unit has similar components
    - these include a system board, microprocessor, and memory
- **Electronic Data and Instructions**
  - Computers are digital devices as opposed to analog devices. Therefore, computers can only understand things as on or off.
    - Binary system
      - A binary coding scheme assigns a unique sequence of **bits** to each character.
      - **Byte** – a group 8 bits
    - Hexadecimal system uses 16 digits to represent binary numbers
  - Character Encoding - how a computer provides representation to communicate
    - Character encoding standards – assigns a unique sequence of bits to each character
      - **ASCII (American Standard Code for Information Interchange)** is a seven bit coding scheme.
      - **EBCDIC (Extended Binary Coded Decimal Interchange Code)** is an eight bit coding scheme
      - **Unicode** is a 16-bit coding scheme originally designed to support international languages like Chinese and Japanese. These languages have too many characters to be represented by the seven and eight-bit ASCII and EBCDIC codes.
        - Most widely used since the explosion of the Internet
- **System Board**
  - Also known as the motherboard or mainboard.
  - It is the communications medium for the entire computer system because every component of the system unit connects to the system board.
  - A large flat circuit board covered with a variety of different electronic components including sockets, slots, and bus lines.
    - **Sockets** provide a connection point for small specialized electronic parts called chips.
    - **Chips** consist of tiny circuit boards etched onto squares of sand-like material called silicon. Also called a **silicon chip, semiconductor, or integrated circuit.**

- **Chip carriers** are used to mount micro chips. They are either plugged directly into sockets on the system board or onto cards that are then plugged into slots on the system board.
- **Slots** provide a connection point for specialized cards or circuit boards. These cards provide expansion capability for a computer system.
- **Connecting lines** called **bus lines** provide pathways that support communication among the various electronic components that are either located on the system board or attached to the system board.
- Laptop, tablets, and mobile system boards
  - Smaller than the desktop system boards
  - Perform the same functions as desktop system boards
- **Microprocessor**
  - The **central processing unit** (CPU) or processor is contained on a single chip called the microprocessor.
  - The **microprocessor** is the “brains” of the computer system.
  - It has two basic components:
    - **The control unit** tells the rest of the computer system how to carry out a program’s instructions. It directs the movement of electronic signals.
    - **The arithmetic-logic unit**, usually called the ALU, performs two types of operations:
      - **Arithmetic operations** – fundamental math operations
      - **Logical operations** – consists of comparisons
- **Microprocessor chips**
  - Chip processing capacities are often expressed in word sizes.
  - A word is the number of bits (such as 16, 32, or 64) that can be accessed at one time by the CPU.
  - The processing speed of a microprocessor is typically represented by its **clock speed** which is related to the number of times the CPU can fetch and process data or instructions in a second.
  - Newer personal computers are much faster and process data and instructions in billionths of a second, or nanoseconds.
  - Supercomputers, by contrast, operate at speeds measured in trillionths of a second, or picoseconds - 1,000 times faster than personal computers.
  - Until recently, 64-bit processors were primarily used in large mainframes and supercomputers. However, 64-bit processors are becoming commonplace in today’s more powerful personal computers.
  - The **multicore chip** can provide two or more separate and independent CPUs thereby allowing a single computer to run two or more operations at the same time.
  - For multicore processors to be used effectively, computers must understand how to divide tasks into parts that can be distributed across each core—an operation called **parallel processing**.
- **Specialty processors**
  - **Coprocessors** are specialty chips designed to improve specific computing operations.
    - One of the most widely used is the **graphics coprocessor**, also called a **graphics processing unit (GPU)**. These processors are

specifically designed to handle the processing requirements related to displaying and manipulating 3-D graphics images and encrypting data.

- **Smart cards** are plastic cards the size of a regular credit card that have an embedded specialty chip.
- Luxury cars have more than 70 separate processors.

- **Memory**

- Memory is a holding area for data, instructions, and information.
- Memory is contained on chips connected to the system board.
- There are three well-known types of memory chips: random-access memory (RAM), read-only memory (ROM), and flash memory
- **RAM**
  - **Random-access memory (RAM)** chips hold the program (sequence of instructions) and data that the CPU is presently processing.
  - RAM is temporary or volatile storage because everything in most types of RAM is lost as soon as the personal computer is turned off.
  - **Cache** memory improves processing by acting as a temporary high-speed holding area between the memory and the CPU. Computer detects which information in RAM is most frequently used and then copies that information into the cache.
  - Memory capacity is expressed in bytes. See chart in Figure 5-12.
  - Having enough RAM is important
  - RAM can be added by inserting an expansion module – **DIMM** (dual in-line memory module). Other types of RAM include DRAM, SDRAM, DDR, and Direct RDRAM.
  - **Virtual memory** is space utilized on a secondary storage device by the operating system when there isn't enough RAM to process all applications. It is a swap area where each part is read into RAM only when needed.
    - For more information on how virtual memory works visit [www.mhhe.com/ce2015](http://www.mhhe.com/ce2015), select Student Edition, then Explore, and then Memory.
- **ROM**
  - **Read-only memory (ROM)** chips have information and programs built into them at the factory.
  - ROM chips are not volatile and cannot be changed by the user.
  - Not long ago, ROM chips were typically used to contain almost all instructions for basic computer operations.
  - Recently, however, flash memory chips have replaced ROM chips for many applications.
- **Flash Memory**
  - Offers a combination of the features of RAM and ROM.
  - Flash memory can be updated to store new information
  - Flash memory chips can retain data even if power is disrupted.
  - Used for a wide variety of applications such as startup instructions for a computer. This information is called the system's BIOS (basic input/output system).

- **Expansion Slots and Cards**

- Expansion cards plug into expansion slots located on the system board.
- Ports on the cards allow cables to be connected from the expansion cards to devices outside the system unit.
- Some of the more common devices are
  - **Graphics cards** – provide high-quality 3D graphics and animation for games and simulations
  - **Sound cards**, accept audio input from a microphone and convert it into a form that can be processed by the computer
  - **Network interface cards (NIC)** - also known as network adapter cards, are used to connect a computer to a network
  - **Wireless network cards**-allow computers to be connected without cables
- Plug and Play is a set of hardware and software standards developed by hardware and software vendors that is associated with the ability to plug any device into a computer and have it play or work immediately.
  - To meet size constraints of laptops, tablets, and mobile devices, small, credit-card sized expansion cards, known as PC cards, plug into ExpressCard slots or PCMCIA slots on personal computers
- **Bus Line**
  - A bus line (also known as simply a bus) - connects the parts of the CPU to each other.
  - Buses also link the CPU to various other components on the system board.
  - A bus is a pathway for bits representing data and instructions.
  - The number of bits that can travel simultaneously down a bus is known as the bus width.
  - A 64-bit bus can move twice as much information at a time as a 32-bit bus, just like a highway with multiple traffic lanes.
  - There are two basic categories of buses:
    - System - connects the CPU to memory on the system board
    - Expansion - connects the CPU to other components on the system board.
  - **Expansion Buses**
    - **Universal serial bus (USB)** widely used today; external USB devices are connected to one another or to a common point or hub and then onto the system board.
      - the current USB standard is USB 3.0
    - **FireWire buses** operate much like USB buses but more specialized; used to connect digital camcorders and video editing equipment to the system board.
    - **PCI Express (PCIe)** is widely used in many of today's most powerful computers. It provides a single dedicated path for each connected device. PCIe buses are much faster and are replacing the PCI bus.
- **Ports**
  - A port is a socket for external devices to connect to the system unit.
  - Some ports connect directly to the system board while others connect to cards that are inserted into slots on the system board.
  - Some ports are standard features of most computer systems and others are more specialized.

- Standard ports. The most common ports include:
  - **VGA (Video Graphics Adapter) and DVI (Digital Video Interface)** ports provide connections to analog and digital monitors, respectively.
    - DVI has become the most commonly used standard
  - **Universal serial bus (USB) ports** – used to connect several devices to the system unit (keyboards, mice, printers, etc.) and a variety of specialty devices. One such device, a USB TV tuner card, allows users to view and record television programs. See Making IT Work for You. A Single USB port can be used to connect many USB devices to the system unit.
  - **FireWire ports** – provide high-speed connections to specialized FireWire devices such as camcorders and storage devices.
  - **Ethernet ports** – high-speed networking ports used to connect multiple computers for sharing files, or to a DSL or cable modem for high-speed Internet access.
- Specialized ports. Numerous specialty ports include eSATA, HDMI, MIDI, MiniDP, and S/PDIF.
  - **External Serial Advanced Technology Attachment (eSATA)** ports provide very high-speed connections for external hard disk drives, optical disks, and other large secondary storage devices.
  - **HDMI** – High Definition Multimedia Interface ports provide high-definition video and audio.
  - **MIDI** – Musical Instrument Digital Interface – special type of port for connecting musical instruments like an electronic keyboard to a sound card.
  - **Mini DisplayPort (MiniDP or mDP)** - audio-visual port typically used to connect large monitors. These ports are used with many Apple Macintosh computers.
  - **Thunderbolt** – first introduced in Apple’s MacBook Pro computer and provide high-speed connections with a single port connecting up to seven devices one to another.
- Cables
  - are used to connect exterior devices to the system unit
  - one end of the cable is attached to the device and the other to a matching connector on a port
- **Power Supply**
  - Computers require direct current (DC) to power their electronic components and to represent data and instructions. PC power can be provided indirectly by converting alternating current (AC) from standard wall outlets or directly from batteries.
  - Desktops have a power supply unit located within the system unit.
  - Laptop and mobile devices use an AC adapter as well as battery power
  - Laptop and mobile devices use AC adapters located outside the system unit
    - Mobile devices typically operate using battery power

- **Electronic Data and Instructions**
  - Computers recognize only digital electronic signals
  - Before processing can occur a conversion must take place from analog, or what we understand, to what the system unit can electronically process
    - Numeric Representation is using the binary system
    - Each 0 or 1 is called a bit
    - 1 is represented by a negative charge and the 0 with no charge
      - Uses two-state binary system to represent data and instructions
    - Character Encoding
      - Standards assign a unique sequence of bits to each character
      - Personal computers have used the ASCII to represent character
      - Mainframe computers used EBCDIC
        - Both are effective but limited due to being 7 bit codes
      - Unicode uses 16 bits
        - Most widely used character encoding standard and recognized by virtually every computer system
- **Careers In IT**
  - Computer technicians
    - Repair and install computer components and systems.
    - May work with computer engineers to diagnose problems and run routine maintenance on complex systems.
    - Employers look for those with certification in computer repair or associate degrees from professional schools
    - Earn an annual salary in the range of \$31,000 to \$46,000.
- **A Look to the Future**
  - Chips inside Your Brain
  - Have you ever thought it would be possible for you to be able to communicate with a computer by merely thinking?
  - Researchers are working with various devices (usually worn on the head) that can use your basic thoughts to move objects, such as wheelchairs.
  - The future will lie in implanted microchips which can communicate directly with our nerve cells. Although their initial purpose will be to treat a variety of medical conditions, they could eventually (and controversially) be used to improve various brain functions of otherwise healthy individuals.

## Teaching Tips

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- **The System Unit**

- This is a good place to cover all the various types of computers from mobile devices to supercomputers. It gives the students a good understanding of the many different types of computers.
- For the lecture on all the personal computer hardware, it is helpful to have several machines open and spread throughout the classroom, so that the students can see what you are talking about. For many of the students, it is the first time they have seen the inside of a computer.
- Discuss the four basic types of computers.

- **Electronic Data and Instructions**

Computers are digital devices as opposed to analog devices. Therefore, computers can only understand things as on or off.

- Numeric Representation
  - On is represented as a 1 and off as a 0, thus a binary system. The binary system consists of only two digits—0 and 1.
  - Each 0 or 1 is called a bit—short for binary digit.
  - In order to represent numbers, letters, and special characters, bits are combined into groups of eight called bytes. Each byte typically represents one character.
  - Binary coding schemes
    - This is a good area to cover binary to decimal conversions. Base conversions occur a lot in computing and students need practice in understanding the technique.
    - The binary code translation table in Figure 5-23 is a good reference to help the students understand what they are and why they are used.
  - Hexadecimal system (hex)
    - Uses 16 digits (0-9 and A-F) to represent binary numbers.
    - Each hex digit represents 4 binary digits, and two hex decimals are commonly used together to represent 1 byte (8 binary digits).
- Character Encoding
  - **ASCII (American Standard Code for Information Interchange)** is a seven bit coding scheme. This is the most widely used binary code for personal computers.
  - **EBCDIC (Extended Binary Coded Decimal Interchange Code)** is an eight bit coding scheme developed by IBM and is used primarily for large computers.
  - **Unicode** – This code is fairly new and now mostly widely used. Ask students to explain its purpose (the explosion of the Internet and subsequent globalization of computing led to the development of Unicode. Allows for the use of non-English characters).



- **System Board**
  - Using the opened machines, as stated earlier, you can point to the various parts of the system board and discuss **Sockets, Chips, Carrier packages, Slots, and Bus lines**
- **Microprocessor**
  - In the opened machine, you can point to the processor and discuss.
  - Using the analogy of the microprocessor being the “brains” of the computer system is an excellent way of introducing what it does.
  - Of its two basic components, you can describe the **control unit** as being like a traffic cop because it coordinates when components can “speak” and how they should handle the information. Describing the **arithmetic-logic unit** is very basic; most students understand this part of the processor well.
  - Microprocessor chips
    - The concept of the word size is quite foreign to most students. Explaining this helps them understand what is meant by 16, 32, or 64 bit processors and why it is significant when purchasing a computer and software
    - Billionths of a second, or **nanoseconds**.
    - Supercomputers operate at speeds measured in trillionths of a second, or **picoseconds**—1,000 times as fast as personal computers.
    - It is good to point out that 64-bit processors are becoming commonplace in today’s more powerful personal computers, but that most of today’s operating systems and application programs were designed to run with 32-bit processors. This will help them understand performance issues with software.
    - Discuss the new type of chip called the multicore chip. Discuss how the multicore chip is used and how it increases processing speeds.
    - Many students come to classes with their laptops and/or tablets/smartphones in hand. Give a demonstration by showing them how to determine what microprocessor their laptop has on it. This can be accomplished by going into the Windows control panel and selecting Systems Properties from the menu bar. They will quickly see information on the processor, installed RAM, and processor speed.
    - Have students find the system properties on tablets and other mobile devices.
- **Memory**
  - Memory is a holding area for data, instructions, and information.
  - There are three well-known types of memory chips: random-access memory (RAM), read-only memory (ROM), and flash memory.
  - **RAM**
    - Using the opened machine, you can point to the memory slots on the board. Mention that adding memory is easy, but when doing so they should consult a users manual to make sure they are adding the right type and in the right combinations.
    - It is good to discuss and define that RAM is temporary or volatile storage because everything in most types of RAM is lost as soon as the personal computer is turned off.

- Virtual memory is space utilized on a secondary storage device by the operating system when there isn't enough RAM to process all applications. It is a swap area where each part is read into RAM only when needed.
- If available, a good demonstration of this concept to students is facilitated by bringing some RAM chips and actually installing them onto the system board.
- **ROM**
  - **Read-only memory (ROM)** chips have programs built into them at the factory.
  - ROM chips are not volatile and the information in them cannot be changed by the user.
  - ROM chips typically contain special instructions for detailed computer operations.
  - Recently, however, flash memory chips have replaced ROM chips for many applications.
  - If available, bring in some ROM chips and let students look at them. Many ROM chips are attached to a carrier package so it is a good opportunity to show them this at the same time.
- **Flash Memory**
  - Offers a combination of the features of RAM and ROM.
  - Flash memory chips can retain data even if power is disrupted.
  - Contains startup instructions called the system's BIOS (basic input/output system).
  - Ask students if they have flash "thumb" drives. Ask how they are used?
- **Expansion slots and cards**
  - You can point to the different expansion cards and ports on the opened machine, and have the students name some common devices.
  - Plug and Play is a set of hardware and software standards developed by hardware and software vendors that is associated with the ability to plug any device into a computer and have it play or work immediately.
  - What are PC and ExpressCard slots?
- **Bus Line**
  - A bus is a pathway for bits representing data and instructions.
  - Bus design or bus architecture is an important factor relating to the speed and power for a particular computer.
  - The wider the bus, the more bits that can be moved simultaneously.
  - There are two types of buses:
    - System bus- connects the CPU to memory on the system board
    - Expansion bus - connects the CPU to other components on the system board.
  - It is good to point out the different types of expansion buses, since this will help students when they are purchasing a new computer.
  - Ask students to explain the difference between a system and an expansion bus.

### **Expansion Buses**

- **Universal serial bus (USB)** combines with a PCI bus on the system board to support several external devices without using expansion cards or slots.
- **FireWire buses** operate much like USB buses.

- **PCI Express (PCIe)** is widely used in many of today's most powerful computers. It provides a single dedicated path for each connected device. PCIe buses are much faster and are replacing the PCI bus.
- **Ports**
  - A port is a socket for external devices to connect to the system unit.
  - You can point to the various ports on the open machine and discuss them.
  - There are:
    - **Standard ports** – VGA, USB, FireWire, Ethernet
    - **Specialized ports** – eSATA, HDMI, MIDI, MiniDP, and S/PDIF.
- **Cables**
  - Cables are used to connect exterior devices to the system unit via the ports.
  - Many teaching labs are set up where Ethernet wires are still very common. Explain how these cables are used.
- **Power Supply**
  - Discuss the power supply for mobile devices. The AC adapter is used to recharge batteries. Discuss the new power supply units that are available in many airports to assist travelers in re-charging theirs.

## Key Terms

Key Term	Definition
AC adapter	A power adapter that converts AC to DC, provides power to drive the system unit components, and can recharge batteries.
all-in-one	A desktop computer that has the monitor and system unit housed together in the same case (e.g., Apple's iMac).
analog	Continuous, signals that vary to represent different tones, pitches, and volume.
arithmetic-logic unit (ALU)	The ALU performs two types of operations: arithmetic and logical.
arithmetic operation	Fundamental math operations: addition, subtraction, multiplication, division.
ASCII	Binary coding scheme widely used on all computers, including personal computers. Eight bits form each byte, and each byte represents one character.
binary system	A numbering system that consists of only two digits, 0 and 1.
BIOS (basic input/output system)	
bit	Data and instructions can be represented electronically with a two-state or binary system of numbers (0 and 1). Each 0 or 1 is called a bit - Short for – Binary Digit.
bus	Connects the parts of the CPU to each other. (See also bus line)
bus line	Connects the parts of the CPU to each other. (See also bus)
bus width	The number of bits that can travel simultaneously down a bus.
byte	Eight bits. Each byte typically represents one character.
cable	Connects external devices to the system unit via ports.
cache memory	A temporary high-speed holding area between the memory and the CPU - used to improve processing time.
central processing unit (CPU)	The “brains” of a computer and is contained on a single chip. (See also microprocessor, processor)
character encoding standards	These standards assign a unique sequence of bits to each character.
chip	Consists of tiny circuit boards etched onto squares of sand-like material called silicon. (See also integrated circuit, silicon chip, semiconductor)
chip carriers	These plug either directly into sockets on the system board or onto cards that are then plugged into slots on the system board.
clock speed	The speed of processing or power of a computer system.
computer technician	People who repair and install computer components and systems.
control unit	The part of a processor that tells the rest of the computer

	system how to carry out a program's instructions, and directs the movement of electronic signals between memory and the CPU.
coprocessor	Specialty chip designed to improve specific computing operations.
desktop	The screen that is displayed on the monitor when the computer starts up. All items and icons on the screen are considered to be on your desktop and are used to interact with the computer.
digital	Signals that are only in two states – on or off – are used to represent voice and data.
DIMM	Dual in-line memory module – an expansion module inserted into the system board for adding additional RAM.
DVI (Digital Video Interface) port	Provides connections to analog and digital monitors.
EBCDIC	Extended Binary Coded Decimal Interchange Code. An 8-bit binary coding scheme developed by IBM and used primarily in large computers.
Ethernet port	A high-speed networking port that has become a standard for many of today's computers.
expansion bus	Connects the CPU to other components on the system board, including expansion slots.
expansion card	Optional devices users can insert into their computers.
expansion slot	Slots provided on a personal computer where users can insert optional devices.
external Serial Advanced Technology Attachment) (eSATA)	A port that provides very high-speed connections for external hard disk drives, optical disks, and other large secondary storage devices.
FireWire bus	A bus dedicated to the acceleration of graphics performance.
FireWire port	Provides connections to specialized FireWire devices such as camcorders.
flash memory	Chips that can retain data even if power is disrupted.
game port	A legacy port used to connect video game controllers and joysticks.
GPU	Graphic processing unit. Graphics coprocessor designed to handle a variety of specialized tasks such as displaying 3-D images and encrypting data.
graphics card	Provides high-quality 3D graphics and animation for games and simulations.
graphics coprocessor	A processor specifically designed to handle the processing requirements related to displaying and manipulating 2-D and 3-D graphics images.
handheld computer	Are the smallest and designed to comfortably fit into the palm of one hand
hexadecimal system (hex)	Hexadecimal system (hex) uses 16 digits to represent binary

	numbers.
High Definition Multimedia Interface (HDMI)	A digital HD audio and video interface.
integrated circuit	Consists of tiny circuit boards etched onto squares of sand-like material called silicon. (See also chip, silicon chip, semiconductor)
laptop	These system units contain the electronic components, selected secondary storage devices, and input devices. (See also notebook system unit)
logical operation	Compare two pieces of data (equal, less than or greater than).
mainboard	Controls communications for the entire computer system. Every component within the system unit connects to the main board. (see also system board or mother board)
memory	A holding area for data, instructions, and information and contained on chips connected to the system board.
microprocessor	The “brains” of a computer and is contained on a single chip. (See also central processing unit, processor)
Mini DisplayPort (MiniDP, mDP)	A port that an audio-visual port typically uses to connect large monitors. These ports are used with many Apple Macintosh computers.
mini notebook	Lighter, thinner, and have longer battery life than other laptops.
motherboard	The communications medium for the entire computer system. (See also main board, system board)
multicore processor	A new type of processor that can provide two or more separate and independent CPUs.
musical instrument digital interface (MIDI)	A special type of serial port for connecting musical instruments to a sound card.
netbook	Similar to notebook system units but smaller, less powerful, and less expensive, designed to support on-the-go Web browsing and e-mail access
network adapter card	Connects a computer to one or more other computers. (See also network interface card)
network interface card (NIC)	Connects a computer to one or more other computers. (See also network adapter card)
notebook	These system units contain the electronic components, selected secondary storage devices, and input devices. (See also laptop computer)
optical audio connections	These ports are used to integrate computers into high-end audio and home theatre systems.
parallel processing	Two separate and independent CPUs that can divide programs into parts that each CPU can process independently.
PC card	A small, credit card-sized expansion card developed to meet the size constraints of notebook, tablet, and mobile devices

	computers.
PC card slot	Credit card–sized expansion card (See also PCMCIA slot)
PCI Express (PCIe)	New type of bus that is 30 times faster than PCI bus.
PCMCIA	Credit card-sized expansion card (see also PC Card Slot)
personal computer	Is the most widely used computer, is most affordable, and is designed to be operated directly by the end user.
Plug and Play	A set of hardware and software standards by hardware and software vendors to create operating systems, processing units, and expansion boards, as well as other devices that are able to configure themselves.
port	A socket for external devices to connect to the system unit.
power supply unit	Converts AC to DC, and provides the power to drive all of the system unit components.
processor	The “brains” of a computer and is contained on a single chip. (See also microprocessor, central processing unit)
random-access memory (RAM)	Chips temporarily holding programs and data that the CPU is presently processing.
read-only memory (ROM)	Chips that typically contain special instructions for detailed computer operations.
semiconductor	Consists of tiny circuit boards etched onto squares of sand-like material called silicon. (See also integrated circuit, silicon chip, chip)
silicon chip	Consists of tiny circuit boards etched onto squares of sand-like material called silicon. (See also integrated circuit, chip, semiconductor)
slot	Provides a connection point for specialized cards or circuit boards.
smart card	A plastic card the size of a regular credit card that has an embedded chip.
smartphone	A smartphone is a mobile phone offering advanced capabilities, often with PC-like functionality.
socket	Provides a connection point for chips
sound card	Accept audio input from a microphone and convert it into a form that can be processed by the computer.
system board	The communications medium for the entire computer system. (See also motherboard, main board)
system bus	Connects the CPU to memory on the system board.
system chassis	A container that houses most of the electronic components that makes up a computer system. (See also system unit, or chassis)
system unit	A container that houses most of the electronic components that makes up a computer system. (See also chassis, or system unit)
tablet	A highly portable device that supports the use of a stylus or pen to input commands and data. (See also tablet PC system unit)

tablet computer	Effectively a notebook computer that accepts stylus input and has a monitor that swivels and folds onto its keyboard.
Thunderbolt	High-speed connections to up to seven separate devices connected one to another.
tower computer	A desktop system unit placed vertically.
tower unit	A desktop system unit placed vertically.
ultrabooks	Are a type of very portable laptops.
ultraportables	Lighter and thinner and have longer battery life than other laptops.
Unicode	A 16-bit binary coding scheme designed to support international languages.
universal serial bus	A buss that combines with a PCI bus on the system board to support several external devices without using expansion cards or slots.
universal serial bus (USB) port	Fastest type of port that can connect several devices at a time to the system unit.
VGA (Video Graphics Adapter) port	Provides connections to analog and digital monitors.
virtual memory	A space utilized on a secondary storage device by the operating system used to swap information when there isn't enough RAM to process all applications.
wireless network card	Expansion card that allows computers to be connected without cables.
word	The number of bits (such as 16, 32, or 64) that can be accessed at one time by the CPU.



## Answers to End-of-Chapter Materials

### Chapter 5

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Num	Multiple Choice Answers (Book)	Matching Answers (Book)	Multiple Choice Answers ( <a href="http://www.mhhe.com/ce2015">www.mhhe.com/ce2015</a> Only)	Matching Answers ( <a href="http://www.mhhe.com/ce2015">www.mhhe.com/ce2015</a> Only)
1	C	C	A	E
2	D	E	A	D
3	D	G	D	J
4	B	H	C	F
5	B	A	B	H
6	D	B	C	B
7	D	D	D	C
8	A	I	B	I
9	A	J	A	G
10	C	F	C	A

#### Open Ended Questions:

#### 1. Describe the four basic types of personal computers and personal computer system units.

- **Desktop system units** - Most desktops have their system unit in a separate case. This case contains the system's electronic components and selected secondary storage devices. Input and output devices are located outside the system unit. Desktop system unit that are placed vertically are sometimes referred to as a tower unit or tower computer. Some desktop computers, like Apple's iMac, have their monitor and system unit housed together in the same case. These computers are known as all-in-one.
- **Notebooks** - although typically not as powerful as desktops, notebooks are portable and much smaller. Their system units are housed with selected secondary storage devices and input devices. Notebooks are often called laptops.
- **Tablets**, also known as tablet computers, are the newest and one of the most popular types of computer. They are effectively a thin slab that is all monitor with the system unit located behind the monitor. Tablets are smaller, lighter, and generally less powerful than notebooks. Like a notebook, tablets have a flat screen but typically do not have a standard keyboard. Instead tablets typically use a virtual keyboard that appears on the screen and is touch sensitive. One distinguishing feature among tablet computers is the operating system that controls their operations. Apple's iPad uses the mobile operating system iOS. It is capable of running apps specifically designed for it. Many other tablets use Microsoft's Windows 8 operating system and can run many general purpose applications as well as apps specifically designed for it.
- **Mobile devices** - By far the most popular computer is the smartphone. These devices are smaller and generally less powerful than tablets. Unlike a tablet, smartphones typically

provide a keypad for entering instructions. Smartphones greatly extend the capabilities of a cell phone by providing computing power. In addition to capturing and sending audio and video, smartphones run apps, connect to the Internet, and more. Their system unit is located behind the display screen and keypad.

## 2. Describe system boards including sockets, chips, chip carriers, slots, and bus lines.

System board is also known as the mainboard or motherboard. The system board controls communications for the entire computer system. Every component within the system unit connects to the system board. All external devices including the keyboard, mouse, and monitor connect to the system board. It acts as a data path and traffic monitor, allowing the various components to communicate efficiently with one another. The system board is a flat circuit board covered with a variety of different electronic components including:

- **Sockets** – provide a connection point for small specialized electronic parts called chips. Sockets are used to connect the system board to a variety of different types of chips, including microprocessors and memory chips.
- **Chips**- consist of tiny circuit boards etched onto squares of sand-like material called silicon. A chip is also called a silicon chip, semiconductor, or integrated circuit.
- **Chip carriers**– chips are mounted on carrier packages. These packages plug either directly into sockets on the system board or onto cards that are then plugged into slots on the system board.
- **Slots** – provide a connection point for specialized cards or circuit boards
- **Bus lines** – provide pathways that support communication among the various electronic components that are either located on the system board or attached to the system board.

## 3. Discuss microprocessors components, chips, and specialty processors.

The central processing unit (CPU) or processor is contained on a single chip called the microprocessor. The microprocessor is the “brains” of the computer system. It has two basic components: the control unit and the arithmetic-logic unit.

- **Control unit**
  - Tells the rest of the computer system how to carry out a program’s instructions.
  - Directs the movement of electronic signals between memory, which temporarily holds data, instructions, and processed information and the arithmetic-logic unit.
  - Directs these control signals between the CPU and input and output devices.
- **Arithmetic-logic unit (ALU)**
  - Performs two types of operations: arithmetic and logic.
  - Arithmetic operations are the fundamental math operations: addition, subtraction, multiplication, and division.

- Logical operations consist of comparison where two pieces of data are compared to see whether one is equal to (=), less than (<), or greater than (>) the other.
- **Multicore chips** – the most significant recent developments in microprocessors are the 64-bit processor and the multicore chip. Multicore chips can provide two or more separate and independent CPUs. These chips allow a single computer to run two or more operations at the same time.
- **Specialty processors** are specialty chips designed to improve specific computing operations. These include:
  - Graphics coprocessors (also called a GPU) are processors designed to handle a variety of specialized tasks such as displaying 3-D images and encrypting data.
  - Smart cards are plastic cards the size of a regular credit card that have an embedded specialty chip.
  - Processors in automobiles, satellites entertainment, and tracking systems.

#### 4. Define computer memory including RAM, ROM, and flash memory.

Memory is a holding area for data, instructions, and information. Memory is contained on chips connected to the system board. There are three well-known types of memory chips: random-access memory (RAM), read-only memory (ROM), and flash memory.

- Random-access memory (RAM) chips hold the program (sequence of instructions) and data that the CPU is presently processing. RAM is called temporary or volatile storage because everything in most types of RAM is lost as soon as the personal computer is turned off.
  - Cache memory improves processing by acting as a temporary high-speed holding area between the memory and the CPU. The computer detects which information in RAM is most frequently used and then copies that information into the cache.
- Read-only memory (ROM) chips have information stored in them by the manufacturer. Unlike RAM chips, ROM chips are not volatile and cannot be changed by the user. “Read only” means that the CPU can read or retrieve data and programs written on the ROM chip. However, the computer cannot write-encode or change- the information or instructions in ROM. Not long ago, ROM chips were typically used to contain almost all instructions for basic computer operations. Recently, however, flash memory chips have replaced ROM chips for many applications.
- Flash memory offers a combination of the features of RAM and ROM. Like RAM, it can be updated to store new information. Like ROM, it does not lose that information when power to the computer system is turned off. Flash memory is used to store startup instructions. This information is called the system's BIOS (basic input/output system).

## 5. Define expansion slots, cards, Plug and Play, PC cards, PCMCIA slots and ExpressCard slots.

Expansion slots are provided on a personal computer where users can insert optional devices known as expansion cards into these slots.

- **Graphics cards:** provide high-quality 3D graphics and animation for games and simulations.
- **Sound cards:** These cards accept audio input from a microphone and convert it into a form that can be processed by the computer. Also, these cards convert internal electronic signals to audio signals so they can be heard from external speakers.
- **Network interface cards (NIC):** These cards are used to connect a computer to one or more other computers. The network adapter card typically connects the system unit to a cable that connects to the network.
- **Plug and Play** was originally a set of specific hardware and software standards developed by Intel, Microsoft, and others. Overtime the concept of Plug and Play has become a generic term that is associated with the ability to plug any device such as a printer or monitor into a computer and have it play or work immediately.
- **PCMCIA slots and ExpressCard slots** – meet the size constraints of notebook, tablets and mobile devices, small credit card-sized expansion cards, known as PC cards, have been developed. These cards plug into PCMCIA slots (called PC Card slots) or, more recently, ExpressCard slots.

## 6. Describe bus lines, bus width, system bus, and expansion bus.

A bus line, or bus, connects the parts of the CPU to each other. Buses also link the CPU to various other components on the system board. A bus is a pathway for bits representing data and instructions.

- The number of bits that can travel simultaneously down a bus is known as bus width.
- Expansion buses connect the CPU to other components on the system board, including expansion slots. The principal types are:
  - **Universal serial bus (USB)** is widely used to connect external USB devices. The USB then connects to the PCI bus on the system board.
  - **FireWire bus** – similar to USB but more specialized. They are used primarily to connect audio and video equipment to the system board.
  - **PCI Express (PCIe)** is widely used in powerful computers. Unlike most other buses that share a single bus line or path with several devices, the PCIe bus provides a single dedicated path for each connected device.

## 7. Define ports including standard and specialized ports.

A port is a socket for external devices to connect to the system unit. Some ports connect directly to the system board while others connect to cards that are inserted into slots on the system board.

The most common standard ports are:

- **VGA (Video Graphics Adapter)** and **DVI (Digital Video Interface)** ports provide connections to analog and digital monitors. DVI is the most commonly used standard.
- **Universal serial bus (USB)** ports can be used to connect several devices to the system unit and are widely used to connect keyboards, mice, printers, storage devices, and a variety of specialty devices.
- **FireWire** ports provide high-speed connections to specialized FireWire devices such as camcorders and storage devices.
- **Ethernet** ports are a high-speed networking port that has become standard for many of today's computers. Ethernet allows you to connect multiple computers for sharing files, or to a DSL, or cable modem for high-speed Internet access.

The most common specialized ports are:

- **External Serial Advanced Technology Attachment (eSATA)** ports provide very high-speed connections for external hard disk drives, optical disks, and other large secondary storage devices.
- **High Definition Multimedia Interface (HDMI)** ports provide high-definition video and audio, making it possible to use a computer as a video jukebox or an HD video recorder.
- **Musical instrument digital interface (MIDI)** ports are a special type of port for connecting musical instruments like an electronic keyboard to a sound card. The sound card converts the music into a series of digital instructions. These instructions can be processed immediately to reproduce the music or saved to a file for later processing.
- **Mini DisplayPort (MiniDP or mDP)** ports are an audio-visual port typically used to connect large monitors. These ports are used with many Apple Macintosh computers
- Thunderbolt ports provide high-speed connections.

## 8. Describe power supply including power supply units and AC adapters.

Computers require DC current to power their electronic components and to represent data and instructions.

- Desktop computers have a power supply unit located inside the system unit that converts AC to DC.
- Notebook and tablet PCs use AC adapters that are typically located outside the systems unit. AC adapters plug into a wall outlet and convert AC to DC.

## 9. Discuss electronic data and instructions.

Computers can only recognize digital electronic signals. Before any processing can occur within the system unit, a conversion must occur from what humans understand (analog) to what the system unit can electronically process (digital).

- Numeric representation:
  - Computers use a two-state (binary system) – on or off arrangement to represent data and instructions.
  - Binary system consists of only two digits – 0 and 1. Each 0 or 1 is called a bit – short for binary digit.
  - In the system unit, the 1 can be represented by a positive charge and the 0 by no electrical charge.
  - In order to represent numbers, letters, and special characters, bits are combined into groups of eight called bytes.
  - Hexadecimal system uses 16 digits to represent binary numbers. Each hex digit represents four binary digits, and two hex digits are commonly used together to represent 1 byte (8 binary digits)
- Character encoding:
  - Nonnumeric characters are assigned encoding schemes or standards which assign a unique sequence of bits to each character.
  - ASCII – used in personal computers and uses 7 bits to represent a character which means that only 128 total characters can be represented
  - EBCDIC – used in mainframe computers
  - Unicode – most widely used character encoding standard and is recognized by virtually every computer system. Unicode uses a variable number of bits to represent each character, which allows non-English characters and special characters to be represented.