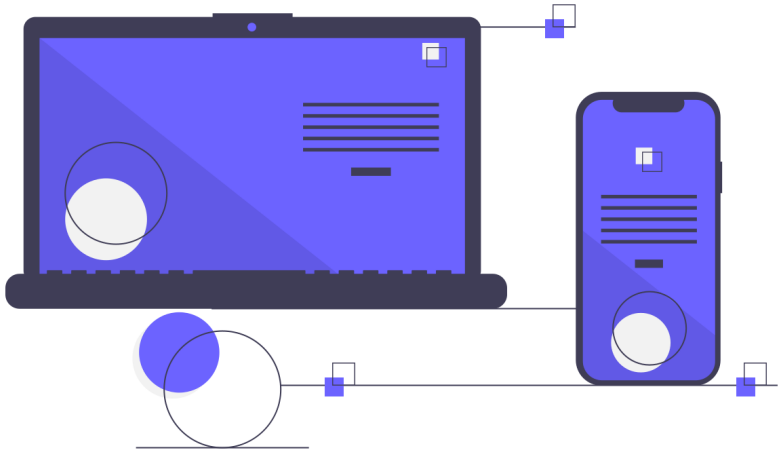
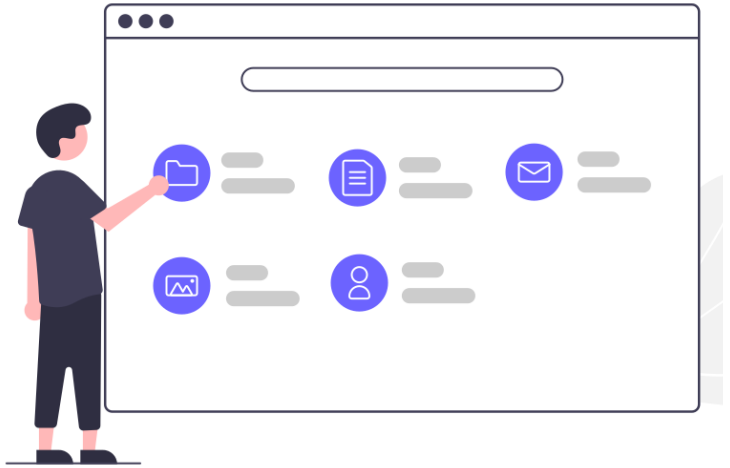
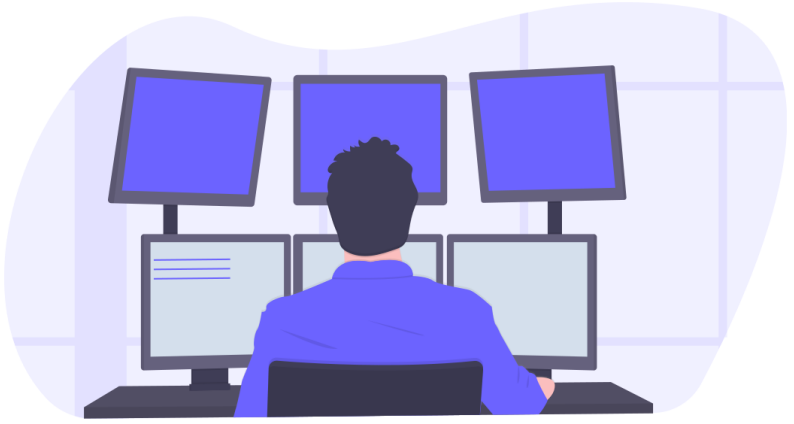
Software







IE 5521 Electronic Data Processing Systems

An Overview of Software

- Software
  - Consists of computer programs that **control the workings of computer hardware**
- Software can be divided into two types:
  - **System software** – includes operating system (OS), utilities, and middleware that coordinate the activities and functions of the hardware and other programs
  - **Application software** – programs that help users solve particular computing problems

Software Sphere of Influence

TABLE 4.1 Software supporting individuals, workgroups, and enterprises

Software Type	Personal	Workgroup	Enterprise
Systems software	Smartphone, tablet, personal computer, and workstation operating systems	Network operating systems	Server and mainframe operating systems
Application software	Word-processing, spreadsheet, database, and graphics programs	Email, group-scheduling, shared-work, and collaboration applications	General-ledger, order-entry, payroll, and human-resources applications

Systems Software

- Controls the operations of computer hardware
- Supports the application programs' problem-solving capabilities
- Types of systems software
  - Operating systems
  - Utility programs
  - Middleware

Operating Systems

- A set of programs that controls computer hardware and acts as an interface with application programs
- Combinations of OSs, computers, and users:
  - Single computer with a single user
  - Single computer with multiple simultaneous users
  - Multiple computers with multiple users
  - Special-purpose computers

Operating Systems

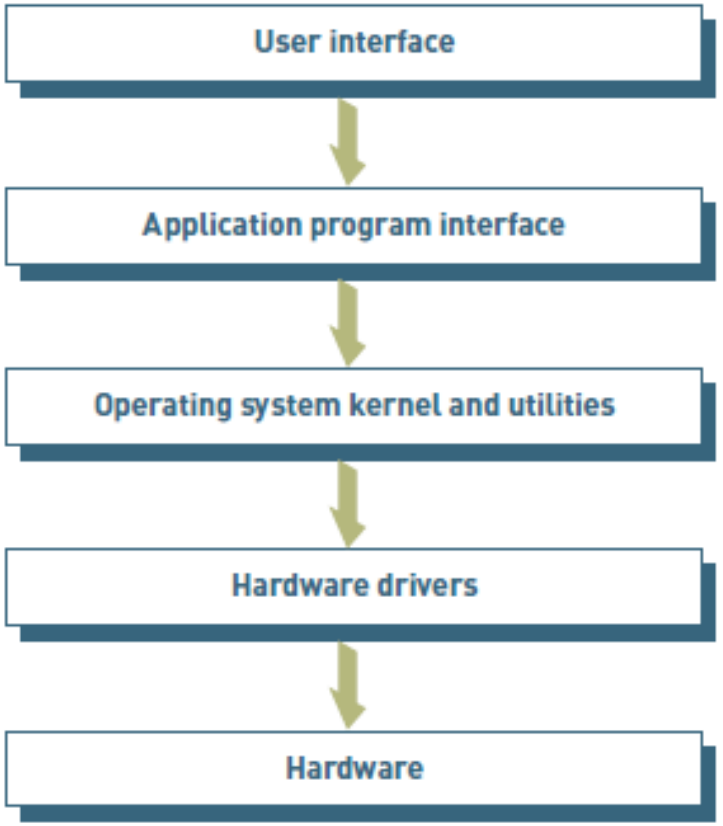


FIGURE 4.3
Role of operating systems
The role of the operating system is to act as an interface between application software and hardware.

Operating Systems

- Kernel
  - The heart of the operating system
  - Controls the most critical processes of the OS
  - Ties all of the OS components together and regulates other programs
- Rescue disk
  - A storage device that contains some or all of the OS and can be used to start the computer if having trouble with the primary hard disk

Operating Systems

- Functions performed by the OS
  - Control common computer hardware functions
  - Provide a user interface and input/output management
  - Provide a degree of hardware independence
  - Manage system memory
  - Manage processing tasks
  - Provide networking capability
  - Control access to system resources
  - Manage files

Operating Systems

- Common Hardware Functions
  - Get input from keyboard or another input device
  - Retrieve data from disks
  - Store data on disks
  - Display information on a monitor or printer
- User Interface and Input/Output Management
  - A user interface allows individuals to access and interact with the computer system
  - A command-based user interface requires text commands
  - A graphical user interface (GUI)
    - The user interacts with icons and menus to send commands to the computer system

Operating Systems

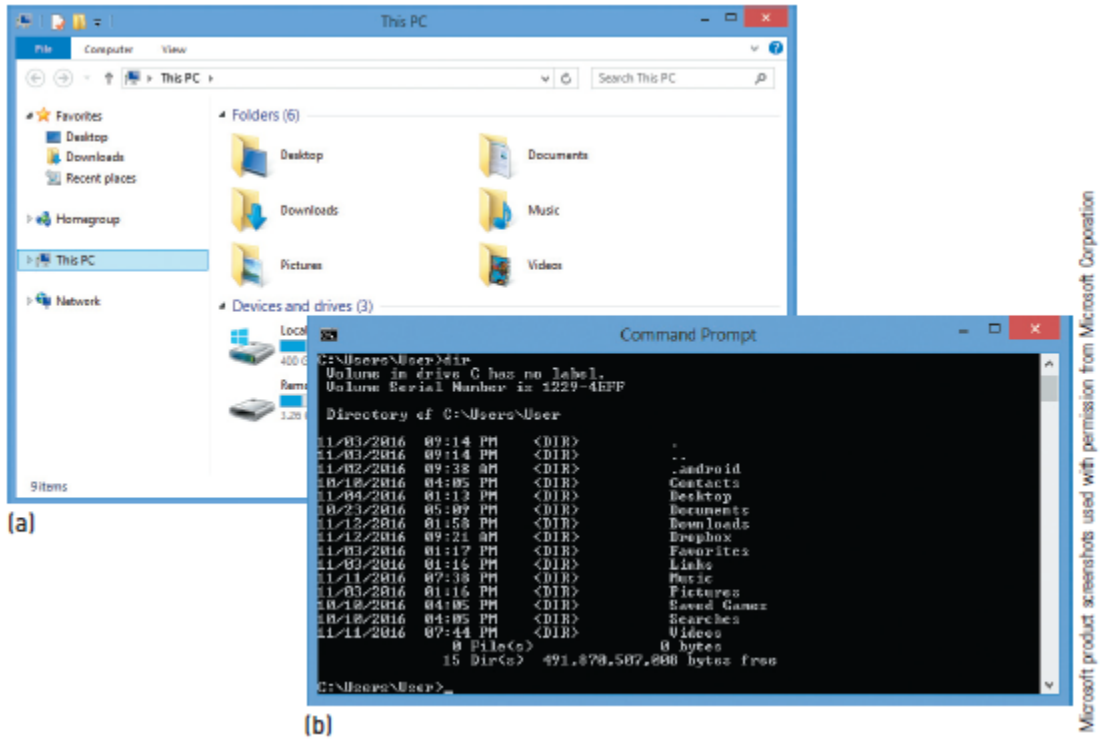


FIGURE 4.4

Command-based and graphical user interfaces

A Windows file system viewed with a GUI (a) and from the command prompt (b).

Operating Systems

- Other user interfaces:
  - A natural user interface (NUI) or multitouch interface
  - Speech recognition
  - Sight interfaces
  - Brain interfaces
- Hardware Independence
  - Application program interface (API): a set of programming instructions and standards for one software program to access and use the services of another software program
  - Hardware independence allows software development without concern for the specific underlying hardware

Operating Systems

- Memory Management
  - Allows the computer to execute program instructions effectively and to speed processing
  - Virtual memory: hard disk space is allocated to supplement the immediate, functional memory capacity of RAM

Operating Systems

- Processing Tasks: Five basic task management techniques
  - Multiuser: allows two or more users to run programs at the same time on one computer
  - Multiprocessing: supports running a program on more than one CPU
  - Multitasking: allows more than one program to run concurrently
  - Multithreading: allows different threads of a single program to run concurrently
  - Real time: responds to input instantly

Operating Systems

- Networking Capability
  - Allows computers in a network to send and receive data and share computing resources
- Access to System Resources and Security
  - Provides protection against unauthorized access to the users' data and programs
  - Establishes a logon procedure
    - May control access to specific system resources
  - Tracks who is using the system, length of use, and attempted security breaches

Operating Systems

- File Management
  - Ensures that files in secondary storage are available when needed
  - Protects files from access by unauthorized users

Current Operating Systems

TABLE 4.2 Operating systems by sphere of influence

Personal	Workgroup	Enterprise
Microsoft Windows	Microsoft Windows Server	Microsoft Windows Server
Mac OS X, iOS	Mac OS X Server	
Linux	Linux	Linux
Google Android, Chrome OS	UNIX	UNIX
HP webOS	IBM i and z/OS	IBM i and z/OS
	HP-UX	HP-UX

Personal Computing Operating Systems

- Microsoft PC OS
  - As of Windows 10, Microsoft is moving away from releasing major new versions, but will provide ongoing, incremental upgrades and improvements

FIGURE 4.5
Microsoft Windows 10
Windows 10 brings back the familiar Start menu, replaces the Explorer browser with the Edge browser, and provides the Cortana personal assistant.

Personal Computing Operating Systems

- Apple Computer OS
  - Mac OS X has been upgraded multiple times
  - First eight versions were named after big cats
  - Latest versions are named after places in California
  - Mac OS X 10.15 Catalina is the latest version
  - Mac users can set up their computers to run both Windows and Mac OS X

Personal Computing Operating Systems

- Linux
  - Open-source operating system
  - Most widely used distributions come from software companies:
    - Red Hat
    - Ubuntu
    - CentOS

Personal Computing Operating Systems

- Google: Android and Chrome
  - Chrome OS
    - Linux-based operating system designed for netbooks and nettops
    - Designed to run on inexpensive low-power computers
  - Chromium OS: an open-source version of Chrome OS
  - Android: an operating system for mobile devices
    - 80 percent of mobile phones worldwide use Android

Workgroup Operating Systems

- Windows Server provides:
  - A powerful Web server management system
  - Virtualization tools that allow various operating systems to run on a single server
  - Advanced security features
  - Robust administrative support
- UNIX/Linux
  - Can be used on many computer system types and platforms

Workgroup Operating Systems

- Red Hat Enterprise Linux Server can manage a cluster of several servers
- Mac OS X Server
  - First modern server OS from Apple
  - Based on the UNIX OS
  - Makes it easy to collaborate, develop software, host Web sites and wikis, configure Mac and iOS devices, and remotely access a network

Enterprise Operating Systems

- Examples of mainframe OSs
  - z/OS: IBM's first 64-bit enterprise OS
  - HP-UX from Hewlett-Packard
  - Linux

Mobile Operating Systems

- Smartphones employ full-fledged computer OSs
  - Google Android
  - Apple iOS

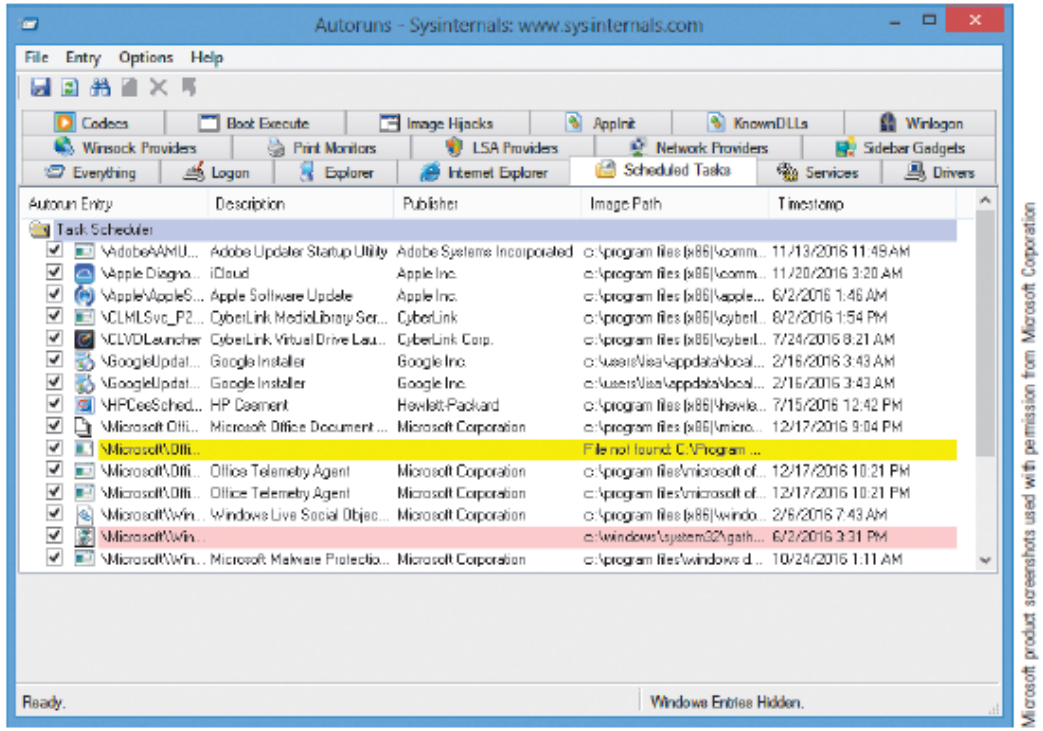
TABLE 4.5 Comparison of smartphone operating systems

Smartphone Operating System	Worldwide Market Share of Sales during 2Q 2015	Estimated Total Number of Applications	Estimated Rate of Increase in Number of New Applications
Google Android	82.8%	1,824,500 (Nov 2015)	980/day
Apple iPhone OS (iOS)	13.9%	1,500,000 (July 2015)	667/day
Microsoft Windows Mobile (to be replaced by Windows 10 Mobile)	2.6%	300,000 (June 2014)	550/day
Blackberry OS	0.3%	Not available	Not available

Sources: "Smartphone OS Market Share, 2015 Q2," International Data Corporation, August 2015, *www.idc.com/prodser/smartphone-os-market-share.jsp*; Costello, Sam, "How Many Apps Are in the App Store?," *About Tech*, September 15, 2015, *http://ipod.about.com/od/iphonesoftwareterms/qt/apps-in-app-store.htm*; Whitney, Lance, "Windows Phone Store Hits More than 300,000 Apps," CNET, August 8, 2015, *www.cnet.com/news/windows-phone-store-hits-more-than-300000-apps*.

Utility Programs

- Utility program: a program that helps to perform maintenance or correct problems with a system



Microsoft product screenshots used with permission from Microsoft Corporation

FIGURE 4.11
Sysinternals Suite
Sysinternals Suite is a collection of utilities for troubleshooting and maintaining a Windows system.

Utility Programs

- Hardware utilities
- Security utilities
- File-compression utilities
- Spam-filtering utilities
- Network and Internet utilities
- Server and mainframe utilities
- Other utilities: mobile device management (MDM), system cleaners, etc.

“Software is eating the world”

Overview of Application Software

TABLE 4.7 Comparison of proprietary and off-the-shelf software

Proprietary Software		Off-the-Shelf Software	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
You can get exactly what you need in terms of features, reports, and so on.	It can take a long time and a significant amount of resources to develop required features.	The initial cost is lower because the software firm can spread the development costs across many customers.	An organization might have to pay for features that it does not require and never uses.
Being involved in the development offers more control over the results.	In-house system development staff may be hard-pressed to provide the required level of ongoing support and maintenance because of pressure to move on to other new projects.	The software is likely to meet the basic business needs. Users have the opportunity to more fully analyze existing features and the performance of the package before purchasing.	The software might lack important features, thus requiring future modification or customization, which can be very expensive, and because users will eventually be required to adopt future releases of the software, the customization work might need to be repeated.
You can more easily modify the software and add features that you might need to counteract an initiative by competitors or to meet new supplier or customer demands.	The features and performance of the delivered software may fail to meet evolving business and end user needs.	The software is likely to be of high quality because many customer firms have tested the software and helped identify its bugs.	The software might not match current work processes and data standards.

Overview of Application Software

- Cloud service providers
  - Companies that provide software, data storage, and other services via the Internet
- Software as a service (SaaS)
  - Businesses subscribe to Web-delivered business application software
  - Vendors include Oracle, SAP, NetSuite, Salesforce, and Google
- Amazon is considered one of the leading public cloud service providers because of Amazon Web Services (AWS) platform

Personal Application Software

- Word Processing
  - Create, edit, and print text documents
- Spreadsheet Analysis
  - Perform statistical, financial, logical, database, graphics, and date and time calculations using a wide range of built-in functions
- Database Applications
  - Store, manipulate, and retrieve data

Personal Application Software

- Presentation Graphics Program
  - Develop graphs, illustrations, drawings, and presentations
- Personal Information Managers
  - Helps people, groups, and organizations store useful information, such as a list of tasks to complete or a set of names and addresses

Personal Application Software

- Software Suites and Integrated Software Packages
  - A collection of single programs packaged together in a bundle
  - Suites can include: word processor, spreadsheet, database management, graphics, communications tools, and organizers
  - Programs are designed to work similarly
  - Bundled suite is cost effective

Personal Application Software

- Other Personal Application Software
  - TurboTax: tax-preparation program
  - Software for creating Web pages and sites, composing music, and editing photos and videos
  - Educational and reference
  - Entertainment, games, and leisure
  - Computer-assisted design (CAD)
  - Statistical software: SPSS and SAS

Personal Application Software

- Mobile Application Software
  - Number of apps has exploded
  - Hundreds of thousands of applications have been developed by third parties
  - Thousands of applications are available for iPhones from the Apple App Store
  - Over one million apps are available in the Android market on Google's Play Store
  - Microsoft and other software companies are investing in mobile app software

Workgroup Application Software

- Workgroup application software
  - Designed to support teamwork with people in the same location or dispersed around the world
- Groupware helps groups of people work together more effectively
  - Also called collaborative software

Enterprise Application Software

- Enterprise application software
  - Software that benefits an entire organization
  - Helps managers and workers stay connected
  - Cost, installation and ability to integrate with other software are major considerations in selecting this software
  - Usability on smartphones and mobile devices is also an important factor

Application Software for Transaction Processing, Business Analytics, and Competitive Advantage

- Available in every industry
- Examples:
  - Blackboard and other learning management software
  - Software to visualize and analyze the human genome
  - Natural resource planning
  - Enterprise Resource Planning (ERP)

Programming Languages

- Programming languages
  - Sets of keywords, commands, symbols, and a system of rules for constructing statements
  - Allows humans to communicate instructions to a computer
- Syntax: a set of rules associated with a programming language

Programming Languages

- **Compiler:** a special software program that converts the programmer's source code into the machine-language instructions
- Software development kits (SDKs) and integrated development environments (IDEs) have made software development easier than ever
  - IDE combines all the tools required for software engineering into one package
  - SDKs often serve the purpose of an IDE for a particular platform

Programming Languages

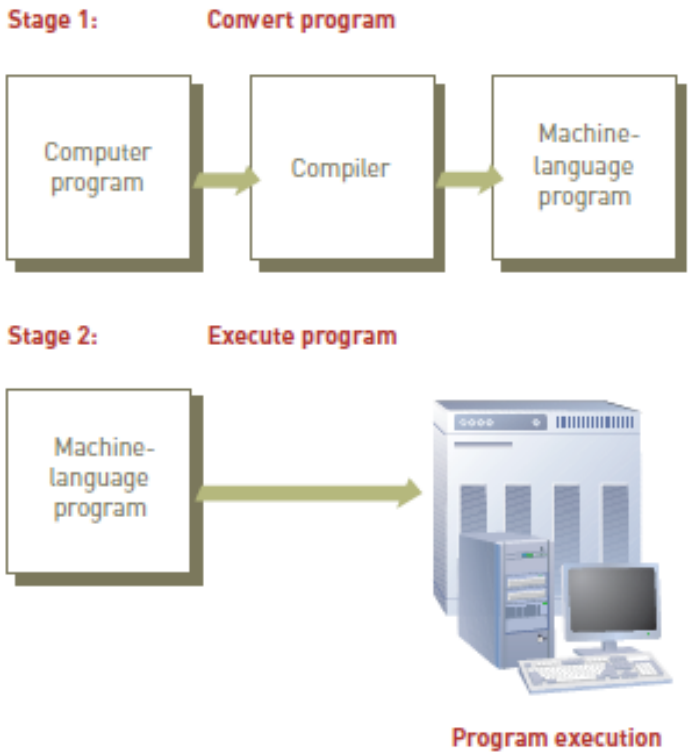
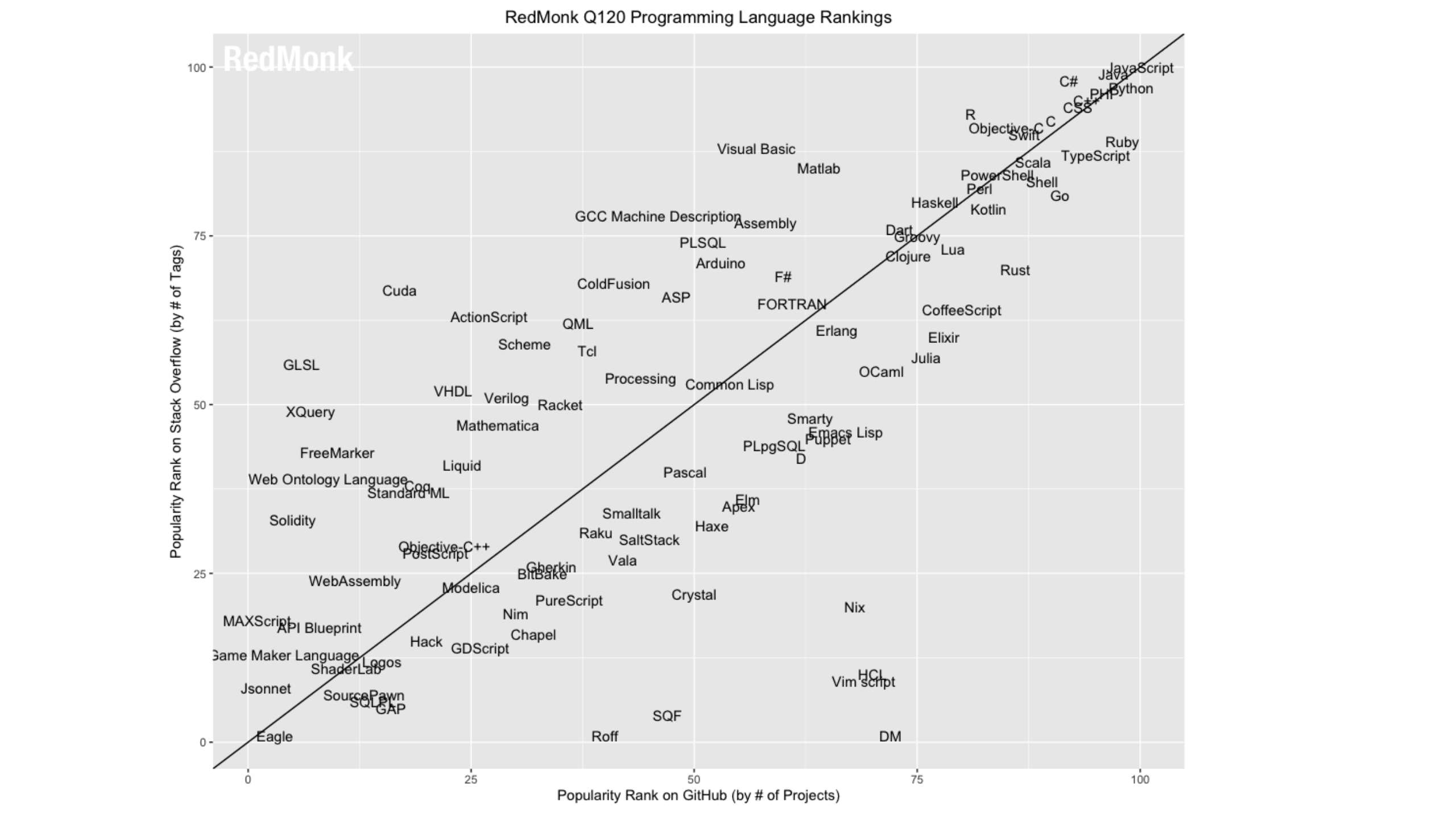


FIGURE 4.22

How a compiler works

A compiler translates a complete program into a complete set of binary instructions (Stage 1). After this is done, the CPU can execute the converted program in its entirety (Stage 2).


RedMonk Q120 Programming Language Rankings
RedMonk
Popularity Rank on Stack Overflow (by # of Tags)
Popularity Rank on GitHub (by # of Projects)
0
25
50
75
100
JavaScript
Java
Python
C#
PHP
C++
CSS
R
Objective-C
C
Swift
Ruby
TypeScript
Scala
PowerShell
Shell
Perl
Go
Haskell
Kotlin
Visual Basic
Matlab
GCC Machine Description
Assembly
Dart
Groovy
Lua
PLSQL
Arduino
Clojure
Rust
F#
ColdFusion
Cuda
ASP
FORTRAN
CoffeeScript
ActionScript
QML
Erlang
Elixir
Scheme
Tcl
Julia
GLSL
OCaml
Processing
Common Lisp
VHDL
Verilog
Racket
XQuery
Smarty
Mathematica
Emacs Lisp
Puppet
PLpgSQL
FreeMarker
D
Liquid
Pascal
Web Ontology Language
Coq
Standard ML
Elm
Apex
Solidity
Smalltalk
Haxe
Raku
SaltStack
Objective-C++
PostScript
Vala
Gherkin
BitBake
WebAssembly
Modelica
Crystal
PureScript
Nix
Nim
MAXScript
API Blueprint
Chapel
Hack
GDScript
Game Maker Language
Logos
ShaderLab
HCL
Vim script
Jsonnet
SourceMod
SQLPL
GAP
SQF
Eagle
Roff
DM

- JavaScript
- Python
- Java
- PHP
- C#
- C++
- Ruby
- CSS
- TypeScript
- C
- Swift
- Objective-C
- Scala
- R
- Go
- Shell
- PowerShell
- Perl
- Kotlin
- Haskell

Summary

- Software is valuable in helping individuals, workgroups, and entire enterprises achieve their goals
- The OS is called the **"soul of the computer"** because it controls how you enter data into your computer, perform meaningful work, and display results
- Organisations typically use **off-the-shelf software** to meet common business needs and **proprietary software** to meet unique business needs
- The software industry continues to undergo constant change; computer users need to be aware of recent trends and issues in the software industry to be effective in their business and personal life