Module 4

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Software refers to the electronic instructions that govern a computer's actions in order to provide a computing service.

Today, software goes by many names, including applications, apps, and programs. The 21st century has seen an explosion of all sorts of software. The mobile computing revolution and cloud computing have created opportunities for millions of apps that provide services anywhere, anytime for every need across desktop and mobile platforms. Today it's more important than ever to learn about the apps that are available, how they work, and how they are created.

Apps are becoming a major force in the U.S. and global economies. The most innovative and successful companies—Apple, Google, Microsoft, Adobe, Intuit, and dozens of others—have made fortunes off seemingly simple apps that serve a valuable purpose. The U.S. is looking to its youth for the entrepreneurial spirit that can continue innovating and help the country to maintain its leadership role in the global economy. But, is the U.S. educational system supporting these expectations?

There is a big push to encourage students to study STEM subjects: Science, Technology, Engineering, and Math. However, programming and computer science have not become core subjects in the K–12 curriculum. Is it possible for young entrepreneurs to carry their visions through to reality without understanding computer code? If programming, like math, was taught to all students at an early age, would it impact the amount of interesting software produced in the U.S. in the next decade or two? How about you? Do you have any ideas for a cool new app? Do you have the skills to implement them? Are you interested in learning how?

A decade ago, the thousands of apps developed by professional software companies for PCs seemed excessive; today, there are millions of apps, many of which are created by students like you. Traditional apps for PCs and businesses are as important today as ever, but now they are accessible across desktop and mobile devices and joined by hundreds of thousands of mobile apps to meet every need. In addition to installed apps on PCs and mobile devices, there are thousands of web apps that run in browsers on any Internet-connected device, and apps designed to run in and with popular online services like Facebook and Twitter.

If you boil down all of the millions of apps available for all the different types of computers and devices, you end up with two basic types: system software and application software. System software assists computer hardware with the work it is designed to do. Examples include operating systems and antivirus software. Application software, on the other hand, assists people with the work and activities

that people do. Examples include spreadsheet software and social media software. There are many different types of system and application software as well as various methods of acquiring them.

Software is designed and developed by software engineers who use programming languages to encode the logic of the software in a manner that a processor can execute. Software usually consists of a number of files, ranging from a single file to dozens of files or more. At least one of the files associated with a program is an executable program file—the file that contains the processing instructions for the processor to execute.

There are many ways to start or run software. The most common way is to click or tap an icon on the desktop or in a program's or application's menu to launch the executable program file. When a program such as a word processor is started, machine-level program instructions are copied from the executable program file in permanent storage into the computer's RAM. Once in memory, the instructions are transferred to the CPU and executed.

This unit provides information on how software is created, acquired, used, maintained, and managed. Apple and Google have very different approaches to controlling the software allowed onto their mobile devices. Apple applies strict controls over what software is allowed in its App Store, where hundreds of thousands of apps are available for download. Applications that are ethically or morally questionable are not allowed. You will not find any porn apps in Apple's App Store, nor will you find any apps that promote hate crimes, warn you of police speed traps, or insult the sensibilities of law-abiding, ethically minded citizens. Apple has been criticized for censoring its app selection. Because Apple is a private company, its software is proprietary, and it is not obligated to support freedom of expression. The iPhone remains the best-selling smartphone on the market.

Google, in contrast, has an open-door policy in its Google Play store, where hundreds of thousands of apps are available for users of Android smartphones, tablets, and Chromebooks. Android is an open-source operating system, and Google figures its app store should be open as well. All kinds of possibly offensive apps can be found in Google Play. It also has hundreds of apps that are written specifically to hack users' phones and steal their data. As Google learns of apps that have illegal intentions, or malware, it removes them from its store. However, Android has become a popular target for hackers and suffers from more virus attacks than Microsoft Windows, while the iPhone remains relatively unscathed. Nonetheless, Android fans appreciate the freedom that Google provides its developers and users. The many varieties of Android phones on the market combined outsell the iPhone.

Which approach do you prefer for your own smartphone needs? Which do you think is a better business model? Which is the best model to drive innovation in the market?

Lesson 4.1: Software Development

Lesson 4.1 Introduction

Software Development

Software development is the systematic process of transforming a software idea into functional software.

Why This Matters

Software begins as a concept or idea for some new or improved use for a computer. Today's software developers, sometimes called software engineers, create software for many different types of computers, including PCs, tablets, smartphones, servers, and supercomputers. Understanding what computers are capable of is very useful in determining if a software concept is feasible. A developer who specializes in mobile software needs to understand the platforms: Apple iOS, Google Android, and Microsoft Windows Phone. The developer also needs to know the capabilities of the handsets, including

processor capabilities, storage capacity, display size, wireless technologies, and whether they have GPS, an accelerometer, a compass, or other sensors. Understanding these capabilities provides the developer with ideas for new apps. For example, the iPhone includes an RFID chip that allows app developers to include contactless payments in apps. iPhone developers also need to learn how to utilize the iPhone's fingertip scanner for authentication. Apple, Google, Microsoft, Facebook, and others provide tools to make it easier to develop software for their platforms. Today, all types of people are developing new apps.


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Essential Information

Software development is a process typically guided by a model that provides sequential steps to take software from concept to reality. The most common model is called the software development life cycle or sometimes the software life cycle.

The software development life cycle (SDLC) is a five-stage process that begins with requirements analysis, proceeds to the design stage, and is followed by implementation, verification (testing), and maintenance. The SDLC is sometimes referred to as the waterfall model because development flows from one stage to the next.
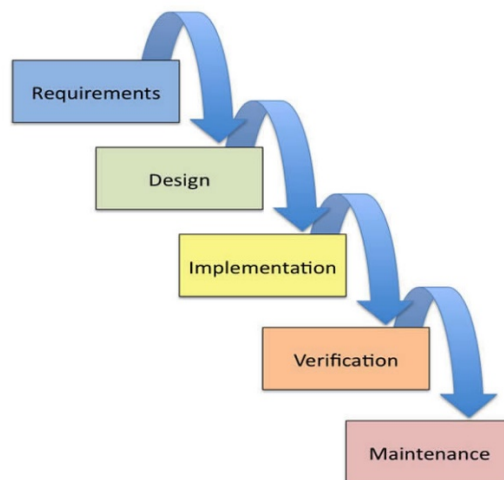
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The SDLC is a cycle because often when software is in its final stage, the maintenance stage, an improved version of the software begins development in the first stage. In this manner, many software packages are in a continuous improvement cycle over many years. Also, although the SDLC is like a waterfall in most ways, when errors are identified and corrections are needed, it requires the water to "flow uphill," back to a previous stage.

Although the waterfall model is popular and has been in use for many years, newer models are finding favor with some developers. Agile software development techniques such as Extreme Programming (XP) use an iterative process where development steps are small and incorporate frequent testing and user feedback to verify that each step is successful.

Distributed revision control systems (DRCS) such as Github have become important tools for groups of developers working together to create and improve software. Using Github, multiple programmers can add new features to software simultaneously without concern for overwriting each other's work. Github maintains a history of the revisions and allows a central coordinator to pick and choose which features to implement in the final version. Many open source software products are managed using these types of systems.

Whether software is being developed by a team of dozens of software engineers for a major software vendor, by a group of individuals volunteering time on an open source project, or by an individual working on a personal project, using an orderly, stepwise development process is the key to effectively and efficiently developing software.

The Five Stages of the SDLC

SDLC Stage	Description
Requirements	Software begins typically as an abstract idea of some end result or output. Requirements analysis is the process of transforming an abstract description into a concise and complete list of input requirements and a full description of how the software should behave from the user's perspective.
Design	From the requirements analysis, software developers create the software specification. Use cases—various ways that the software will be used—are explored. Tools such as flowcharts and pseudocode may be used to create an algorithm for processing the input to create the desired output.
Implementation	In this stage, the detailed software specification is translated into actual programming code, using a programming language.
Verification	Sometimes called testing, verification may use in-house alpha testing and external beta testing to expose errors in the code. Errors may be either syntax errors (a misuse of the programming language) or logic errors (flaws in the programming logic and algorithms).
Maintenance	Maintenance refers to repairs or enhancements to software that are applied after the software has been formally released.

Reading: Computer Programming

Computer Programming

Computer programming, or coding, is the process of creating software through the use of logic, algorithms, and programming languages.

Why This Matters

In the very early years of computing, computer programming was accomplished by manually setting various switches and circuits within a computer. Later, programmers encoded software instructions as a series of holes punched on cards that were fed into the computer. After punched cards, the development of programming languages allowed software to be typed as a series of commands that the computer interpreted into binary code. Since then, software has been created to assist programmers in writing code and finding errors. More recently, toolkits have been released that make coding for specific platforms, such as Facebook or iPhones, even easier. Computer programming has gotten substantially easier over the years, making it increasingly accessible to people in every profession.

Essential Information

Program code is the set of statements that instruct the CPU to perform circuit-switching operations. Software exists as sets of program code with a specified purpose. Computer programmers, sometimes called coders, are people who write or create the instructions or statements that become complete software programs. Within the computer industry, programmers are often called software engineers. In recent years, many people outside the computer industry have begun programming. Computer programming, or coding, has become a valuable skill in many professions. It teaches logical thinking and problem solving, useful skills no matter what your profession.

Before writing program code, software developers map out the logical design of software, using a variety of tools. When the logical design for the software is complete, it is time to code it using instructions that the computer can follow. Software may either be installed on the user's computer or mobile device or installed on a server and accessed through a web browser from any device. All software, including system software and application software, is written using coding schemes called programming languages.

Many tools are available to assist programmers with the coding process. Code editors are text editors that assist the programmer in using a particular programming language. A code editor often features automatic command completion, the ability to suggest useful commands, and color-coding that illustrates the relationship between commands. Debugging software is able to evaluate programming code to determine if and where errors, or bugs, occur. An integrated development environment (IDE) integrates all of the above tools and provides other helpful features. But, no matter how helpful an IDE, a programmer still needs to be thoroughly educated in programming languages.

Reading: Programming Languages

Programming Languages

Programming languages provide a set of symbols, commands, and rules (syntax) used to write program code.

Why This Matters

Programming languages automate the tedious process of creating the detailed step-by-step machine instructions used in software. Programmers, or coders, use programming languages, or code, to create software, using English-like statements and high-level logic that are then translated into the low-level

machine instructions that run in the CPU. Programming languages have transformed the programming process from tedious labor to a creative intellectual endeavor for problem solving.

Essential Information

Software typically solves some problem or need through a logical sequence of steps. Whether the software is intended to create an online presentation, calculate a tax return, post a message for friends to view, or navigate a game character through a virtual landscape, logic plays a huge role in the development process. Since computers process software instructions sequentially in tiny steps, software development requires programmers to step through the process of problem solving logically. Talented programmers are masters of problem solving with logic.

All programming languages share a core set of tools (see the table below), with each language excelling in some type of application. Each language has a particular syntax—the rules that guide how programming statements are constructed. By combining these common programming tools in unique ways and taking advantage of special traits of specific programming languages, developers create useful new apps.
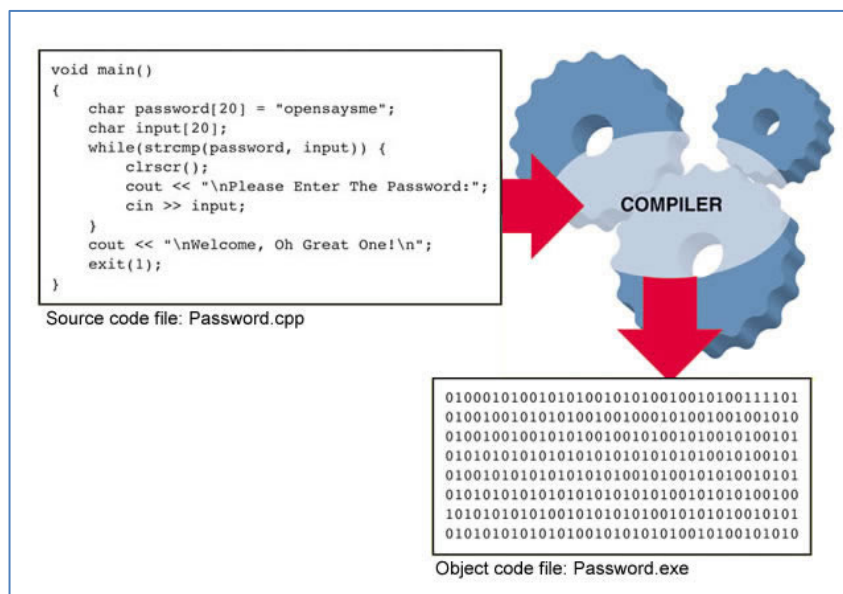
Programming Language Tools

Tool	Description	Example
Variables	Named storage for specific types of data	X = 12 assigns the value 12 to the variable named x
Strings	A collection of characters	Str = "algernon" Assigns the word algernon to the variable named str
Arrays	A collection of variables	myCars = ["Saab","Volvo","BMW"] myCars[0] is Saab, myCars[1] is Volvo, etc.
Arithmetic operations	The ability to carry out math equations with variables	x = 12 + 3 y = x + 8 x holds 15, and y holds 23
Comparison operations	The ability to compare data using comparison operators	(x >= 12) would be true only if the value in x is 12 or greater
Conditional statements	The ability to choose different operations depending on a condition	If (x >=12){print x} x will be printed to the screen only if it is 12 or greater
Iteration	The ability to repeat an operation as long as a condition remains true	While (x < 12){print x} Prints x repeatedly until x is 12 or greater

Object-oriented programming (OOP) has become the dominant programming paradigm. In object-oriented programming, data, instructions, and other programming procedures are grouped together, or encapsulated, in reusable objects. Objects are linked in a manner that creates a useful program: one object's output serves as another object's input. Objects can be connected in different ways to create different applications. Object-oriented programming is popular because it approaches problem solving in a manner that mimics the real world, and also because it saves development time.

Utilizing a programming language's syntax, programmers create a source code file that is translated into an object code file containing the machine-level instructions that the processor carries out. Most software is developed using a software tool called a compiler. A compiler takes source code—a program written in a programming language—and produces object code, which contains an executable file and supportive files, as output. Some programming languages use an interpreter rather than a compiler to create object code. An interpreter translates source code to object code one command at a

time, while the software is executing. A compiler takes source code as input and outputs an executable file.

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Popular Programming Languages

Languages	Description
C	General-purpose language popular on UNIX and Linux platforms
C++, Java, Python	General-purpose object-oriented languages; Java is perhaps the most popular programming language and is used for developing Android apps. Python is a popular beginner's language that is easy to learn.
JavaScript, Jquery, AJAX	Based on JavaScript, these languages are used mostly for client-side web programming.
PHP, Ruby, Perl	Popular web server-side programming languages
SQL, MySQL	Database manipulation languages
C#, VB, .NET	Popular for Microsoft Windows programming
Objective-C	Used to develop iOS apps for iPhone and iPad

## Reading: Application Programming Interface

Application Programming Interface (API)

An **application programming interface** is a set of programming tools specifically designed for developing apps for a particular platform.

Why This Matters

An API allows others besides the manufacturer to develop software to run on the system or device. Without APIs, only Microsoft would develop software for Windows computers, only Apple would develop software for the Mac and iPhone, and only Sony would develop software for the PlayStation. APIs

provide users with a rich variety of software and provide an opportunity for less experienced programmers to make valuable software contributions.
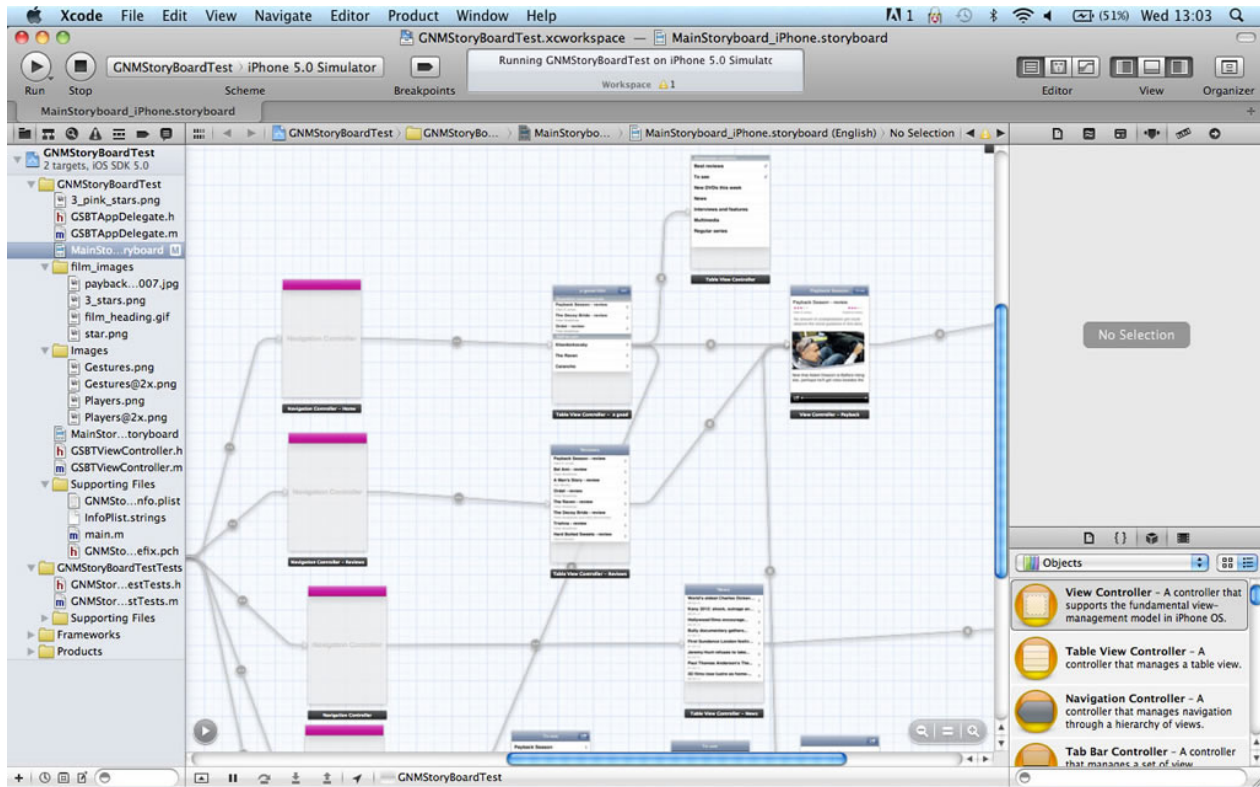
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Essential Information

An API might be restricted to one particular programming language, or it could support many languages. For example, Facebook designed its API to require the PHP scripting language. Microsoft Windows, however, supports many programming languages that can manipulate the Windows environment using the programming tools provided by the Windows API.

Some APIs are combined with an SDK. An SDK, or software development kit, is a programming environment designed to write software for a particular computing platform. Facebook, iPhone, Google Maps, and Google Android all provide SDKs for software developers. The iPhone SDK is shown in the above figure. Notice that the SDK provides an iPhone storyboard that allows developers to visualize use-case sequences.

APIs may be made publicly available or may be licensed to specific software developers. For example, the PlayStation API is available only to software companies that Sony has approved for developing software for its gaming console.

SDKs make software development less complicated. For example, to develop applications for iPhone, Android, or Facebook, the SDKs require only basic programming skills and knowledge of the capabilities of the device or environment. This provides opportunities for amateurs to try their hand at software development. Many of the hundreds of thousands of iPhone apps were designed, developed, and published by amateurs. Amateurs may not have the skills to develop a full desktop application, but they often can learn the smaller skill set required to use the SDK.

Lesson 4.2: Software and Applications

Lesson 4.2 Introduction

System software is any software that coordinates the activities of the hardware and assists the computer in functioning safely, effectively, and efficiently.

Controlling the operation of computer hardware is one of the most critical functions of system software. System software includes operating systems that interact with the computer hardware, creating a layer of insulation between the hardware and application software and keeping computer systems running smoothly and safely. System software also includes utilities like security software, file management software, and DVD burning software. System software is essential for all types of computers from smartphones to supercomputers, to special-purpose computers and other digital devices.
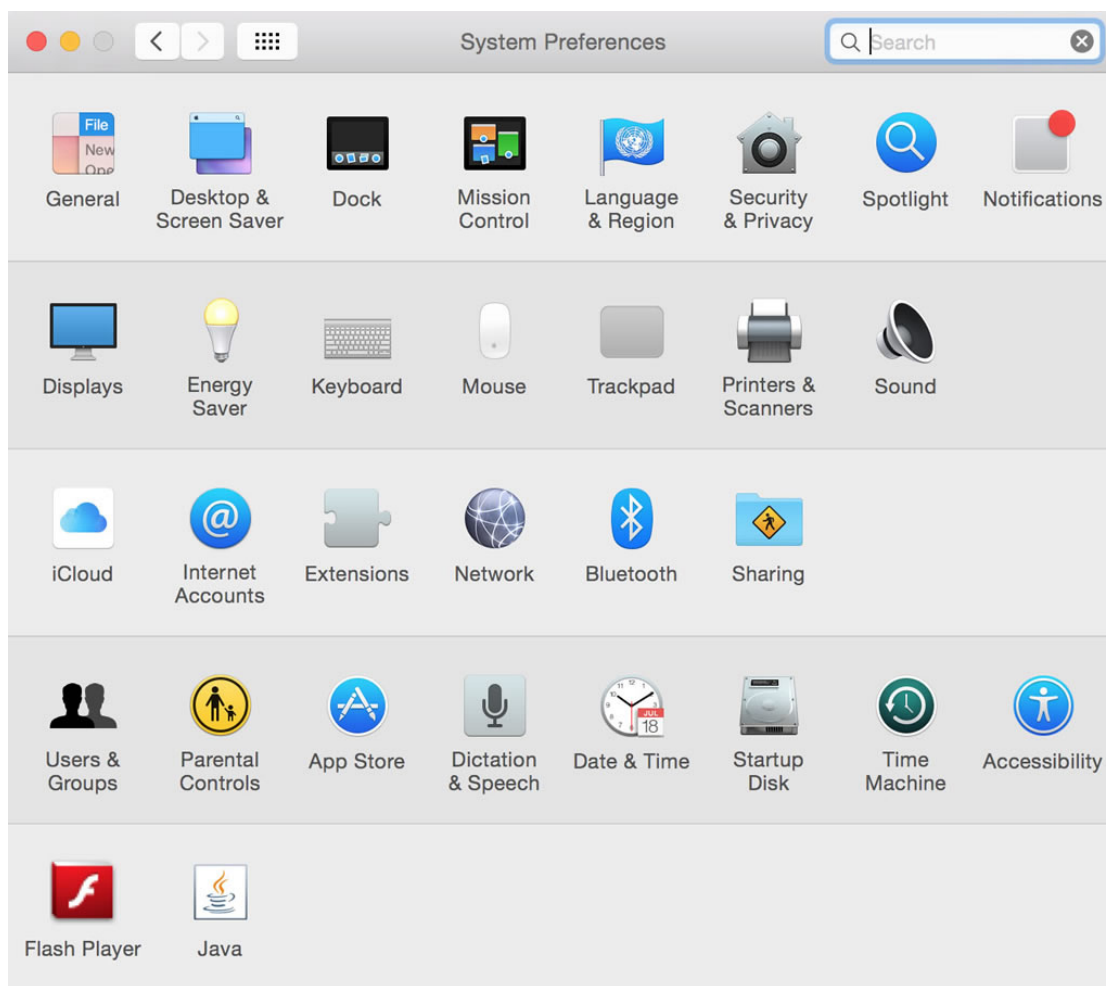
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System software includes operating systems, such as Microsoft Windows, Mac OS, Android, and iOS, that are essential for all computers to operate. Other system software, such as disk management tools and antivirus software, is designed to keep the computer running safely, smoothly, and effectively. System software, especially the operating system, is written for a specific CPU and set of hardware. The hardware configuration of the computer system combined with the particular operating system in use is known as the software platform. For example, a mobile software developer might specialize in developing apps for the Android platform.

Reading: Operating System (OS)

Operating System (OS)

An **operating system** is a set of computer programs that runs or controls the computer hardware and acts as a user interface.

Why This Matters

The operating system plays a central role in the functioning of any computer system. Operating systems run on most digital devices. Nearly all operating systems perform certain similar tasks, such as controlling computer hardware, managing RAM, managing the processor(s), controlling input and output devices, storing and managing files, and providing a user interface. The operating systems also provide networking functionality.

Essential Information

When a computer of any kind is powered on, a boot process, hard wired into the device, runs some self-checks and then loads the operating system into memory. From that point on, the operating system takes control of all computing activities.

Operating systems control many common hardware functions, such as providing a user interface, managing the processor and memory, managing files and storage, communicating with peripheral devices and accessories, capturing user input, and providing output. Operating systems are designed to work with specific types of computers and processors. Application software is written to operate on a particular type of operating system, not on a particular type of computer. For example, there are apps that run only on Android, and others that run only on iPhone. PC apps run on Windows, Mac, or Linux platforms. If a developer wants to have an app on the two most popular mobile platforms, he or she needs to create multiple versions of it, using at least two APIs and programming languages—one each for iPhone and Android.

The selection and quality of apps available for a platform has a large impact on the popularity of the platform. A decade ago, Windows computers vastly outsold Macs, primarily because of the amount of software available for each. More recently, iPhone and Android phones vastly outsold Windows Phones, primarily for the same reason.

The operating system provides a user interface that allows the user to interact with the system. The user interface is what defines the user's computing experience and causes some users to prefer Windows over Mac, or iPhone over Android.

The operating system also provides a structure for system storage. Typically, data is stored in files, and the files are organized with folders and subfolders. Windows has added the ability to store commonly used files in libraries. Cloud storage from Apple iCloud, Google Drive, Microsoft OneDrive, and other providers makes it possible to easily access files, apps, and app settings across multiple devices.

"Underneath the hood," so to speak, the operating system controls processing and memory use. The OS retrieves instructions from the running software, decodes it, and sends it to the CPU for execution, storing any resulting data. Most PC and mobile operating systems multitask, running multiple applications at the same time.

The OS also controls input and output. It receives input from a keyboard, mouse, touch screen, microphone, or other input device, and then returns the results of processing to the display, printer, speakers, or other output device. The OS can communicate with many different external devices and accessories, called peripherals, such as scanners, printers, keyboards, and displays. To do so requires

a device driver—software that is installed for each device connected to a PC, which allows the OS to communicate with that device.

Mobile versions of operating systems for tablets and smartphones are lightweight versions of their PC equivalents. They require fewer system resources, and so can run on smaller processors with less storage and provide a streamlined user interface for smaller touchscreens. Microsoft, Apple, and Google have all recently unified their operating systems across devices so that users can have a common experience across their PCs, tablets, and smartphones.

Reading: User Interface

User Interface

A **user interface** (UI) allows one or more people to have access to and command of a computer system or computer software.

Why This Matters

One of the most important functions of any operating system is providing a user interface. An OS user interface allows one or more people to have access to and command of the computer system. The user interface defines the computing experience for the user.
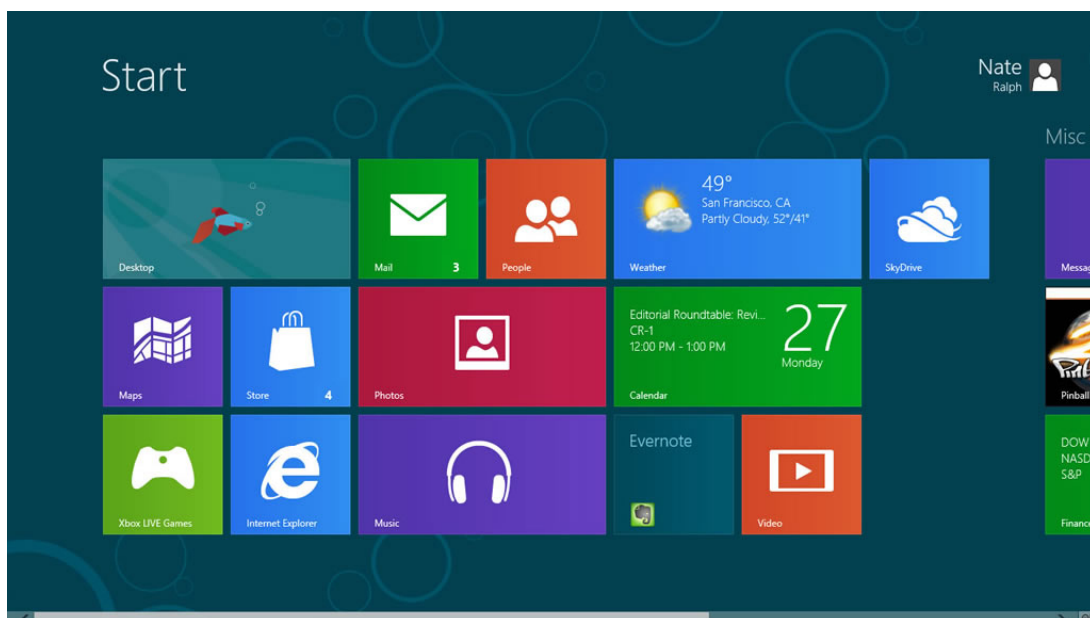
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Essential Information

The first user interfaces for servers and personal computers were command based. A command-based user interface requires that commands be typed at a prompt in order to perform basic tasks. Most operating systems still provide access to a command line to allow system administrators and advanced users to interact more directly with the operating system. However, the default user interface today is the graphical user interface.

A graphical user interface (GUI) uses a keyboard and mouse, touch screen, joystick, or other pointing device to manipulate graphics images on the display to issue commands to the computer system. A graphical user interface offers many advantages over a command-based user interface. For example, a

GUI is very intuitive. Often you can simply explore to figure out how to perform some task; and if you can't figure it out, help menus and wizards can assist you. A multitasking GUI allows you to view several applications at once and copy data between applications.

The most popular graphical user interfaces on personal computers include similar features and functionality; however, the style of those features may differ from OS to OS. GUIs generally include icons, a desktop, windows, menus, dialog boxes, an information bar (taskbar or dock), a trashcan, program launch area, file viewer and organizer, system viewer, and system settings. It typically doesn't take long for an experienced computer user to switch to a new computer platform. Many Windows users have switched to Mac computers in recent years, some motivated by the iPhone, the iPad, and Apple's ecosystem.

There is a GUI battle raging on smartphones. The iPhone ushered in the age of smartphones with a user interface that featured pages and pages of app icons. The Android operating system introduced the notion of smartphone "widgets" that allow applications to display information on the home screen along with app icons. Microsoft introduced "live tiles" that provide app information on tiles and a new way of interacting with information and apps.

Wearable user interfaces are the next big trend. Google Glass utilizes a head-mounted display and voice commands to interact with mobile apps. Apple, Samsung, Microsoft, Google, and others have developed smart bands and watches that connect wirelessly to a smartphone for easy access to text messages and mobile apps. The new generation of Virtual Reality systems provide yet another opportunity to explore new ways to interact with the system. The HTC Vive, for example, allows users to pull up menus with a click of a button on the handset controller and select options by shooting them with a laser beam in the virtual space.

Reading: File Management

File Management

File management refers to the physical and logical storage system and practices provided for managing data on a computer.

Why This Matters

The operating system keeps track of files stored on disk and sometimes in the cloud, and manages all storage devices within and attached to the system. When you save a file to a hard drive or flash drive, store it in the cloud, or burn it to a CD or DVD, the operating system finds space on the device to store the file in an efficient manner and records the location so the file can be accessed later. Maintaining an organized file system makes it easy to find files and information.

Mac OS provides several options for viewing files, including "cover flow," which provides a preview of the file contents.
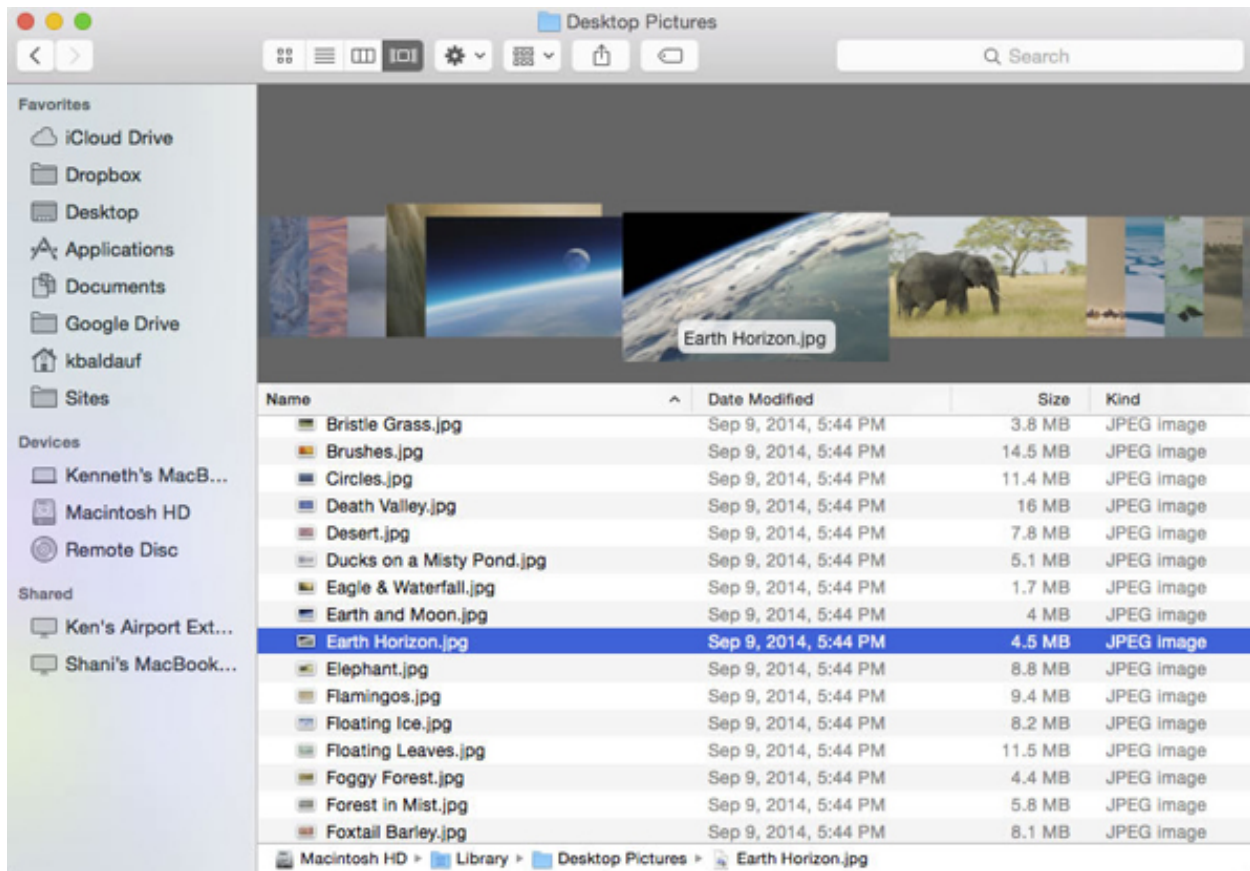
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Essential Information

The storage-management portion of an OS converts a logical request for data into the physical location where the data is stored. A logical view of data is the way a user thinks about data—for example, C:/Users/Johnson/Documents/Homework/report.doc. That is, the report.doc file is stored in the Homework folder, which is in the Documents folder in the Johnson folder in Users on the C drive. With a logical view, the user doesn't have to know where the data is physically stored in the computer system. However, a computer can translate the logical view of data into the physical view of data—for example, hard disk, track 1, sector 3.

The operating system performs this task through the use of a file system—a way of organizing how data and files are physically stored and how they are logically manipulated. Windows operating systems use the New Technology File System (NTFS). The Linux and UNIX operating systems use several different file systems such as ext3 and UFS. Mac OS uses a file system called HFS+ (HFS stands for Hierarchical File System). Popular operating systems also provide options for encrypting files as they are stored on disk for heightened security.

Operating systems provide tools for managing files. Microsoft Windows 10 uses File Explorer (called Windows Explorer in earlier Windows versions) to manage files, while Mac OS uses Finder. Computers of all types and sizes store and manipulate files that can contain data, program instructions, or both. Operating systems allow you to organize files into folders, sometimes referred to as directories. Folders can hold one or more files. Organizing files into folders or subfolders makes it much easier to locate files, compared to having all files in one large folder or directory. Windows also provides libraries, which allow you to view files and folders from various locations as a single collection. Lists of folders and files on a computer can be viewed alphabetically, by size, by type, or by the date they were created or last

modified. Operating systems typically provide several types of views of files, including list view, icon view, thumbnail view, or cover flow view.

Operating systems allow files to be copied from hard disks to portable media such as USB drives and CDs and DVDs. Increasingly, files are being stored in the cloud, where they can be accessed from many locations and devices. Microsoft Windows and Office provide access to One Drive when files are accessed or saved. Android has a similar feature for Google Drive, and Apple has the ability to back up files to iCloud.

Each OS has conventions that specify how files can be named and organized. In Windows, Mac, and Linux, file names can be up to 256 characters long, both numbers and spaces can be included in the file name, and upper- and lowercase letters can be used. Windows and Mac permit spaces in file names while Linux does not. Mac and Linux file names are case sensitive while Windows file names are not. Certain characters, such as \, *, <, and >, cannot be used in file names. File names may have an extension such as .docx, .html, .jpg, or .txt. Extensions help identify the type of file, such as Word document, webpage, photo, or text file. Windows and Mac both have settings to hide file name extensions from view, which are turned on by default.

Reading: Microsoft Windows and Windows Phone

Microsoft Windows and Windows Phone

The Microsoft Windows platform includes the **Microsoft Windows** OS for PCs and tablets and **Windows Phone** for smart phones.

Why This Matters

Microsoft Windows runs on roughly 90 percent of all personal computers. The latest version of Windows provides a single platform across all devices, altering features to suit the device. Since Windows is by far the dominant OS and is found in most business environments, it is useful for everyone to be fluent in its use.
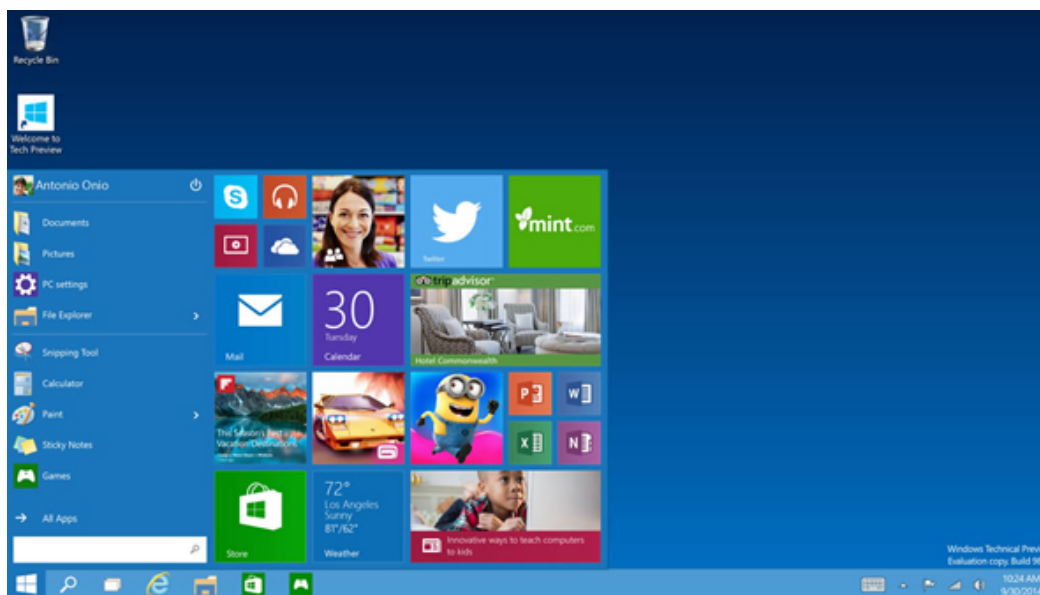
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Essential Information

Over the years, there have been many versions of Microsoft Windows: Windows NT, ME, 2000, XP, Vista, 7, 8, and now 10, each version adding features and improvements over previous editions. Windows 10 claims to be a whole new start for Windows: a universal operating system for everything from phones to laptops, tablets, big touchscreen PCs, and everything in between.

Windows 10 was intended to fix the mistakes of Windows 8. Microsoft decided to skip Windows 9 altogether, perhaps to put some distance between the new generation Windows and the failed last attempt.

With Windows 10, Microsoft brought back the Start menu and a unified system so that users don't have to choose between the new tile interface and the old desktop as they did in Windows 8 and 8.1. Now, users can access whatever they need from one desktop.

Rather than trying to force a tablet interface on PC users, Windows 10 knows if it is on a desktop or tablet and configures accordingly. When a transformable PC switches from notebook to tablet mode, the user is asked which interface he or she prefers. Windows 10 features improved navigation, search, and file management and features Cortana, a voice-controlled assistant similar to Apple's Siri.

Windows 10 is a unified system. Developers use one development kit for developing apps across all devices. There is one Microsoft store for all versions of Windows 10: PCs, Surface, tablets, Xbox, and Phone.

Reading: Apple Mac OS and iOS

Apple Mac OS and iOS

Apple Mac OS, iOS, and Watch OS are the native operating systems for Apple Macs, the iPad and iPhone, and Apple Watch.

Why This Matters

The Mac OS has gained popularity as Mac computers have grown in market share. The most recent version of the Mac OS is called macOS Sierra, and it is competitive with Windows 10 in terms of performance and capabilities. The previous 11 versions of Mac OS were categorized as updates to the tenth version with a roman numeral X. With this latest version of its operating system, Apple has dropped the X naming convention, calling it macOS rather than Mac OS X. Mac users prefer macOS over Windows because of its ease of use and relative smooth and safe operation.

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Essential Information

Like Windows, Apple operating systems have gone through revisions and changes to make them more useful. Easy-to-use graphical user interfaces have always been a hallmark of Apple systems. The latest version of macOS continues to be easy to learn and use. Simplicity does not mean that macOS is not powerful, however. Mac systems offer outstanding graphics capabilities and are popular with professionals working in art, photography, motion pictures, animation, and music. Because high-end Macs offer powerful processing, they are also popular with mathematicians and scientists.

The macOS is built on the UNIX operating system, an industrial-strength OS originally developed for mainframe systems and renowned for its stability and security. Like Windows 10, macOS Sierra is designed to provide a seamless user interface between platforms: Macs, iPads, iPhones, and Apple Watch. It incorporates the personal digital assistant, Siri, as a voice interface used to find files, launch apps, and other useful tasks. Like Microsoft Windows 10, Sierra utilizes cloud computing to share apps, media, and files across devices. Sierra automatically logs in users wearing an Apple Watch, and authenticates online payments with fingerprint validation on an iPhone.

Apple's iOS for the iPhone and iPad blends seamlessly with macOS. The most recent version, iOS 10, features advanced photo editing and organizing; messaging with advanced features that support handwritten notes, cartoon characters, and quick prerecorded responses; the map app that allows you to make reservations and book a ride through Lyft; Apple Pay for wireless payments, and touch ID for unlocking the device with a fingerprint. The Apple ecosystem extends to your wrist; Apple Watch OS provides a platform for apps to run on a small watch face.

Mac users often use apps from Apple, downloaded from its App Store. Safari is Apple's web browser, Mail is the Mac email program, Address Book stores contacts, and iChat is for instant messaging with or without video. These and many other useful software tools are provided free with macOS. The Mac iLife suite of apps (sold separately) includes iChat, iPhoto, iMovie HD, iDVD, iTunes, iWeb, and GarageBand. Mac iWork software (also sold separately) includes the Pages word processor, Numbers spreadsheet, and Keynote presentation software. These apps can be downloaded independently from Apple's App Store for between $15 and $20 each. Many of the popular apps for macOS are also available for iOS with the ability to share files on iCloud. Since many of Apple's apps run only on Apple devices, users may be unable to use them to connect with non-Apple-using friends.

Because Apple makes both the hardware and the operating system for its computers, and because macOS is built on UNIX technology, Macs have a reputation of being more stable and secure than Microsoft Windows PCs. Mac users also do not face as large a threat from viruses and spyware as do Windows users, although that is changing as some Mac users are being tricked into downloading malware on the web. The macOS provides file encryption, password protection, and a firewall to keep hackers out of your files, and some Mac users install additional antivirus software, like Sophos Antivirus, as recommended by Apple.

Reading: Google Chrome and Android

Google Chrome and Android

Google Chrome and **Android** are Google's operating systems that extend over phones, tablets, laptops, desktops, watches and other wearable devices, TV, and autos.

Why This Matters

Android is the most popular mobile OS, controlling around 86 percent of the global smartphone market and 65 percent of the global tablet market. Android's open and free architecture is popular with many users on a budget. Its market share has attracted developers who are interested in selling more apps.
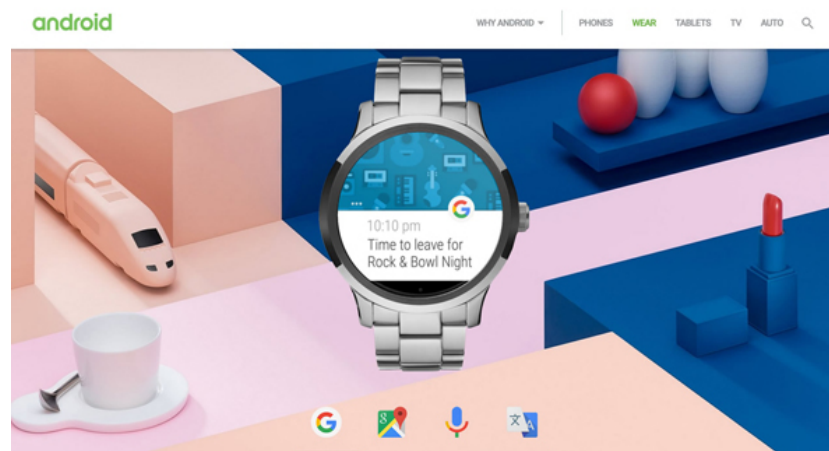
Authored by Android, License: Fair Use

Essential Information

After the iPhone launched the mobile revolution, Android was the first OS to challenge iOS. Android is based on free and open-source Linux, and so any device maker could use it for its phones. And use it they did! The tidal wave of low-priced smartphones running Android quickly surpassed Apple's market share, making Android the most popular mobile OS. Like iOS, Android offers millions of apps in its Google Play store.

A similar iPhone vs. Android phenomenon has occurred in the tablet market with tablets running Android overtaking the iPad's market share. The iPad remains the most popular tablet, but all of the tablets running Android combined have a greater share of the market.

Android is designed for several platforms: phones, tablets, wearable devices, TV, and autos. However, Android does not extend to desktops and laptops. For computers, Google offers Chrome OS. Chrome OS is Google's attempt to do away with installed apps and move our computing life to the web. Google Chrome runs on low-priced Chromebooks designed to run only web apps: Gmail, Google Calendar, Google+ with Hangouts, Google Docs, Sheets, and Slides with all files stored on Google Drive. Google

offers hundreds of other web apps from a variety of developers. The latest version of Google Chrome is also able to run the millions of apps designed for Android.

The Asus Chromebook Flip provides full laptop features with a hi-def touchscreen and 8 hour battery life for $250.

Authored by Asus, License: Fair Use

Google has begun expanding its offerings into the hardware realm. At http://madeby.google.com Google shows off its Google-branded cell phone, named Pixel – the first Android phone that reviewers claim equals or surpasses the quality of iPhone. Pixel includes Daydream View (a virtual reality headset that works with Pixel), a personal digital assistant for the home named Google Home, Google Wifi, and Chromecast media-streaming devices.

Reading: Linux

Linux

Linux is a free, open-source operating system for PCs, servers, and other types of computers.

Why This Matters

Linux owns a small percentage of the PC operating system market but is mostly popular with technically inclined individuals, with users looking for free and open-source software, and with some corporations. Because it is open-source, Linux can be customized to meet specific needs. Businesses and organizations appreciate this feature. Linux is growing in popularity as a lightweight and inexpensive operating system for mobile computing devices such as laptops, tablets, and smartphones.
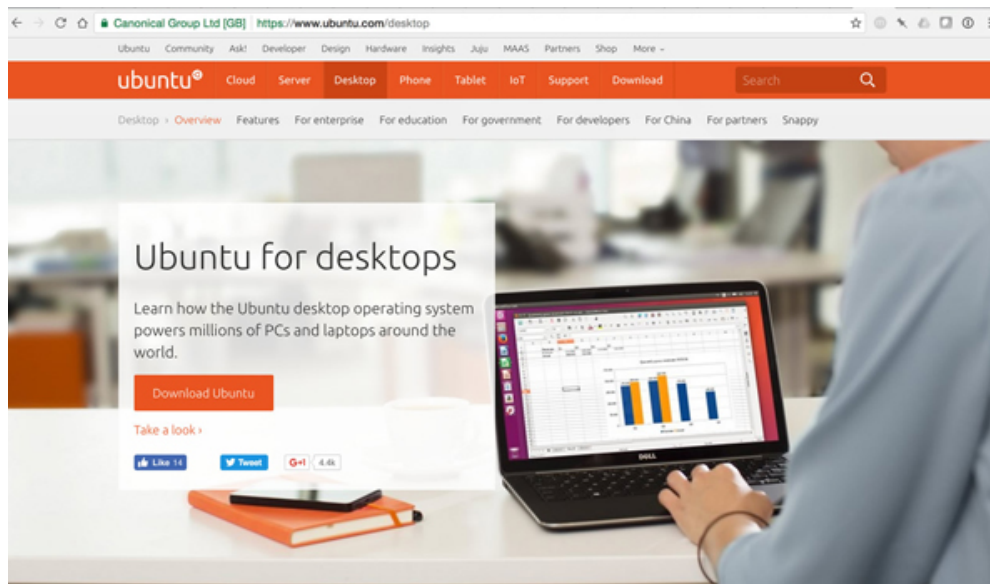
Authored by: Ubuntu Linux, License: Fair Use

Essential Information

Linux was developed by Linus Torvalds in 1991. It was designed to provide a powerful, free, UNIX-like operating system that would run on desktop PCs. As with UNIX, Linux can be used as a command-line operating system or through a graphical user interface such as GNOME. Today, it is used on computers ranging from smartphones to servers. The operating system is available for free to users under a General Public License (GPL) arrangement. Some vendors also offer commercial (not free) versions of Linux that include more features and offer user support.

Many versions, called distributions or distros, of Linux have been designed by the user community. Because Linux is open source, it has many more customized versions than Microsoft Windows or Mac OS. Distributions based on Debian Linux feature free, unencumbered software and have a reputation for being very stable; the popular Ubuntu distro falls under this category. Red Hat Enterprise–based distributions are designed for large corporate systems and servers, with a free community version called Fedora. Slackware-based distributions are highly customizable and are favored by techies.

Specialized distributions are created for specific devices such as smartphones. Ubuntu for phones and tablets has received notoriety recently for providing a free alternative to the big three smartphone platforms: iPhone, Android, and Windows Phone. Ubuntu won the Best in Show award at the 2014 Mobile World Congress, the world's largest mobile technologies convention. Like the latest versions of Windows and macOS, the latest version of Ubuntu is designed to work seamlessly across desktop and mobile devices, utilizing the cloud to share apps, media, and files across devices.

Linux has a big advantage over proprietary operating systems such as Windows and Mac OS X: People can not only get copies of Linux free of charge or at low cost, but they can also develop utilities, applications, and enhancements to the operating system. Besides including all the standard OS functionality, settings, and support, Linux Ubuntu comes loaded with free open-source applications. Ubuntu includes several productivity applications, Internet apps, references apps, graphics and media apps, accessories, and games. The downside of using Linux is that it does not support many of today's popular software titles. Some Linux fans get around this by setting up their PC to dual boot—that is, to have the option of running either Linux or Windows on a single PC.

Reading: Virtual Machine Software

Virtual Machine Software

Virtual machine software, also referred to as **virtualization software**, allows one operating system to run on top of another by creating a virtual machine on which the guest operating system can run.

Why This Matters

Virtual machine (VM) software is useful for users who wish to run more than one operating system on a computer. This includes programmers who need to develop software for multiple platforms. It also includes professionals who wish to access specific software that is only available for a certain OS. Also, home users may enjoy having access to multiple operating systems to support diverse interests and needs.

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Essential Information

There are several virtual machine applications available for PCs and Macs. VirtualBox software from Oracle allows Linux to run in a window on a Windows PC or Mac. It can allow Windows to run on a Mac, and practically any OS to run on any other. Parallels Desktop VM and VMware are other popular virtual machine software packages. Microsoft provides the Hyper-V virtualization client with some Windows 10 editions. Because of the amount of resources required for two operating systems to run simultaneously, VM software is most successful when run on more powerful PCs. Users should also be aware that running multiple OSs on a single computer requires you to purchase multiple OSs and the software that runs on them, and to maintain the OSs and keep them secure. For this reason, running VMs can be costly in terms of expense, time, and effort.

Virtualization is also used on servers to make more efficient use of server resources. Server virtualization allows one physical server to run several individual virtual servers and different server operating systems. Virtual servers have become very popular in data centers as a means of getting more computing out of the hardware, reducing the number of physical servers needed, and supporting green computing by saving energy and helping the environment.

Reading: Server Operating Systems

Server Operating Systems

Server operating systems control large networked systems and servers.

Why This Matters

Server computers operate in a much more complex manner than PCs and require an operating system that can manage multiple processors—sometimes hundreds or even thousands of processors—and many users. Companies that manufacture the systems, such as IBM and Oracle, typically design and provide the operating system with the hardware.

Essential Information

Some operating systems are designed specifically for larger computer systems or computer systems that require a server. Network management functions are an important element, as is the ability to manage multiple processors, complex storage architectures, massive amounts of RAM, and many users. Today's server OSs support the latest trends in technology, including virtual machine functionality and cloud computing. Windows Server, Linux, and Oracle Solaris are examples of server operating systems. Windows Server 16 is the most recent version of Windows Server and contains many of the client features of Windows 10.

Oracle Solaris is the most popular version of the UNIX operating system for industries. The online marketplace eBay uses Solaris servers, software, storage, and services to run its operations. The Idaho National Laboratory uses the Solaris operating system to conduct research in its work to design more efficient and safe nuclear reactors.

Large mainframe server manufacturers typically provide proprietary operating systems with specific hardware, such as z/OS, a 64-bit operating system for IBM's large mainframe servers. IBM says that z/OS can support thousands of workloads concurrently while delivering service levels to meet the most demanding customer requirements. The OS is used by the largest banks, financial organizations, and service organizations.

Reading: Embedded Operating Systems

Embedded Operating Systems

Embedded operating systems, or just **embedded systems**, are hardwired into a computer component, such as ROM or flash memory, to control a special-purpose computer.

Why This Matters

There are several thousand different types of special-purpose computers and computer-driven devices in the world. Computers control medical equipment, cars, elevators, kitchen appliances, media players, televisions, and most of the electronic devices that we interact with on a daily basis. Every computer is controlled by an operating system. While general-purpose computers use operating systems stored on disk, the many special-purpose computers typically employ an embedded operating system, or embedded system (for short).

Essential Information

Embedded systems typically are designed to perform a relatively limited number of tasks. Consider the functions of a dedicated GPS navigation device. Compared to a general-purpose computer, GPS navigation is very limited. Or consider the fuel injection system of a car that regulates the flow of fuel to

the engine. The embedded system that controls it has an even more limited set of instructions than that of the GPS device.

Because embedded systems are developed for specific tasks, they can be optimized more easily, which increases reliability and performance and reduces size and cost. Some embedded systems are classified as real-time operating systems. A real-time operating system (RTOS) is an operating system that has time constraints placed on its functionality: When a button is pushed or a command is delivered, the system must execute the command within a certain amount of time. Consider systems that control an aircraft or the scheduling of online airline ticket sales. In both examples, when a command is given—extend left flap, or reserve seat—the amount of time it takes for that command to be executed is crucial.

Reading: Utility Software

Utility Software

Utility software is any system software besides the OS that assists in maintaining, managing, and protecting computer system resources.

Why This Matters

Utility software helps keep computers running smoothly and safely. With operating systems growing more complex and risks associated with Internet-connected computers increasing, utilities are more important than ever before.

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Essential Information

Utility programs often come installed on computer systems; a number of utility programs can also be purchased. As operating systems have developed, they have incorporated features that were originally found in separate utility programs, such as disk maintenance.

The following are common utilities that protect computer systems and keep them running smoothly:

- Defragmentation and disk utilities: Maintain files on disk and arrange them in a manner that allows for fast access
- Backup utilities: Safeguard files by creating backup copies
- Security software: Search for and remove malware such as viruses and spyware from computers, and guard against attacks
- Windows cleaners: Remove unwanted programs and leftover traces of programs from the system and maintain the Windows Registry for smoother OS operation
- Diagnostic software: Provide a view of system resources in a graphical format to see how the CPU, RAM, and other resources are performing

A number of utilities are designed to assist users in managing and transferring files:

- File management utilities: Provide tools for copying, deleting, renaming, and organizing files
- File compression utilities: Allow files to be bundled together into one compressed file to save storage space and allow for easier transfer
- CD/DVD burners: Copy and store files on CDs and DVDs
- File transfer utilities: Move and share files across computer networks
- Search utilities: Find files on a computer system
- Synchronization software: Synchronize files across multiple computers, such as a desktop, laptop, tablet, and smartphone

Other utilities provide a way to customize your computing environment and make computing resources more convenient to access:

- Desktop enhancements: Provide customization tools for desktops, including icons, shortcuts, color schemes, and other visual elements of the desktop
- Screensavers, skins, themes, and wallpaper: Provide a visual style for the desktop
- Automation software, macros, and shortcut keys: Allow the user to automate frequent commands and command sequences and assign them to a shortcut key or group of keys (i.e., Ctrl+Alt+R)

Reading: Apps – Desktop, Mobile, and Web

Apps – Desktop, Mobile, and Web

Apps, or **application software**, consist of programs written to perform tasks or solve problems for people, groups, and organizations on PCs, mobile devices, and wearables.

Why This Matters

You've learned that there are two general categories of software: system software and application software. In the last section you learned all about system software. Now it's time to turn your attention to apps. While system software is useful to the machines that run them, application software is what makes computers useful to people. Millions of applications have been developed to assist people in all professions and in their personal lives.

Essential Information

If you were to list all of the software that you use, chances are, each app would fall under one of the following categories:

- Productivity and office suites – apps that allow you to be more productive, of which the most common are office suites
- Information – apps that provide you with information
- Communication – apps used to communicate with others
- Creativity – apps that allow you to create things
- Personal Information – apps that help you to organize and manage your life
- Entertainment – apps that entertain
- Professional – apps you use for your job

One of the major benefits of computers is that they can make us more productive. Our ability to manage information, crunch numbers, calculate solutions to problems, and connect with one another has transformed our culture into a super-productive colony of thinkers and doers. From a simple clock app that allows you to set an alarm, to project management apps that track the expenses and resources of massive projects over time, productivity apps have become an important part of our daily lives.

Perhaps the most widely used productivity apps are those included in office suites: word processing, spreadsheet, and presentation apps. These apps are just the tip of the iceberg when it comes to productivity. There are thousands of apps for taking notes, making to-do lists, and recording ideas, and thousands more for making calculations of all kinds: budgets, taxes, payroll, statistics, projections, mortgage calculators, and many more.

The Internet has made an abundance of information available to the world. Apps that assist us in gathering useful information are another form of productivity app. Apps that connect us with others through text, voice, and video communication and allow us to share information also support productivity.

Apps support all types of creativity, including music composition and performance, artistic creation, video editing, and software development. Apps enable communication through text, voice, and video. They also entertain us with music, movies, television programs, games, and books.

Although many of today's applications are designed to be used by a single individual, it is becoming increasingly common to work on electronic documents in groups. Collaborative software is any software that facilitates group collaboration within the software. Google Docs is a good example of collaborative software, as it supports multiple users editing a common document from different locations over the web. Microsoft Office has adopted similar online collaborative features in Office Online.

Many types of application software are provided through a web interface. Web technologies provide developers with the tools to create powerful applications that run in a web browser without the need for any installation on the local computer. Web apps are a popular form of cloud computing since they run on web servers, and they typically also store user data on web servers so that it can easily be shared with collaborators and others.

As computing has gone mobile, people are using mobile apps as much as, if not more than, they use desktop apps. In fact, many apps are available across all computing platforms so that users can work anywhere, anytime, on any device.

Many of the apps used by businesses are custom apps designed to provide some unique function valued to the business. Businesses today invest heavily in apps in order to gain a competitive advantage over their competition.
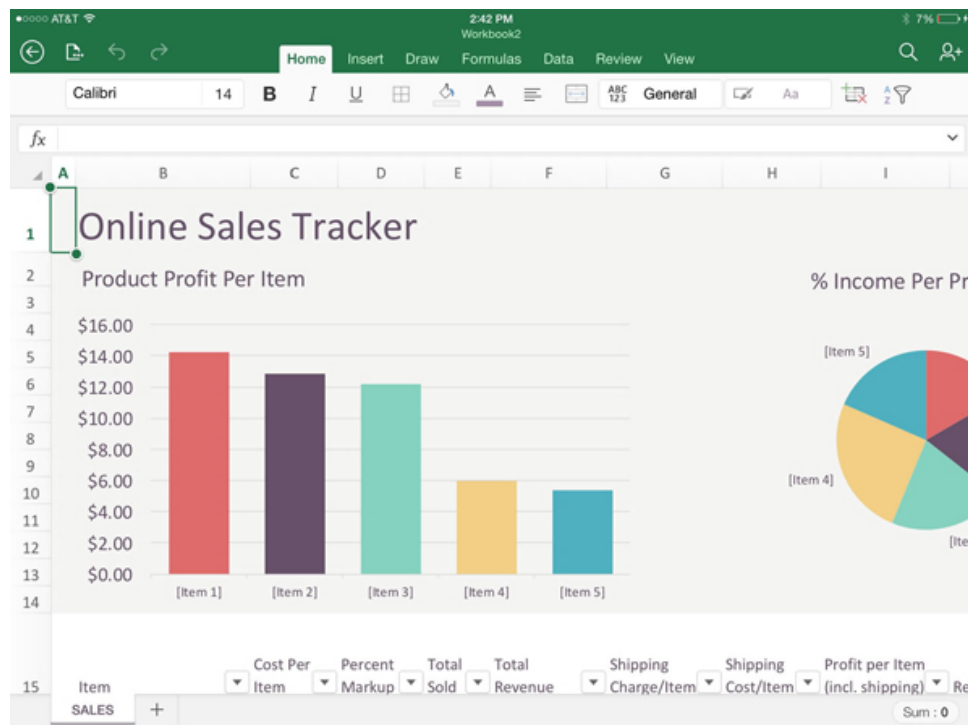
Reading: Office Suites

Office Suites

Office suites are software collections that include a word processor, a spreadsheet app, presentation software, and sometime database and other useful software.

Why This Matters

Office suites are the most common type of software used at work, school, and home. These apps have many common uses: recording ideas (word processing), making calculations (spreadsheet) and creating graphic depictions (presentation). These apps provide many useful functions for many different situations.

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Essential Information

A software suite is a collection of applications sold together as a package. Office suites typically include word processors, spreadsheets, and presentation software, and they sometimes include database-management systems, personal information managers, and other applications. Office suites aren't just useful at work; they also assist individuals in managing home life, school work, and other activities.

Microsoft Office is by far the most popular software suite. Microsoft Office is available for Windows and Mac platforms and includes Word, Excel, PowerPoint, Access, and other tools depending on the version. Office is also available online and as mobile apps for iOS and Android devices.

Other office suites include Google Docs (Docs, Sheets, and Slides) and Apple iWork (Pages, Numbers, and Keynote). Office suites are an important part of technology ecosystems from Microsoft, Apple, and Google. Apache OpenOffice, a free open-source productivity suite, is compatible with Microsoft Office and available for Microsoft Windows, Solaris, Linux, and Mac OS. Zoho Office Suite is a free web-

based suite of applications, including Writer, Sheet, Show, Wiki, Notebook, Projects, CRM, Creator, Planner, and Chat.

Google Docs was one of the first office suites in the cloud, and now Microsoft Office and Apple iWork have cloud-based versions of their software. Mobile versions of office suites have also become very popular for staying productive while on the go. Generally speaking, cloud-based and mobile apps are less powerful with fewer features than installed apps. But, combined with cloud drives, these apps are ideal for mobile access and collaborating with others on documents and projects.

Office 365 is the latest version of Microsoft Office that is sold as a monthly subscription. For $8.25 per month, a user gets:

- The latest version of Word, Excel, PowerPoint, Outlook, Publisher, and OneNote for use on up to 5 PCs or Macs per user
- Office Online Web Apps: Word, Excel, PowerPoint and OneNote
- Office mobile apps on up to 5 tablets and 5 phones
- One TB of storage in the cloud
- Outlook Email, Calendar and Contacts

The subscription model for Microsoft Office means never having to make major software upgrades. Office apps are updated and improved incrementally as needed.
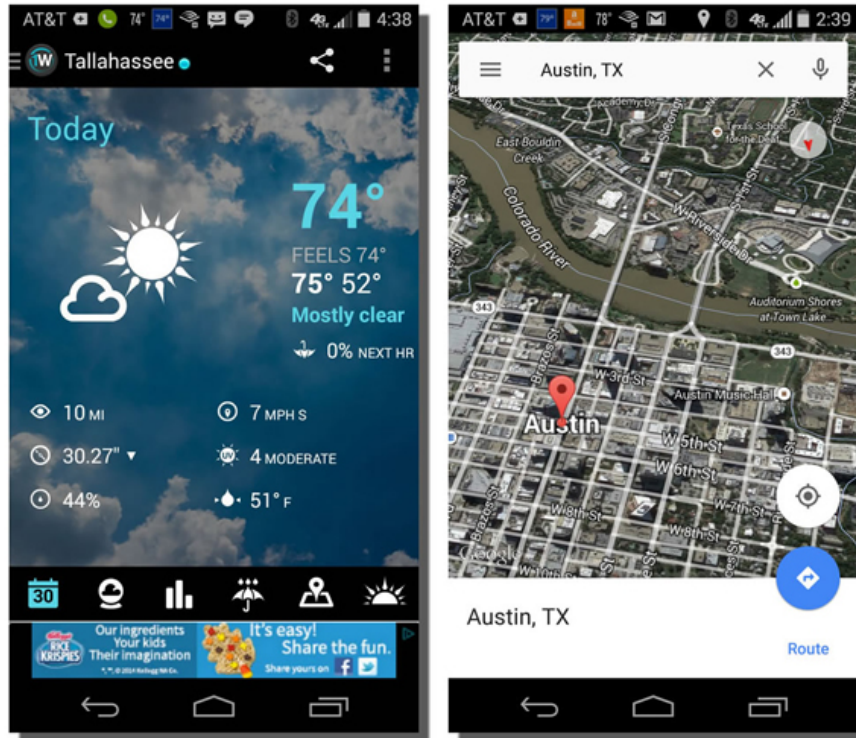
Reading: Information Apps

Information Apps

Information apps provide useful information on a variety of topics.

Why This Matters

The Internet provides seemingly limitless amounts of information on every topic. Some information is more useful than others. For this purpose, apps have been developed to deliver valued information on demand. Information apps are available for access to public and private information.

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Essential Information

A popular app on many smartphones is the weather app. People are always interested in the constantly changing weather. Weather apps from weather.com and others are one example of information apps. Another popular category of information app is maps and navigation. Map applications from Microsoft, Google, Apple, and others not only allow you to explore the landscape and find your way across new territories, but may also provide turn-by-turn navigation.

Personal assistant apps like Siri, Google Now, Google Assistant, and Microsoft Cortana provide answers to questions that are posed by sifting and sorting through online information sources. There are health apps that provide caloric information for all known food products, medical apps that inform on every illness and injury, news apps, sports apps, and all kinds of reference apps.

Reading: Communication Apps

Communication Apps

Communication apps support communication between people and groups through text, voice, and video.

Why This Matters

The Internet supports all kinds of communications between people. There have been many apps developed to support forms of communication. Learning about the communication apps available provides many options for staying close and connected to others.

Authored by: Courtesy of Softpedia, License: Fair Use

Essential Information

Cellular carriers provide voice and text communication over the cellular network. With the birth of Voice over Internet Protocol (VoIP), telephone style voice communication moved to the Internet. Now there are many apps available to support all kinds of communication over the Internet, accessed on computers of all types as well as mobile devices.

WhatsApp is a good example of an app that saves cellular users money by utilizing an Internet connection rather than a cellular plan to send and receive text messages. Facebook understands the value of online communication and bought WhatsApp in 2014 for $22 billion.

It's a similar story for Skype. Skype is an app that takes online communications a step further than WhatsApp by providing free video, voice, or text chat over the Internet between computers, tablets, or mobile phones. Microsoft bought Skype for $8.5 billion in 2011.

Naturally, wherever Microsoft is investing, so are Google and Apple, and vice versa. Google provides its Google+ members with Hangouts, and Apple has Facetime; both apps are similar to Skype. Communication apps sometimes include the ability to video chat with a group of people as well as the ability to share your computer desktop with others, which is useful in teaching computing skills or getting tech support.

There are hundreds of communication applications available for all platforms for computers and mobile devices. The one drawback to adopting a communication app is that the people you communicate with must use the same app. Because of that, companies that already have huge user bases, such as Facebook, Twitter, Google, Apple, and Microsoft, have a huge advantage in the market. View the Internet Communications page for more details on the topic.

Reading: Creativity Apps

Creativity Apps

Creativity apps include any software that assists people in creating items of value like art, music, video, and even software used to create software.

Why This Matters

Some fear that computers are depriving us of our humanity, while others use computers to enhance and express their humanity. Apps that assist people in creating objects of beauty, whether they be songs, artwork, movies, or software algorithms, are perhaps the most rewarding of all.

Apple's GarageBand app includes guitar lessons that allow you to play along; it even corrects your mistakes.

Authored by: Courtesy of Apple Inc., License: Fair Use

Essential Information

Categories of creative apps include music and audio recording, graphics editing, video editing, photo editing, and software development. These topics are covered in various units throughout Emerge. Here, we look at popular apps in these categories.

Apple's GarageBand (for Mac and Windows) is popular software that amateurs and professionals use to record music and audio. The software is designed to make it easy to lay down tracks and loops in all kinds of music styles. It also has lessons to teach users how to play instruments. More advanced recording software like Logic Pro provides professional-grade recording studio features. Audacity, an alternative to GarageBand, is a free open-source audio editor and recorder.

There are many fun music apps for mobile devices. For example, NodeBeat lets anyone create music by adjusting settings and moving various musical elements around visually in the mix. WavePad is an app that allows you to record voice or music, edit the recording and add sound effects, and clean up background noise to create high quality audio recordings. The Caustic app turns a mobile device into a rack of synthesizers and sampling rigs. Use the DJStudio app to mix the music for your next party.

Software from Adobe has dominated graphics editing, photo editing, and video editing for the past decade. Now, similar software is provided on mobile devices as standard equipment. Apple's iOS advertises that you can make every photo look even better immediately after you've taken it with powerful new editing tools, no matter your skill level. SketchBook Express from Autodesk allows users to create magnificent works of art on their mobile devices. Adobe offers a suite of 13 mobile apps for creating and editing graphics, photos, and videos.

The process of creating apps and software can be as expressive as creating artwork. Apps like Udacity Learn to Code teach you how to code. Once you've learned coding, apps like Codeanywhere allow you to code all the time!

There are many creative activities that people participate in, and there are apps to support nearly every one of them. Be sure to read the Digital Media unit for more in-depth coverage of creativity apps.
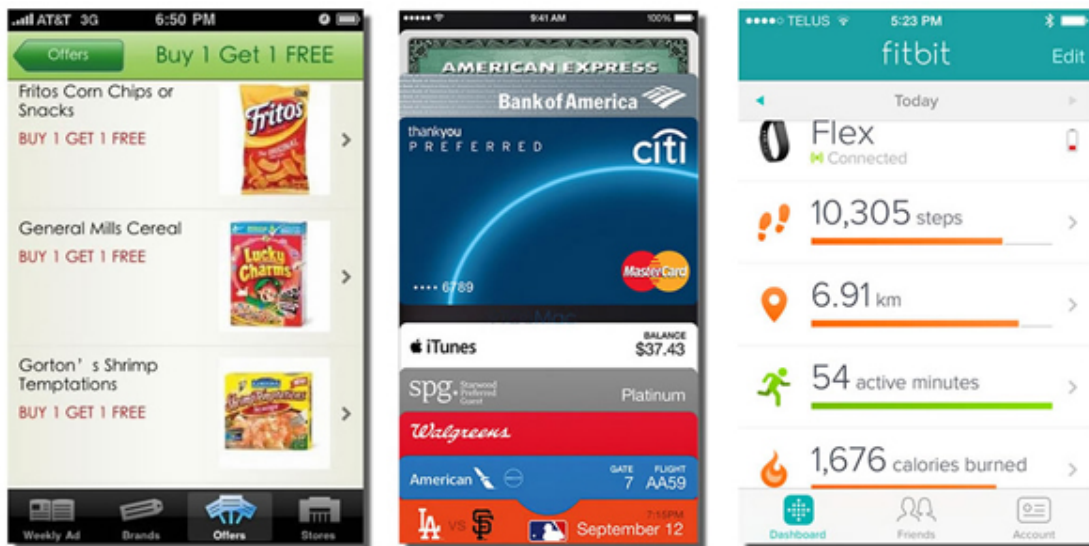
Reading: Personal Information Apps

Personal Information Apps

Personal information apps assist people in managing their personal lives, including their contacts, calendar, to-do list, health, and money.

Why This Matters

Computers and software were originally designed to support business needs. Today, computers and software are assisting people with every aspect of their personal lives as well. Contacts, calendar, and to-do list apps have been around for a while. Now, health apps and money apps are becoming popular. Stores like Publix provide apps to organize your shopping. People who use personal information apps are able to free up more time for fun while leading a better managed and healthier lifestyle.

Personal info apps like Publix, Apple Pay, and Fitbit help us organize our lives and stay healthy.

Authored by: Courtesy of Publix Markets, Apple Inc., and Fitbit, License: Fair Use

Essential Information

Microsoft Outlook is the most popular traditional personal information management (PIM) software, included in the Microsoft Office suite. Google and Apple provide PIM software as well. PIM typically includes calendaring applications to keep track of appointments, contact lists to keep track of the contact information of those you deal with, to-do lists, and email. PIM software needs to be accessible from both PCs and mobile devices so that it can be accessed anywhere, anytime. PIM data is often shared among colleagues to allow the easy scheduling of meetings and to provide support for collaborative work.

New software has emerged to assist people with all aspects of their personal, at-home lives. Two growth areas in personal information management software are financial software and health software. These have arisen in parallel with new hardware technologies.

Apple and Android phones that incorporate NFC (near field communication) technology have the potential to replace old-fashioned wallets. By swiping a smartphone across a pad, bank accounts or credit cards can be automatically charged for the purchase. The ability for Google, Apple, Samsung, or other companies to collect all financial records for an individual provides opportunities for financial management. For example, Apple Pay can assist a consumer in viewing all purchases for the past year and deciding where to cut back in order to meet financial goals. A task that used to require a person to collect information from numerous sources could be handled automatically by financial software. Google Wallet, Apple Pay, Microsoft Wallet, or Samsung Pay would be happy to manage this for you.

Wearable technologies make it possible to collect information about a user's physical activities—steps taken, heart rate, location, sleep, and speed. Having access to this information, along with information on food consumed, allows the software to guide a user in how much additional activity or what dietary changes are required for a healthy lifestyle. Apps available for this purpose includes Fitbit, Android Wear, Apple Health, and Microsoft HealthVault.

With smart home technologies and smart car technologies beginning to take off, software will soon be able to learn more about people's activities and provide more suggestions for improving life. As you might guess, many people have privacy concerns about these technologies.

Reading: Entertainment Apps

Entertainment Apps

Entertainment apps are any apps that are used for enjoyable leisure time activities, including listening to music; watching TV, videos, and movies; reading books and magazines; and playing games.

Why This Matters

The entertainment industry is one of the biggest in the country because after working hard, we all value our leisure time and like to have fun. Entertainment apps play an important role in leisure-time activities. We engage with computer games, sometimes for hours at a time, on game consoles at home, or for short breaks on our phones or tablets throughout the day. Some of us listen to music on our phones for a majority of our waking hours. We enjoy videos on YouTube and Netflix and read or listen to ebooks as we exercise and fade off to sleep at night. When you think about it, some of our greatest enjoyments of life occur thanks to entertainment apps.

Essential Information

Computer games have been around nearly as long as computers. Today, game consoles are standard equipment in most households. We enjoy games in many categories, including sports, racing, adventure, arcade, role playing, and board games, at home on consoles and computers and out and about on tablets and smartphones.

Increasingly, Internet-connected devices are complementing, if not replacing, televisions. Microsoft, Google, Apple, and Amazon all have devices that transform TVs into Internet entertainment centers. Microsoft's Xbox connects to your TV to provide access to games, television, online videos and movies, music, photos, and your online community of friends, and is controlled through game controllers, Kinect, or your mobile device. Google has Google TV and Chromecast that connect to your TV to provide apps for finding cable TV content and over 100,000 movies and TV episodes from on-demand Internet sources like Netflix and YouTube as well as games, web browsing, and other entertainment apps. Apple offers Apple TV that connects to your TV to provide similar services controlled with an iPhone or iPad.

Music apps, including iTunes, Google Play Music, Xbox Groove, Amazon Music, Spotify, Pandora, and others have become the source for most music listening enjoyment. You can store your entire music

collection in the cloud using music apps or let the apps discover new music based on your musical tastes. One should consider which technology ecosystem offers the best options for music and movie access since it is cumbersome to move purchased music and movies from one ecosystem to another.

Ebooks and emagazines are yet another form of entertainment delivered through apps like Amazon Kindle, Apple Bookshelf, Google Play, and many others. Amazon's Audible is an app that provides books read aloud so that you can "read" any time, even when you are driving or running.

Be sure to read the Digital Media unit for more in depth coverage of entertainment apps.

Reading: Professional Apps

Professional Apps

Professional apps are general-purpose, custom apps required for use at work.

Why This Matters

The specialized skills required in many professions require the use of professional apps. Software suites that include word processing, spreadsheet, and presentation apps are standard equipment for professionals. Software designed for more specific activities, such as project management, graphics design, and customer management are used depending on the professional's responsibilities. Employees of large corporations often use custom-designed software on their computers and mobile devices to access and manipulate corporate data.

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Essential Information

There are many business applications that are critical to professionals in specific industries and professions. Computer aided drawing (CAD) software is essential to many engineers and product designers. Desktop publishing software is used by publishers. Statistical software and math software like MATLAB are useful to scientists and engineers. Financial management software packages and tax preparation software are critical to accountants.

Project management software helps project leaders organize complex projects that involve many resources and coordinated activities. It is used to plan, schedule, allocate, and manage people and resources (money, time, and technology) to complete a project according to a schedule. Microsoft Project is the most popular project management software. There are several alternatives, including OpenProj, which you can download and use for free, and SeeNowDo, which is a free lightweight app for managing tasks.

Enterprise systems provide software for manipulating enterprise data including transactions, payroll, customer, and financial data. Recently, enterprise data and software has been migrating to the cloud. Knowledge management software, Customer Relationship Management (CRM), Enterprise Resource Management, Business Intelligence, and other key systems are utilizing cloud services from PeopleSoft, SAS, Oracle, Microsoft, and others and accessing the valuable information from these systems using desktop and mobile apps. See the Business Systems unit for more detailed information about business apps.

There are more professional apps than there are professions. In most instances, the app that is used and the skill level of the user provide advantages to the user over others in the profession. Many professionals no longer work just 9 to 5 Monday through Friday, but integrate work with their life whenever and wherever necessary. Because of this, professionals need to make sure that the technology infrastructure that they choose for their personal life integrates with the requirements of the professional life. For example, a Mac user may find it difficult to carry out professional obligations in a company that demands Windows PCs.

Lesson 4.3: The Life Cycle of Software

Lesson 4.3 Introduction

Managing software refers to activities required to acquire, install, maintain, and remove software and apps from computers and mobile devices.

Computers and mobile devices are only as useful as the software that runs on them. In order to maximize the benefits of owning a mobile phone, tablet, or PC, users should research software that will be most useful to their lifestyle, interests, and activities. Selecting and managing software is one of the most important responsibilities of a computer user.

Although computers and mobile devices typically come with many software applications (or apps) preinstalled, most users find it beneficial to add software selected to meet their individual needs. Smart users spend considerable time and effort seeking out new and useful software for use on both computers and mobile devices. The process typically entails reading reviews, consulting with friends, finding the source where software is available, downloading the software, and installing it. Once installed, the software must be maintained and eventually uninstalled when it is no longer useful. This section discusses all of these software management activities.

Reading: Acquiring Software

Acquiring Software

Acquiring software refers to the several methods by which software can be purchased or accessed, including packaged software, downloaded software, cloud apps, and custom designed software.

Why This Matters

The manner in which software is acquired has changed over the years. At one time, it was delivered on floppy disks; then, as software required more storage space, it was made available on CDs and DVDs.

Today, new software is often downloaded from an online app store or market. Increasingly, software is run on web servers and accessed through a web browser. It is useful to consider the many ways in which software is made available for business and personal use. Microsoft Office 365 and many other software packages are moving to a subscription purchase model.
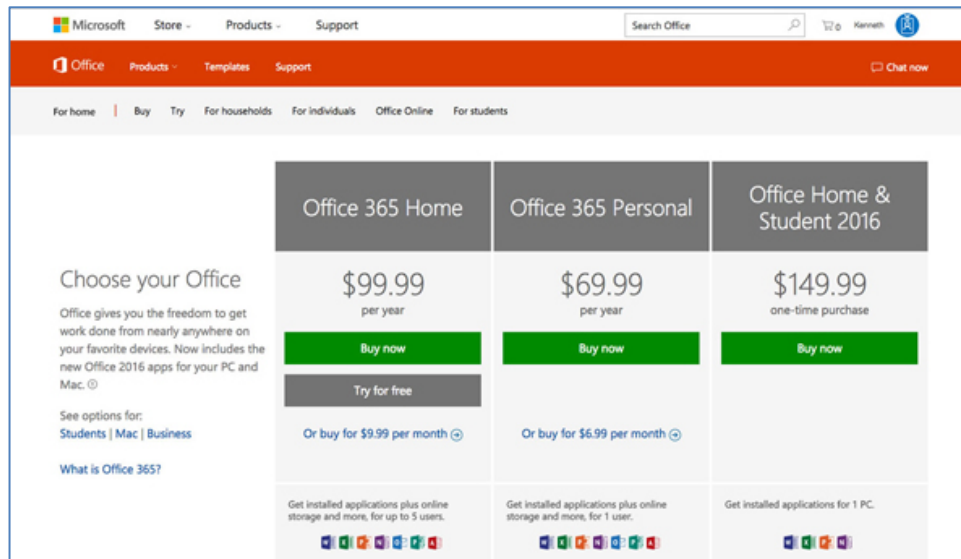
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Essential Information

Today's PC users typically use both installed software and apps accessed on the web. They might use Microsoft Office applications installed on their computers as well as Gmail, Facebook, Google Docs, and YouTube on the web. Apps accessed on the web are called cloud apps because they run on web servers that exist on the Internet or in the cloud. The data files created in cloud apps are typically stored in the cloud as well. Businesses are increasingly turning to cloud apps for enterprise applications like Customer Relationship Management and Supply Chain Management. Cloud apps are convenient because they require no installation or maintenance, they are accessible from any Internet-connected device, and data is easily shared among users. Even Microsoft Office has transitioned to the cloud, with Office 365. Office 365 charges users a yearly subscription fee and automatically updates Office on the user's PC while storing data files in the cloud and providing access to web versions of Office apps. The downside of cloud apps is that you may need to be connected to the Internet to use them, although Google, and Microsoft both have options to edit documents stored in the cloud even when offline. Some people are concerned about the privacy and security of data when stored in the cloud. Can the company providing the service view the data? Who accepts responsibility if hackers access the data or if the data is lost due to equipment malfunction?

While most apps may soon become cloud apps, many of today's most popular and powerful apps require installation on your computer or mobile device. Installing software on computers allows the software to take advantage of specific hardware features. For example, software installed on mobile devices can take advantage of hardware features such as GPS and accelerometers. Locally installed apps are also able to respond and load files more quickly and are able to include more functionality because they are not limited by web browser functionality.

Apple was the first to offer an app store dedicated to distributing apps for a specific platform. At first it was for the iPhone, and then it extended to the iPad. Finally, Apple created an app store for its Mac software. Google followed Apple's example with its Android Market, which later became Google Play. Microsoft joined in with the Windows Phone Marketplace and later with the Microsoft Store. Since Google Android is an open platform, Amazon was able to set up its own Appstore for Android. App

stores and marketplaces are convenient for users. They also provide control of app availability to the manufacturer who typically takes a percentage of each sale and controls which apps are available.

Increasingly, apps that are purchased can be shared across one user's devices. So, for example, if you download a game for your iPhone, you may also find it available to download to your iPad. Apple has also implemented a family share program that allows apps to be shared between family members.

Sometimes, a business has unique needs that can't be addressed by cloud apps, packaged software, or downloaded software. In such cases, a business might create its own custom-designed software by hiring programmers or outsourcing the work to a software development company. Software has become central to business effectiveness and often gives a company a competitive advantage. Because of this, businesses invest heavily in software development and information management systems and guard such systems as trade secrets.

Reading: Software Licensing

Software Licensing

Software licensing defines the permissions, rights, and restrictions assigned to the person who purchases a copy of software.

Why This Matters

A license is the primary tool used to protect intellectual property. Individuals and companies that create software can support themselves as businesses by setting a price for the use of their software by individuals and groups. A software license allows the owners of the software (their intellectual property) to define legal use of the software and exercise legal authority over its distribution and use. Software may be protected by a traditional license, may incorporate a more liberal license policy like Creative Commons or the General Public License (GPL), or may be freeware.

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Essential Information

A copyright defines exclusive rights legally granted to the owner. A software license defines the permissions, rights, and restrictions provided to the person who purchases a copy of the software. The

two are legally tied together in that the copyright certifies certain rights to the owner and the license informs the buyer of what he or she can legally do with the software according to the copyright.

A software license typically addresses questions such as how many users can access the software and how many computers the software can be installed on. Software licenses are typically written to protect and favor the software company. Penalties and fines for violating the terms of a software license can be severe. U.S. copyright law allows for penalties of up to $150,000 per infringed software title.

Software Licenses

License	Description
Single-user license	Permits the user to install the software on one or, sometimes, two computers used by one person—typical for software on PCs
Multiuser license	Specifies the number of users allowed to install the software on their computers
Concurrent user license	Designed for network-distributed software; specifies the number of users that can use it concurrently (at the same time)
Site license	Permits the software to be used anywhere and by everyone on a particular site, such as a college campus

The Creative Commons license is designed to grant certain freedoms to users while providing the creators of intellectual property with some control and the ability to profit from distribution of the work. There are four license conditions available in Creative Commons licenses, which can be combined to form a very specific license:

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- Share Alike: You allow others to distribute derivative works only under a license identical to the license that governs your work.
- No Derivative Works: You let others copy, distribute, display, and perform only verbatim copies of your work, not derivative works based upon it.
- Non-Commercial: You let others copy, distribute, display, and perform your work—and derivative works based upon it—but for non-commercial purposes only.

Freeware is software that is made available to the public for free. Some examples of freeware include the Thunderbird email client, Pidgin instant messaging software, Adobe Reader, AVG antivirus software, all web browser software, and OpenOffice productivity software. Also, many popular web applications are provided free of charge, like Facebook, Picasa, and Google Docs. There are several reasons software developers might give away their product. Some wish to build customer interest and name recognition, and some make money from sponsors that advertise within the software. Freeware may use a software license to impose some restrictions on the use of the software.

Freeware differs slightly from a classification of software known as free software. Freeware simply implies that the software is distributed for free. Freeware typically is proprietary software that cannot be altered. The term free software was coined by Richard Stallman and the Free Software Foundation, and implies that the software is not only freeware, but it is also open source.

Open-source software is distributed, typically for free and with the source code so that it can be studied, changed, and improved by its users. Open-source software evolves from the combined contributions of its users. Linux, the most well-known open-source software, is an operating system based on the original GNU operating system. Businesses and governments have been attracted to open-source

software because it gives them more control over the software. Open-source software can be altered to meet a business's particular needs.

Open-source software is not completely devoid of restrictions. Much of the popular open-source software in use today is protected by the GNU General Public License (GPL). The GPL grants users the right to run the program for any purpose, study how the program works and adapt it to their needs, redistribute copies, improve the program, and release improvements to the public.

Reading: Installing Software

Installing Software

Installing software is the process by which software is added to a computer so that it is available for use.

Why This Matters

Installing software on PCs, tablets, and smartphones is a common activity for computer users. Installing software allows computers to be customized to meet the user's needs. All computer users should be familiar with the process.
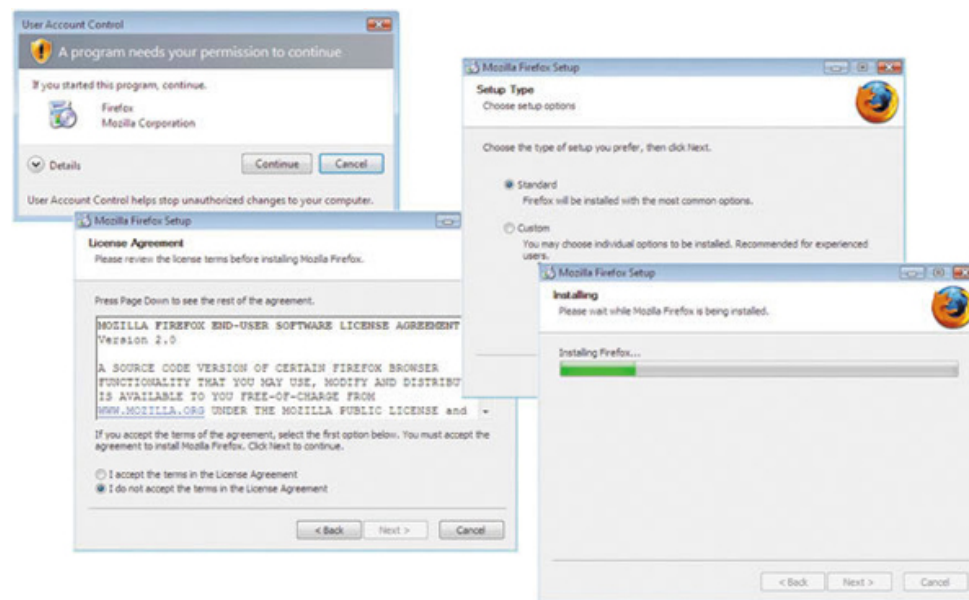
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Essential Information

Much of today's software is able to run in a web browser. This includes software like Facebook, Gmail, Google Calendar, and YouTube. However, the majority of the most useful apps are installed on PCs, Macs, and mobile devices in order to take advantage of the hardware for the best performance.

Software for tablets and smartphones is typically installed from an online app store, which automates the installation process to a greater degree. To install new software on a mobile device, you often just agree to the conditions of the license and click an Install button. The app store approach so popular with mobile devices is being adopted for PCs as well. The most recent versions of Mac OS and iOS allow software to be installed once across all Apple devices owned by the same user. So, if you install the latest version of Angry Birds on your iPhone, it will automatically be available on your iPad and Mac. Google and Microsoft plan to offer similar options.

Installing large applications on a PC can be a little more complicated. PC software is typically downloaded as a compressed file from the web. The table below shows the steps of a typical PC installation process. Once the software is installed, you will find a launch icon on your desktop, the Start menu, or wherever your particular operating system stores its applications.

Typical PC Software Installation Steps

| Installation Step	Description
1. Run the installation file	Download the installation file, or access it on disk. Installation software will often include instructions for installation at the website or in an associated README text file.
2. Interact with the installation wizard	Once the installation process has begun, follow the instructions as they appear on the screen. You likely will be given choices during the installation. Most software products have recommended default installation settings. Default settings are those chosen in advance for you as typical settings.
3. Agree to the license terms	You will probably be asked to agree to the terms of the software license. You have no choice if you wish to install the software; you cannot progress without agreeing.
4. Select the install location	You may be asked where on your hard drive you wish to install the software. Unless you have an unusual system, the default choice is best.
5. Choose standard or custom	You may be asked to choose standard installation or custom installation. Standard installation installs the most commonly used components of the software, or perhaps all of it. Custom installation allows you to select which components of the software you wish to install.
6. Register and/or activate the software	Once the software is installed, you might have to register or activate the software before it can be used. This is usually done over the Internet.

Reading: Maintaining Software

Maintaining Software

Maintaining software involves applying software updates to correct software bugs, improve the software, or add new features.

Why This Matters

To get the most out of your software investment, and to keep your computer safe and secure, it is wise to update both system software and application software as soon as updates are made available. Updates are provided by software companies in order to fix bugs, patch security holes, improve functionality, and add features. Updates to apps on tablets and smartphones are important as well.
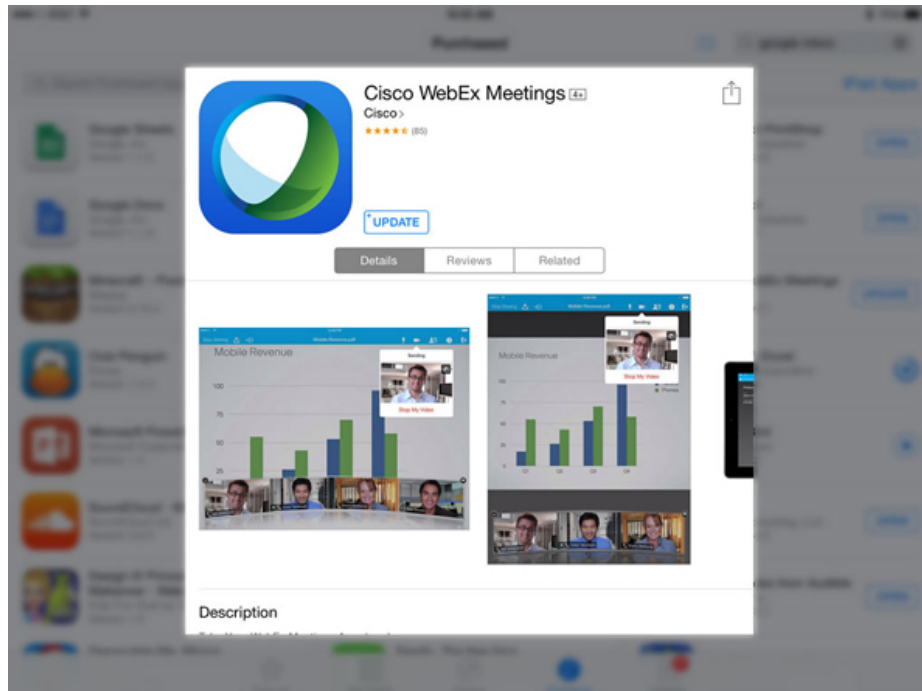
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Essential Information

There are a number of reasons why software is updated throughout its lifetime. Software is often complex, involving tens of thousands of lines of code. Developers often discover improvements that can be made after the software is released. Most updates are intended to make software run more effectively or to add new features. Most operating systems, including mobile operating systems like iOS and Android, have built-in notifications for software updates. It's not unusual for smartphone users to approve updates for a few apps each week.

Software patches are intended to secure holes caused by software bugs. Software bugs consist of one or more defects that prevent the software from working as intended or working at all. Software bugs are classified as "critical" when they allow hackers to take control of a system. Microsoft issues software patches for Windows on the second Tuesday of each month. Newer Windows subscriptions apply patches as soon as they are released. Apple releases patches as needed.

Here are some things you can do to overcome pesky software bugs:

Be careful when buying or acquiring the latest software. Some people prefer to get software that is a year old or older to make sure that most errors have been found and fixed.

Read the documentation that accompanies the software to discover any known issues and special instructions.

Register the software with the software company. Software companies will often alert you if there is a problem or bug and give you steps to follow to eliminate it.

Respond to update requests quickly. Updates eliminate known bugs and patch security holes.

If software is malfunctioning, try running the setup program again. Sometimes it contains a utility to fix software problems. If it doesn't have such an option, you can try uninstalling and reinstalling the software.

Use search engines to find information on specific software bugs and possible solutions.

If all else fails, carefully document exactly what happened when you found the bug and then contact the software vendor for a solution.

Reading: Uninstalling Software

Uninstalling Software

Uninstalling software refers to the process of completely removing software from a computer.

Why This Matters

Users should uninstall software that they no longer use in order to free up disk space and streamline their system. Because installed software maintains a presence in many areas of an operating system, it is important to use proper procedures to remove all of it. Removing software requires a special process that deletes all files and references related to the software. The process varies slightly between computing platforms and mobile platforms.

Operating systems provide a method to safely and completely remove software from the system.
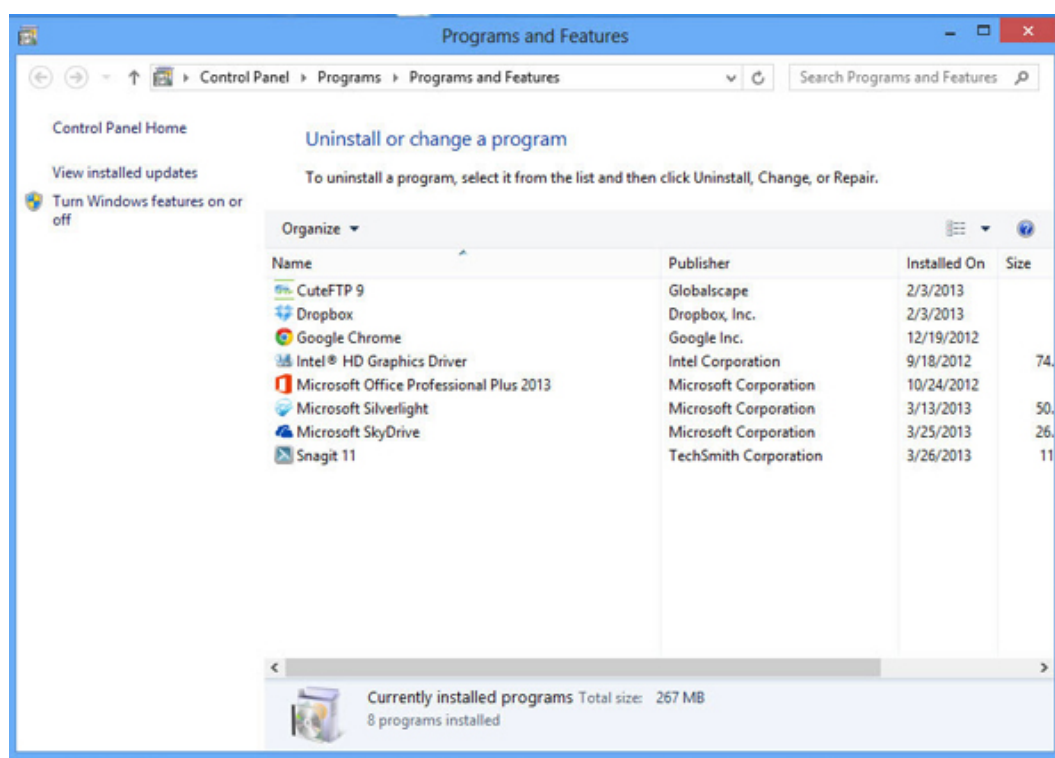
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Essential Information

Operating systems provide a method for safely and completely removing software from the system. In Microsoft Windows, you use the "Uninstall a program" feature in the Control Panel. In Mac OS, you simply drag the program icon from the Applications window to the Trash. On iPhones and iPads, you press and hold the program icon, and then click the X. On Android devices, you go to the Application Manager, tap the app icon, and tap Uninstall.

On desktop and laptop PCs, even the proper procedure sometimes does not uninstall the software correctly, which creates system problems. This is especially a problem for Windows users and is addressed by a number of system utilities. For example, Norton Utilities and McAfee Registry Power Cleaner help eliminate unwanted elements of software you have removed to help your system run smoothly.

Mac users should regularly use the Disk Utility app found in the Utilities folder, to verify and repair the Disk and Disk permissions. This process cleans up files left behind by old apps and arranges files on the disk for smoother and faster loading.