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# COMPLETE A+ GUIDE TO IT HARDWARE AND SOFTWARE

A CompTIA® A+ Core 1 (220-1101) &  
A CompTIA® A+ Core 2 (220-1102) Textbook



CHERYL A. SCHMIDT

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A CompTIA A+ Core 1 (220-1101) &  
CompTIA A+ Core 2 (220-1102) Textbook

EIGHTH EDITION

**CHERYL A. SCHMIDT**  
FLORIDA STATE COLLEGE AT JACKSONVILLE

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## Complete A+ Guide to IT Hardware and Software, Eighth Edition

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## About the Author

**Cheryl Schmidt** is a professor of Network Engineering Technology at Florida State College at Jacksonville. Prior to joining the faculty ranks, she oversaw the LAN and PC support for the college and other organizations. She started her career as an electronics technician in the U.S. Navy. She teaches computer repair and various networking topics, including CCNA, network management, and network design. She has published other works with Pearson, including *IP Telephony Using CallManager Express and Routing and Switching in the Enterprise Lab Guide*.

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## Dedication

### *A Note to Instructors:*

I was a teacher long before I had the title professor. Sharing what I know has always been as natural as walking to me, but sitting still to write what I know is not as natural, so composing this text has always been one of my greatest challenges. Thank you so much for choosing this text. I thank you for sharing your knowledge and experience with your students. Your dedication to education is what makes the student experience so valuable.

### *A Note to Students:*

Writing a textbook is really different from teaching class. I have said for years that my students are like my children, except that I don't have to pay to send them through college. I am happy to claim any of you who have this text. I wish that I could be in each classroom with you as you start your IT career. How exciting!

Another thing that I tell my students is that I am not an expert. IT support is an ever-changing field and I have been in it since PCs started being used. You have to be excited about the never-ending changes to be good in this field. You can never stop learning or you will not be very good any more. I offer one important piece of advice:

Consistent, high-quality service boils down to two equally important things: caring and competence.

—Chip R. Bell and Ron Zemke

I dedicate this book to you. I can help you with the competence piece, but you are going to have to work on the caring part. Do not ever forget that there are people behind those machines that you love to repair. Taking care of people is as important as taking care of the computers.

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Finally, thank you to the students who have taken the time to share their recommendations for improvement. You are the reason I write this book each time. Please send me any ideas and comments you may have. I love hearing from you and of your successes. I may be reached at [cheryl.schmidt@fscj.edu](mailto:cheryl.schmidt@fscj.edu).

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# Introduction

*Complete A+ Guide to IT Hardware and Software*, eighth edition, is a textbook and optional lab manual intended for one or more courses geared toward CompTIA A+ Certification and computer repair. It covers all the material needed for the CompTIA A+ Core 1 (220-1101) and CompTIA A+ Core 2 (220-1102) exams. The book is written so that it is easy to read and understand, with concepts presented in building-block fashion. The book focuses on hardware, software, mobile devices, virtualization, basic networking, and security.

Some of the best features of the book include the coverage of difficult subjects in a step-by-step manner, carefully developed graphics that illustrate concepts, photographs that demonstrate various technologies, reinforcement questions, critical thinking skills, soft skills, and hands-on exercises at the end of each chapter. Also, this book is written by a teacher who understands the value of a textbook from someone who has been in IT her entire career.

## What's New in the Eighth Edition?

This update has been revised to include more coverage of hardware, mobile devices, and troubleshooting. There are also new sections on managed/unmanaged switches, VLANs, cloud-based network controllers, IoT device configuration, Active Directory settings, common documentation, and scripting. The following are a few of the many new features of this edition:

- > This book conforms with the latest CompTIA A+ exam requirements, including those of the CompTIA A+ Core 1 (220-1101) and CompTIA A+ Core 2 (220-1102) exams.
- > Chapter 2 now includes network cabling basics.
- > The video chapter has been removed as the certification exam includes only Windows configuration of video, which is covered in Chapter 16.
- > Chapter 12 now includes all virtualization and cloud technologies information.
- > Chapter 13 includes IoT device configuration.
- > The operating system-related chapters have been rearranged. Chapter 14 is an introduction to operating systems and Windows basics. Chapter 15 contains the command prompt and scripting sections. Chapter 16 contains the bulk of the information on configuring and supporting Windows 7, 8, and 10. Chapter 17 is still the macOS and Linux chapter.
- > Chapters 1 through 9 focus on hardware. Chapter 10 covers mobile devices. Chapter 11 is on computer design and serves as a troubleshooting review. Chapter 12 covers Internet connectivity, virtualization, and cloud computing. Chapter 13 dives into networking. Chapters 14 through 17 cover operating systems. Chapter 18 handles security concepts. Finally, Chapter 19 contains operational procedures. Appendix A provides an introduction to subnetting.
- > The book has always been filled with graphics and photos, but even more have been added to target those naturally drawn to the IT field. This edition is full color.
- > There are questions at the end of each chapter, and even more questions are available in the test bank available from the Pearson Instructor Resource Center.

## Organization of the Text

The text is organized to allow thorough coverage of all topics and also to be a flexible teaching tool. It is not necessary to cover all the chapters, nor do the chapters have to be covered in order.

- > **Chapter 1** provides an introduction to IT and careers that need the information in this book. It identifies computer parts. Chapter 1 does not have a specific soft skills section, as do the other chapters. Instead, it focuses on common technician qualities that are explored in greater detail in the soft skills sections of later chapters. Finally, Chapter 1 has a great introduction to using Notepad, the Windows Snipping Tool, and Internet search techniques.
- > **Chapter 2** is about connecting things to the computer and port identification. Details are provided on video, USB, and sound ports. The soft skills section is on using appropriate titles.
- > **Chapter 3** details components, features, and concepts related to motherboards, including processors, caches, expansion slots, and chipsets. Active listening skills are the focus of the soft skills section.
- > **Chapter 4** deals with system configuration basics. BIOS options, UEFI BIOS, and system resources are key topics. The soft skills section covers the importance of doing one thing at a time when replacing components.
- > **Chapter 5** steps through how to disassemble and reassemble a computer. Tools, ESD, EMI, and preventive maintenance are discussed. Subsequent chapters also include preventive maintenance topics. Basic electronics and computer power concepts are also included in this chapter. The soft skills section involves written communication.
- > **Chapter 6** covers memory installation, preparation, and troubleshooting. The importance of teamwork is emphasized as the soft skill.
- > **Chapter 7** deals with storage devices, including PATA, SATA SCSI, SAS, and SSDs. RAID is also covered. Phone communication skills are covered in the soft skills section of this chapter.
- > **Chapter 8** covers multimedia devices, including optical drives, sound cards, cameras, scanners, and speakers. The chapter ends with a section on having a positive, proactive attitude.
- > **Chapter 9** provides details on printers. A discussion of work ethics finishes the chapter.
- > **Chapter 10** is on mobile devices, including details on mobile device operating systems, configuration, backup, security, and troubleshooting. The soft skills section takes a brief foray into professional appearance.
- > **Chapter 11** covers computer design. Not only are the specialized computers and components needed within the types of systems covered, but computer subsystem design is also included. Because design and troubleshooting are high on the academic learning progression, the chapter also includes a review of troubleshooting, including logic, error codes, and troubleshooting flowcharts. The soft skills section provides recommendations for dealing with irate customers.
- > **Chapter 12** handles Internet connectivity, virtualization, and cloud technologies. Internet browser configuration is covered, along with the soft skill of mentoring.
- > **Chapter 13** introduces networking. Basic concepts, terminology, and exercises make this chapter a favorite. The introduction to subnetting has been moved to an appendix. The focus of the soft skills section is being proactive instead of reactive.
- > **Chapter 14** provides an introduction to operating systems in general and discusses basic differences between the Windows versions and how to function in the various Windows environments. The soft skills section includes tips on how to stay current in this fast-paced field.
- > **Chapter 15** is a new introduction to scripting and includes how to function from the command prompt and the basics of scripting in Python, JavaScript, shell scripting, VBScript, batch files, and PowerShell. The soft skills section discusses looking at a problem from the user's perspective and being more empathetic.
- > **Chapter 16** covers Windows 7, 8, and 10. Details include how to install, configure, and troubleshoot the environment. Avoiding burnout is the soft skill discussed in this chapter.
- > **Chapter 17** discusses the basics of macOS and Linux. It provides a basic introduction to these two environments to help a technician become familiar with the environment and a few tools. The soft skills section talks about being humble.
- > **Chapter 18** describes computer, mobile device, and network security. The soft skills section is on building customer trust.
- > **Chapter 19** guides the student through operational procedures such as workplace safety, recycling, disposal, a review of power protection, change management, and communication skills.

## Features of This Book

The following key features of the book are designed to enable a better learning experience.

- > **Objectives**—Each chapter begins with *both* chapter objectives and the CompTIA A+ exam objectives.
- > **Graphics and photographs**—Many more full-color images and all-new graphics have been added to better illustrate the concepts.
- > **Tech Tips**—The chapters are filled with Tech Tips that highlight technical issues and certification exam topics.
- > **Key terms in context**—As you read the chapter, terms that appear in blue are considered key terms and are defined in the glossary.
- > **Key Terms list**—At the end of the chapter, all key terms are listed, along with page numbers to which to refer for context.
- > **Soft Skills**—Technology is not the only thing you must learn and practice; each chapter offers advice, activities, and examples of how to be a good tech, an ethical tech, a good work mate, a good communicator, and so on.
- > **Chapter Summary**—The summary recaps the key concepts of the chapter, and you can use it for review to ensure that you've mastered the chapter's learning objectives.
- > **A+ Certification Exam Tips**—Read through these tips on the CompTIA A+ exams so you aren't caught off guard when you sit for the exam.
- > **Review Questions**—Hundreds of review questions, including true/false, multiple choice, matching, fill-in-the-blank, and open-ended questions, assess your knowledge of the topics taught in each chapter.
- > **Applying your knowledge**—There are hundreds of Exercises and Activities by which to put into practice what you are learning. For example:
  - > **Exercises**—Sometimes called “paper labs,” these need no lab devices to complete in the classroom or for homework.
  - > **Activities**—Extensive practice with Internet discovery, soft skills, and critical thinking skills round out your technical knowledge so that you can be prepared for IT work. These can be used to “Flip the Classroom;” instead of lectures, instruction is interactive and in the hands of the students.
- > **Lab Exercises**—The separate companion *Complete A+ Guide to IT Hardware and Software Lab Manual* (ISBN 978-0-13-538019-2) contains more than 140 labs in total. These hands-on labs enable you to link theory to practical experience.

## Companion Website

Register this book to get access to sample videos plus additional bonus content to help you succeed with this course and the certification exam. Check this site regularly for any updates or errata that might become available for this book. Be sure to check the box that you would like to hear from us to receive news of updates and exclusive discounts on related products.

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## CompTIA A+ Exam Objectives

To earn CompTIA A+ certification, you must pass both the CompTIA A+ Core 1 (220-1001) and CompTIA A+ Core 2 (220-1002) certification exams.

Tables I-1 and I-2 summarize the domain content for each exam.

**TABLE I-1** CompTIA A+ Core 1 (220-1001)exam

| Domain                                   | Percentage of examination |
|--|---------------------------|
| 1.0 Mobile Devices                       | 14%                       |
| 2.0 Networking                           | 20%                       |
| 3.0 Hardware                             | 27%                       |
| 4.0 Virtualization and Cloud Computing   | 12%                       |
| 5.0 Hardware and Network Troubleshooting | 27%                       |
| Total                                    | 100%                      |

**TABLE I-2** CompTIA A+ Core 2 (220-1002) exam

| Domain                       | Percentage of examination |
|------------------------------|---------------------------|
| 1.0 Operating Systems        | 27%                       |
| 2.0 Security                 | 24%                       |
| 3.0 Software Troubleshooting | 26%                       |
| 4.0 Operational Procedures   | 23%                       |
| Total                        | 100%                      |

Table I-3 shows a summary of the exam domains addressed in each chapter. Each chapter lists the certification objectives it covers in the chapter opener. See Appendix B on the companion website for a detailed table that identifies where you can find all the CompTIA A+ exam objectives covered in this book.

**TABLE I-3** Summary of exam domains by chapter

| Table of contents                          | 220-1001 domains | 220-1002 domains |
|--|------------------|------------------|
| Chapter 1: Introduction to the World of IT | 3                | 4                |
| Chapter 2: Connectivity                    | 1, 2, 3          | 4                |
| Chapter 3: On the Motherboard              | 3, 5             | 4                |
| Chapter 4: Introduction to Configuration   | 3, 5             |                  |
| Chapter 5: Disassembly and Power           | 3, 5             | 4                |
| Chapter 6: Memory                          | 3, 5             | 1                |
| Chapter 7: Storage Devices                 | 3, 5             | 1, 2, 3, 4       |
| Chapter 8: Multimedia Devices              | 3                | 1, 4             |
| Chapter 9: Printers                        | 2, 3, 5          | 1, 3, 4          |
| Chapter 10: Mobile Devices                 | 1, 2, 3, 5       | 1, 2, 3          |

| <b>Table of contents</b>  | <b>220-1001 domains</b> | <b>220-1002 domains</b> |
|---|-------------------------|-------------------------|
| Chapter 11: Computer Design and Troubleshooting Review                    | 3, 5                    | 4                       |
| Chapter 12: Internet Connectivity, Virtualization, and Cloud Technologies | 2, 3, 4                 | 1, 2, 3                 |
| Chapter 13: Networking  | 2, 3, 4, 5              | 1, 2, 3, 4              |
| Chapter 14: Introduction to Operating Systems                             |                         | 1, 2, 3                 |
| Chapter 15: Introduction to Scripting                                     |                         | 1, 3, 4                 |
| Chapter 16: Advanced Windows  |                         | 1, 2, 3, 4              |
| Chapter 17: macOS and Linux Operating Systems                             |                         | 1, 3                    |
| Chapter 18: Computer and Network Security                                 | 2, 3                    | 1, 2, 3, 4              |
| Chapter 19: Operational Procedures  |                         | 4                       |

# 1

# Introduction to the World of IT



## In this chapter you will learn:

- > Qualities a technician should have
- > Basic skills needed to function in the Windows environment and in the technical world
- > Important computer parts
- > Basic computer terms

## CompTIA Exam Objectives:

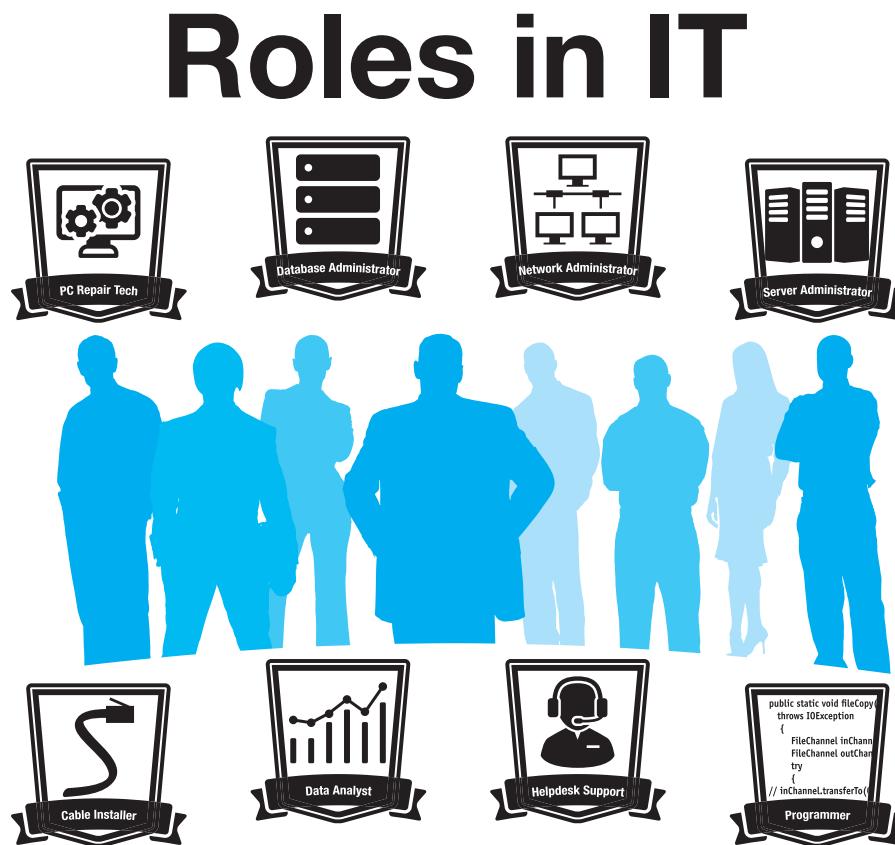
What CompTIA A+ exam objectives are covered in this chapter?

- ✓ 1001-3.6 Explain the purposes and uses of various peripheral types.
- ✓ 1002-4.4 Explain common safety procedures.
- ✓ 1002-4.7 Given a scenario, use proper communication techniques and professionalism.

## Who Needs This Book?

More types of people than you would first think need this book. People who obviously need this information are those who will fix computers or work on a help desk or support desk. However, there are other types of users who might not be so obvious. Many folks who break into the information technology (IT) world do so through jobs that require the A+ certification. Consider medical electronics technicians who repair common equipment used in hospitals. These technicians need this course because many medical devices connect to a PC or have PC-based software that controls the device. Further, the medical devices commonly attach to wired and wireless networks.

Look at Figure 1.1 to see the types of jobs and people who need the information in this book. It might also give you ideas about something you might like to do for a career.

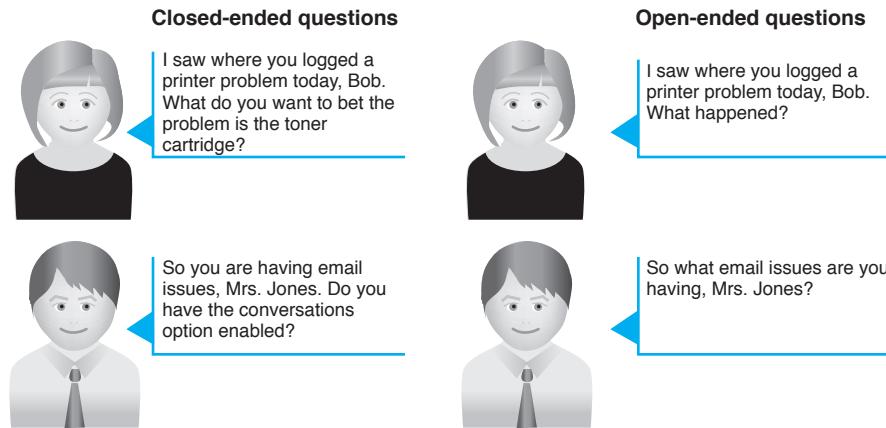


**FIGURE 1.1** IT roles

## Technician Qualities

Each chapter includes a small bit of space on qualities a technician should possess or strive toward. Spending a little brain power on improving what many call your “soft skills” will pay off in promotions and divergence into other IT-related fields. Three of the most important qualities of a technician are active listening skills, a good attitude, and logic. Active listening means that you truly listen to what a person (especially one who is having a problem) is saying. Active listening skills involve good eye contact, nodding your head every now and then to show that you are following the conversation, taking notes on important details, and avoiding distractions such as incoming cell

phone calls or text messages. Clarify customer statements by asking pertinent questions and avoid interrupting. Allow customers to complete their sentences. Many technicians jump into a problem the moment they hear the first symptom described by the user. Listen to the entire problem. Ask open-ended questions—questions that allow the user to expand on the answer rather than answer with a single word, such as *yes* or *no*. Figure 1.2 illustrates this point.



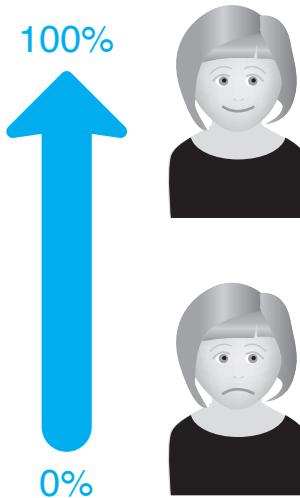
Allow the users to state the problem without leading them toward a solution. Restate the problem to ensure understanding and ask questions for clarity and to narrow your understanding.

**FIGURE 1.2** Asking technical questions

A positive attitude is probably the best quality a technician can possess. A good attitude is helpful when a user is upset because a computer or an attached device is not working properly. A technician with a positive attitude does not diminish the customer's problem; every problem is equally important to the computer user. A positive attitude is critical for being successful in the computer service industry. Figure 1.3 shows how negative attitudes affect your success.

### Chances of Success Increase with a Positive Attitude.

- I see every issue as an opportunity to help or be positive.
- I am sensitive to other cultures.
- I don't take the time to listen to the entire problem.
- I blame others.
- I think, "I can't, I won't, or I won't even try."



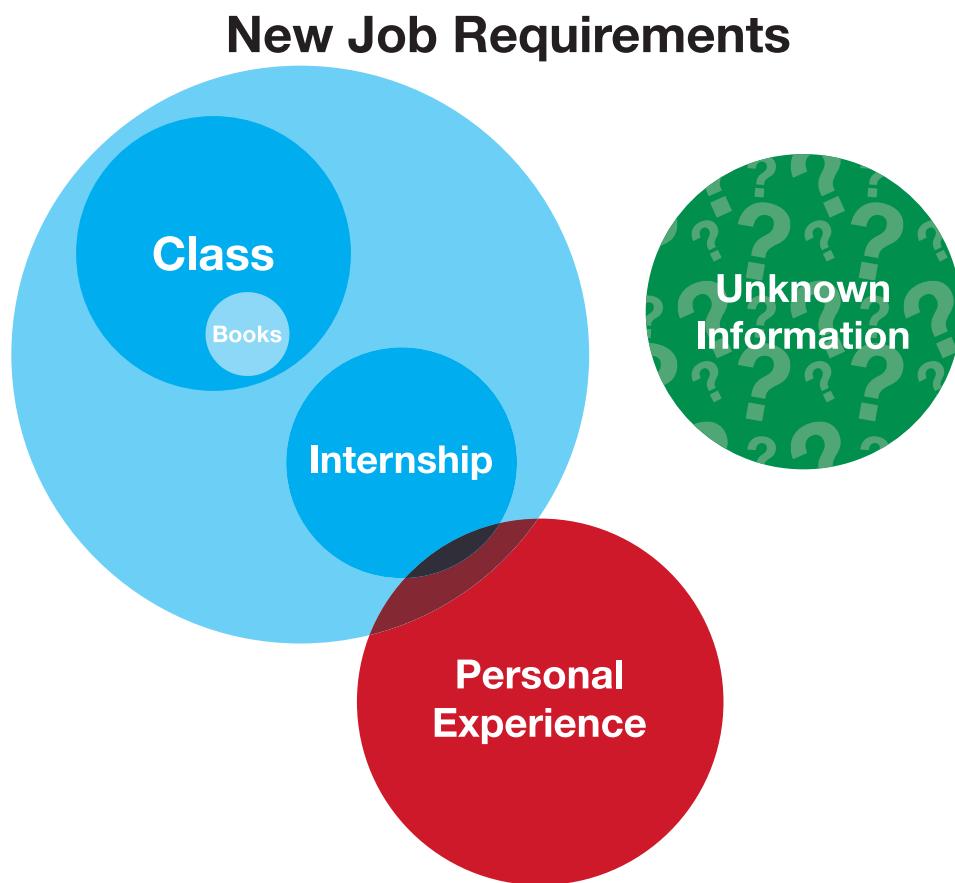
**FIGURE 1.3** Have a positive attitude

A technician must be familiar with and thoroughly understand computer terminology to (1) use logic to solve problems; (2) speak intelligently to other technical support staff in clear, concise, and direct statements; (3) explain the problem to the user; and (4) be proficient in the field. Changes

occur so frequently that technicians must constantly update their skills. Develop a passion for learning the latest information and searching for information that helps you solve problems.

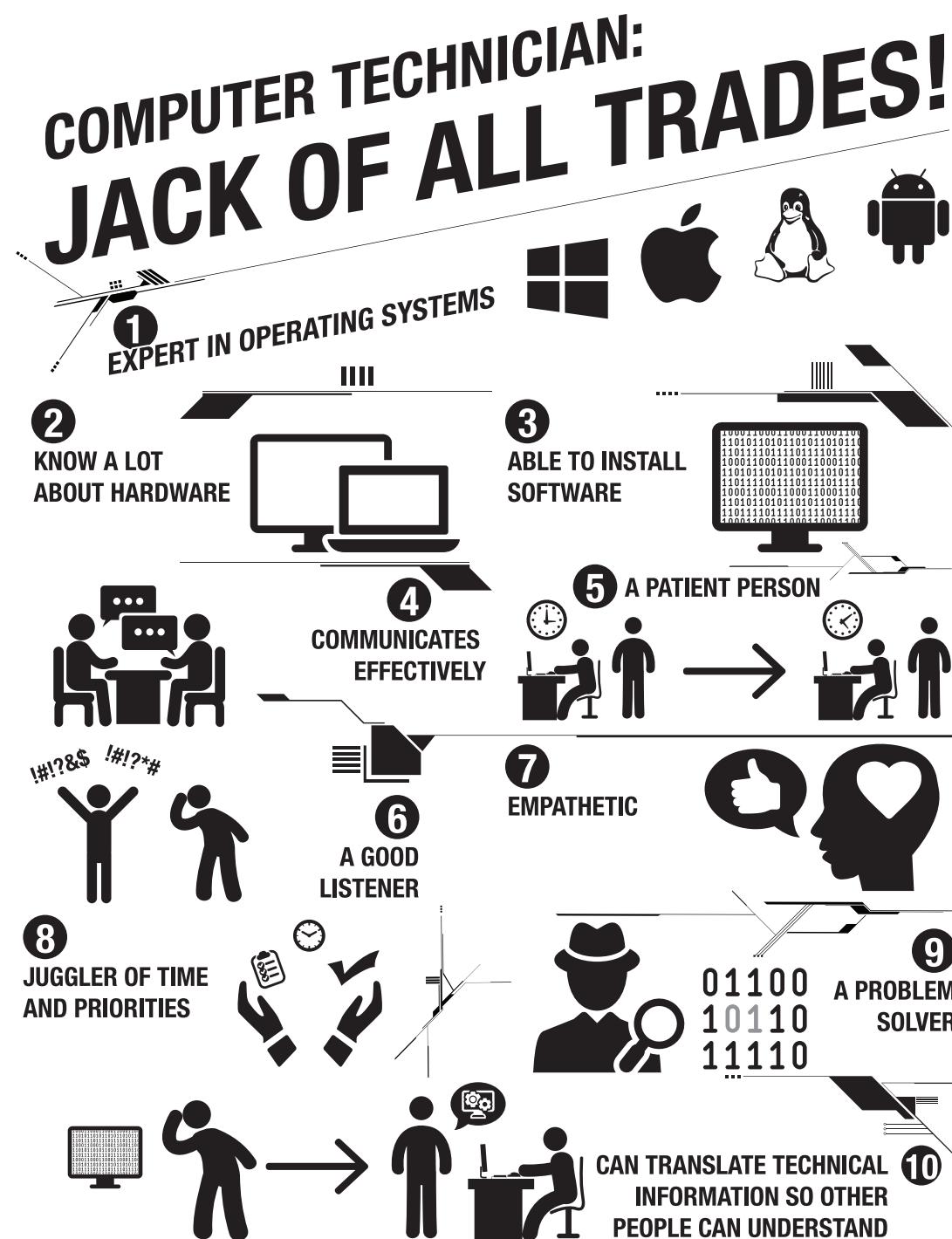
Avoid developing tunnel vision (that is, thinking that there is only one answer to a problem). Step back and look at the problem so that all possible issues can be evaluated. Be logical in your assessment and the methods used to troubleshoot and repair. This book will help you with all of this by explaining computer terminology in easy-to-understand terms and providing analogies that can be used when dealing with customers.

Before delving into computer topics, you should remember that a class can't fully prepare you for every aspect of a job. You must learn things on your own and constantly strive to update your skills so you do not become obsolete. The IT field changes rapidly. Figure 1.4 illustrates this concept.



**FIGURE 1.4** Preparing for IT job requirements

Finally, you will find that you must be a jack-of-all-trades, as shown in Figure 1.5.



**FIGURE 1.5** Computer technician skills

### Breaking into IT with the CompTIA A+ Certification

Many IT-related jobs require the A+ certification. Even if not required, the certification shows that you have a good understanding of how computers work. This certification does not guarantee you a job, but it does open doors in that a company may interview you if you lack IT experience but have the A+ certification.

A+ certification requires that you take two exams (220-1001 and 220-1002). Each of these exams covers specific material. Table 1.1 shows the major categories for the 220-1001 exam and how they map to information in this book. Table 1.2 shows the same type of information for the 220-1002 exam.

**TABLE 1.1** CompTIA 220-1001 A+ certification topics

| Domain                                   | Percentage of examination | Chapter(s) |
|--|---------------------------|------------|
| 1.0 Mobile Devices                       | 14%                       | 10         |
| 2.0 Networking                           | 20%                       | 12–13      |
| 3.0 Hardware                             | 27%                       | 1–9, 11    |
| 4.0 Virtualization and Cloud Computing   | 12%                       | 12         |
| 5.0 Hardware and Network Troubleshooting | 27%                       | 1–13       |

**TABLE 1.2** CompTIA 220-1002 A+ certification topics

| Domain                       | Percentage of examination | Chapter(s) |
|------------------------------|---------------------------|------------|
| 1.0 Operating Systems        | 27%                       | 14–17      |
| 2.0 Security                 | 24%                       | 18         |
| 3.0 Software Troubleshooting | 26%                       | 14–18      |
| 4.0 Operational Procedures   | 23%                       | 19         |

“What are the exams like?” you might ask. The exams include multiple-choice and performance-based questions. Performance-based questions might be a drag-and-drop scenario or ask you to do something specific on a particular device or within a particular operating system environment. Each exam is 90 minutes long and contains a maximum of 90 questions. The testing system allows you to bookmark questions that you might want to return to at the end if you have time. Successful candidates will have the knowledge required to do the following:

- > Assemble components based on customer requirements.
- > Install, configure, and maintain devices including Internet of Things (IoT) devices, personal computers (PCs), and software for end users.
- > Understand the basics of networking and security/forensics.
- > Properly and safely diagnose, resolve, and document common hardware and software issues.
- > Apply troubleshooting skills.
- > Provide appropriate customer support.
- > Understand the basics of virtualization, desktop imaging, and deployment.

More information can be found on the CompTIA website ([www.comptia.org](http://www.comptia.org)).

At the beginning of each chapter, you will see a list of the CompTIA A+ exam objectives that are covered in that chapter. At the end of each chapter, I’ve provided some A+ certification exam tips—tips to definitely pay attention to if you plan on taking the A+ exams. By the end of this course, you will have learned all the topics covered on the certification exams; however, before you actually take the exams, I recommend that you dedicate some time to review the chapters in this book thoroughly, study the objectives, and take some practice exams. Pearson IT Certification, the publisher of this book, develops many different certification exam prep resources that suit various study styles. See the back of this book for more information or go to <http://pearsonitcertification.com/aplus> to browse the options.

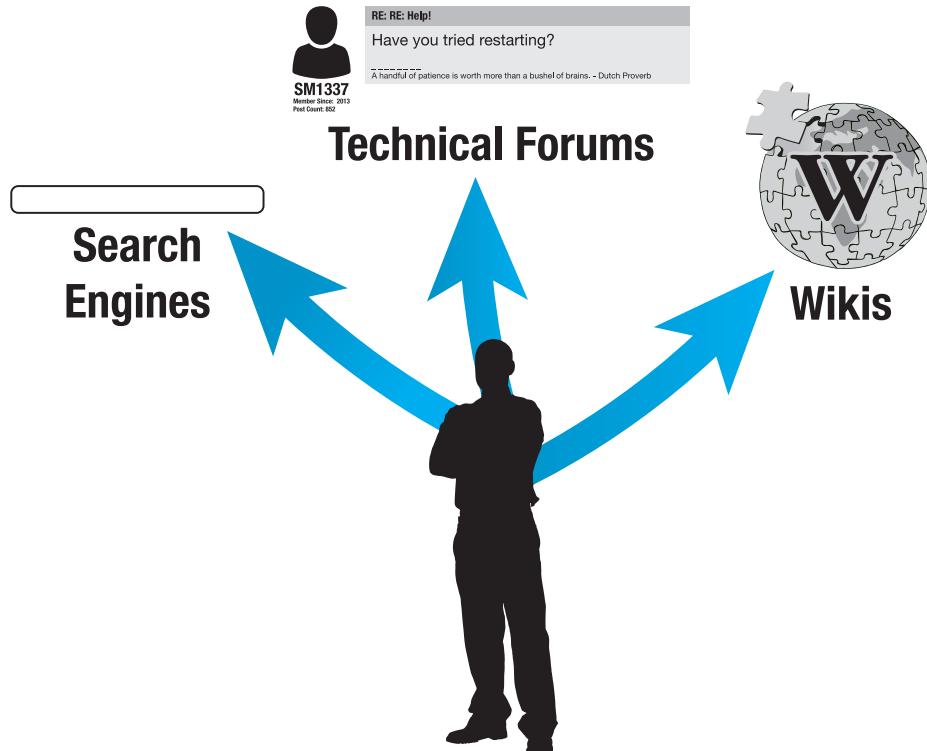
## Basic Skills for This Course

In order to repair a computer, you need a few basic skills that include being familiar with the keyboard and inputting information, searching for information on the Internet, and capturing

information. Just because you may not be a good typist does not mean that you will not be good in an IT-related field.

## Searching for Information on the Internet

IT people need to use all available resources, including online resources. As noted, you need to be capable of searching for information online. Figure 1.6 illustrates various online resources that IT people search all the time.



**FIGURE 1.6** Search skills

Each chapter in the book has an activity at the end of it that enables you to practice searching the Internet for information relevant to the chapter. Tips for searching include the following:

- > Search engines use different algorithms, so if one does not work, try another one. Examples of search engines are Google, Bing, Yahoo, AOL, Ask, and Lycos. To access a search engine, open a web browser and type one of the search engine names followed by .com. Figure 1.7 shows where you enter the search engine name in the address bar.



**FIGURE 1.7** Web browser address bar

- > Use descriptive key words.
- > Do not include common words like *the*, *in*, *at*, or *for* because search engines tend to skip these words anyway. If you do want to use one of them, put a plus sign (+) in front of the word.
- > Avoid using a complex version, plural, or past tense of a word to avoid elimination of pages that are relevant. For example, to search for how to install a Bluetooth headset, avoid using the word *installation*, *installed*, or *installing* in the search window. Simply include the word *install*.
- > If several words are used together (an exact phrase), such as Windows 10, put quotations around the phrase—"Windows 10".
- > Use as many distinguishing words as possible.
- > If two words have the same meaning and are commonly used, use the word *or* in the search. For example, to search for generic information on a dot matrix printer, which is sometimes called an impact printer, you might search as follows: "dot matrix" or "impact printer". Note that the vertical bar (!), which is the key above the *Enter* key, can be used instead of the word *or*, as follows: "dot matrix" | "impact printer".
- > If a particular term can have two meanings (such as the word *memory* relating to something inside a computer or else relating to a brain function), you can use the minus sign in order to keep some information from being displayed. *memory -brain*, for example, would be a search for memory without any brain function results included.
- > If a particular term (such as *memory*) is generic, you can add a word and use the word *AND* in order to clarify the search, such as *computer AND memory*.
- > When searching for technical information, include the hardware or software manufacturer. A search for Microsoft Windows 10 provides different results than simply a search for Windows 10.
- > If nothing relevant is on the first page of links, change the key words used in your search.

Consider the situation of a keyboard that intermittently works on a Microsoft Surface computer. The keyboard does not come standard as part of a Surface purchase. You do not own a Surface yourself and are unfamiliar with the tablet but must support it. An example of what might be typed into a search engine is Microsoft Surface intermittent keyboard.

## Capturing Files

Sometimes, part of technical documentation is being able to capture what is on the screen. Windows versions come with a great tool for doing just that. The Snipping Tool makes documenting problems easy. It is also easy to copy what you capture into other applications. No matter what IT job you may have when you enter the workforce, documentation is a part of all IT jobs.

## Creating a Text File

Another part of documentation might involve creating or using a text file, known as a .txt file. You might need to send it as an attachment, or you might need to create a text file as part of the documentation process or as part of the job. Sometimes a text file is the easiest type of file to create, especially on a mobile device. Text files can be created using a word processor and the *Save As* process, or they can be created using specific text software or an app. Text files are popular because they can be opened by many applications or other mobile apps. Text files commonly include only text, without multiple fonts or graphics. Windows ships with a basic application called Notepad that can be used to create or open text files.

## Types of Computers

The simplest place to start to learn about computer technical support is with the devices themselves. Computer devices come in many shapes and sizes. The **PC**, or personal computer, comes in desktop, tower, and all-in-one models, as well as mobile models such as laptops, smartphones, and tablets. Figure 1.8 shows some of the computing devices technical staff are expected to support.



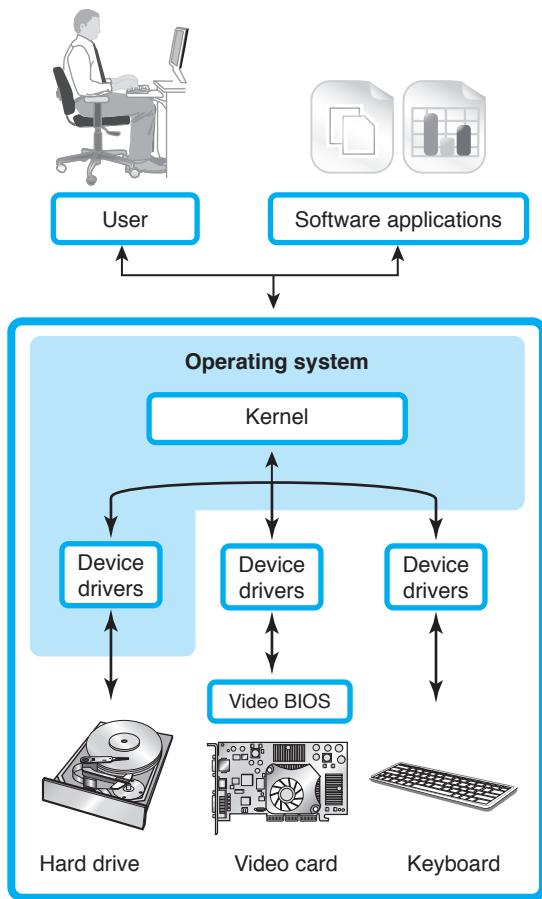
**FIGURE 1.8** Types of computers

## Basic Computer Hardware

Computer systems include hardware, software, and firmware. **Hardware** is something you can touch and feel; the physical computer and the parts inside the computer are examples of hardware. The monitor, keyboard, and mouse are hardware components. **Software** interacts with the hardware. Windows, Linux, macOS, Microsoft Office, Solitaire, Google Chrome, Adobe Acrobat Reader, and WordPerfect are examples of software.

Without software that directs the hardware to accomplish something, a computer is no more than a doorstop. Every computer needs an important piece of software called an **operating system**, which coordinates the interaction between hardware and software applications. The operating system also handles the interaction between a user and the computer. Examples of operating systems include Windows 7, 8, 8.1, and 10, macOS, and various Linux systems, such as Red Hat and Ubuntu.

A **device driver** is a special piece of software designed to enable a hardware component. The device driver enables the operating system to recognize, control, and use the hardware component. Device drivers are hardware and operating system specific. For example, a printer requires a specific device driver when connected to a computer loaded with Windows 7. The same printer will most likely require a different device driver when using Windows 8 or 10. Each piece of installed hardware requires a device driver for the operating system being used. Figure 1.9 shows how hardware and software must work together.



**FIGURE 1.9** Hardware and software

Notice in Figure 1.9 the operating system kernel. The kernel is the central part of an operating system. The kernel is the connection between hardware and the applications being used.

Software applications are normally loaded onto the hard drive. When a user selects an application, the operating system controls the loading of the application. The operating system also controls any hardware devices (such as the mouse, keyboard, monitor through the video adapter, and printer) used with the application.

**Firmware** is a combination of hardware and software, such as electronic chips that contain software: The chip is physical, which is hardware, and it has software built into the chip. An example of firmware is the basic input/output system (**BIOS**) chip. The BIOS always has startup software inside it that must be present for a computer to operate. This startup software locates and loads the operating system. The BIOS also contains software instructions for communication with input/output devices, as well as important hardware parameters that determine to some extent what hardware can be installed. For example, the system BIOS has the ability to allow other BIOS chips that are located on adapters (such as the video card) to load software that is loaded in the card's BIOS.

A PC typically consists of a case (chassis), a keyboard that allows users to provide input into the computer, a **monitor** that outputs or displays information (shown in Figure 1.10), and a mouse that allows data input or is used to select menus and options. Figure 1.10 shows a computer monitor, which may also be called a flat panel, display, or screen.

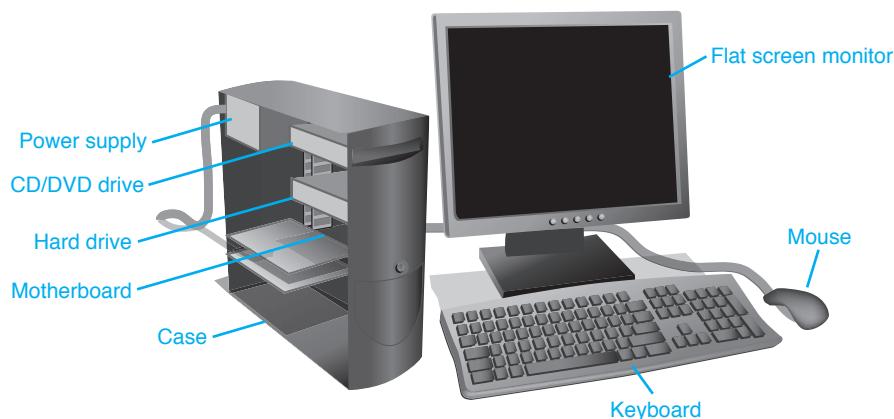
When the computer cover or side is opened or removed, the parts inside can be identified. The easiest part to identify is the **power supply**, which is the metal box normally located in a back corner of a case. A power cord connects the power supply to a wall outlet or surge strip. One purpose of the power supply is to convert the outlet AC voltage to DC voltage used internally in the

PC. The power supply distributes this DC voltage using power cables that connect to the various internal computer parts. A fan located inside the power supply keeps the computer cool to prevent damage to the components.

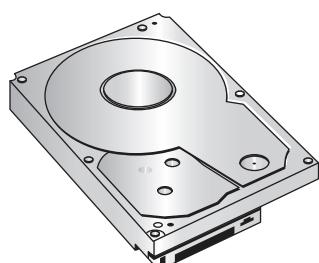


**FIGURE 1.10** Computer monitor

A personal computer usually has a device to store software applications and files. Two examples of storage devices are the hard drive and optical drive. The **hard drive**, sometimes called the hard disk, is a rectangular box normally inside the computer's case that is sealed to keep out dust and dirt. The hard drive has no external opening. The computer must be opened in order to access a hard drive. A **DVD drive**, or **optical drive**, holds discs (compact discs, or CDs), digital versatile discs (DVDs), or Blu-ray discs (BDs) that have data, music, video, or software applications on them. The front of the optical drive has a tray that would eject outward so a disc may be inserted. Figure 1.11 shows the major components of a tower computer. Figure 1.12 shows a hard drive. Figure 1.13 shows an optical drive. Figure 1.14 shows a power supply. The hard drive in Figure 1.12, optical drive in Figure 1.13, and power supply in Figure 1.14 all are shown as they would look before being installed into the computer case. Figure 1.15 shows a tower computer case.



**FIGURE 1.11** Tower computer



**FIGURE 1.12** Hard drive



**FIGURE 1.13** DVD or optical drive

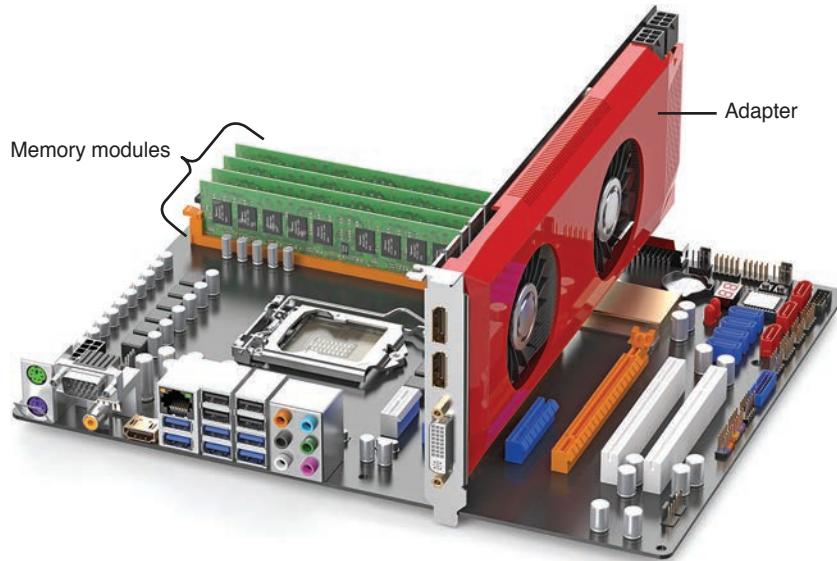


**FIGURE 1.14** Power supply



**FIGURE 1.15** Tower case

The **motherboard** is the main circuit board inside a PC and contains the most electronics. It is normally located on the bottom of a desktop or laptop computer and mounted on the side of a tower computer. Other names for the motherboard include mainboard, planar, or system board. The motherboard is the largest electronic circuit board in the computer. External devices connect directly to the back of the motherboard or ports on the front of the computer. Figure 1.16 shows a motherboard when it is not installed inside a computer as well as memory and an adapter, which are covered next.



**FIGURE 1.16** Computer motherboard

The motherboard holds memory modules. **Memory** is an important part of any computing device. Memory modules hold applications, part of the operating system, and user documents. Random access memory (**RAM**) is the most common type of memory and is volatile—that is, the data inside the module is lost when power is removed. When a user types a document in a word processing program, both the word processing application and the document are in RAM. If the user turns the computer off without saving the document to removable media or the hard drive, the document is lost because the information does not stay in RAM. (Note that some applications have the ability to periodically save a document, but this is not a guarantee that it has the latest information.) Figure 1.17 shows memory modules when they are not installed into the motherboard memory slots. Look back to Figure 1.16 to see the memory modules installed in the motherboard. Memory is covered in great detail in Chapter 6, “Memory.”



**FIGURE 1.17** Memory modules

A device may have a cable that connects the device to the motherboard. Other devices require an adapter. An **adapter** is an electronic card that plugs into an **expansion slot** on the motherboard. Other names for an adapter are controller, card, controller card, circuit card, circuit board, and adapter board. Adapters allow someone to add a functionality or enhancement that is not provided through the ports on the motherboard. An example is someone who wants better sound or video graphics, or additional ports of some type in order to connect external devices. Figure 1.18 shows an adapter. Notice how the contacts at the bottom are a particular shape. Chapter 3, “On the Motherboard,” goes into more detail about the types of expansion slots and adapters. You can also look back to Figure 1.16 to see a video adapter installed into a motherboard expansion slot.



**FIGURE 1.18** Adapter

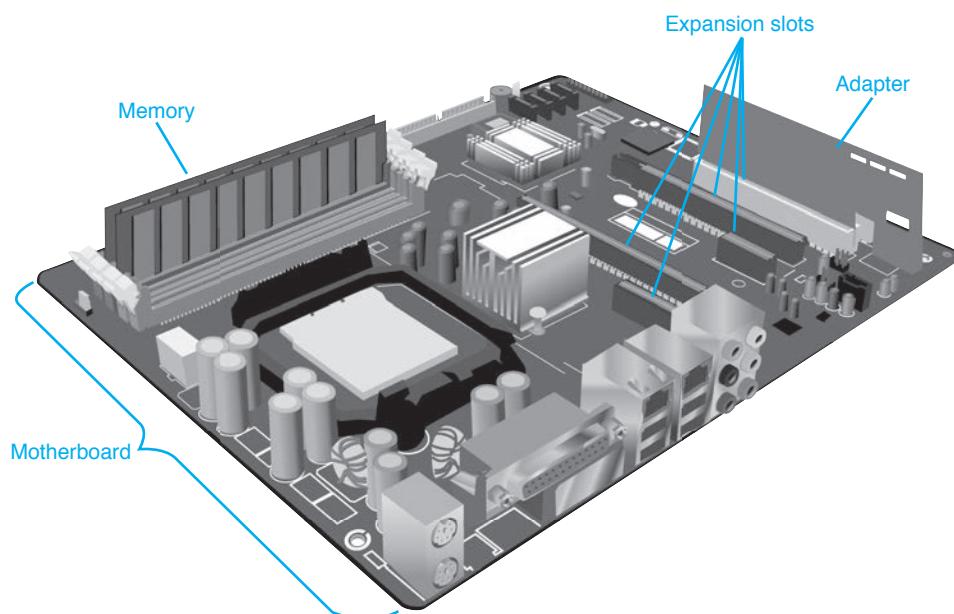
**TECH TIP****How to identify an adapter's function**

Tracing the cable attached to an adapter or looking at the device connected to the adapter can help identify an adapter's function.

The following are the generic steps for installing adapters:

- Step 1.** Always follow the manufacturer's installation directions. Use an antistatic wrist strap when handling adapters. Electrostatic discharge (ESD) can damage electronic parts. (See Chapter 5, "Disassembly and Power," for more details on ESD.)
- Step 2.** Be sure the computer is powered off and unplugged.
- Step 3.** Remove any brackets from the case or plastic covers from the rear of the computer that may prevent adapter installation. Install the adapter in a free expansion slot and reattach any securing hardware.
- Step 4.** Attach any internal device cables that connect to the adapter, as well as any cables that go to an external port on the adapter.
- Step 5.** Attach any internal or external devices to the opposite ends of the cable, if necessary.
- Step 6.** Power on any external devices connected to the adapter, if applicable.
- Step 7.** Reattach the computer power cord and power on the computer.
- Step 8.** Load any application software or device drivers needed for the devices attached to the adapter.
- Step 9.** Test the device connected to the adapter.

See Figure 1.19 for an illustration of a motherboard, expansion slots, memory, and an adapter in an expansion slot.



**FIGURE 1.19** Motherboard with expansion slots and an adapter

## Mice and Keyboards

Input devices, such as the mouse and keyboard, attach to the motherboard. The most common type of **mouse** is an optical mouse, which has optical sensors that detect the direction in which the mouse moves. It uses reflections from light-emitting diodes (LEDs) from almost any surface to detect the mouse location. Mice commonly can be adjusted for sensitivity—how far you have to move the mouse to move the cursor on the screen a desired amount. Mice are rated in dots per inch (DPI), or how many dots (pixels) on the screen the mouse moves per square inch. The higher the number, the more sensitive the mouse. Mouse sensitivity can range from 100 to 6400 DPI; mice with higher DPI numbers are typically used for gaming or design. Figure 1.20 shows a photo of the bottom of an optical mouse.



**FIGURE 1.20** Optical mouse

A **keyboard** is an input device that connects to a port on the motherboard or attaches wirelessly. Features users look for in a keyboard include a separate numeric keypad for those that have to input a great deal of numbers, adjustable tilt legs, and spill resistance. Figure 1.21 shows the type of keyboard and mouse that are commonly used with a tower, desktop, or all-in-one computer.



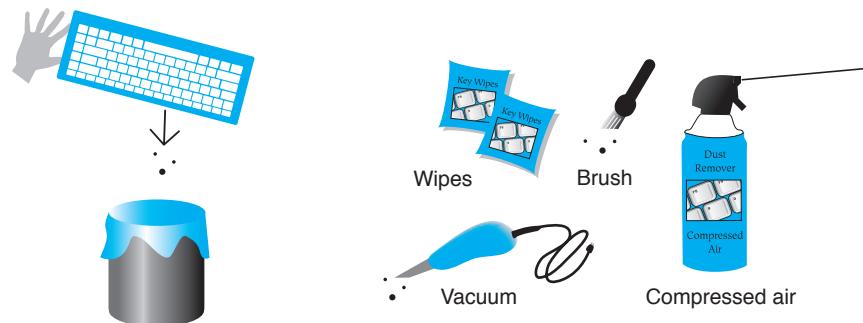
**FIGURE 1.21** Keyboard and mouse

## Mouse and Keyboard Preventive Maintenance

Mouse cleaning kits are available in computer stores, but normal household supplies also work. Use the following procedures to clean an optical mouse:

- > Wipe the bottom with a damp, lint-free cloth.
- > Use compressed air to clean the optical sensors.

Keyboards also need periodic cleaning. Figure 1.22 shows keyboard-cleaning techniques.



1. Turn keyboard upside down and gently shake out debris
2. Clean the keyboard (several options shown)

**FIGURE 1.22** Keyboard cleaning techniques

## Keyboard/Mouse Troubleshooting

One of the easiest ways to determine whether a keyboard is working is to press the or key and watch to see if the keyboard light illuminates. Sometimes an application setting may be causing what appears to be a keyboard problem. Use another application to see if the keyboard is the problem. Keyboards can have LED lights that indicate particular functions. Table 1.3 lists the most common ones. Note that different vendors label the lights in various ways.

**TABLE 1.3** Common keyboard lights

| Associated<br>toggle key | Keyboard light                   | Description   |
|--------------------------|----------------------------------|---|
|                          | Number lock (NUM LOCK)           | Toggles the 10-key pad between digits 0 through 9 and various functions, such as HOME, PG UP, PG DOWN, END, and various arrow keys. |
|                          | Capital letters lock (CAPS LOCK) | Toggles between all uppercase and lowercase letters.  |
|                          | Scroll lock                      | A rarely used key used to prevent scrolling and use of the arrow keys to progress through information displayed.                    |

### TECH TIP

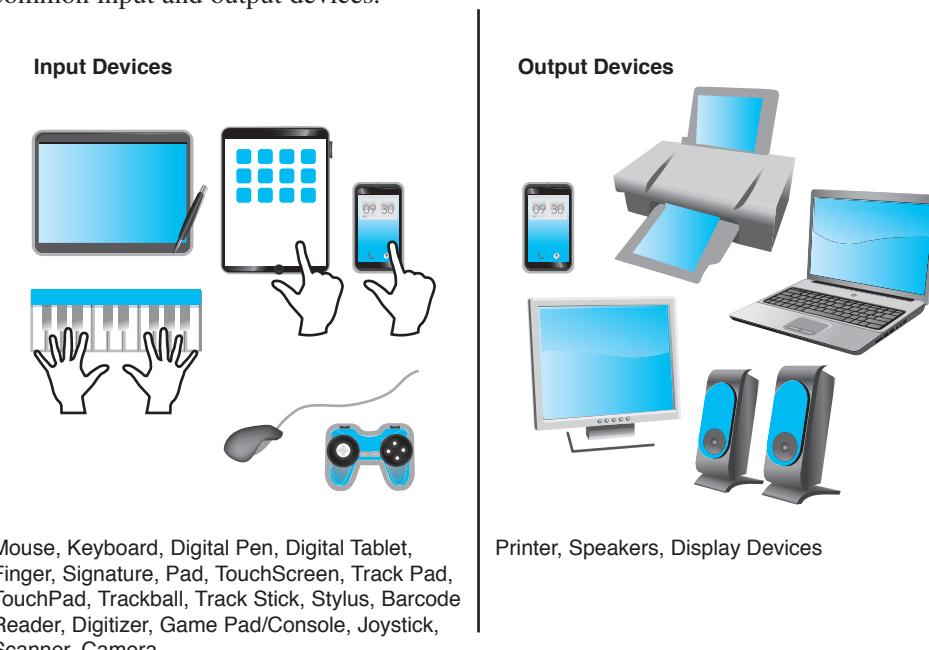
#### One key doesn't work

If a particular key is not working properly, remove the key cap. A small, flat-tipped screwdriver can assist with this. After removing the key cap, use compressed air around the sticky or malfunctioning key.

If coffee or another liquid spills into a PC keyboard, all is not lost. It is sometimes possible to clean a PC keyboard by disconnecting it, removing any batteries it might have, and soaking it in a bathtub or a flat pan of water. Distilled or boiled water cooled to room temperature works best. Afterward, the keyboard can be disassembled and/or scrubbed with lint-free swabs or cloths. However, PC keyboards and mice are normally considered throw-away technology. It is cheaper to get a new one rather than spend a lot of time trying to repair it.

## Common Peripherals

Many devices connect to a computer to provide input, such as a mouse or keyboard, or output, such as a display. Some devices can be both input and output devices, such as smart TVs, set-top boxes (the boxes used to connect a TV to a cable or satellite system), Musical Instrument Digital Interface- (MIDI-) enabled devices (which are electronic musical devices), touchscreens, or printers. In the case of a printer, data is sent from a computer to the printer, and the printer can send data (information), such as an out-of-ink message, back to the computer. Figure 1.23 shows some common input and output devices.



**FIGURE 1.23** Input and output devices

Table 1.4 lists various peripherals that you will see used and attached to computers today.

**TABLE 1.4** Common peripherals

| Peripheral                        | Description  |
|-----------------------------------|--|
| <b>Printer</b>                    | An output device that transfers information such as text and graphics from a computer onto paper or other media.   |
| <b>Flatbed scanner</b>            | An input device that digitizes words or graphics and can be used as a copier. A scanner may have an automatic document feeder ( <b>ADF</b> ) that allows one or more documents to be fed into the scanner.                                   |
| <b>Barcode scanner/QR scanner</b> | A handheld device that reads a code displayed as a series of vertical lines of varying widths or a quick response (QR) code that is a square that has embedded information such as a website within the displayed pattern (see Figure 1.24). |
| <b>VR headset</b>                 | A virtual reality (VR) device that is worn over the eyes to see a high-definition image or situation as part of a game, demonstration, or tour (see Figure 1.25).  |

| Peripheral                          | Description   |
|-------------------------------------|---|
| <b>Touchpad</b>                     | A space on a laptop below the keyboard that is used to control the cursor.  |
| <b>Signature pad</b>                | A digital input device that allows users to digitally sign their names, such as when credit cards are used at a checkout register.  |
| <b>Game controller</b>              | An input device used with games or entertainment systems.   |
| <b>Camera/webcam</b>                | An input device used to capture video images or motion. More information can be found in Chapter 8, "Multimedia Devices."   |
| <b>Microphone</b>                   | An input device used to capture sound. More information can be found in Chapter 8.  |
| <b>Headset</b>                      | An input/output device that commonly has a microphone and headphones, as shown in Figure 1.26.  |
| <b>Projector</b>                    | An output device used to show an image on a screen or wall. The amount of <b>brightness</b> the projector outputs is measured in <b>lumens</b> . Common projector specifications for a business or educational environment is 2500 to 6000 lumens. Use the higher lumens projector for rooms that have windows or lights that cannot be dimmed. |
| <b>External storage drive</b>       | An external hard drive, flash drive, or memory used to store data. These devices are covered in detail in Chapters 6, "Memory," and 7, "Storage Devices."   |
| <b>KVM</b>                          | A switch that enables connectivity of devices so they can be shared between computers (see Figure 1.27). For example, one keyboard, one mouse, and one display and two computers could connect to a keyboard, video, and mouse (KVM) switch.  |
| <b>Magnetic reader/chip reader</b>  | A device that accepts cards that are inserted into the device in order to read data from the card or the chip on the card.  |
| <b>NFC device/tap-to-pay device</b> | A device that accepts cards that are tapped against the display (tap-to-pay) or held in close proximity (near field communication [NFC]) in order to read data from a smartphone or card.   |
| <b>Smart card reader</b>            | A device that can read data from a card that has a magnetic strip such as a credit card, special business card, ID card, or room access card.   |



FIGURE 1.24 Barcode and QR code



**FIGURE 1.25** VR headset



**FIGURE 1.26** Headset



**FIGURE 1.27** KVM switch

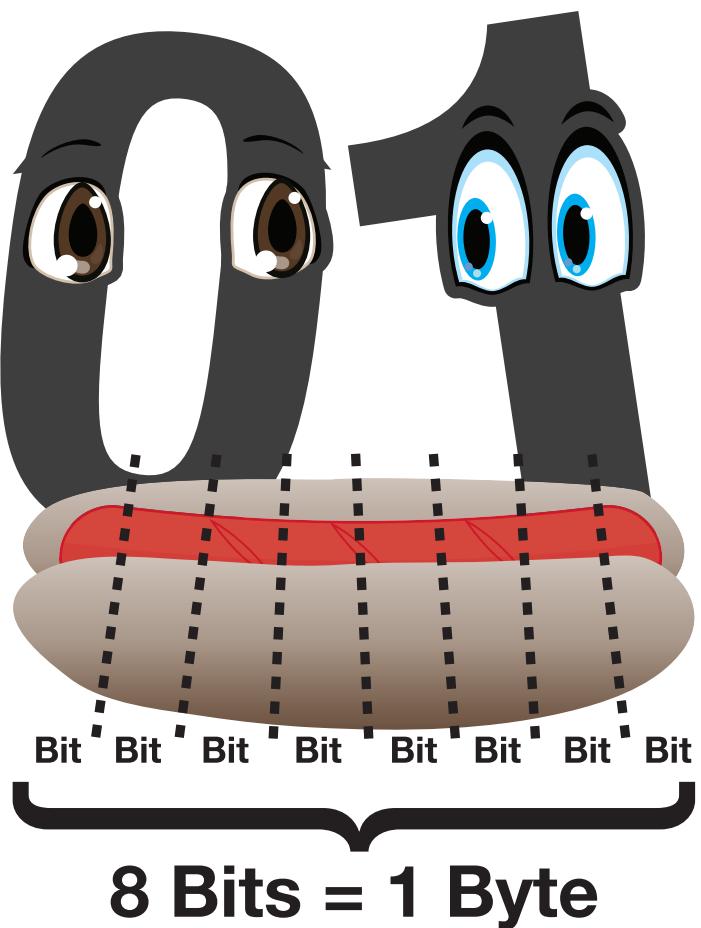
## 1s and 0s

Computers are digital devices. That means they understand 1s and 0s. One 1 or one 0 is known as a **bit**. In actuality, a 1 is simply a voltage level. So, when we type characters into a word processing application, the keyboard translates those characters into voltage levels. Figure 1.28 shows this concept. Notice that each letter is represented by a combination of eight 1s and 0s. Each 1 is a voltage level sent to the motherboard (and components on it). Each 0 is simply the absence of a voltage level.

|                      | D | E        | A        | R        | [space]  | M        | O        | M        |
|----------------------|---|----------|----------|----------|----------|----------|----------|----------|
| What we see          |   | 01000100 | 01000101 | 01000001 | 01010010 | 00100000 | 01001101 | 01010010 |
| What a computer sees |   | ###      | ###      | ###      | ###      | ###      | ###      | ###      |

**FIGURE 1.28** Binary bits

Technicians need to be able to describe capacities such as hard drive capacities and available drive space. Eight bits grouped together are a **byte**. Figure 1.29 shows a hot dog divided into eight sections (which make a big old “byte”).



**FIGURE 1.29** A byte

Approximately 1,000 bytes is a **kilobyte** (kB), as shown in Figure 1.30. 1 kB is 1,024 bytes to be exact, but industry folks simply round off the number to the nearest thousand for ease of calculation. Approximately 1 million bytes is a **megabyte** (MB), but a true megabyte is 1,048,576 bytes. 540 megabytes is abbreviated as 540 MB, or 540 M. Notice in Figure 1.31 that a megabyte stores a lot more 1s and 0s than a kilobyte.

Approximately 1 billion bytes (1,073,741,824 bytes) is a **gigabyte** (GB), which is shown as 1 GB or 1 G. Approximately 1 trillion bytes (1,099,511,627,776 bytes) is a **terabyte**, which is shown as 1 TB or 1 T. Figures 1.32 and 1.33 show how storage capacities get larger.

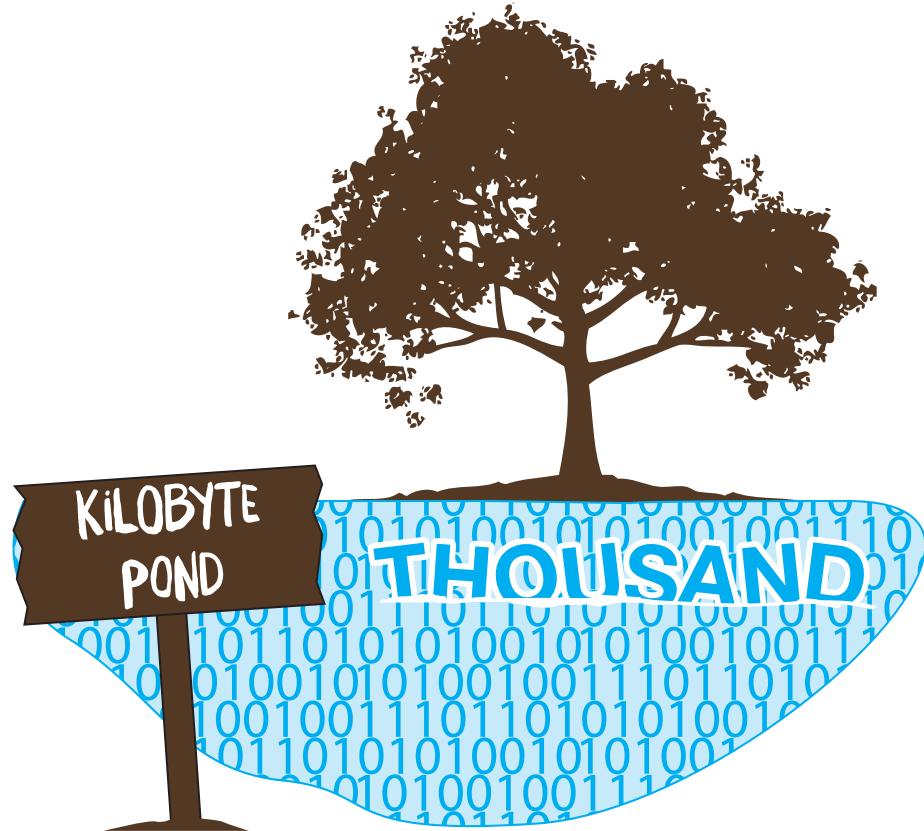


FIGURE 1.30 A kilobyte

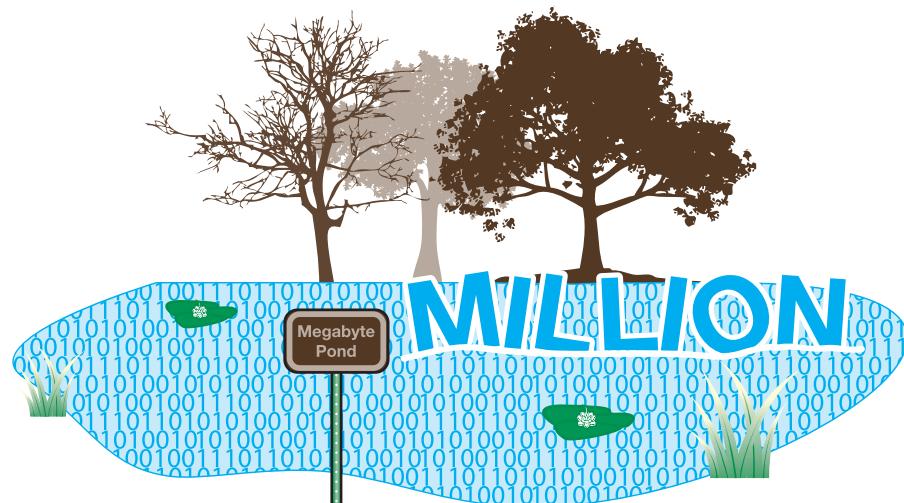


FIGURE 1.31 A megabyte

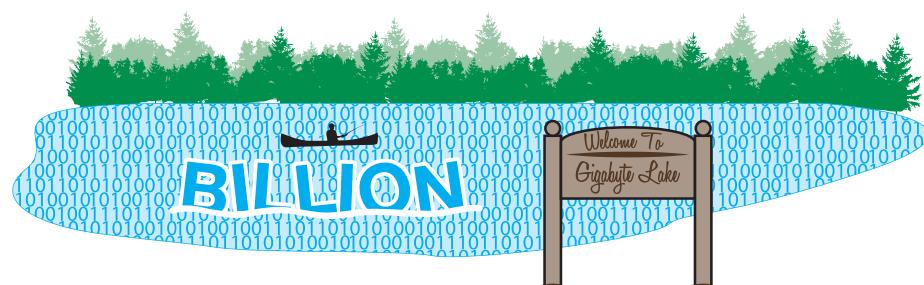


FIGURE 1.32 A gigabyte



**FIGURE 1.33** A terabyte

When information needs to be expressed exactly, binary prefixes are used. For example, when describing the value  $2^{10}$  (1,024), instead of saying this is 1 kilobyte, which people tend to think of as approximately 1,000 bytes, the term kibibyte (KiB) is used. When describing the value  $2^{20}$ , or 1,048,576, the term mebibyte (MiB) is used. Table 1.5 shows the terms used with computer storage capacity and binary prefixes when exact measurements are needed.

**TABLE 1.5** Storage terms and binary prefixes

| Term               | Abbreviation | Description                           |
|--------------------|--------------|---------------------------------------|
| Kilobyte/kibibyte  | KB/KiB       | ~1 thousand bytes/ $2^{10}$ bytes     |
| Megabyte/mebibyte  | MB/MiB       | ~1 million bytes/ $2^{20}$ bytes      |
| Gigabyte/gibibyte  | GB/GiB       | ~1 billion bytes/ $2^{30}$ bytes      |
| Terabyte/tebibyte  | TB/TiB       | ~1 trillion bytes/ $2^{40}$ bytes     |
| Petabyte/pebibyte  | PB/PiB       | ~1,000 trillion bytes/ $2^{50}$ bytes |
| Exabyte/exbibyte   | EB/EiB       | ~1 quintillion bytes/ $2^{60}$ bytes  |
| Zettabyte/zebibyte | ZB/ZiB       | ~1,000 exabytes/ $2^{70}$ bytes       |
| Yottabyte/yobibyte | YB/YiB       | ~1 million exabytes/ $2^{80}$ bytes   |

Frequencies are also important measurements in computers because people want to know how fast their computers, processors, memory, and other parts are operating. Frequencies are shown in similar measurements, but instead of bits (b) or bytes (B), speeds are shown in hertz (Hz). A hertz is a measurement of cycles per second. Something that operates at approximately 1 million cycles per second is said to operate at 1 megahertz (1 MHz). For 1 billion cycles per second, the measurement is known as 1 gigahertz, or 1 GHz. Transfer speeds are commonly shown in bits per second, such as gigabits per second, or Gb/s, or bytes per second, such as in megabytes per second,

or MB/s. Notice the capital letter B to indicate bytes as compared to the lowercase b to indicate bits. These measurements are used in a lot of IT-related hardware and software.

## Safety Notes

Safety is covered in each chapter, especially in Chapter 5, but no book on computer repair can begin without stating that both the technician and the computer can be harmed by poor safety habits. Before beginning any PC service, remove jewelry. To protect yourself and the computer, make sure to power off the computer and remove the power cord when disassembling, installing, or removing hardware or when doing preventive maintenance (cleaning).

### TECH TIP

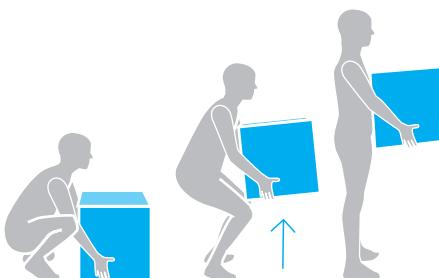
#### Some things should be left alone

Never take apart an older CRT monitor or power supply unless you have been specifically trained on these components.

Technicians can also be harmed when doing menial tasks such as lifting a computer or heavy laser printer. Lifting is a common requirement listed in IT job advertisements or explained during interviews. Technical jobs frequently specify a maximum lifting requirement of 40 to 50 pounds. Use proper safety precautions, such as those shown in Figure 1.34. The type of equipment you need and things you can do to prevent harm to the computer are covered more explicitly in Chapter 5, on power and disassembly.



Remove jewelry  
before working  
inside of a computer



- Bend at the knees
- Use your legs to lift
- Use lifting aids when possible
- Ask for assistance when possible

FIGURE 1.34 Safety tips

## Chapter Summary

- > Many IT roles require detailed knowledge of PC hardware and software.
- > Computer technicians should actively listen, have a positive attitude, and use logic when solving problems.
- > The CompTIA A+ certification requires two exams: 220-1101 and 220-1102. Many people break into the IT field with this certification.
- > IT staff must be proficient at searching for information on the Internet, capturing files, and documenting technical information.
- > Computers consist of hardware (the physical parts), software (the operating system and applications), and firmware (hardware that contains software).

- > A technician needs to be able to identify important computer parts installed in a computer and as standalone parts: case, keyboard, mouse, motherboard, monitor, power supply, hard drive, optical drive, adapter, and memory.
- > A technician needs to know the purposes of common peripherals used in industry: printer, ADF/flatbed scanner, barcode/QR scanner, VR headset, touchpad, signature pad, game controller, camera/webcam, microphone, speakers, headset, projector, external storage device, KVM, magnetic/reader, chip reader, NFC/tap-to-pay device, and smart card reader.
- > Mice, keyboards, and touchscreens are important input devices. Mice and keyboards can be wired or wireless.
- > Safety is important when working on a computer. Power it down and remove the power cord before working inside it.
- > Use proper lifting techniques when servicing equipment.

**A+**  
**CERTIFICATION**  
**EXAM TIPS**

- ✓ Get a good night's rest the night before the exam.
- ✓ Ensure that you are knowledgeable about and proficient with all of the terms and technologies listed in the official CompTIA A+ exam objectives. Some students study for a particular exam by going through the objectives one by one and reviewing the material as they go through.
- ✓ Ensure that you can identify the basic parts of a computer and explain the purpose of each one. Ensure that you know the following parts: hard drive, DVD drive, power supply, motherboard, and RAM.
- ✓ Know the purpose of common peripherals used in the industry: printer, ADF/flatbed scanner, barcode/QR scanner, monitor, VR headset, optical drive, mouse, keyboard, touchpad, signature pad, game controller, camera/webcam, microphone, speakers, headset, projector, external storage device, KVM, magnetic/reader, chip reader, NFC/tap-to-pay device, and smart card reader.
- ✓ Know the following safety procedures: disconnect power, remove jewelry, lifting techniques, and weight limitations.
- ✓ Review the "Soft Skills" section at the end of the chapter. Make sure you know what open-ended questions are.

## Key Terms

|                         |    |                 |    |                   |    |
|-------------------------|----|-----------------|----|-------------------|----|
| adapter                 | 14 | gigabyte        | 22 | operating system  | 9  |
| ADF                     | 18 | hard drive      | 11 | optical drive     | 11 |
| barcode scanner         | 18 | hardware        | 9  | PC                | 9  |
| BIOS                    | 10 | headset         | 19 | power supply      | 10 |
| bit                     | 21 | keyboard        | 16 | printer           | 18 |
| brightness              | 19 | kilobyte        | 22 | projector         | 19 |
| byte                    | 21 | KVM switch      | 19 | QR scanner        | 18 |
| camera                  | 19 | lumens          | 19 | RAM               | 13 |
| chip reader             | 19 | magnetic reader | 19 | signature pad     | 19 |
| device driver           | 9  | megabyte        | 22 | smart card reader | 19 |
| DVD drive               | 11 | memory          | 13 | software          | 9  |
| expansion slot          | 14 | microphone      | 19 | tap-to-pay device | 19 |
| external storage device | 19 | monitor         | 10 | terabyte          | 22 |
| firmware                | 10 | motherboard     | 13 | touchpad          | 19 |
| flatbed scanner         | 18 | mouse           | 16 | VR headset        | 18 |
| game controller         | 19 | NFC device      | 19 | webcam            | 19 |

## Review Questions

1. Match each part to the appropriate description.

|                   |   |
|-------------------|---|
| ____ motherboard  | a. Converts AC to DC                    |
| ____ RAM          | b. Holds the most data                  |
| ____ DVD drive    | c. Has the most electronics             |
| ____ hard drive   | d. Fits in an expansion slot            |
| ____ adapter      | e. Contents disappear when power is off |
| ____ power supply | f. Holds a disc                         |
2. Which device would commonly be found in a laptop?  
[ mouse | barcode scanner | touchpad | signature pad ]
3. Which of the following are important suggested Internet search tips? (Choose two.)
  - a. Try another search engine if the first one does not provide satisfactory results.
  - b. Use as many common words as possible, like the, in, at, or for.
  - c. Put quotation marks around two or more words that might be found consecutively in output.
  - d. Use as few words as possible.
  - e. Avoid using the name of the equipment manufacturer.
4. Which type of memory is commonly found on a motherboard?  

---
5. When lifting a heavy computer, you should squat, bend at the knees, and use your legs to lift. [ T | F ]
6. How many tests must a person take in order to be A+ certified?  
[ 0 | 1 | 2 | 3 | 4 ]
7. Is the following question open ended or closed ended? You say your computer has been running slowly since Monday. Which applications have you installed this week? [ open ended | closed ended ]
8. List one example of having a positive attitude.  

---

---

---
9. Which of the following devices are common output devices? (Select all that apply.)  
[ digital piano | speakers | display | stylus | track stick | barcode reader | printer ]
10. People who work with computers might be expected to lift up to how many pounds?  
[ 10 to 20 | 20 to 30 | 30 to 40 | 40 to 50 ]
11. Which Microsoft Windows application could be used to create a text file?  
[ Textpad | Notepad | WriteIt | NoteIt ]
12. Which Windows tool can be used to capture the screen?  
[ Notepad | Bluetooth | Internet Explorer | Snipping Tool ]
13. Rewrite the following conversation into an open-ended question.  
Technician: Good morning. I have a service log that states you are getting an error message whenever you access a PDF file. Have you done your Acrobat updates lately?  

---

---

---

14. List one procedure you would do to help an erratic optical mouse.

---

---

15. Match the capacity to the description.

|                |                                   |
|----------------|-----------------------------------|
| _____ bit      | a. 8 bits                         |
| _____ kilobyte | b. a 1 or a 0                     |
| _____ megabyte | c. approximately 1,000 bytes      |
| _____ byte     | d. approximately 1 million bytes  |
| _____ gigabyte | e. approximately 1 trillion bytes |
| _____ terabyte | f. approximately 1 billion bytes  |

16. Match the peripheral to the description.

|                       |  |
|-----------------------|--|
| _____ flatbed scanner | a. has an ADF                                      |
| _____ KVM             | b. might send you to a web page                    |
| _____ QR scanner      | c. used to capture video                           |
| _____ touchpad        | d. allows two computers to share multiple monitors |
| _____ webcam          | e. found on a laptop near the keyboard             |

17. What is a feature of an optical mouse?

- a. LEDs
- b. contacts
- c. volatility
- d. electrical conversion

18. Which device is normally found inside a computer?

[ touchpad | printer | headset | hard drive ]

19. Which device normally can be seen if looking inside a desktop computer with the cover off and when normally looking at the computer?

[ hard drive | motherboard | DVD drive | RAM ]

20. Where can you find RAM in a desktop computer?

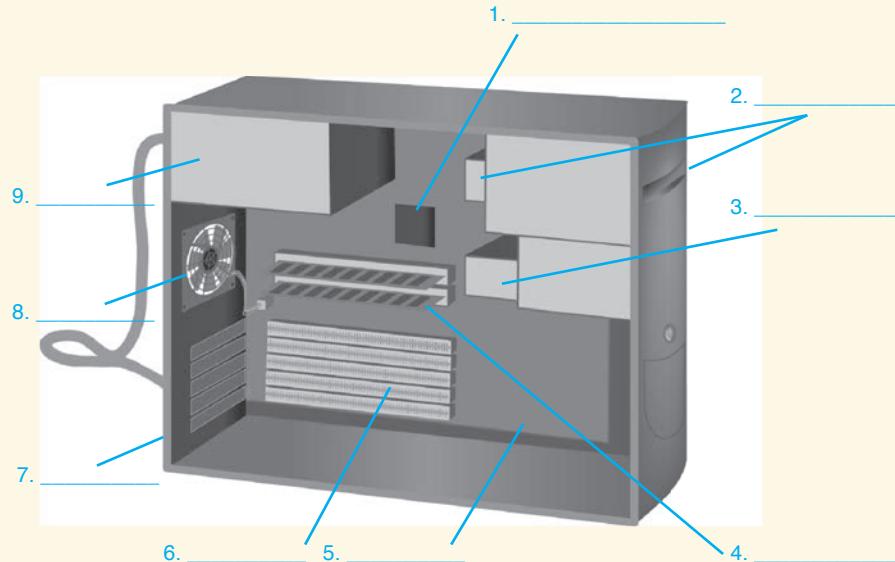
- a. inside the power supply
- b. inserted into the motherboard
- c. below the keyboard
- d. in a KVM

## Exercises

### Exercise 1.1 Identifying Tower Computer Parts

**Objective:** To identify various computer parts correctly

**Procedure:** Identify each computer part in Figure 1.35.



**FIGURE 1.35** Tower computer parts identification

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

6. \_\_\_\_\_

7. \_\_\_\_\_

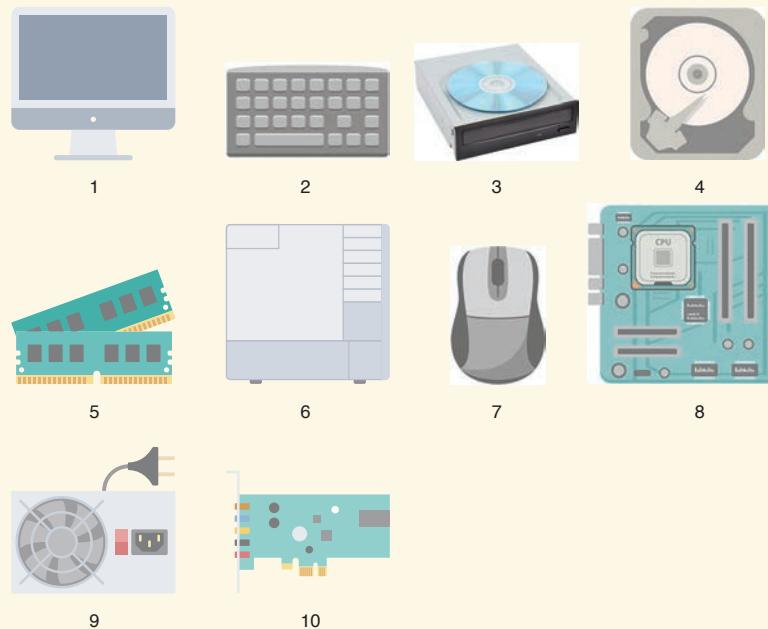
8. \_\_\_\_\_

9. \_\_\_\_\_

### Exercise 1.2 Identifying Computer Parts

**Objective:** To identify various computer parts correctly

**Procedure:** Identify each computer part in Figure 1.36.



**FIGURE 1.36** Computer parts identification

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_

## Activities



### Internet Discovery

**Objective:** To obtain specific information from the Internet regarding a computer or its associated parts

**Parts:** Computer with Internet access

**Procedure:** Using the Internet, locate technical information about a computer. Answer the following questions based on the retrieved information. Note that you may need to open more than one document in order to answer the questions.

**Questions:**

1. What is the name of the computer for which you found technical information?
- 

2. How much RAM comes with the computer?
- 

3. Which URL did you use to find this information?
- 

4. Which search term(s) would you use for the following scenario? An HP Windows 10 computer has a Samsung ML-2160 laser printer attached. This printer supports both wired and wireless printing. The computer that is wired to the printer can print just fine, but no wireless devices in the house can access or even see the printer.
- 

5. Which search term(s) would you use in a search engine to help a friend who has accidentally deleted a file on a Windows 7 computer?
- 

6. Which search terms would you use to find a video that shows you how to add an application to a Windows 8.1 desktop?
- 



## Soft Skills

**Objective:** To enhance and fine-tune a future technician's ability to listen, communicate in both written and oral forms, and support people who use computers in a professional manner

**Procedure:**

1. In a team environment, list three qualities that are important in a computer technician. Create scenarios that demonstrate these qualities. Share these findings in a clear and concise way with the class.
2. In a team environment, list three qualities that are not good practices for computer technicians. Create scenarios that demonstrate these qualities. Share these findings in a clear and concise way with the class.



## Critical Thinking Skills

**Objective:** To analyze and evaluate information as well as apply learned information to new or different situations

**Procedure:**

1. Find an advertisement for a computer in a local computer flyer, in a newspaper, in a magazine, in a book, or on the Internet. List the components you know in one column and the components you do not know in another column. Select one component you do not know and research that component. On a separate piece of paper, write a description of the component, based on your research, and then share it with at least one other person. Write the name of the person with whom you shared.
2. Why do you think that many computer components are considered “throw-away” technology? List your reasoning. In groups of three or four, share your thoughts. Nominate a spokesperson to share your group reaction in two sentences or less.
3. One device touts a transfer speed of 100 Mb/s, whereas another device advertises 50 MB/s. Compare the two devices' transfer speeds and indicate which one is faster. Locate a component you have or would like to have. Compare products paying particular attention to the transfer speed. Document your findings.

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