

## Chapter 4

### System Software

#### Lecture Guide

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- **Learning Objectives**

- Describe the differences between system software and application software.
- Identify the four types of system software programs.
- Explain the basic functions, features, and categories of operating systems.
- Compare mobile operating systems including iOS, Android, and Windows Phone.
- Compare desktop operating systems including Windows, Mac OS, UNIX, Linux, and virtualization.
- Explain the purpose of utilities and utility suites.
- Identify the four most essential utilities.
- Illustrate Windows utility programs.
- Describe device drivers, including Windows' Add a Device Wizard and Update.

#### Chapter Outline

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- **System Software**

- System software works with end users, application software, and computer hardware to handle the majority of technical details.
- It is a collection or a system of programs that handle hundreds of technical details with little or no user intervention.
- System software consists of four types of programs:
  - **Operating systems** - coordinate computer resources, provide an interface between users and the computer, and run applications.
  - **Utilities** - perform specific tasks related to managing computer resources.
  - **Device drivers** - specialized programs that allow particular input or output devices to communicate with the rest of the computer system.
  - **Language translators** - convert the programming instructions written by programmers into a language that computers understand and process.

- **Operating Systems**

- An operating system is a collection of programs that handle many of the technical details related to using a computer.
- Without a functioning operating system the computer would be useless.
- Functions can be classified into three groups:
  - **Managing resources** – coordinate all the computer's resources including memory, processing, storage, and devices such as printers and monitors.
  - **Provide user interface** – how the user interacts with the computer. Almost all newer operating systems use a graphical user interface (GUI).
  - **Running applications** - load and run applications such as word processors and spreadsheets. Most operating systems support multitasking, or the ability to switch between different applications stored in memory. The program that you are currently working on is described as running in the **foreground**. The other program or programs are running in the **background**.
- **Features**

- **Booting** – the process of starting up or restarting the operating system.
  - Warm boot – occurs when the computer is already on, and you restart it without turning off the power.
  - Cold boot – is starting the computer when it is turned off.
- **Desktop** – a place which provides access to computer resources.
- **Icons** - graphic representations for a program or function.
- **Pointer** - controlled by a mouse, trackpad or touch screen and changes shape depending upon its current function.
- **Windows** - rectangular areas for displaying information and running programs.
- **Menus** - provide a list of options or commands.
- **Tab** – divide menus into major activity areas.
- **Dialog boxes** - provide information or request input.
- **Help** - provides online assistance for operating system functions and procedures.
- **Gesture control** – ability to control operations with finger movements such as swiping, sliding, and pinching
  
- Most operating system store data and programs in a system of files and folders
  - Files are used to store data and programs.
  - Folders store related files. They can contain other folders for organizational purposes.
- **Categories**
  - There are hundreds of different operating systems, but only three basic categories:
    - **Embedded operating systems** are entirely stored within a device. See Figure 4-3.
    - **Network operating systems (NOS)** are used to control and coordinate computers that are networked or linked together. NOS are typically located on one of the connected computers' hard disks. Called the network server, this computer coordinates all communication between the other computers.
      - Examples include Linux, Windows Server and UNIX.
    - **Stand-alone operating systems** also called **desktop operating systems**, control a single desktop or laptop computer. Often desktop computers and laptops are part of a network and are referred to as the client operating system.
- **Software environment, or software platform**
  - Almost all application programs are designed to run with a specific software platform.
  - Many applications have different versions allowing one version to run on Windows and another to operate with the Mac OS.

- **Mobile Operating Systems**
  - Known as mobile OS; are a type of embedded operating system.
  - Every mobile computer, including smartphones and tablets requires an operating system.
  - These mobile OSs are less complicated and more specialized for wireless communication.
  - Best known are:
    - **Android** – introduced in 2007 and developed by Android, Inc., but purchased by Google; widely used in many smartphones.
    - **iOS** – formerly known as iPhone OS developed by Apple in 2007 for the iPhone and iPod
    - **Windows Phone 8**, introduced in 2012 by Microsoft to support a variety of mobile devices including smartphones. It has the ability to run many powerful programs designed for desktop and laptop computers.
- **Desktop Operating Systems**
  - **Microsoft's Windows**
    - The most widely used operating system.
    - More application programs are developed to run under Windows than any other operating system.
      - Windows comes in a variety of different versions and is designed to run with a variety of different microprocessors.
    - Two most current versions: Windows 7 and Windows 8
    - Windows 7
      - Released in 2009
      - Has a traditional user interface similar to previous version of Windows. See Figure 4.6
      - Features include: improved handwriting recognition and advanced searching capabilities for locating files, folders and other content on a computer.
    - Windows 8
      - Released in 2012
      - Created to better integrate with Microsoft's mobile operating systems.
      - Providing support for gestures, cloud integration, and apps.
      - Introduced a new interface which is similar to the interface for Microsoft's mobile operating system.
      - Start screen consisting of tiles with each tile linked to an application
  - **MAC OS**
    - Designed to run only with Apple computers
    - Not as widely used as the Windows operating system
    - Fewer application programs have been written for it
    - The use of Mac OS is rapidly increasing.
    - Current version: Mac OS X:
    - Its two most recent versions are:

- **OS X Lion**, released in 2011 and introduced *Launchpad* to display and provide direct access to applications, *Mission Control* to display all running applications, and *gestures*.
  - **OS X Mountain Lion**, released in 2012, with its user interface very similar to the interface used with its tablets and smartphones. The functionality of Mountain Lion is similar to Windows 8 although it is generally regarded as easier to use.
- **Unix and Linux**
    - Originally designed to run on minicomputers in network environments.
    - Now, being used by powerful microcomputers and by servers on the Web and mainframe computers
    - There are a large number of different versions of UNIX. **Linux** is an operating system that extended one of the UNIX versions
    - **Linux**
      - Open source operating system
      - Developed at the University of Helsinki by Linus Torvalds in 1991
      - Popular and powerful alternative to the Windows operating system
      - Modifications and improvements to the OS are encouraged
      - Google's Chrome OS operating system is based on Linux
- **Virtualization**
  - The ability to support multiple operating systems on a single physical machine.
  - With virtualization software the physical machine can be logically separated into separate into two or more independent virtual computers known as virtual machines.
    - Each machine appears to the user as a separate independent computer with its own operating system
      - Host operating system – is the OS of the physical machine
      - Guest operating system - is the OS on all of the virtual machines
- **Utilities**
  - Specialized programs designed to make computing easier.
  - Essential programs:
    - **Troubleshooting or diagnostic programs** that recognize and correct problems, ideally before they become serious.
    - **Antivirus programs** that guard a computer system against viruses or other damaging programs.
    - **Backup programs** that make copies of files to be used in case the originals are lost or damaged.
    - **File compression programs** that reduce the size of files so they require less storage space and can be sent more efficiently over the Internet.
  - **Window Utilities**
    - **Backup and Restore** is a utility program included with the many versions of Windows that makes a copy of all files or selected files that have been saved onto a disk. It helps to protect from the effects of a disk failure. (Figure 4-11 illustrates the Windows 7 Backup and Restore utility)

- **Disk Cleanup** is a trouble-shooting utility that identifies and eliminates nonessential files. This frees up valuable disk space and improves system performance. (Figure 4-12 illustrates the Windows 7 Disk Cleanup utility)
- **Disk Defragmenter** is a utility program that locates and eliminates unnecessary fragments and rearranges files and unused disk space to optimize operations. (Figure 4-14 illustrates the Windows 7 Disk Defragmenter utility)
- **Utility Suites:**
  - Combine several programs into one package
  - Buying the suite is less expensive than buying the programs separately
  - The three best-known utility suites are:
    - BitDefender
    - Norton Utilities
    - Zone Alarm
  - Suites provide a variety of utilities, including programs that protect your system from dangerous programs like computer viruses. See Figure 4-16.
- **Device Drivers**
  - A program or driver that is associated with every hardware device on a computer.
  - Works with the operating system to allow communication between the device and the rest of the computer system.
  - The operating system loads all of the device drivers into memory.
  - Whenever a new device is added to a computer system, a new device driver must be installed before the device can be used.
  - Windows supplies hundreds of different device drivers with its system software.
  - Some drivers are automatically selected and installed when the device is first connected to the computer system. For others, the device driver must be manually installed.
    - Windows' **Add a Device Wizard** provides step-by-step guidance for selecting the appropriate hardware driver and installing that driver.
    - Windows makes it easy to update the drivers on your computer using Windows Update.
- **Careers in IT**
  - Computer Support Specialists or Technical Support Specialists or Help-desk Technicians
    - Provide technical support to customers and other users.
    - Manage the everyday technical problems faced by computer users.
    - Resolve common networking problems and may use troubleshooting programs to diagnose problems.
    - Increasingly common for companies to provide technical support as an outsourced service.
    - Degrees in advanced associate's degree or a bachelor's degree or a degree in computer science or information systems may be preferred.
    - Because demand for qualified applicants is high, those with practical experience and certification from a training program increasingly fill these positions.
    - Employers seek individuals with good analytical and communication skills
    - Good people skills and customer service experience is an advantage

- Computer support specialists can expect to earn an annual salary of \$31,000 - \$58,000.
- Advancement opportunities are very good
- **A Look to the Future**
  - Self-Healing Computers Could Mean an End to Computer Crashes and Performance Problems
    - Computers fixing themselves
    - What if your computer could continually fine-tune its operations to maintain peak performance?
    - What if you never had to help your computer recover after a virus or other intrusion?
    - IBM has announced plans to concentrate research efforts on developing just such a server.
    - Autonomic computing is a system that allows machines to run with little human intervention.
    - Autonomic machines would be able to identify security flaws and repair them.

## Teaching Tips

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- **System Software**
  - Students tend to know very little about system software. Emphasize that it interfaces with the user, applications and the hardware. A good analogy is that it works like an interpreter between the user and the hardware.
  - Make it clear that there are four types of system software programs:
    - Operating systems - coordinate computer resources, provide an interface between users and the computer, and run applications.
    - Utilities - perform specific tasks related to managing computer resources.
    - Device drivers - specialized programs that allow particular input or output devices to communicate with the rest of the computer system.
    - Language translators - convert the programming instructions written by programmers into a language that computers understand and process.
- **Operating Systems**
  - Functions
    - Managing resources – a good way to illustrate the management portion of the operating system is to use the Performance tool.
      - Go to Windows 7 – All Programs – Accessories – System Tools – Resource Monitor. You can show the students how the memory, disk, and processor are performing.
      - You can have them launch applications and do calculations to see the different performance rates.
    - Provide user interface
      - Most of today’s students have only known a GUI interface.
      - To illustrate the different types of interfaces, go to the command prompt on a Windows 7 - All Programs – Accessories – Command Prompt system and show them different types of commands, such as Dir, CD, and MD

- Then you can switch into Windows 7 and show the Browse, File/New/Folder, etc.
  - Runs applications
  - Most support multitasking, the ability to switch between different applications. The program that you are currently working on is described as running in the foreground. The other program or programs are running in the background.
- **Features**
  - Booting
    - You can ask the students what a cold (or hard) boot is, and see how many answers you receive, then do the same for a warm (or soft) boot. You can then explain why you want to do one over another in different instances.
  - Icons—Pointer—Windows—Menus—Dialog boxes—Help
    - You can use any application or utility projected onto a screen to show the students these things. Most of them will be familiar with terms. Or you can refer to Figure 4-2.
  - File management system
    - A good way to explain a file system is to use the analogy of a file cabinet
    - A good lab is to use Windows Explorer and create, copy, and move files and folders. You can also introduce short cuts, such as Ctrl + click, or Shift+click.
- **Categories**
  - Discuss the three categories of operating systems:
    - **Embedded operating systems** are used for handheld devices such as smart phones, cable and satellite television tuner boxes, and other small electronics.
    - **Network operating systems (NOS)** are used to control and coordinate computers that are networked or linked. Typically located on one of the connected computers' hard disks, called the network server, this computer coordinates all communication between the other computers.
    - Examples include Linux, Windows Server, and UNIX
    - **Stand-alone operating systems** also called **desktop operating systems**, control a single desktop or notebook computer. Often desktop computers and notebooks are part of a network and are referred to as the client operating system.
- **Software environment, or software platform**
  - Almost all application programs are designed to run with a specific platform.
  - Windows, Mac OS, Unix and Linux are operating systems commonly used by individuals.
- **Microsoft's Windows**
  - Most students are familiar with the Windows environment.
  - Discuss the changes for Windows 8

- **MAC OS**
  - Many students use Mac OS
  - Designed to run only with Apple computers
  - Fewer application programs have been written for it
  - Two most recent versions:
    - **Mac OS X Lion**, released in 2011 and introduced *Launchpad* to display and provide direct access to applications, *Mission Control* to display all running applications, and *gestures*.
    - **Mac OS X Mountain Lion**, released in 2012, with its user interface very similar to the interface used with its tablets and smartphones. The functionality of Mountain Lion is similar to Windows 8 although it is generally regarded as easier to use.
- **Unix and Linux**
  - More experienced students have heard of Linux, but they may not know that it is a type of UNIX.
- You can go over some benefits and features of Linux and UNIX operating systems, proprietary and non-proprietary systems.
  - Ask the students what they would do if they wanted to run two or more applications on one single machine where each application requires a different operating system.
  - Discuss with students how it is possible to do this task with virtualization.
  - Give a lab demonstration and show students how they can readily switch between virtual computers and programs running on them. Explain to them how each machine appears to the user as a separate independent computer with its own operating system.
    - Host operating system – operating system of the physical machine
    - Guest operating system – operating system for each virtual machine
- **Mobile Operating Systems**
  - Mobile operating systems (mobile OS), are a type of embedded operating system.
  - Every mobile computer, including smartphones, has an embedded operating system.
  - Discuss with students why all apps (OSs) cannot run on all phones. Students need to be made aware that they must run the correct OS per the smartphone's requirements.
  - As a lab exercise – ask students who have mobile computers or smartphones what OS is on their device.
- **Utilities**
  - You can have students run some of these utilities, so that they can have first hand experience using them. It is a good way to generate questions and teach good computer management techniques.
    - **Diagnostic programs**
    - **Antivirus programs**
    - **Backup and Restore**
    - **Disk Cleanup**
    - **Disk Defragmenter**

- Utility Suites
  - BitDefender
  - Norton Utilities
  - Zone Alarm
- **Device Drivers**
  - A program (driver) associated with every hardware device on a computer.
  - Works with the operating system to allow communication between the device and the rest of the computer system.
  - The operating system loads all of the device drivers into memory.
  - Whenever a new device is added to a computer system, a new device driver must be installed before the device can be used.
- **Careers in IT**
  - Computer Support Specialists:
    - Provide technical support to customers and other users.
    - Manage the everyday technical problems faced by computer users.
    - Resolve common networking problems and may use troubleshooting programs to diagnose problems.
    - Degrees in computer science or information systems may be required or preferred.
- **A Look to the Future**
  - Autonomic computing (self-healing computers), but not a form of AI
  - Computers may become too complex for humans to oversee.
  - IBM announced plans to make self-repairing, self-updating, and self-protecting computers.
  - As an exercise – break students up into small groups. Task them to come up with some ideas where they think autonomic computing would be extremely valuable.

## Key Terms

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Key Term	Definition
Add a Device Wizard	A Windows feature provides step-by-step guidance for selecting the appropriate driver and installing that driver.
Android	Mobile phone operating system developed by Andriod for the Andriod phone.
antivirus program	A system utility that guards a computer system against viruses or other damaging programs that can invade it.
background	Program or programs that are not active in your window on the desktop but are available to switch to from your foreground program
Backup and Restore	A utility program included with the many versions of Windows that makes a copy of all files or selected files that have been saved onto a disk.
backup program	A system utility that makes copies of files to be used in case the originals are lost or damaged.
Blackberry OS	Also know as RIM OS, a mobile phone operating system designed as the platform for the BlackBerry handheld computer
booting	The process of starting or restarting a computer
Chrome OS	Linus OS designed for netbook computers and focuses on Internet connectivity through cloud computing
cold boot	The process of starting a computer after it has been turned off.
computer support specialist	A person who provides technical support to customers and other users.
desktop	A place an operating system provides users in order to access computer resources.
desktop operating system	An operating system that controls a desktop or laptop computer. (See also stand-alone operating system)
device driver	Specialized programs that allow particular input or output devices to communicate with the rest of the computer system. (See also driver)
diagnostic program	A system utility that recognizes and corrects problems, ideally before they become serious. (See also troubleshooting program)
dialog box	A feature of a GUI operating system which provides information or requests input.
Disk Cleanup	A trouble-shooting utility included in many versions of Windows that identifies and eliminates nonessential files.
Disk Defragmenter	<a href="http://www.mhhe.com/ce2015">www.mhhe.com/ce2015</a> , select Student Edition, choose Chapter 4, and then Flashcards
driver	Specialized programs that allow particular input or output devices to communicate with the rest of the computer system. (See also device driver)
embedded operating system	A device that has the operating system programs permanently

	stored on ROM
file	Where data and programs are stored
file compression program	A system utility that reduces the size of files so they require less storage space and can be sent more efficiently over the Internet.
folder	A container in a file management system where related files are stored.
foreground	Program in which you are currently running in the active window on your desktop.
fragmented	When a file cannot be stored to disk as one contiguous block, it is broken up into small parts and stored wherever space is available.
gesture control	Use of fingers to run programs and to control the content of the display screen.
graphical user interface (GUI)	A user interface that uses graphical elements such as icons and windows.
guest operating system	The operating system for a virtual machine.
Help	Provides online assistance for operating system functions and procedures.
host operating system	The operating system of a physical machine.
Hyper-V	Created by Microsoft and runs virtual machines.
icon	A graphic representation for a program or function.
iOS	Developed by Apple (formerly known as iPhone OS) to support iPhone, iPod Touch, and iPad. One of the fastest-growing mobile OS.
iPhone OS	Type of mobile phone operating system used as the platform for Apple's iPhone, iPod Touch and iPad.
Language translator	Converts the programming instructions written by programmers into a language that computers understand and process
Launchpad	Displays and provides direct access to all apps installed on a computer
Linux	A nonproprietary version of Unix
Lion	Most recent version of Mac OS 10.7(See also (Mac OS 10.7)
Mac OS	The operating systems that are designed to run on Apple computers.
Mac OS X	One of the latest versions of MAC OS.
menu	Provides a list of options or commands.
Mission Control	Feature of the Mac OS that displays all running programs at one time.
mobile operating system	Type of embedded operating system on every smartphone to control the operations. (See also mobile OS)
mobile OS	Type of embedded operating system on every smartphone to control the operations. (See also mobile operating system)
multitasking	The ability to switch between different applications stored in memory.

network operating systems (NOS)	Operating systems that are used to control and coordinate computers networked or linked together.
network server	In a network environment, it is the main computer that coordinates all communication between the other computers.
open source	Programs released for free distribution to allow the program code to be modified and further developed by others.
operating system	Software that coordinates computer resources, provides an interface between users and the computer, and runs applications.
Optimize drives	A utility program that locates and eliminates unnecessary fragments and rearranges files and unused disk space to optimize operations.
OS X Lion	An operating system for Mac that introduced several powerful features including Launchpad and Mission Control.
OS X Mountain Lion	An operating system for Mac that was released in 2012 and designed for desktops and laptops.
pointer	A graphic that is controlled by a mouse and changes shape depending upon its current function.
RIM OS	A mobile phone operating system designed as the platform for the BlackBerry handheld computer. (See also Blackberry OS)
sector	Wedge-shaped section of a disk platter that help organize the storage of files on a magnetic disk.
software environment	Another name for an operating system. (See also software platform)
software platform	Another name for an operating system. (See also software environment)
stand-alone operating system	An operating system that controls a desktop or laptop computer. (See also desktop operating system)
Start screen	Windows 8 offers this new interface consisting of tiles.
system software	Works with end users, application software, and computer hardware to handle the majority of technical details.
tabs	Common feature of an application that divide menus into major activity areas.
tile	Displays active content linked to an application on the Windows 8 start screen.
track	Concentric rings on a disk platter that help organize the storage of files on a magnetic disk.
troubleshooting program	A system utility that recognizes and corrects problems, ideally before they become serious.
UNIX	An operating system that was originally designed to run on minicomputers in network environments, and currently runs on powerful microcomputers and servers.
user interface	How the user communicates with the operating system, computer, and/or application.
utilities	Perform specific tasks related to managing computer

	resources.
utility suite	A combination of several utility programs into one package.
virtual machine	Virtual machine appears to the owner as a separate independent computer with its own operating system.
virtualization	A method in which a physical computer can support multiple operating systems that operate independently.
virtualization software	Software that allows the physical computer to be logically separated into separate and independent virtual computers.
virus	A dangerous program that can cause a variety of damage or problems to a computer.
warm boot	The process of starting or restarting a computer when the computer is already on.
WebOS	Developed by Palm, Inc. and later purchased by HP. Evolved into the operating system for many of HP's mobile devices.
window	A rectangular area for displaying information and running programs.
Windows	An operating system released by Microsoft corporation.
Windows 7	Designed to run with many different microprocessors
Windows 8	Released in 2012 and is designed to better integrate Microsoft's desktop operating systems with its mobile operating systems. It provides support for gestures, cloud integration, and apps.
Windows Phone 8	Introduced in 2012 by Microsoft to support a variety of mobile devices including smartphones. It has the ability to run many powerful programs designed for desktop and laptop computers.
Windows RT	A version of Windows 8 designed to run with tablets using a particular microprocessor from ARM.
Windows Update	A Windows utility that makes it easy to update the drivers on a computer.

## Answers to End-of-Chapter Materials

### Chapter 4

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	D	H	B	B
2	D	J	A	E
3	B	F	B	D
4	B	G	C	H
5	D	E	D	C
6	A	I	A	G
7	C	A	B	F
8	A	B	A	J
9	B	D	C	I
10	D	C	D	A

#### Open Ended Questions:

#### 1. Describe system software. Discuss each of the four types of system programs?

System software works with end users, application software, and computer hardware to handle the majority of technical details. System software is not a single program. Rather it is a collection or a system of programs that handle hundreds of technical details with little or no user intervention.

System software consists of four types of programs:

- **Operating systems** coordinate computer resources, provide an interface between users and the computer, and run applications.
- **Utilities**, also known as service programs, perform specific tasks related to managing computer resources.
- **Device drivers** are specialized programs that allow particular input or output devices to communicate with the rest of the computer system.
- **Language translators** convert the programming instructions written by programmers into a language that computers understand and process.

#### 2. Define operating systems. Describe the basic features and the three categories of operating systems.

An operating system is a collection of programs that handle many of the technical details related to using a computer. The operating system is considered the most important type of computer program. Without an operating system, your computer would be useless.

Every computer has an operating system and every operating system performs a variety of functions. These functions can be classified into three groups:

- **Managing resources:** Operating systems coordinate all the computer's resources including memory, processing, storage, and devices such as printers and monitors. They also monitor system performance, schedule tasks, provide security, and start up the computer.
- **Providing user interface:** Operating systems allow users to interact with application programs and computer hardware through a user interface. Almost all operating systems use a graphical user interface (GUI). A graphical user interface uses graphical elements such as icons and windows.
- **Running applications:** Operating systems load and run applications such as word processors and spreadsheets. Most operating systems support multitasking, or the ability to switch between different applications stored in memory. With multitasking, you could have Word and Excel running at the same time and switch easily between the two applications. The program that you are currently working on is described as running in the foreground. The other program or programs are running in the background.

Operating systems have several features in common with application programs including:

- **Icons** – graphic representations for a program, type of file, or function.
- **Pointer** – controlled by a mouse, trackpad, or touchscreen, the pointer changes shape depending upon its current function.
- **Windows** – rectangular areas for displaying information and running programs
- **Menus** – provide a list of options or commands
- **Tabs** – divide menus into major activity areas
- **Dialog boxes** – provide information or request input.
- **Help** - provides online assistance for operating system functions and procedures.
- **Gesture control** – ability to control operations with finger movements such as swiping, sliding, and pinching.

The three main categories of operating systems are:

- **Embedded operating systems** are used for handheld devices such as smartphones. The entire operating system is stored within or embedded in the device.
- **Network operating systems (NOS)** are used to control and coordinate computers that are networked or linked together.
- **Stand-alone operating systems** control a single desktop or notebook computer.

**3. What are mobile operating systems? Describe the leading mobile operating systems.**

Mobile operating systems, also known as mobile OS, are a type of embedded operating system. Every mobile computer including smartphones requires an operating system. These mobile operating systems are less complicated and more specialized for wireless communication. While there are numerous mobile operating systems, some of the best known are:

- **Android** – was originally developed by Android Inc. and later purchased by Google. Android is widely used in many of today's smartphones.
- **BlackBerry OS** – also known as RIM OS, a mobile phone OS designed as the platform for the BlackBerry handheld computer, but has evolved into a powerful mobile operating system.
- **iOS** – formerly known as iPhone OS. iOS is based on Mac OS and is used as the platform for Apple's iPhone, iPod Touch, and iPad.
- **WebOS** – originally developed for Palm's handheld computers, it has evolved to support HP's smartphones and tablet computers.
- **Windows Phone 8** – was introduced in 2012 by Microsoft to support a variety of mobile devices including smartphones. It has the ability to run many powerful programs designed for desktop and laptop computers.

**4. What are desktop operating systems? Compare Windows, Mac OS, Linux, and Chrome OS. Discuss virtualization.**

Desktop operating systems, also called stand-alone operating systems, control a single desktop or notebook computer. Every microcomputer has an operating system controlling its operations. These operating systems are located on the computer's hard disk. Often desktop computers and notebooks are part of a network. In those cases, the desktop operating system works with the network's NOS to share and coordinate resources. The operating system is often referred to as the software environment or software platform. Almost all application programs are designed to run with a specific platform.

- **Windows** – is the most widely used microcomputer operating system market, because its market share is so large, more application programs are developed to run under Windows than any other operating system. Windows comes in a variety of different versions and is designed to run with a variety of different microprocessors. The most recent version Windows 8 was created to better integrate Microsoft's desktop operating systems with its mobile operating systems. It provides support for gestures, cloud integration, and apps.
- **MAC OS**- Designed to run on Apple machines, Mac OS is not as widely used as the Windows operating system. Fewer applications have been written for it. Mac OS X is the most widely used Mac OS. Its two most recent versions are:

- **OS X Lion**, released in 2011, included several powerful features including Launchpad to display and provide direct access to applications, Mission Control to display all running applications, and gestures.
- **OS X Mountain Lion**, released in 2012, was designed for desktops and laptops. Its user interface is very similar to the interface used with its tablets and smartphones. The functionality of Mountain Lion is similar to Windows 8 although it is generally regarded as easier to use.
- **Linux** is an operating system that extended one of the UNIX versions. It was released as open source which allows free distribution of the operating system code and encourages others to modify and further develop the code. Linux is a popular and powerful alternative to the Windows operating system.
- **Google's Chrome OS** is based on Linux. Chrome OS focuses on Internet connectivity and cloud computing.
- **Virtualization** – a method in which a physical computer can support multiple operating systems that operate independently. With virtualization software a single computer operates as though it were two or more separate and independent computers known as virtual machines. Each virtual machine appears to the user as a separate independent computer with its own operating system. The OS of the physical machine is known as the host operating system. The OS for each virtual machine is known as the guest operating system. Users can readily switch between virtual computers and programs running on them. There are several programs to create and run virtual machines. One such program, Microsoft's Hyper-V, is included with Windows 8 Professional version.

5. **Discuss utilities. What are the most essential utilities? What is a utility suite?**

Utilities are specialized programs designed to make computing easier. The most essential are:

- **Troubleshooting or diagnostic programs** that recognize and correct problems, ideally before they become serious.
- **Antivirus programs** that guard your computer system against viruses or other damaging programs that can invade your computer system.
- **Backup programs** that make copies of files to be used in case the originals are lost or damaged.
- **File compression programs** that reduce the size of files so they require less storage space and can be sent more efficiently over the Internet.

**6. Explain the role of device drivers. Discuss the Add a Device Wizard and Windows Update.**

Every device, such as a mouse or printer that is connected to a computer system has a special program associated with it. This program, called a device driver, works with the operating system to allow communication between the device and the rest of the computer system. Each time the computer system is started, the operating system loads all of the device drivers into memory.

- **Windows' Add a Device Wizard** provides step-by-step guidance for selecting the appropriate hardware driver and installs that driver.
- **Windows Update** makes it easy to update the drivers on your computer. At times when your computer behaves unpredictably, users find this utility to be an invaluable resource.