

Unit 2

2.1 INSTALLING AND UPGRADING WINDOWS

Once you have the hardware lined up for whichever specialized PC you want to build, it's time to install an operating system.

Media Sources

At its most basic, a **Windows installation has two steps**.

First, **boot the system from the OS installation media**.

Second, **answer the installation wizard's initial queries and let it do its thing**.

Windows offers a surprising number of **boot methods**, giving you many options to get the process started. The most common way to start—historically at least—is to **insert a Windows installation DVD, change the boot order in the system setup utility**, and power up the system.

Alternatively, you can boot to a storage device inserted into a USB port. That includes flash drives, external hard drives, or external solid-state drives. Any number of *external/hot-swappable drives* will do the job.

Types of Installation

You can install Windows in several ways. A **clean installation** of an OS involves installing it onto an empty hard drive or completely replacing an existing installation.

An **upgrade installation** means installing an OS on top of an earlier installed version, thus inheriting all previous hardware and software settings.

You can **combine versions of Windows by creating a multiboot installation**.

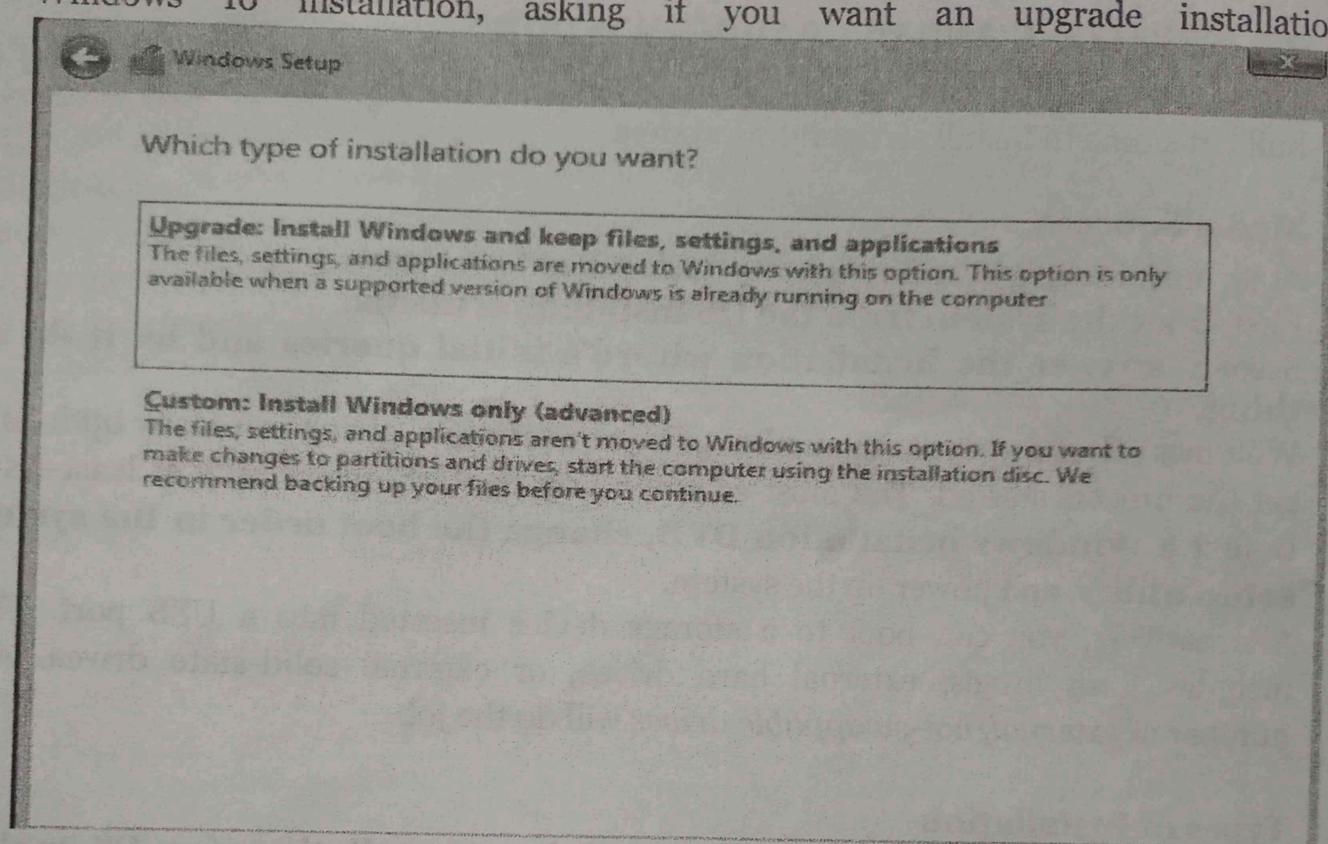
Clean Installation

A clean installation means your installation ignores a previous installation of Windows, **wiping out the old version as the new version of Windows installs**. A clean installation is also performed on a new system with a **completely blank mass storage drive**. The **advantage** of doing a clean installation is that you **don't carry problems from the old OS over to the new one**. The **disadvantage** is that you **need to back up and then restore all your data**, reinstall all your applications, and reconfigure the desktop and each application to the user's preferences. You typically perform a clean installation by setting CMOS to boot from the optical drive or USB before the hard drive or SSD. You then boot off a Windows installation disc/drive, and Windows gives you the opportunity to partition and format the hard drive or SSD during the installation process.

Upgrade Installation

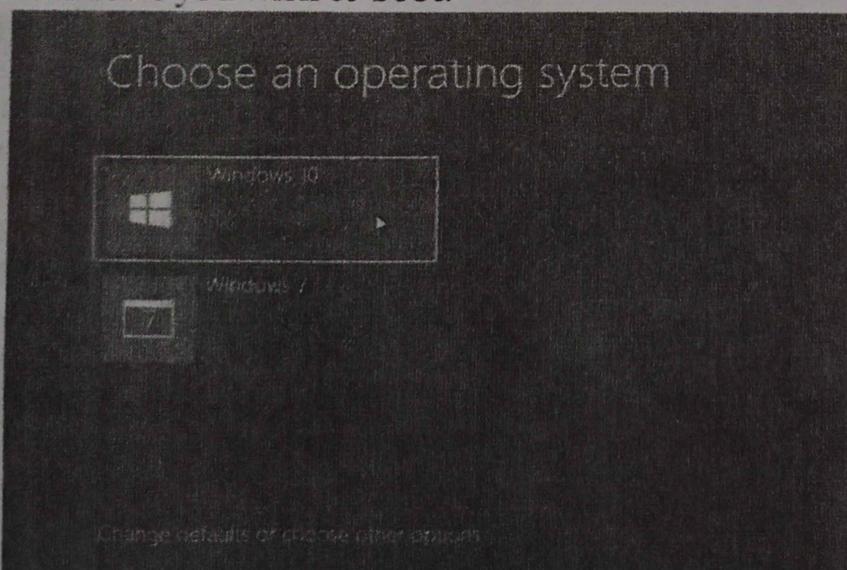
In an upgrade installation, the new OS installs into the same folders as the old OS, or in tech speak, the **new installs on top of the old**. The **new OS replaces the old**

OS, but retains data and applications and also inherits all of the personal settings (such as font styles, desktop themes, and so on). The best part is that you don't have to reinstall your favorite programs. Below figure shows the start of the Windows 10 installation, asking if you want an upgrade installation.



Multiboot Installation

A third option that you need to be aware of is the dual-boot or multiboot installation. This means your system has more than one Windows installation and you may choose which installation to use when you boot your computer. Every time your computer boots, you'll get a menu asking you which version of Windows you wish to boot.

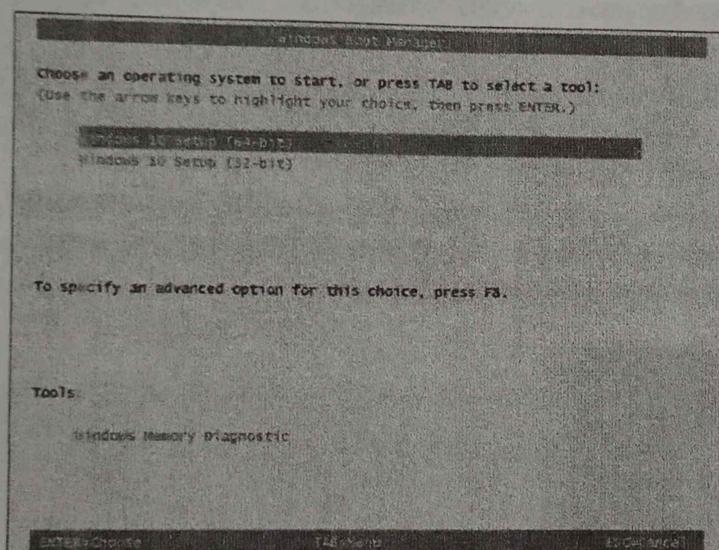


The OS Installation Process

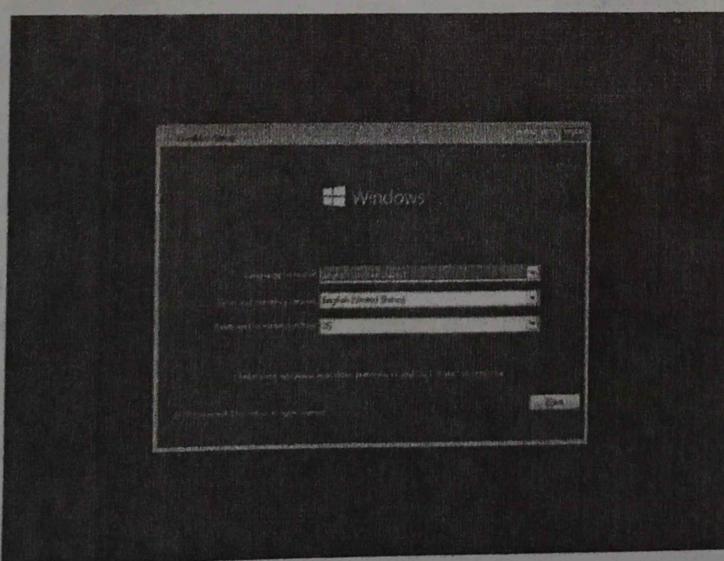
At the most basic level, installing any operating system follows a standard set of steps. You turn on the computer, **insert an operating system disc/disk into the optical drive or USB port, or access the media some other way, and follow the installation wizard until you have everything completed.** Along the way, you'll accept the **End User License Agreement (EULA)**—the terms and conditions for using the OS—and enter the product key that says you're not a pirate.

Windows 10 Clean Installation Process

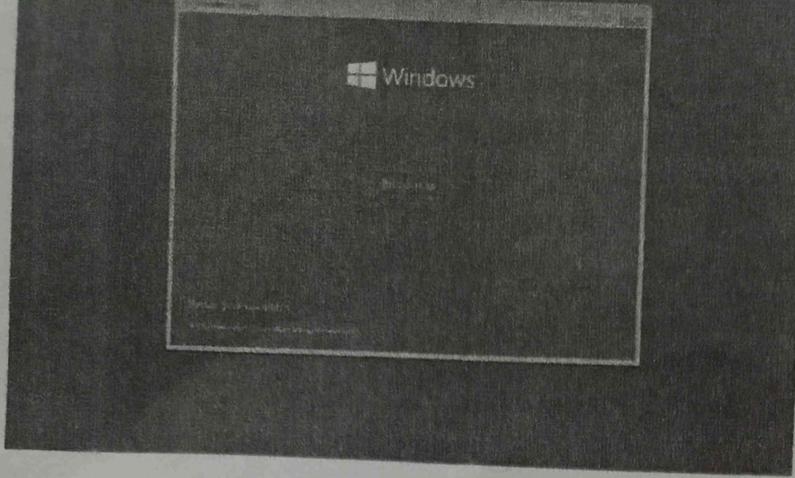
Start by booting your computer from some sort of Windows 10 installation media. When you've booted into the installer, **the first screen you see asks you if you want 32-bit or 64-bit Windows.** Since almost all CPUs support 64-bit, select that option



Your next screen asks for language, time and currency, and keyboard settings,



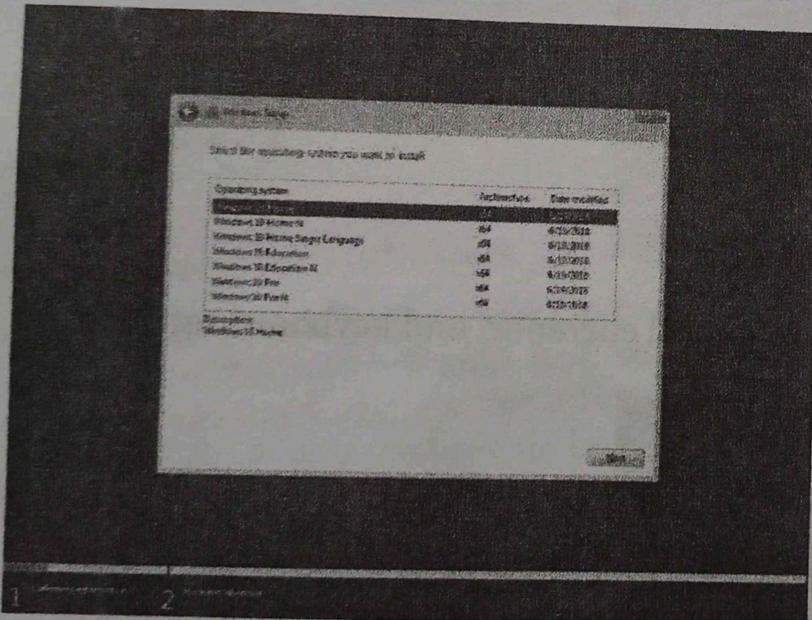
The next screen starts the installation process, but note the lower-left corner. This screen also enables techs to start the installation disc's repair tools. click Install now.



The next screen prompts you to enter your product key before you do anything else. The product key comes with the installation media.

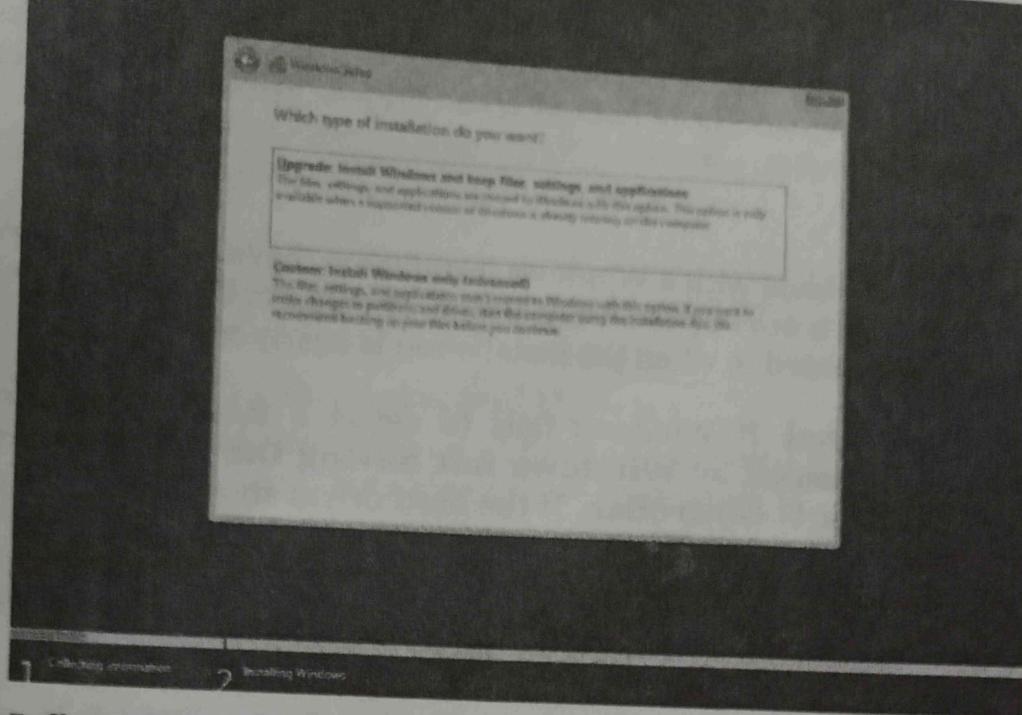
Every Windows installation disc/disk contains all of the available editions within a version. The product key not only verifies the legitimacy of your purchase; it also tells the installer which edition you purchased.

If you click the *I don't have a product key* link (or leave the product key blank and click the Next button in versions before Windows 10), you will be taken to a screen asking you which version of Windows you would like to install.

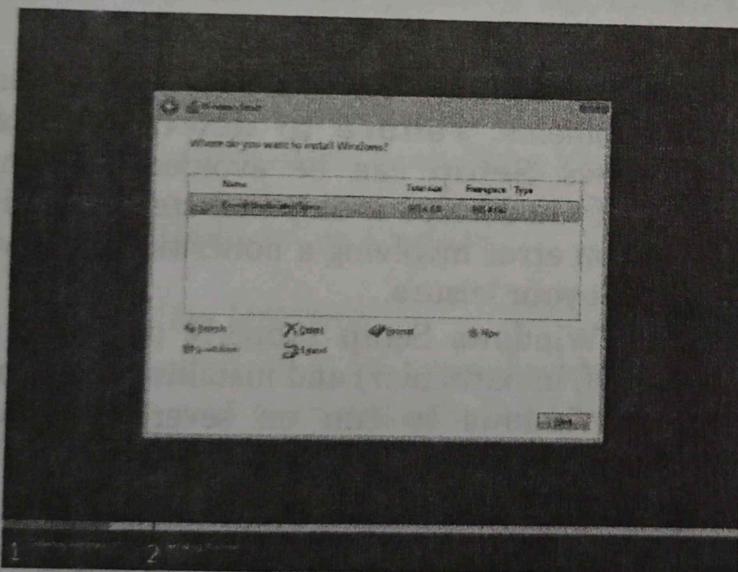


you will no longer be able to boot to the desktop without entering a valid product key that matches the edition of Windows you installed. After the product key screen, you'll find Microsoft's EULA,

On the next page, you get to decide whether you'd like to do an **upgrade installation or a clean installation**.



Bellow **Figure** shows how **you can partition hard drives and choose a destination partition for Windows**. From this screen, you can click the New link [or Drive options (advanced) link in pre-Windows 10 versions] to display a variety of partitioning options.



Once you've partitioned drives and selected a partition into which to install Windows, the installation process takes over, copying files, expanding files, installing features, and just generally doing lots of computerish things.

When Windows has finished unpacking and installing itself, it lights up the oh-so-irritating Cortana to help you finish up the installation.

where you configure a system to work in a workgroup (personal use) or in an organization.

Next asks you to **set up a user name and password** for your main user account. All operating systems require the creation of this account.

12 TROUBLESHOOTING INSTALLATION PROBLEMS

The term “installation problem” is rather deceptive. The installation process itself almost never fails. Usually, something else fails during the process that is generally interpreted as an “install failure.” Let’s look at some typical installation problems and how to correct them.

Media Errors

If you’re going to have a problem with a Windows installation, have a **media error**, like a **scratched DVD or a corrupted USB drive**. It’s always better to have the error right off the bat as opposed to when the installation is nearly complete.

RAID Array Not Detected If Windows fails to detect a RAID array during installation, this could be caused by **Windows not having the proper driver for the hard drive or RAID controller**. If the hard drives show up properly in the RAID controller setup utility, then it’s almost certainly a driver issue. Get the driver disc from the manufacturer and run setup again. Press F6 when prompted very early in the Windows installation process. Nothing happens right away when you push F6, but later in the process you’ll be prompted to install drivers.

No Boot Device Present When Booting Off the Windows Installation Disc Either the installation media is bad or the system setup is not set to look at that installation media first. Access the system setup utility as discussed in Chapter 5, “Firmware.”

Graphical Mode Errors

Once the graphical part of the installation begins, errors can come from a number of sources, such as hardware or driver problems. **Failure to detect hardware properly by any version of Windows Setup** can be avoided by simply researching compatibility beforehand. Or, if you decided to skip that step, you might be lucky and only have a hardware detection error involving a noncritical hardware device. You can troubleshoot this problem at your leisure.

Every Windows installation depends on Windows Setup properly detecting the computer type (motherboard and BIOS stuff, in particular) and installing the correct hardware support. Microsoft designed Windows to run on several hardware platforms using a layer of software tailored specifically for the hardware, called the **hardware abstraction layer (HAL)**.

Lockups During Installation

Lockups are one of the most challenging problems that can take place during installation, because they don’t give you a clue as to what’s causing the problem. Here are a few things to check if you get a lockup during installation.

Disc, Drive, or Image Errors Bad media can mess up an installation during the installation process. **Bad optical discs, optical drives, or hard drives may cause lockups.** Similarly, faults on a USB-based drive can stop an installation in its tracks. Finally, **problems with a downloaded ISO image—also part of the media—can cause lockups.** Check each media component. Check the optical disc for scratches or dirt, and clean it up or replace it. Try a known-good disc in the drive. If you get the same error, you may need to replace the drive or perhaps the ISO.

Log Files Windows versions before Windows 10 generate a number of **special text files called log files** that track the progress of certain processes. **Windows creates different log files for different purposes.** The Windows installation process creates about 20 log files, organized by installation phase. Each phase creates a setuperr.log file to track any errors during that phase of the installation. Windows 10 creates a setup.etl file (among others) in the %WINDIR%/Panther folder that you can open with Event Viewer.

2.3 POST INSTALLATION TASKS

Patches, Service Packs, and Updates

Someone once described an airliner as consisting of millions of parts flying in close formation. I think that's also a good description for an operating system. And we can even carry that analogy further by thinking about all of the maintenance required to keep an airliner safely flying. Like an airliner, the parts (programming code) of your OS were created by different people, and some parts may even have been contracted out. Although **each component is tested as much as possible, and the assembled OS is also tested, it's not possible to test for every possible combination of events.** Sometimes a piece is simply found to be defective. The fix for such a problem is a corrective program called a patch.

In the past, Microsoft provided patches for individual problems. They also accumulated patches up to some sort of critical mass and then bundled them together as a service pack, but Windows 7 was the last version to get one. Today, Windows simply sends individual updates to your system via the Internet.

Immediately after installing Windows, Windows should install the latest updates on the computer. The easiest way to accomplish this task is to turn on **Windows Update.**

Upgrading Drivers

During installation, you may decide to go with the default drivers that come with Windows and then upgrade them to the latest drivers after the fact. This is a good strategy because installation is a complicated task that you can simplify by installing old but adequate drivers. Maybe those newest drivers are just a week old—waiting until **after the Windows installation to install new drivers gives you a usable driver to go back to if the new driver turns out to be a lemon.**

Restoring User Data Files (If Applicable)

Remember when you backed up the user data files before your upgrade installation? You don't? Well, check again, because now is the time to restore that data. Your method of restoring depends on how you backed up the files in the first place. If you used a third-party backup program, you need to install it before you can restore those files, but if you used Backup and Restore, you are in luck, because they are installed by default. If you did something simpler, such as copying to optical discs, USB or other external drive, or a network location, all you have to do is copy the files back to the local hard drive.

Install Essential Software

The final step in the installation process is to install the software that makes the computer work the way you or your client wants. If you install software that requires a license key, have it ready. Similarly, if you install subscription software such as Microsoft Office 365, make sure you have accurate user names and passwords available.

WINDOWS 7

2.4 THE WINDOWS INTERFACE

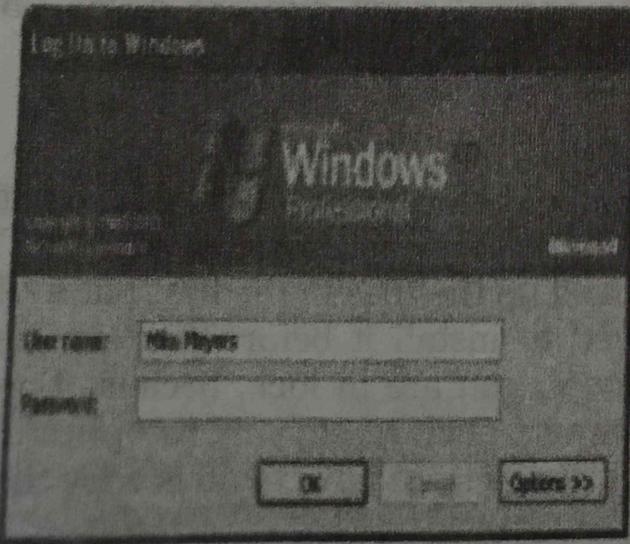
All versions of Windows share certain characteristics, configuration files, and general look and feel. Here's some good news: **You'll find the same, or nearly the same, utilities in almost all versions of Windows**, and once you master one version-both GUI and command-line interface-you'll pretty much have them all covered. **This section covers the essentials: where to find things, how to maneuver, and what common utilities are available.** Where versions of Windows differ in concept or detail, I'll point that out along the way. You'll get to the underlying structure of Windows in the subsequent two sections of this chapter. For now, let's look at the common user interface.

User Interface

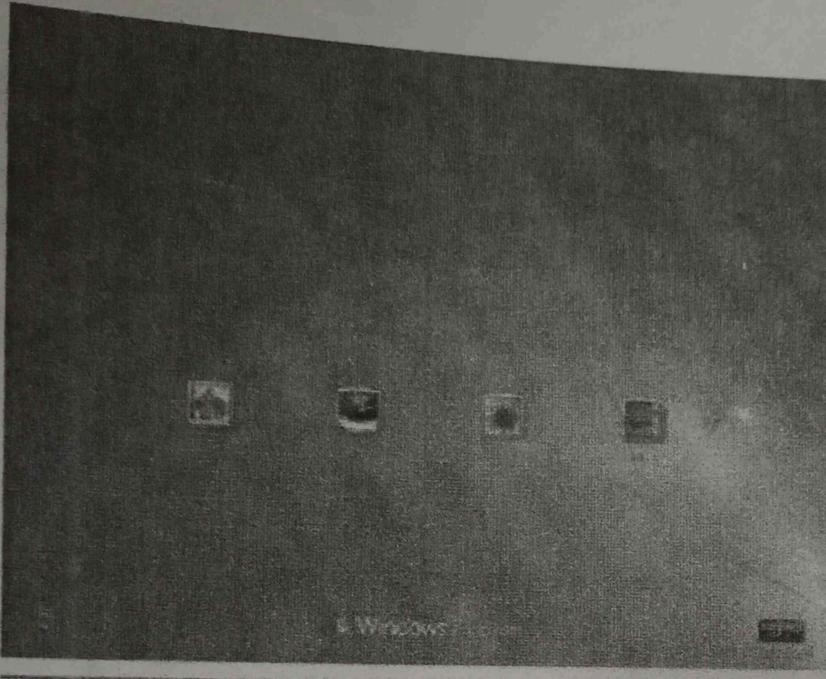
Windows offers a set of utilities, or interfaces, that every user should know about-both how and why to access them. And since every user should know about them, certainly every CompTIA A+ certified tech should as well! Let's take a quick tour of the typical Windows GUI.

Logon

Logging onto a Windows computer is something we all do, but few of us take time to appreciate the process. Your username and password define what you can do on your computer. Every version of Windows supports multiple users on a single machine, so the starting point for any tour of the Windows user interface starts with the logon screen. Figure shows the Windows XP logon screen.



Windows XP introduced a new type of logon called the **Welcome Screen**. If you're using Windows XP Home or MediaCenter, this is the only logon screen you will see. All editions of Windows Vista and Windows 7 use an improved version of Windows XP's Welcome screen.



• **Figure 2.19** Windows 7 Welcome screen

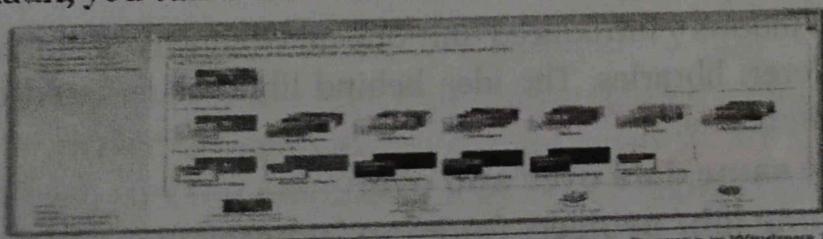
Desktop

The Windows **desktop** is your primary interface to the computer. The desktop is always there, underneath whatever applications you open.

Clearly the Windows Vista and Windows 7 desktops differ a lot compared to the Windows XP desktop. What you're seeing is something called the Aero desktop. The Aero desktop adds a number of impressive aesthetic features to your desktop that Microsoft claims makes the user experience more enjoyable and productive. I'm not going to get into an argument on the value of the Aero desktop, but it is an important part of the modern Windows interface. Most of the Aero features are more about looks than adding.

Taskbar and Start Menu

The taskbar runs along the bottom of all Windows desktops and includes up to four sections. Although the taskbar sits at the bottom of the desktop by default, you can move it to either side or to the top of the screen.



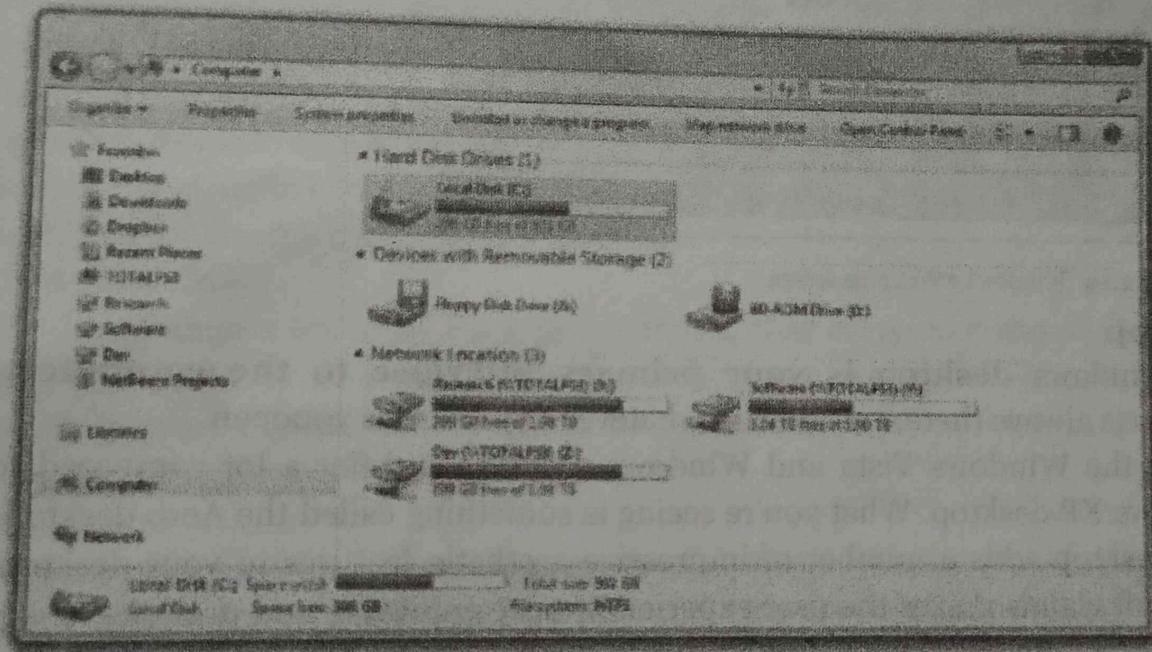
• **Figure 2.26** Select one of the Aero themes to activate the Aero Desktop in Windows 7.

Windows 7 takes the Quick Launch toolbar and marries it to the running program area thumbnails; creating pinned applications. You can pin application icons directly

onto the running application area. When you open one of these pinned applications, its icon changes to show that it is now open. If you open an application that isn't pinned to the task-bar, its icon still shows up, but will disappear when you close it. If you've ever used the Apple OS X dock (perish the thought!), then you've used this type of feature.

The Many Faces of Windows Explorer

Windows Explorer enables you to manipulate files and folders stored on all the drives in or connected to your computer. Microsoft presents the tool in a variety of ways to help you focus quickly on what you want to accomplish. If you want to see the contents of an optical disc, for example, you can open **Computer** (Windows Vista/7) by double-clicking the icon on the desktop or selecting the icon from the Start menu to have Windows Explorer open with the drives displayed. To display the contents of a drive or folder, double-click it.



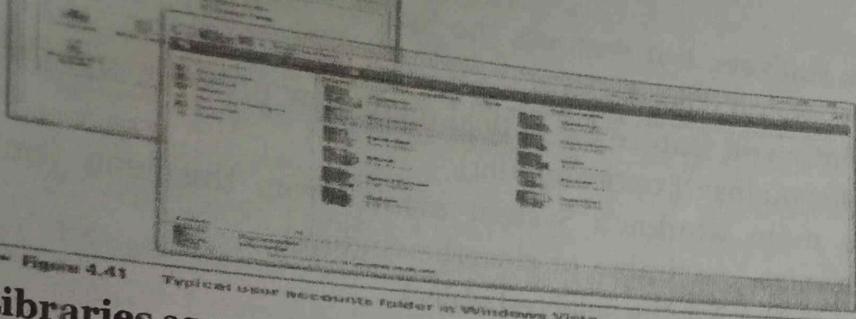
• **Figure 4.34** Windows Explorer in Windows 7 displaying the drives installed and showing tasks

My Documents, My [Whatever] All versions of Windows provide a **special folder structure for each user account so users have their own places** to store personal data.

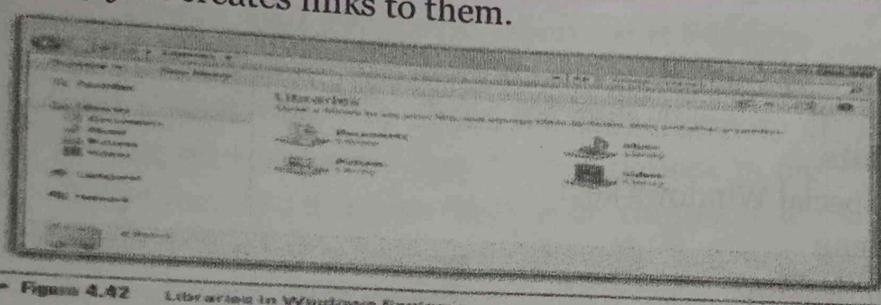
User's Files Windows Vista and Windows 7 take the equivalent of My Documents to a whole new level with the User's Files.

Windows 7 Libraries Windows 7 introduced only one new-but very useful Feature to Windows Explorer: libraries. The idea behind libraries is based on two fairly straightforward assumptions:

- **People tend to need the same data over and over**
- **The data you need for one job/ project/ function/ whatever is rarely Stored in a single folder.**



Libraries aggregate folders from multiple locations and place them in a single easy-to-find spot in Windows Explorer. The files and folders don't actually move. The library just creates links to them.



By default, every user has at least four libraries: Documents, Music, Pictures, and Videos. These libraries consist of two folders: the user's My Whateverfolder for that type of data plus the Public Whatever folder under C:\Users\Public. (You'll learn more about these a little later in the chapter) Let's clarify this subtle but critical concept.

Libraries are not folders but collections of existing folders.

Recyclebin

In windows, a file is not erased when you delete it. Windows adds a level of protection in the form of a special folder called the Recycle Bin. When you delete a file in Windows, the file moves into the Recycle Bin. It stays there until you empty the Recycle Bin or restore the file, or until the Recycle Bin reaches a preset size and starts erasing its oldest contents.

My Network Places/Network

Systems tied to a network, either via a network cable or by a modem, have a folder called My Network Places in Windows XP or simply Network in Windows Vista/7. This folder shows all the current network connections available to you. You'll learn about Places/Network in Chapter 22.

Windows Sidebar

Windows Vista comes with a GUI feature called the Windows Sidebar, a tool that sits on one side of the desktop and enables small helper applications—called Microsoft Gadgets—to run. You can display a clock, for example, or a dynamic weather update. Vista comes with a handful of Gadgets, but developers have gone crazy with them, enabling you to add all sorts of useful tools, such as the Twitter feed and word of Warcraft search and realm status Gadgets in.

Windows 7 also includes Gadgets, but removes the Sidebar concept. You can place Windows 7 Gadgets anywhere on your desktop.

SHIFT Bypass the automatic-run feature for optical media (by pressing and holding down the SHIFT key while you insert optical media)

ALT-SPACE Display the main window's System menu (from this menu you can restore, move, resize, minimize, maximize, or close the window)

ALT-ENTER Open the properties for the selected object

Working with Text

Copy CTRL-C

Cut CTRL-X

Paste CTRL-V

Undo CTRL-Z

Windows Key Shortcuts

These shortcuts use the special Windows key:

WINDOWS KEY Start menu

WINDOWS KEY-D Show desktop

WINDOWS KEY-E Windows Explorer

WINDOWS KEY-L Lock the computer

WINDOWS KEY-TAB Cycle through taskbar buttons (or Flip 3D with Windows Aero in Vista/7)

WINDOWS KEY-PAUSE/BREAK Open the System Properties dialog box

2.5 OPERATING SYSTEM FOLDERS

The modern versions of Windows organize essential files and folders in a relatively similar fashion. All have a primary system folder for storing most Windows internal tools and files. All have a set of folders for programs and user files. Yet once you start to get into details, you'll find some very large differences. It's very important for you to know in some detail the location and function of many common folders and their contents.

System Folder

System Root is the tech name given to the folder in which Windows has been installed. Windows XP, Vista, and 7 all use C:\windows as the default system Root. Be warned: this is the default folder, but you can change where Windows is installed during the installation process.

The system folder contains many subfolders, too numerous to mention here, but CompTIA wants you to know the names of a number of these sub-folders as well as what goes in them. Let's run through the subfolders you should recognize and define (these folders are in all versions of Windows):

- **%System Root%\Fonts** All of the fonts installed in Windows live here.
- **%SystemRoot%\offline Files (Offline Web Pages in Windows 7)**

When you tell your Web browser to save Web pages for offline viewing, they are stored in this folder. This is another folder that Windows automatically deletes if it needs the space.

- **%SystemRoot%\System32** This is the real Windows! All of the most critical programs that make Windows run are stored here. 64-bit editions of Windows also store critical files in %SystemRoot%\SysWOW64
- **%SystemRoot%\Temp** Anytime Windows or an application running on Windows needs to create temporary files, they are placed here. Windows deletes these files automatically as needed, so never place an important file in this folder.

Program and Personal Document Folders

Windows has a number of important folders that help organize your programs and documents. They sit in the root directory at the same level as the system folder, and of course they have variations in name depending on the version of Windows. We'll assume that your computer is using a C: drive - a pretty safe assumption, although there actually is a way to install all of Windows on a second hard-drive partition.

C:\Program Files (All Versions)

By default, most programs install some or all of their essential files into a Subfolder of the Program Files folder. If you installed a program, it should have its own folder in here. Individual companies decide how to label their subfolders. files within it.

C:\Program Files (x86)

The 64-bit editions of Windows Vista and Windows 7 create two directory structures for program files. The 64-bit applications go into the :\ProgramFiles folder, whereas the 32-bit applications go into the C:\Program Files (x86) folder. The separation makes it easy to find the proper version of whatever application seek.

2.6 TECH UTILITIES

Windows offers a huge number of utilities that enable techs to configure the OS, optimize and tweak settings, install hardware, and more. The trick is to know where to go to find them. This section shows the most common locations in windows where you can access utilities: right click, control panel, Device Manager, System tools, command line, Microsoft Management.

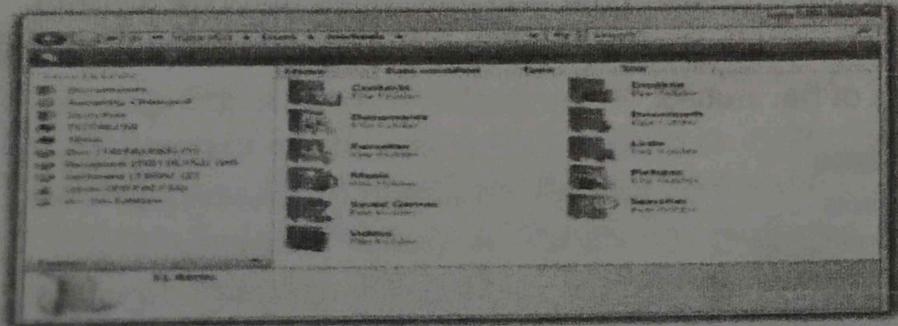
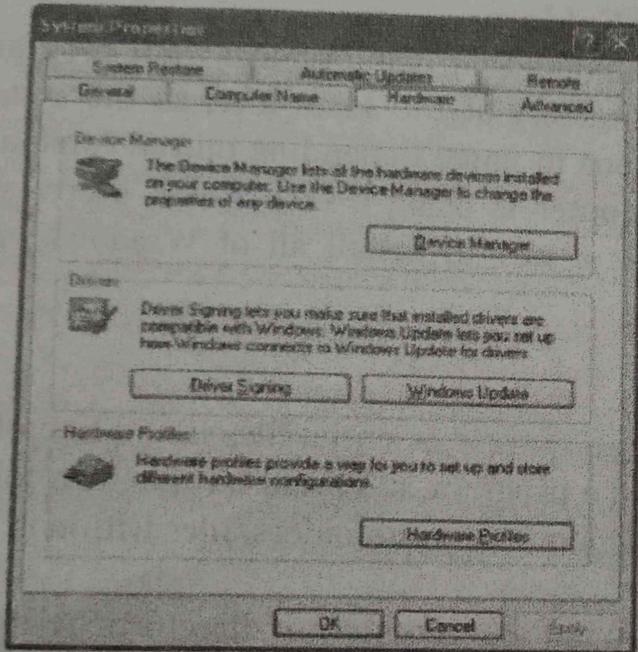


Figure 4.47 Contents of a typical Windows User Profiles folder in Vista
Every icon you see in the Control Panel is actually a file with the extension .CPL. Any time you get an error opening the Control Panel, you can bet you have a corrupted

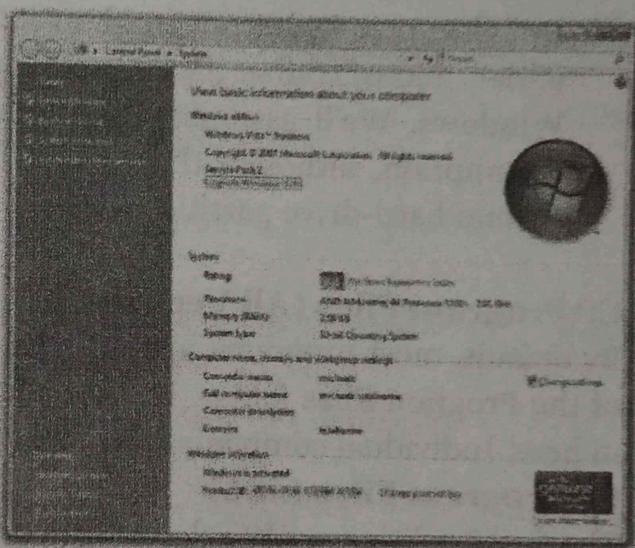
CPL file. These are a pain to fix. You have to rename all of your CPL files with another extension (if use CPB) and then rename them back to .CPL one at a time, each time reopening the Control Panel, until you find the CPL file that's causing the lockup. You can use the Control Panel applets to do an amazing array of things to a Windows system, and each applet displays text that helps explain its functions.

Device Manager

With Device Manager, you can examine and configure all of the hardware and drivers in a Windows PC.



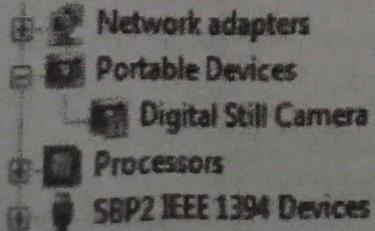
* Figure 4.55 Windows XP System applet with the Hardware tab selected



* Figure 4.56 Windows Vista System applet with the Device Manager menu option circled

The method to open Device Manager is to right-click My Computer/Computer and select Manage. This opens a window called Computer Management, where you see Device Manager listed on the left side of the screen, under System Tools. Just click on Device Manager and it opens.

Device Manager displays every device that Windows recognizes, organized in special group's called types., All devices of the same type are grouped under the same type heading. to see the devices of a particular type, you must open that type's group. Device Manager isn't just for dealing with problems. It also enables you to update drivers with a simple click of the mouse.



* Figure 4.58 Problem device

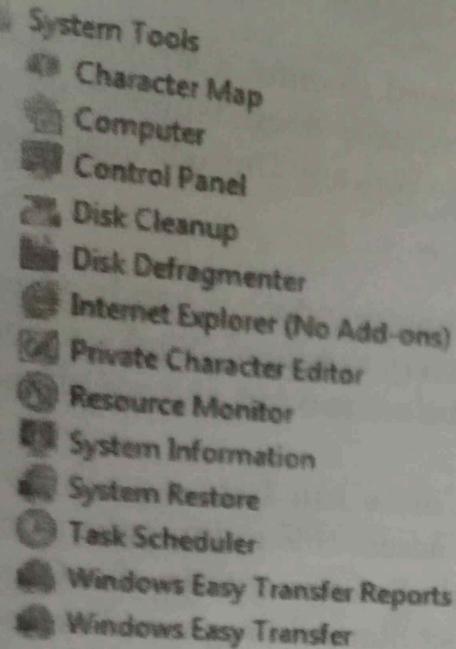


Figure 4.62 System Tools menu options

The CompTIA A+ certification exams therefore test you on a variety of paths to appropriate tools.

To access System Tools in all three versions of Windows, go to Start All Programs Accessories System Tools. Each version of Windows shares many of the same tools, but each includes its own utilities as well. I'll note which version of Windows uses each particular system tool.

Activate Windows (All)

Windows XP unveiled a copy-protection scheme called **activation**. Activation is a process where your computer sends Microsoft a unique code generated on your machine based on the Install CD/DVD's product key and a number of hardware features, such as the amount of RAM, the CPU processor model, and other ones and zeros in your PC. Normally, activation is done at install time, but if you choose not to activate at install or if you make "substantial" changes to the hardware, you'll need to use the Activate Windows utility. With the Activate Windows utility, you can activate over the Internet or over the telephone.

Backup (Windows XP)

The Backup utility enables you to back up selected files and folders to removable media such as tape drives.

Backup Status and Configuration (Windows Vista)

Vista does not enable you to back up files on your computer selectively. You can only back up personal data with the Backup Status and Configuration Tool or, if you have Vista Business, Ultimate, or Enterprise, perform a complete PC backup by using Windows Complete PC Backup. If you want to pick and choose the file to back up, you need to buy a third-party tool. This tool allows you to back up to optical media, a hard drive, or a networked drive.

Character Map (All)

Ever been using a program only to discover you need to enter a strange character such as the euro character (€) but your word processor doesn't support it? That's when you need the Character Map. It enables you to copy any Unicode character into the Clipboard.

Disk Cleanup (All)

Disk Cleanup looks for unneeded files on your computer, which is handy when your hard drive starts to get full and you need space. Every version of Windows since XP starts this program whenever your hard drive gets below 200 MB of free disk space.

Disk Defragmenter (XP and Vista)

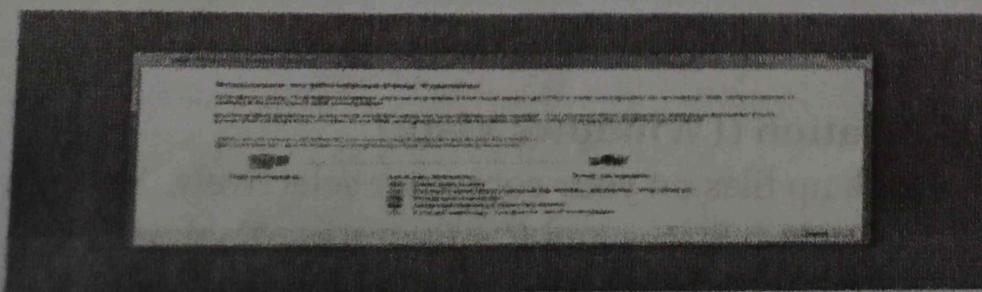
You use Disk Defragmenter to make your hard drive run faster—you'll see more details on this handy tool in Chapter 12. You can access this utility in the same way you access Device Manager; you also find Disk Defragmenter in the Computer Management Console. A simpler method is to select Start>All Programs|Accessories\System Tools; you'll find Disk Defragmenter listed there. You can also right-click on any drive in My Computer or Computer, select Properties, and click the Tools File tab, where you'll find a convenient Defragment Now button.

Files and Settings Transfer Wizard (Windows XP)

Suppose you have an old computer full of files and settings, and you just bought yourself a brand new computer. You want to copy everything from your old computer onto your new computer what to do? Microsoft touts the Files and Settings Transfer Wizard as just the tool you need. This utility copies your desktop files and folders and, most conveniently, your settings from Internet Explorer and Outlook Express; however, it won't copy over your programs, not even the Microsoft ones, and it won't copy settings for any programs other than Internet Explorer and Outlook Express. If you need to copy Everything from an old computer to a new one, you'll probably want to use a disk-imaging Norton Ghost.

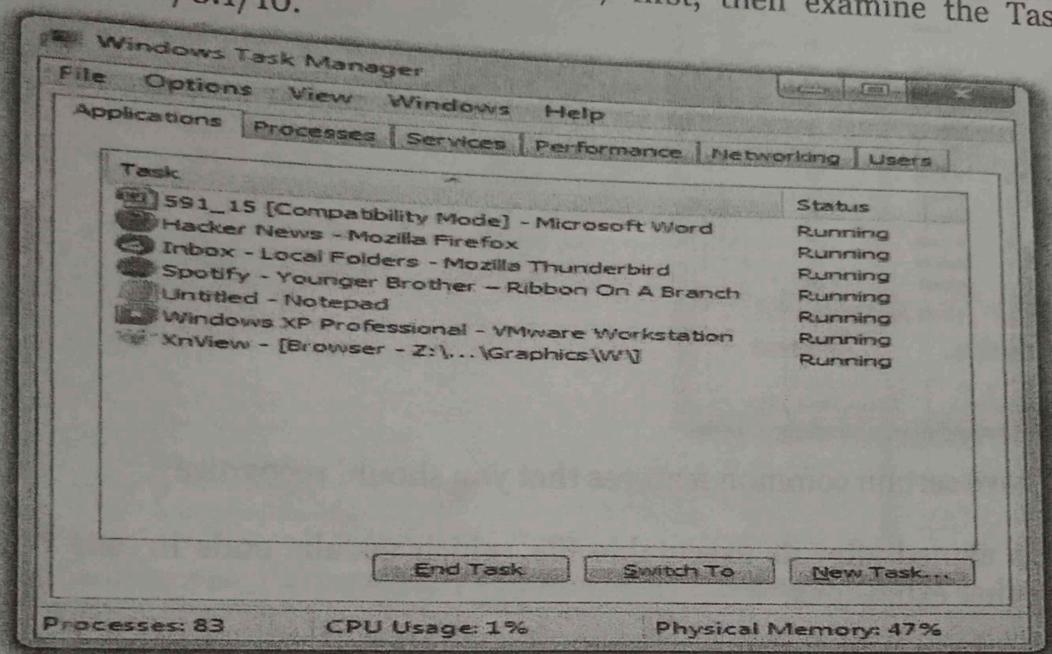
Windows Easy Transfer (Windows Vista/7)

Windows Easy Transfer is an aggressively updated version of the Files and Settings Transfer Wizard. It does everything the older version does and adds the capability to copy user accounts and other settings.



2.7 TASK MANAGER

Microsoft offers the Windows Task Manager as the one-stop-shop for anything you need to do with applications, processes, and services. The Microsoft development team significantly redesigned Task Manager for Windows 8. We'll look at the tool in Windows 7 first, then examine the Task Manager in Windows 8/8.1/10.



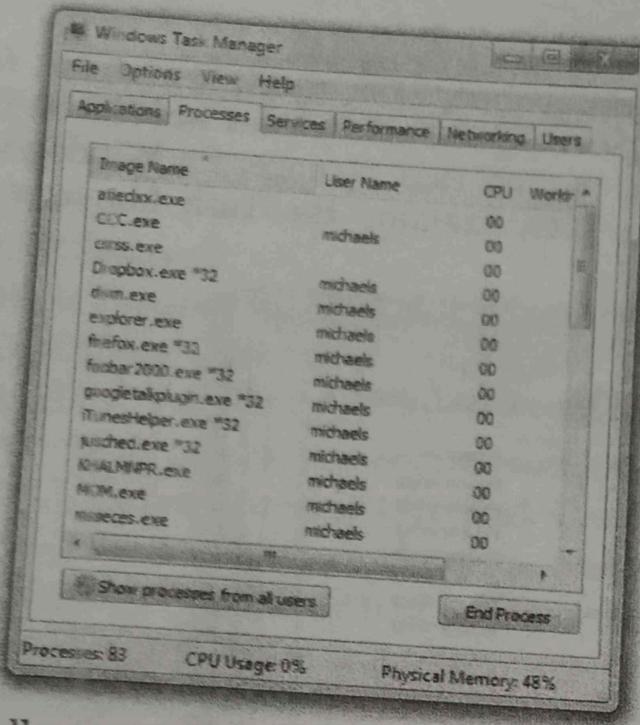
The quickest way to open the Task Manager is to press CTRL-SHIFT-ESC. There are two other ways to open the Task Manager that you might see on the CompTIA A+ exams: go to Start | Search, type **taskmgr**, and press ENTER; or press CTRL-ALT-DELETE and select Task Manager.

Applications The Applications tab shows all the running applications on your system. If you're having trouble getting an application to close normally, this is the place to go. To force an application to shut down, select the naughty application and click End Task, or right-click on the application and select End Task from the context menu. Be careful when using this feature! There is no "Are you sure?" prompt, and it's easy to accidentally close the wrong application.

There are two other handy buttons on the Applications tab:

- **Switch To** enables you to bring any program to the front (very handy when you have a large number of applications running).
- **New Task** enables you to run programs if you know the executable. Click New Task, type **cmd**, and press ENTER, for example, to open the command-line interface.

Processes If you really want to tap the power of the Task Manager, you need to click the **Processes** tab. Since everything is a process, and the Processes tab shows you every running process, this is the one place that enables you to see everything running on your computer.



All processes have certain common features that you should recognize:

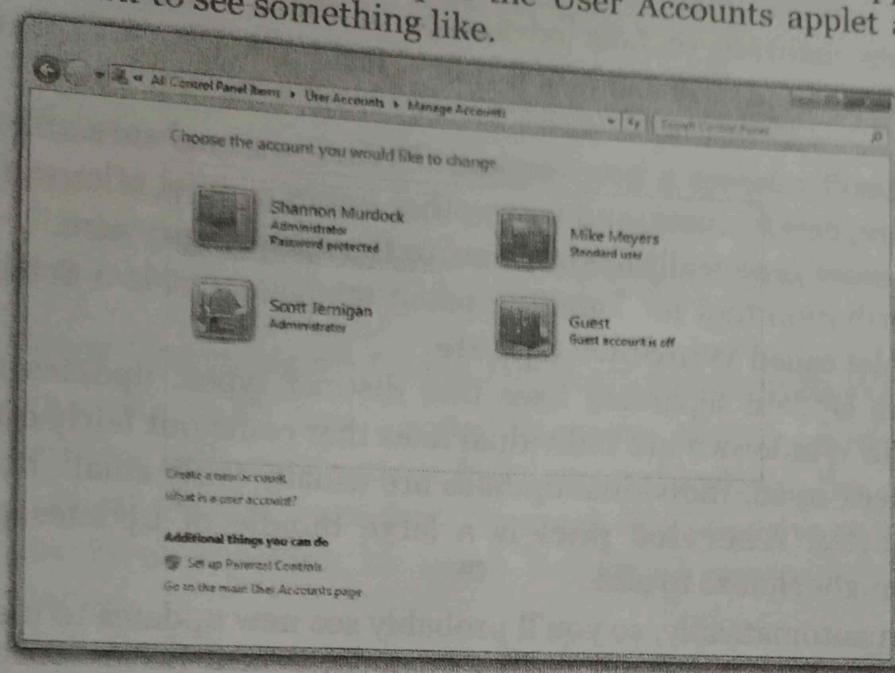
- A process is named after its executable file, which usually ends in .exe but can also end with other extensions.
- All processes have a user name to identify who started the process. A process started by Windows has the user name System.
- All processes have a process identifier (PID). To identify a process, you use the PID, not the process name. The Task Manager doesn't show the PID by default. Click View | Select Columns and select the PID (Process Identifier) checkbox to see the PIDs

Services You can use the **Services** tab in the Task Manager to work with services directly. Here, you can stop or start services, and you can go to the associated process.

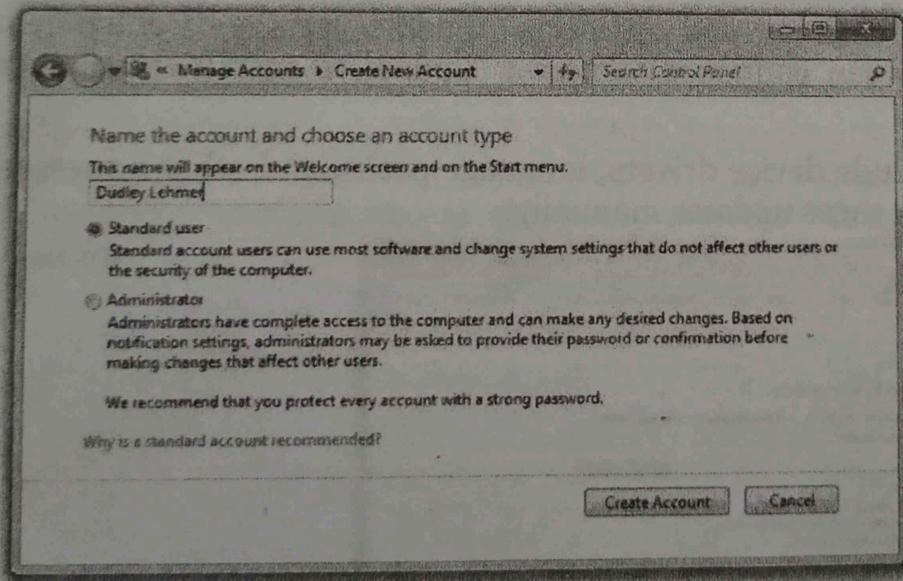
Performance For optimization purposes, the Task Manager is a great tool for investigating how hard your RAM and CPU are working at any given moment and why. Click the **Performance** tab to reveal a handy screen with the most commonly used information: CPU usage, available physical memory, size of the disk cache, and other details about memory and processes. shows a system with an eight-core processor, which is why you see eight graphs under CPU Usage History. A system with a single-core processor would have a single graph.

2.8 MANAGING USERS IN WINDOWS 7

Windows 7 offers a utility called the **User Accounts** applet in the Control Panel. To create a user account, open the User Accounts applet and select *Manage another account* to see something like.



Click *Create a new account* to see your options for making a new account. Note that this applet only enables you to make administrator accounts (in the Administrators group) or standard users (in the Users group).



2.9 MAINTAINING WINDOWS

Operating systems need patching; mass storage devices must be kept organized and running well. Registries and temporary files need the occasional cleaning. In the past many of these jobs were handled manually. Today, operating systems handle many if not most of these jobs automatically.

Patch Management

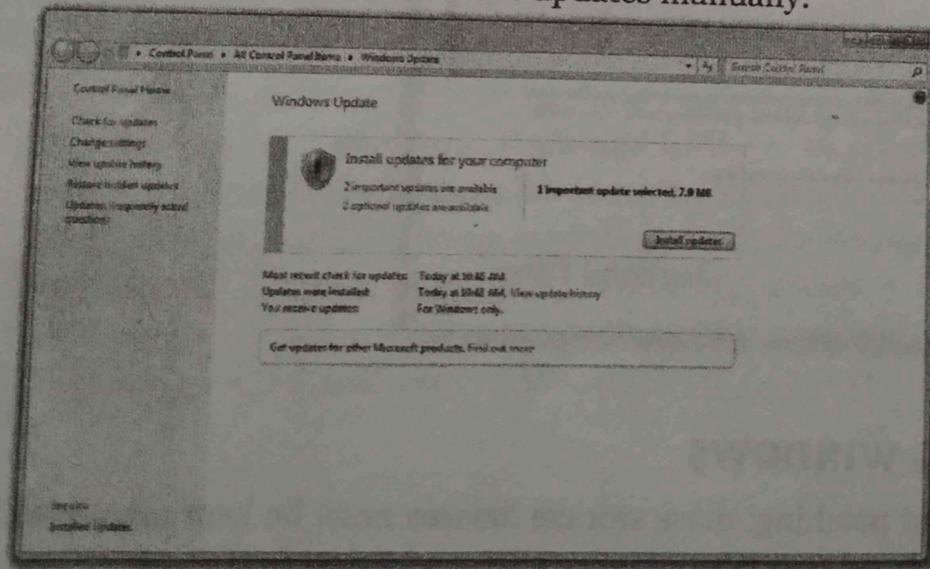
There's no such thing as a perfect operating system. First, all operating system makers come up with new or improved features. Second, bad actors discover weaknesses and generate malware to take advantage of those weaknesses. The process of keeping software updated in a safe and timely fashion is known as **patch management**.

From the moment Microsoft releases a new version of Windows, malware attacks, code errors, new hardware, new features, and many other issues compel Microsoft to provide updates, known more generically as **patches**, to the operating system. Microsoft's primary distribution tool for handling patch management is a Settings tool or Control Panel applet called **Windows Update**.

In Windows 7, Windows Update separates fixes into distinct types: updates and service packs. **Updates** in Windows 7 are individual fixes that come out fairly often, on the order of once a week or so. Individual updates are usually fairly small, rarely more than a few megabytes. A **service pack** is a large bundle of updates plus anything else Microsoft might choose to add.

Windows Update can run automatically, so you'll probably see new updates to install every time you open the applet. Windows 7 divides updates into three common types:

- **Important** These updates address security or stability issues and are the most critical. You can configure Windows Update to install these updates automatically.
- **Recommended** A recommended update is an added feature or enhancement that is not critical. You can configure Windows Update to install these updates automatically.
- **Optional** These include device drivers, language packs, and other nonessential updates. You must install these updates manually.



Registry Maintenance

The Registry is a huge database that Windows updates every time you add a new application or hardware or make changes to existing applications or hardware. As a result, the Registry tends to be clogged with entries that are no longer valid. These usually don't cause any problems directly, but they can slow down your system.

Interestingly, Microsoft does not provide a utility to clean up the Registry. To clean your Registry, you need to turn to a third-party utility. Quite a few Registry cleaner programs are out there, but my favorite is the freeware CCleaner by Piriform. You can download the latest copy at www.piriform.com/ccleaner/.

Disk Maintenance Utilities

Every modern OS has one or more utilities designed to maintain hard disk drives (HDDs) and solid-state drives (SSDs), though Windows requires a little more manual action than macOS or Linux.

Error Checking and Disk Defragmentation in Windows

When you can't find a software reason (and there are many possible ones) for a problem such as a system freezing on shutdown, the problem might be the actual physical mass storage drive. You can test the drive with **Error checking**. You can run Error checking by using the `chkdsk` command from an elevated command prompt.

Disk Defragmenter keeps hard drives running efficiently by reorganizing files scattered into pieces on your hard drive into tight, linear complete files.

Handy Windows Administration Tools

System Information

Windows comes with a built-in utility known as the **System Information tool** that collects information about hardware resources, components, and the software environment. When it finishes doing that, it provides a tidy little report, enabling you to troubleshoot and diagnose any issues and conflicts. As with many other tools, you can access this tool from the Start | Search bar; simply enter `msinfo32`.

The screenshot shows the Windows System Information window with the following data:

Item	Value
OS Name	Microsoft Windows 10 Pro
Version	10.0.17134 Build 17134
Other OS Description	Not Available
OS Manufacturer	Microsoft Corporation
System Name	DESKTOP-SUCH802
System Manufacturer	System manufacturer
System Model	System Product Name
System Type	x64-based PC
System SKU	SKU
Processor	AMD Ryzen 7 2700X Eight-Core Processor, 3700 Mhz
BIOS Version/Date	American Megatrends Inc. 401B, 7/12/2018
SMBIOS Version	2.8
Embedded Controller	255.255
BIOS Mode	Legacy
BaseBoard Manufacturer	ASUSTeK COMPUTER INC.
BaseBoard Model	Not Available
BaseBoard Name	Base Board
Platform Role	Desktop
Secure Boot State	Unsupported
PCR7 Configuration	Binding Not Possible
Windows Directory	C:\Windows
System Directory	C:\Windows\System32
Boot Device	\Device\HarddiskVolume1
Locale	United States
Hardware Abstraction Layer	Version = "10.0.17134.285"
User Name	DESKTOP-SUCH802\Michaelm
Time Zone	Central Daylight Time
Installed Physical Memory	32.0 GB
Total Physical Memory	31.9 GB
Available Physical Memory	10.6 GB

Find what: Close Find

Search selected category only Search category names only

2.10 OPTIMIZING WINDOWS

Anything you do that makes Windows better than it was before, such as adding a piece of software or hardware to make something run better, is an *optimization*.

Installing and Removing Software

Optimizing by installing and removing software is part of the normal life of any computing device. Each time you add or remove software, you make changes and decisions that can affect the system beyond whatever the program does, so it pays to know how to do it right.

Installation Concepts

Installing software in any OS requires consideration of several issues. First, what are the system requirements? Does the target computer have sufficient drive space for the app? Does it have enough RAM to run the program well? Does the version of OS running on the system match the OS requirements for compatibility with the application?

For a long time, most software was distributed on some sort of removable media, such as a floppy disk (from my youth) to an optical disc, such as a CD-ROM or DVD-ROM. These days, most application software comes from the Internet, so a network download is the process.

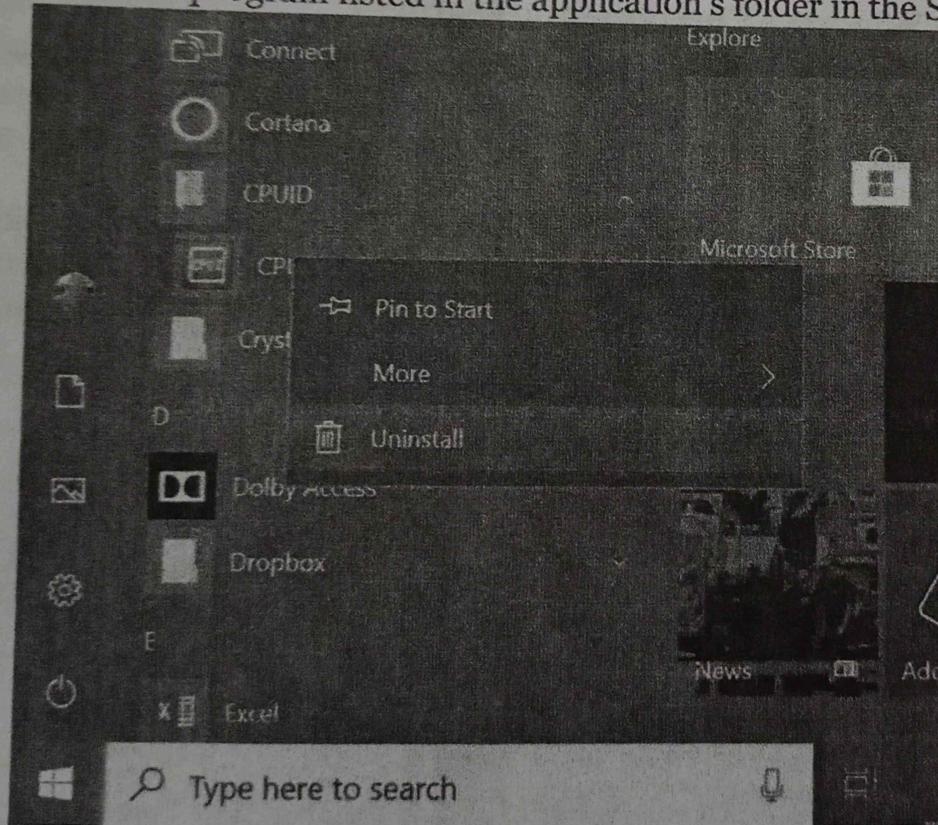
The user account trying to install the software has to have administrative or root privileges.

If you can't download or access an application over the Internet, it'll probably come on an optical disc. Windows supports Autorun, a feature that enables the operating system to look for and read a special file called—wait for it—autorun.inf. Immediately after a removable media device (optical disc or thumb drive) is inserted into your computer, whatever program is listed in autorun.inf runs automatically.

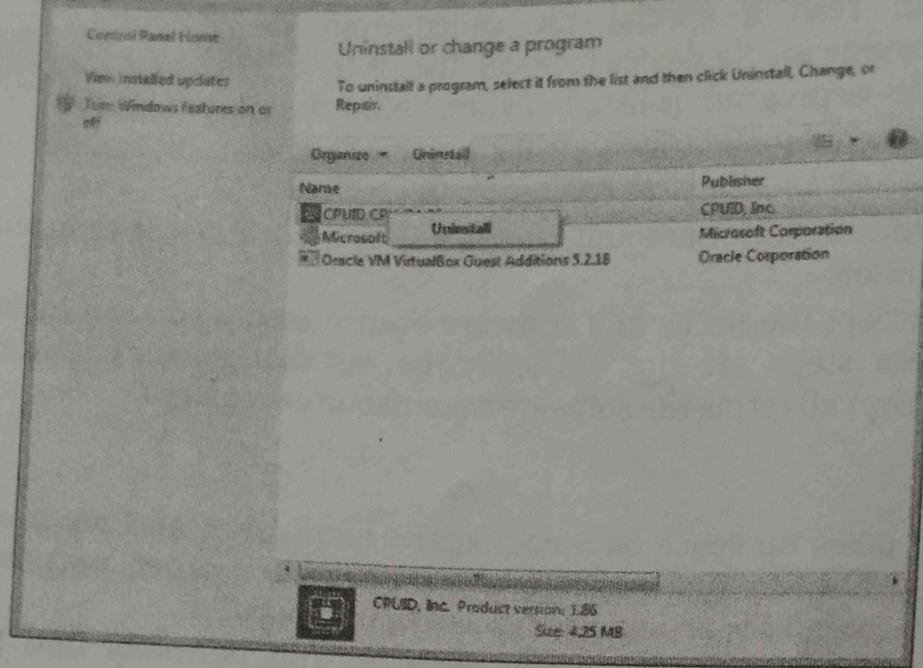
1. To start an installation manually, double-click on the disc icon in Explorer or File Explorer.
2. If you are using an administrator account, you can simply click Yes or Continue and finish the installation
3. You typically must accept the terms of a software license before you can install an application. These steps are not optional; the installation simply won't proceed until you accept all terms the software manufacturer requires.

Removing Software

Each installed program takes up space on a computer's hard drive, and programs that you no longer need waste space that could be used for other purposes. Removing unnecessary programs is an important piece of optimization. Use the application's own uninstall program, when possible. You normally find the uninstall program listed in the application's folder in the Start menu,



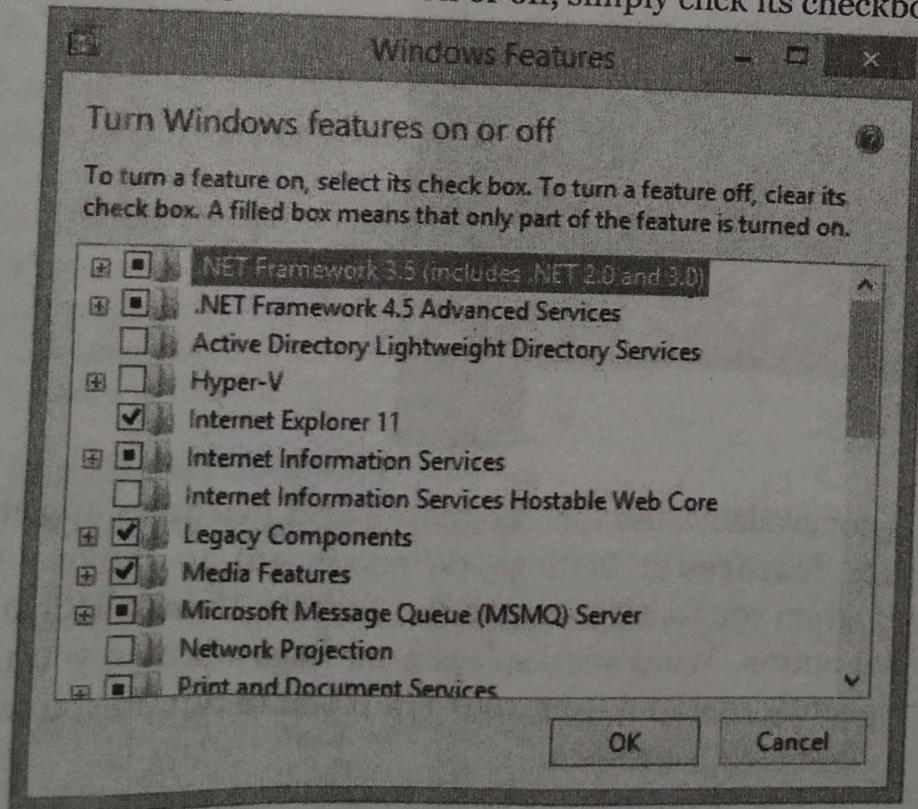
If an uninstall program is not available, use the **Programs and Features** applet in Control Panel or **Apps & features** in Settings (Windows 10) to remove the software. You select the program you want to remove and click the Uninstall/Change button or Change/Remove button. Windows displays a message warning you that the program will be permanently removed from your PC. If you're certain you want to continue, click Yes.



Adding or Removing Windows Components/Features

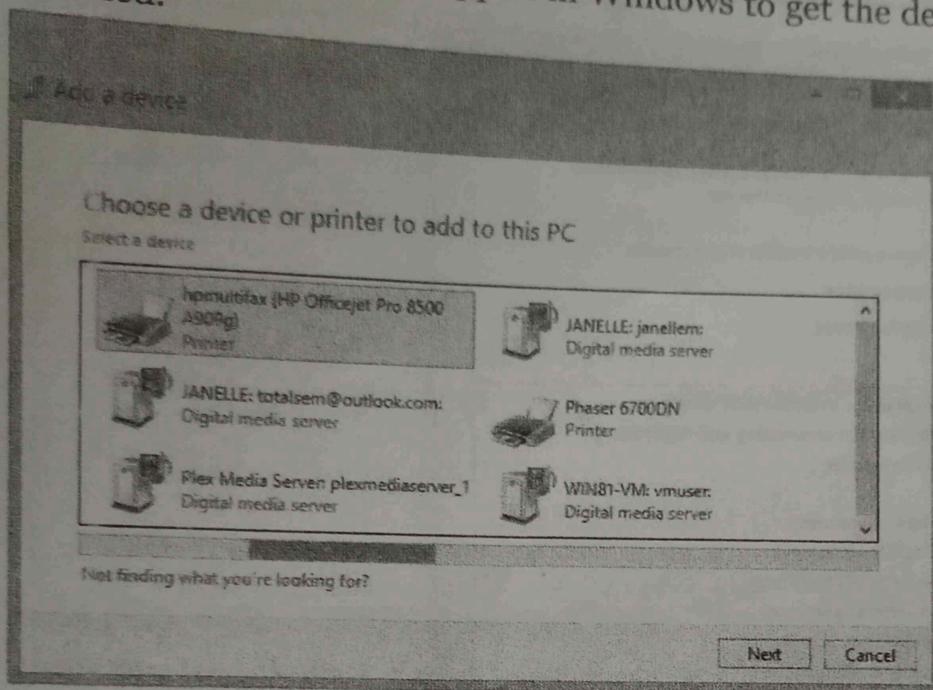
When you installed Windows, it included certain features by default. It installed Notepad, network support, and games on your computer. You can remove these Windows components from your system if you like, and add other components as well.

Open the Programs and Features applet in the Control Panel, and then click the *Turn Windows features on or off* option on the Tasks list. Click Yes or Continue if prompted by UAC and you will be presented with the Windows Features dialog box. To toggle a feature on or off, simply click its checkbox.



Adding a New Device

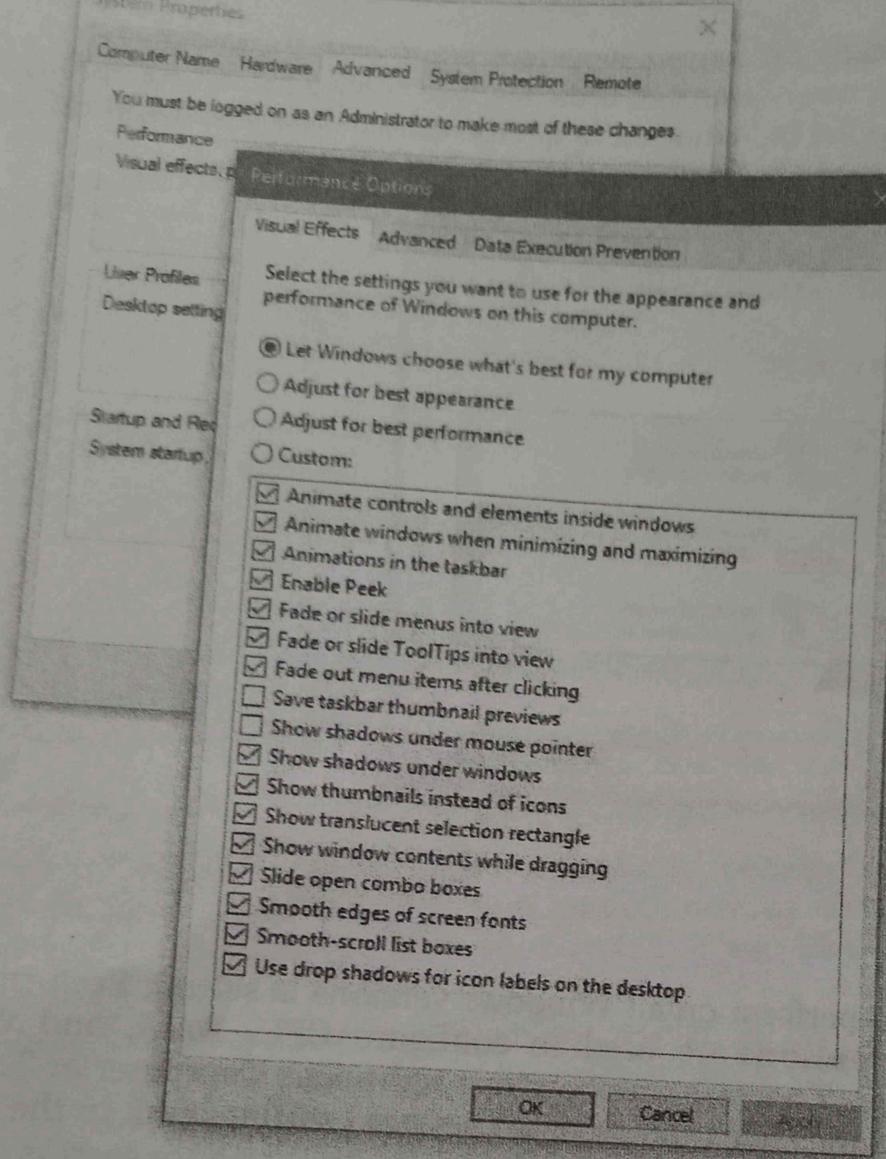
Windows should automatically detect any new device you install in your system. If Windows does not detect a newly connected device, use the *Add a device* option in the Devices and Printers applet in Windows to get the device recognized and drivers installed.



Performance Options

One optimization you can perform on all Windows versions is setting Performance Options. **Performance Options** are used to configure CPU, RAM, and virtual memory (page file) settings. To access these options right-click Computer or This PC and select Properties, and then click the Advanced system settings link in the Tasks list. On the Advanced tab, click the Settings button in the Performance section.

The Performance Options dialog box has three tabs: Visual Effects, Advanced, and Data Execution Prevention. The Visual Effects tab enables you to adjust visual effects that impact performance, such as animations, thumbnails, and transparencies. Try clicking the top three choices in turn and watch the list of settings.



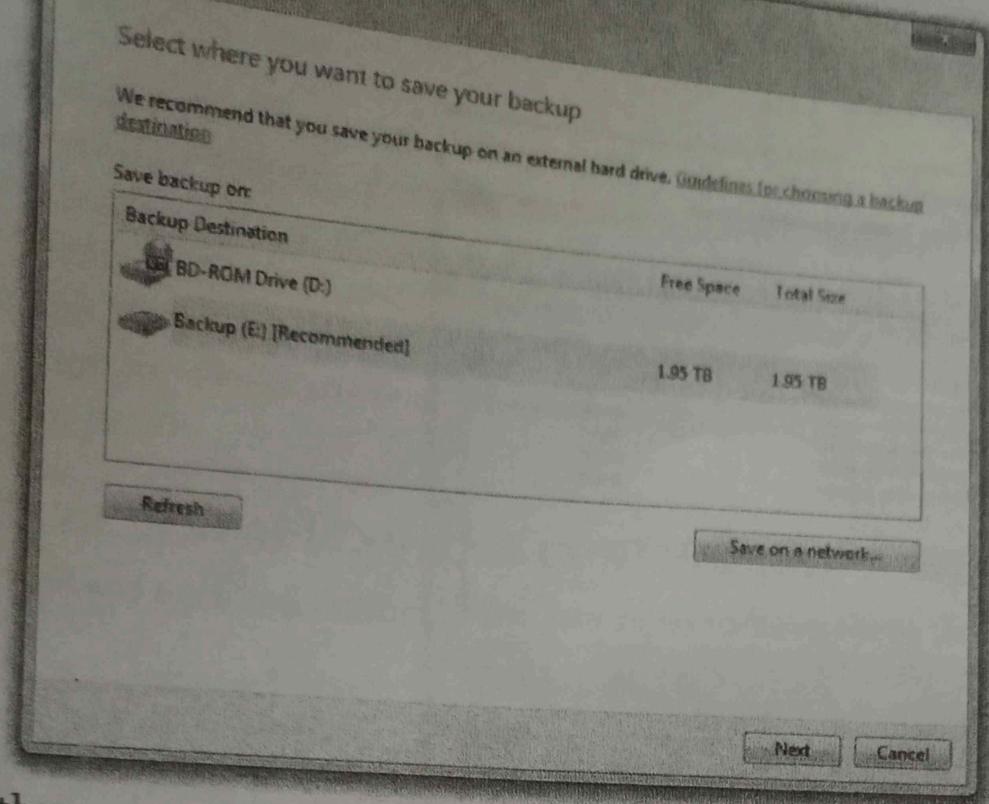
2.11 PREPARING FOR PROBLEMS

Techs need to prepare for problems. You must have critical system files and data backed up and tools in place for the inevitable glitches. Every modern operating system has options for backing up data and, as you might imagine, they all offer different features. Windows offers System Restore to recover from problems, too.

Backing Up Personal Data

The most important data on your computer is the personal data: your documents, e-mail messages and contacts, Web favourites, photographs, and other files. To handle backing up personal data, every version of Windows comes with some form of backup utility. macOS and Linux of course have backup tools as well.

Microsoft includes the automated and simple **Backup and Restore** Control Panel applet in Windows 7. The process begins by asking where you want to save your backup



there are two choices: *Let Windows choose (recommended)* and *Let me choose*. If you select *Let Windows choose (recommended)*, you'll back up each user's personal data, but Windows 7 doesn't stop there. Assuming you have enough space in your backup location, Windows 7 will automatically add a system image that includes the entire Windows operating system, every installed program, all device drivers, and even the Registry.

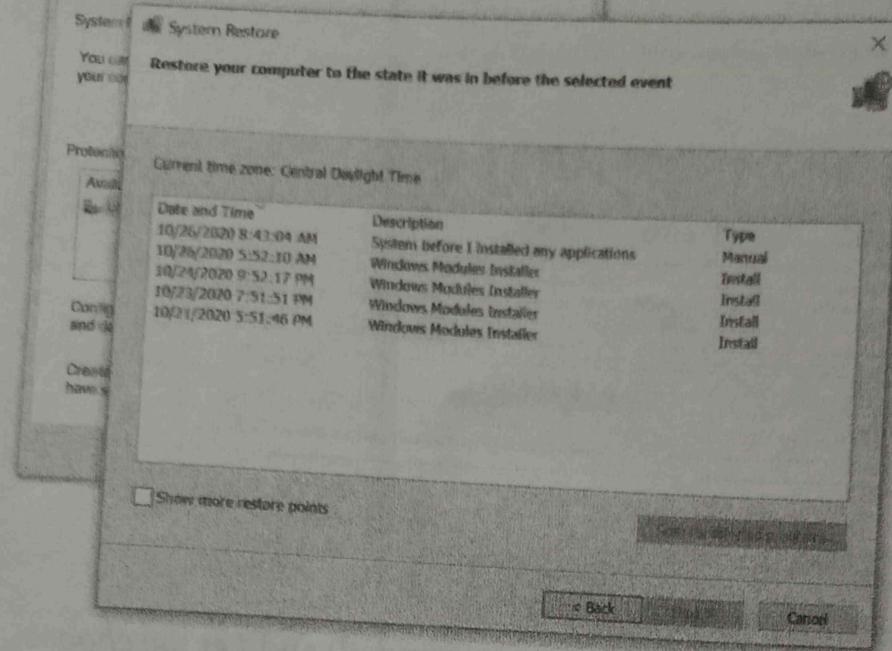
Selecting *Let me choose* is equally interesting. Windows 7 enables you to pick individual users' files to back up. This can be a handy situation when you store important files outside of the folders the *Let Windows choose* option covers.

System Restore in Windows

The **System Restore** tool enables you to create a **restore point**, a snapshot of a computer's configuration at a specific point in time. If the computer later crashes or has a corrupted OS, you can restore the system to its previous state, specifically *restoring system files and folders*.

When System Restore is turned on, it makes a number of restore points automatically. To make your own restore point, right-click Computer or This PC and select Properties, and then click the System protection link in the Tasks list. On the System Protection tab, click the Create button to open the dialog box shown in Figure. Name your restore point appropriately and then click Create.

The System Restore tool creates some of the restore points automatically, including every time you install new software. Thus, if installation of a program causes your computer to malfunction, simply restore the system to a time point prior to that installation, and the computer should work again.



2.12 FAILURE TO BOOT

When a computer fails to boot, you need to determine whether the problem relates to hardware or software.

Failure to Boot: Hardware or Configuration

Most failed-boot scenarios require you to determine where the fault occurred: with the hardware and configuration, or in Windows. This is a pretty straightforward problem.

Hardware problems can give you a blank screen on boot-up, so you follow the tried-and-true troubleshooting methodology for hardware. Make sure everything is plugged in and turned on.

If the user says that the screen says “No boot device detected” and the system worked fine before, it *could* mean something as simple as the computer has attempted to boot to an incorrect device, such as to something other than the primary hard drive.

Failure to Boot: Windows

Two critical boot files risk corruption in Windows, bootmgr and bcd, both of which you can fix with one tool, bcdedit. You can use this tool in the Windows Recovery Environment.

Getting to Windows RE

In Windows 7, you can access WinRE in three ways. First, you can boot from the Windows installation media and select Repair. Second, you can use the Repair Your Computer option on the Advanced Boot Options (F8) menu. Third, you can create a

system repair disc or system image before you have problems. Go to Control Panel | Backup and Restore and select *Create a system repair disc* or select *Create a system image*.

Windows Memory Diagnostic Bad RAM causes huge problems for any operating system, creating scenarios where computers get Blue Screens of Death (BSODs), system lockups, and continuous reboots. In Windows 7, the Windows Recovery Environment enables you to click the Windows Memory Diagnostic link from the main WinRE screen. When clicked, it prompts you to *Restart now and check for problems (recommended)* or *Check for problems the next time I start my computer*

2.13 INSTALLING AND CONFIGURING A WIRED NETWORK

To have network connectivity, you need to have three things in place:

- **Connected NIC** The physical hardware that connects the computer system to the network media.
- **Properly configured IP addressing** Your device needs correct IP addressing for your network, either via DHCP or static.
- **Switch** Everything connects to a switch in a wired network.

Installing a NIC

The NIC is your computer system's link to the network, and installing one is the first step required to connect to a network. but every modern desktop computer has a built-in Gigabit NIC. Windows will automatically install a driver for the NIC at installation.

Full-Duplex and Half-Duplex

All modern NICs run in **full-duplex** mode, meaning they can send and receive data at the same time. The vast majority of NICs and switches use a feature called *autosensing* to accommodate very old devices that might attach to the network and need to run in half-duplex mode. **Half-duplex** means that the device can send and receive, but not at the same time.

Link Lights

Network interfaces have some type of light-emitting diode (LED) *status indicator* that gives information about the state of the NIC's link to whatever is on the other end of the connection.

Configuring IP Addressing

This one's easy. All operating systems by default will be set for DHCP and acquire IP addressing settings automatically. This is true for both IPv4 and IPv6 configuration options. On the off-chance scenario where you need to configure a client to use a static IP address, you can readily do so.

Sharing and Security

Windows systems can share all kinds of **resources** across your network: files, folders, entire drives, printers, faxes, Internet connections, and much more.

Network Organization

Once a network is created, users need to be able to share resources in some organized fashion. Operating systems need a way to determine which users can access resources such as folders and printers and how those resources can be used. Microsoft designed Windows networks to work in one of three categories: workgroups, domains, or homegroups.

2.14 CONNECTING TO THE INTERNET

Computers commonly connect to an ISP by using one of eight technologies that fit into four categories: dial-up, both analog and ISDN; dedicated, such as DSL, cable, and fiber; wireless, including Wi-Fi and cellular; and satellite.

Dial-Up

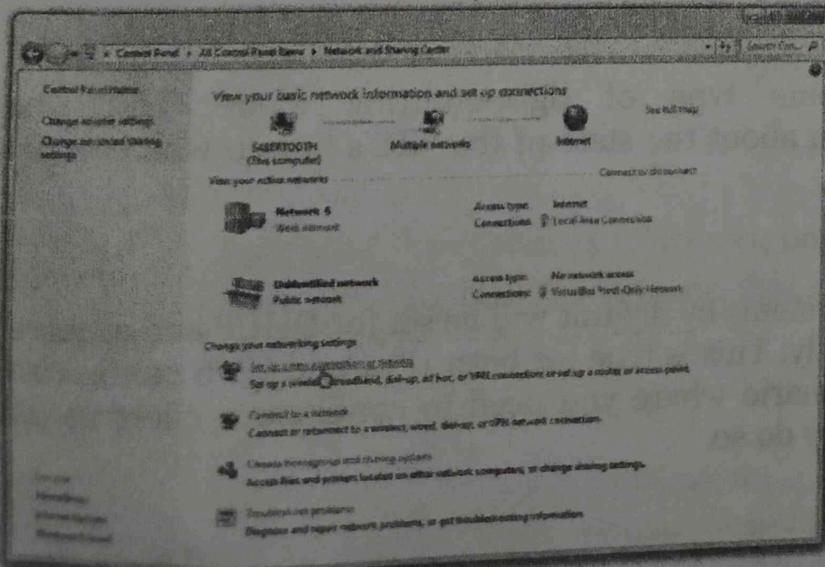
A dial-up connection to the Internet requires two pieces to work: hardware to dial the ISP, such as a modem or ISDN terminal adapter; and software to govern the connection, such as Microsoft's **Dial-up Networking (DUN)**. Let's look at the hardware first, and then we'll explore software configuration.

Modems

Creating a dial-up network required equipment that could turn digital data into an analog signal to send it over the telephone line, and then turn it back into digital data when it reached the other end of the connection. A device called a **modem** solved this dilemma.

Modems enable computers to talk to each other via standard commercial telephone lines by converting analog signals to digital signals, and vice versa. The term *modem* is short for modulator/demodulator, a description of transforming the signals. Telephone wires transfer data via analog signals that continuously change voltages on a wire. Computers hate analog signals.

Configuring Dial-Up To start configuring a dial-up connection, open the Network and Sharing Center applet and click *Set up a new connection or network*.

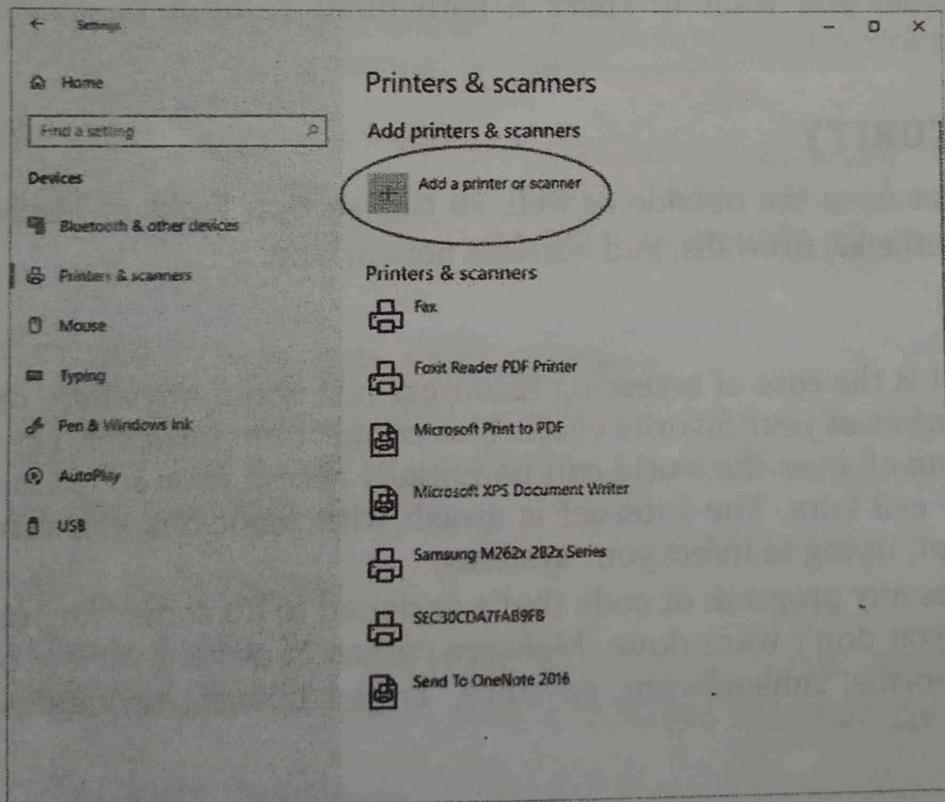


2.15 INSTALLING A PRINTERS IN WINDOWS

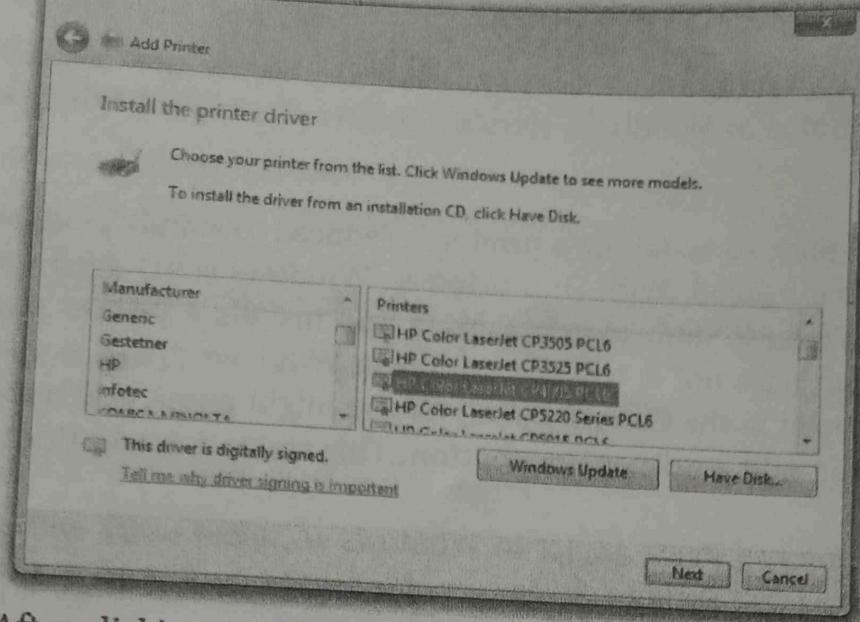
The general installation, configuration, and troubleshooting issues are basically identical in all modern versions of Windows. Here's a review of a typical Windows printer installation.

Most printers are plug and play, so installing a printer is reduced to simply plugging it in and loading the driver if needed. With USB printers, Windows won't even wait for you to do anything—Windows immediately detects and installs a printer once you connect it. If the system does not detect the printer in Windows 7/8/8.1, open the Devices and Printers applet in the Control Panel. As you might guess, you install a new printer by clicking the Add a printer icon/button. This starts the Add Printer Wizard.

Although you can use the Control Panel applet in Windows 10, most users will opt for the simpler Settings | Devices | Printers & scanners for setting up a printer. Click the *Add a printer or scanner* option to find a connectable printer.



Whether you use a USB port or a TCP/IP port, you'll need to select the proper driver manually. Windows includes a lot of printer drivers, but you can also use the handy Have Disk option to use the disc that came with the printer. If you use the driver included on the disc, Windows will require administrator privileges to proceed; otherwise, you won't be able to finish the installation. The Windows Update button enables you to grab the latest printer drivers via the Internet.



After clicking the Next button, you'll be asked if the new local printer should be the default printer and whether you want to share it with other computers on the network.

2.16 NETWORK SECURITY

Networks are under threat from the outside as well, so this section looks at issues involving Internet-borne attacks, firewalls, and wireless networking.

Malicious Software

The beauty of the Internet is the ease of accessing resources just about anywhere on the globe, all from the comfort of your favorite chair. This connection, however, runs both ways, and people from all over the world can potentially access your computer from the comfort of their evil lairs. The Internet is awash with malicious software that is, even at this moment, trying to infect your systems.

The term **malware** defines any program or code that's designed to do something on a system or network that you don't want done. Malware comes in quite a variety of guises, such as viruses, worms, ransomware, spyware, Trojan horses, keyloggers, and rootkits.

Forms of Malware

Virus A virus is a program that has two jobs: to replicate and to activate. **Replication** means it makes copies of itself, by injecting itself as extra code added to the end of executable programs, or by hiding out in a drive's boot sector. **Activation** is when a virus does something like corrupting data or stealing private information. A virus only replicates to other drives, such as thumb drives or optical media. It does not self-replicate across networks. A virus needs human action to spread.

Worm A worm functions similarly to a virus, except it does not need to attach itself to other programs to replicate. It can replicate on its own through networks, or even hardware like Thunderbolt accessories. If the infected computer is on a network, a worm will start scanning the network for other vulnerable systems to infect.

Trojan Horse A Trojan horse is a piece of malware that appears or pretends to do one thing while, at the same time, it does something evil. A Trojan horse may be a game, like poker, or ironically, a fake security program. The sky is the limit. Once installed, a Trojan horse can have a hold on the system as tenacious as any virus or worm; a key difference is that installed Trojan horses do not replicate.

Keylogger Keylogger malware does pretty much what you might imagine, recording the user's keystrokes and making that information available to the programmer. You'll find keylogging functions as part of other malware as well. Keyloggers are not solely evil; a lot of parental control tools use keyloggers.

Rootkit A rootkit is a program that takes advantage of very low-level operating system functions to hide itself from all but the most aggressive of anti-malware tools. Worse, a rootkit, by definition, gains privileged access to the computer. Rootkits can strike operating systems, hypervisors, and even firmware.

Behavior

Knowing what form the malware takes is all well and good, but what really matters is how "mal" the malware will be when it's running rampant on a system. To get things started, let's dive into an old favorite: spyware.

Spyware Spyware—malicious software, generally installed without your knowledge—can use your computer's resources to run distributed computing applications, capture keystrokes to steal passwords, or worse.

Malware Prevention and Recovery

The only way to permanently protect your PC from malware is to disconnect it from the Internet and never permit any potentially infected software to touch your precious computer.

Dealing with Malware

You can deal with malware in several ways: anti-malware programs, training and awareness, patch/update management, and remediation.

Anti-Malware Programs

An **anti-malware program** such as a classic **antivirus program** protects your PC in two ways. It can be both sword and shield, working in an active seek-and-destroy mode and in a passive sentry mode. When ordered to seek and destroy, the program scans the computer's boot sector and files for viruses and, if it finds any, presents you with the available options for removing or disabling them. Antivirus programs can also operate as **virus shields** that passively monitor a computer's activity, checking for viruses only when certain events occur, such as a program execution or file download.

Antivirus programs use different techniques to combat different types of viruses. They detect boot sector viruses simply by comparing the drive's boot sector to a standard boot sector. This works because most boot sectors are basically the same. Some antivirus programs make a backup copy of the boot sector. If they detect a

virus, the programs use that backup copy to replace the infected boot sector. Executable viruses are a little more difficult to find because they can be on any file in the drive. To detect executable viruses, the antivirus program uses a library of signatures. A **signature** is the code pattern of a known virus. The antivirus program compares an executable file to its library of signatures. There have been instances where a perfectly clean program coincidentally held a virus signature. Usually the antivirus program's creator provides a patch to prevent further alarms.