

# Computer Service and Repair

Sixth Edition

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Chuck Easttom • Richard M. Roberts

**Correlates to CompTIA A+ 220-1101/220-1102 Objectives**

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Publisher  
**The Goodheart-Willcox Company, Inc.**  
Tinley Park, IL  
[www.g-w.com](http://www.g-w.com)



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Library of Congress Control Number: 2023940632

ISBN 979-8-88817-184-4

1 2 3 4 5 6 7 8 9 – 25 – 28 27 26 25 24 23

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# Preface

Support for PCs and mobile devices has evolved into one of the largest service industries in the world, and the demand for skilled technicians to maintain, support, and upgrade PCs and mobile devices is ever-growing. Working as a PC technician is a rewarding and challenging career that can take you anywhere in the world and is the perfect place to start if you wish to learn computer networking, programming, administration, or any of the computer sciences. A good foundation in computer technology provides a base of knowledge that will assist you in other technical areas, such as networking and cybersecurity.

*Computer Service and Repair* provides an introduction for becoming a certified support professional in the IT industry. The text focuses on configuration, troubleshooting, repair, maintenance, and support for desktop computers, mobile devices, operating systems, application software, and printers. In addition, it provides critical content for becoming a professional, courteous, and successful support technician.

The text is aligned to CompTIA A+ Certification 220-1101 (Core 1) and 220-1102 (Core 2) Exam Objectives. The CompTIA A+ Certification Exam is an industry-recognized certification and starting point for a career in IT. The CompTIA A+ Certification is also a CompTIA Core Skills Certification, meaning it provides a groundwork for future career growth by going beyond just PC repair to prepare candidates for troubleshooting and problem-solving for a wide variety of scenarios, including those associated with networking, operating systems, mobile devices, and security.

By studying *Computer Service and Repair* and using the ancillary Study Guide and Lab Manual, you can improve your level of preparation to earn an industry-recognized certification. Upon completing this course, you should be able to

- recall and identify essential components of a personal computer (PC);
- differentiate between operating system releases and understand how they interact with the computer on which they are installed;
- understand how motherboards operate and how they interact and work with individual components;
- compare, select, troubleshoot, and install a central processing unit;
- troubleshoot, replace, and understand the functionality of power supplies;
- upgrade, install, and understand the construction and operation of memory;
- list and identify common input devices and their interactions with computers;
- compare, troubleshoot, and install monitors and video adapter cards;
- describe characteristics of audio data and install sound cards;
- differentiate, troubleshoot, and replace both magnetic and solid-state storage devices;
- compare, contrast, and comprehend the construction and operation of optical storage technologies;
- troubleshoot and explain the operation principles of various printer types;
- compare, contrast, troubleshoot, and replace laptop and mobile device components;
- understand the differences among Internet-connection methods and troubleshoot modems;
- discuss methods for physically securing a workstation and enforcing authentication;
- categorize malware and list common security applications;
- diagnose a variety of commonly encountered PC symptoms, differentiate between Windows diagnostic utilities, and apply preventive maintenance procedures;
- differentiate among and apply various data recovery techniques;
- discuss the benefits of a computer network and differentiate among common network devices;

- understand the communication process between networks and identify network media and tools;
- manage administration functions of a network;
- recall network operation;
- design and install a SOHO network;
- apply communication, professionalism, and customer-support skills;
- actively and efficiently prepare for and pass the CompTIA A+ Certification Exam; and
- understand employment options and requirements for a professional career.

Studying *Computer Service and Repair* will provide you with the knowledge for earning professional credentials for technical support and operational roles, help you learn to connect users to the data they need to do their jobs, and prepare and validate your foundational skills required as an IT professional.

## About the Authors

**Dr. Chuck Easttom** is the author of 41 books, including several on computer security, forensics, and cryptography. He is also an inventor with 25 patents and the author of over 70 research papers. He holds a D.Sc. in cybersecurity; a Ph.D. in Nanotechnology; a Ph.D. in computer science; and master's degrees in applied computer science, education, and systems engineering. He is a senior member of both the IEEE and the ACM. He is also a Distinguished Speaker of the ACM and a Distinguished Visitor of the IEEE. Dr. Easttom is currently an adjunct professor for Georgetown University and for Vanderbilt University.

**Richard M. Roberts** has designed curriculum; taught electricity, electronics, and computer technology; and supervised technical teachers for nearly 50 years. He was an adjunct instructor at South Florida State College. He has divided his time between consulting, teaching students and instructors, and writing instructional materials. He also coauthored the *Networking Fundamentals* textbook and the *Electricity and Electronics* textbook. He holds active CompTIA A+, Network+, and Security+ certifications.

# Reviewers

The author and publisher wish to thank the following industry and teaching professionals for their valuable input into the development of *Computer Service and Repair*.

Dr. Marsha Craig, Ed.D.  
Calhoun Community College  
Decatur, Alabama

Franklin Fondjo Fotou  
Langston University  
Langston, Oklahoma

Julie Hester  
Northeast Alabama Community College  
Rainsville, Alabama

Steven R. Hultgren  
Johnson County Community College  
Parkville, Missouri

Valeria McLain  
Lake Superior College  
Duluth, Minnesota

Stephen Paduhovich  
York County School of Technology  
York, Pennsylvania

Veronica Pulido, A+, CCNA  
San Elizario High School  
San Elizario, Texas

Kenneth Schaffer  
Southwest Technical Institute  
Sioux Falls, South Dakota

Brian Volkmuth  
St. Cloud Technical and Community College  
St. Cloud, Minnesota

Anthony Zampino  
Kent State University Trumbull  
Warren, Ohio

# CompTIA A+ Certification

## How to Become CompTIA Certified

This training material can help you prepare for the CompTIA A+ Certification 220-1101 (Core 1) and 220-1102 (Core 2) Exams. The Computing Technology Industry Association (CompTIA) is a nonprofit information technology (IT) trade association, and its certifications are designed by subject-matter experts. Each certification is vendor-neutral, covers multiple technologies, and requires demonstration of skills and knowledge widely sought after by employers in the IT industry. There are four general steps to achieving CompTIA certification:

1. Choose the desired IT certification from CompTIA
2. Familiarize yourself with the exam, its objectives, and the types of questions used
3. Begin studying, learning, and preparing for the exam
4. Register for the exam, read and sign the Candidate Agreement, and take and pass the exam

For more information about CompTIA certifications, such as industry acceptance, benefits, or updates, visit [certification.comptia.org](https://certification.comptia.org).

## CompTIA A+ Correlation Charts

Complete mappings (correlation charts) of the CompTIA A+ Exam Objectives to the content of the *Computer Service and Repair* textbook are located on the G-W website at [www.g-w.com](https://www.g-w.com). On this website, you will find one correlation chart per exam:

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

Each chart lists the exam objectives and corresponding page numbers where you can find the related content.



# How to Use This Text

The *Computer Service and Repair* text and accompanying resources will help you prepare for the CompTIA A+ Certification Exam by teaching you the basics of PC maintenance, troubleshooting, repair, and component replacement. Additionally, you will learn about networking, have access to an A+ practice exam, and understand qualities employers seek in job candidates while maintaining realistic expectations about employment. These are concepts that you will need to understand for not only the certification exam, but also your career as an information technology professional.

Each chapter in *Computer Service and Repair* begins with a set of Learning Outcomes that outline the goals you should focus on accomplishing by the time you complete each chapter. For each outcome, there is a corresponding top-level heading, review question, and set of summary bullet points to help ensure you understand the topics covered in the chapter. There is also a list of CompTIA A+ Certification Exam Objectives in the beginning of each chapter that outlines the CompTIA content to be discussed.

In addition to Learning Outcomes, the chapter-opening material also lists a set of key terms discussed throughout the material. These terms are in boldface when they appear in the content to make them easily distinguishable from the rest of the text. There are also important words or phrases printed in italic text to which you should pay special attention and consideration. Studying these terms will help you understand the material and better prepare you for certification and employment.

Each chapter concludes with a summary of important points to remember, organized by level-one headings. This summary will help you review important topics from each section of the chapter.

The following suggested guidelines will help you make the most of your introduction to computer maintenance and repair.

- Read the Learning Outcomes listed in the chapter opener. Each outcome is tied directly to a heading within the content as well as a set of summary bullet points and end-of-chapter review questions. The connection of Learning Outcomes throughout the content helps you focus and apply important information as you read each chapter.
- Read the list of CompTIA A+ Objectives in the chapter-opening material. These objectives are also noted in the margin with an icon where the material is covered. Use the list of objectives in the chapter opener as a checklist to take inventory of CompTIA standards you understand as well as information you need to review. The icons in the margins are there to direct you to the coverage of each objective for review.
- Pay attention to the illustrations. Each illustration is strategically created to highlight important information. By studying these, you will extend your learning and improve retention and application of the content.
- Read all A+ Note, Tech Tip, and Caution features as you progress through the material. This information helps supplement your learning by highlighting study tips, providing useful industry information, and helping you ensure personal and machine safety when working with computing devices.
- Review the summary at the end of each chapter. This will help you retain important information from the chapter.
- Answer the review questions and sample A+ questions in the end-of-chapter material. These questions provide exposure to the types of questions likely to be on the CompTIA A+ Certification Exam. By practicing these questions, you increase your chances of successfully earning CompTIA A+ certification.

# New to This Edition

The sixth edition of *Computer Service and Repair* was revised to align to current CompTIA A+ Exam Objectives. Additionally, updates were made in each chapter to provide coverage of the newest operating systems and recent technological developments in computing and mobile devices.

- **Chapter 1 Introduction to a Typical PC** was reorganized and streamlined to present data in a more logical fashion. Similar topics now appear closer together than in the previous edition and outdated or irrelevant material has been removed from the chapter.
- **Chapter 2 Operating Systems** underwent significant changes in this edition. Not only were Windows 7 and Windows 8 removed, but short introductions to Windows 11 were also provided in anticipation of wider adoption. Additionally, the macOS and Linux handbook that appeared as an appendix in the previous edition has been relocated and included in this chapter. As a result, the existing macOS and Linux sections of this chapter have grown.
- **Chapter 3 Motherboards** was reorganized to streamline the chapter and group similarly related topics together.
- **Chapter 4 Central Processing Unit (CPU)** received a general update to reflect today's technological advancements in processing. Like other chapters, Chapter 4 was also reorganized to streamline the reading and group similar topics under one heading.
- **Chapter 5 Power Supplies** received updates to both content and visuals. Additionally, the chapter was reorganized in an effort to group similar topics closer together.
- **Chapter 6 Memory** was updated to include details about DDR5 memory. Additionally, outdated types of memory were truncated or removed as necessary.
- **Chapter 7 Input Devices** received a general update to remove references to outdated operating systems and devices. Additionally, a new section dedicated to managing mobile device hardware and components was added.
- **Chapter 8 Video Systems** received substantial reorganization to group similar topics together and reduce the number of top-level headings and objectives. Additionally, outdated topics such as CRTs were removed from the chapter.
- **Chapter 9 Audio Systems** received a minor update, largely to the content and visuals. Examples of new content include a dedicated Windows Control Panel section as well as information about audio capture cards.
- **Chapter 10 Magnetic and Solid-State Storage Devices** received a general update to place greater emphasis on solid-state media. Additionally, information about partition systems and disk-centric commands was revised to reflect today's technology.
- **Chapter 11 Optical Storage Technology** was updated to reflect advances in optical technology and add material about digital information rights.
- **Chapter 12 Printers** was updated to reflect modern aspects in printing, specifically information about 3D printing and printing languages.
- **Chapter 13 Laptops and Mobile Devices** received extensive updates to reflect today's technological landscape. Much of the new information added was about mobile devices, including new operating system information, security topics, and troubleshooting. Additionally, the symptoms listed at the end of the chapter content were reorganized to merge similar symptoms and make space for additional symptoms.
- **Chapter 14 Modems and Transceivers** was revised to begin phasing out discussion of outdated equipment. While legacy topics such as dial-up connectivity have been retained for historical and comparative reasons, these obsolete topics have been pared down substantially to provide space for current topics such as cable access and 5G.
- **Chapter 15 Physical Security and Authentication** was revised to provide expanded information about topics such as physical security measures, including bollards and access control vestibules. Additionally, a significant amount of authentication information was added, including a discussion of HSMs. The content about passwords was also expanded to include new information such as rainbow tables. Finally, the social engineering section was relocated to a location where it makes more sense for the reader.
- **Chapter 16 Security Applications and Malware** was updated to include information about additional malware types, social engineering attacks, and web-based threats according to the CompTIA A+ Certification objectives.



- **Chapter 17 PC Troubleshooting** was updated to include expanded discussion of the DiskPart utility. Other areas were revised to provide more general discussion of some troubleshooting tips. Additionally, information about installing and upgrading operating systems has been merged with appropriate sections of existing content as opposed to being a small, standalone section.
- **Chapter 18 Data Recovery** was updated to reflect the current menu and utility names in Windows 10 and remove references to outdated operating systems.
- **Chapter 19 Introduction to Networking** was reorganized to group similarly related items together. Additionally, some top-level headings were renamed to better reflect the content contained within them. Some material, such as DNS, was introduced to provide foundational material for the student that can be helpful in upcoming networking chapters. Finally, much of the visuals have been updated to provide students with contemporary examples of devices.
- **Chapter 20 Network Communication, Media, and Tools** received numerous content updates, including discussion of coaxial RG-8 and Category 8 cabling. Concepts such as DSL and cable modems, optical network terminals, and software-defined network were also added to make content easier to understand without having to look to a different chapter. Finally, additional protocols were added to the discussion of protocol suites.
- **Chapter 21 Managing Networks**, previously titled *Network Administration*, underwent an extensive reorganization to provide a more logical flow of information and reduce redundancy. Similar topics are now grouped under top-level, overarching headings instead of having multiple sections of tangentially related material.
- **Chapter 22 Network Operation and Connectivity**, previously titled *Wide Area Network (WAN)*, was revised to be more generalized, which is reflected in the new title. In previous editions, this chapter focused on WAN management, but many of the concepts were applicable to other network types. Additionally, outdated cloud services and methods, such as those specific to Windows 7, were removed from this edition.
- **Chapter 23 Small-Office/Home-Office (SOHO) Networking** was updated to reflect new information in SOHO networking and provide fresh screen captures. Specifically, the material about cloud services was expanded to include discussion of topics such as VDI and remote access.
- **Chapter 24 Customer Support, Communication, and Professionalism** underwent light revisions, including the addition of ticketing systems and an expanded section about document types. Additionally, the change-management section was updated to include example risk levels.
- **Chapter 25 CompTIA A+ Certification Exams Preparation** was updated to reflect the domain percentages of the 220-1101 and 220-1102 exams. Both practice exams within the chapter were revised to match those percentages.
- **Chapter 26 Employment and Advanced Education** received a general content update to reflect new certifications and remove outdated certifications. Additionally, the section on professional attire was revised to be more gender-neutral. Finally, information about job searches was unified to one section.

# Focus on Certification

*Computer Service and Repair* is designed with certification in mind. In addition, it guides students through upgrading, configuring, troubleshooting, and networked desktop and mobile computers and devices.

This text has been updated to reflect current programs, systems, and practices in the information technology industry. It adheres to the CompTIA A+ 220-1101 and 220-1102 Exam Objectives, ensuring students are up to date with the most recent testing domains.

## Chapter Opening Materials

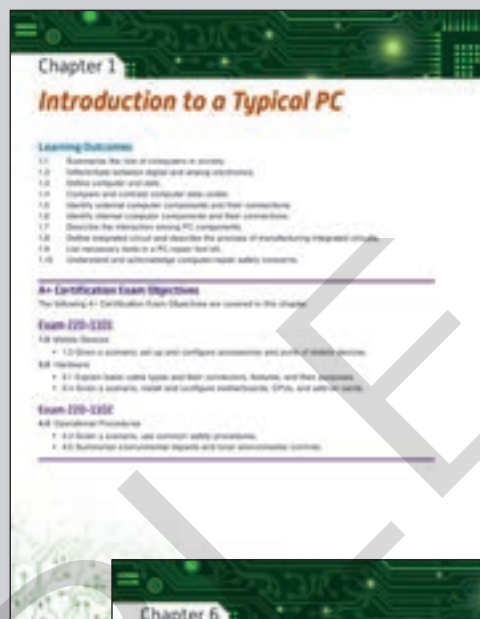
At the beginning of each chapter, a list of outcomes guides your learning as you read the material presented. Each outcome is aligned with a content heading, as well as with a summary bullet point and review question at the end of the chapter. This alignment provides a logical flow through each page of the material so you may build on individual knowledge as you progress through the chapters.

## A+ Objectives

CompTIA A+ Exam Objectives are listed in the opening of each chapter to engage learning and highlight important testing points presented in the content. Use the list of objectives as a checklist to verify your understanding of the A+ standards as presented in the material. In addition, objectives are noted by an icon in the margin where material is covered and provides a visual clue as to where each objective is met.

## Tech Tip

The Tech Tip feature highlights supplemental information about practical application of networking concepts. These tips vary in their scope, ranging from simple synonyms or definitions of discussed material to real-world advice that provides you with insight that will help in your assignments and careers.



# A+ Note

The A+ Note feature provides tips and facts regarding the CompTIA A+ Certification Exams. These tips will help you as you study for the A+ Certification Exams.

# Caution!

The Caution! feature highlights important personal- and machine-safety information you need to know before performing specific tasks. These features alert you to actions that may cause personal injury or damage to a computer or electronic device.

# End-of-Chapter Content

End-of-chapter material provides an opportunity for review and application of concepts.

- A concise **Summary** reiterates the Learning Outcomes and provides a brief review of the content for your reference. This helps you focus on important concepts presented in the text.
- **Review** questions highlight basic concepts presented in the chapter so you can evaluate your understanding of the material.
- **Sample A+ Exam Questions** challenge you to answer questions similar to those you will face on the CompTIA A+ Certification Exam, providing a sample of what to expect on the exam.





# TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

## Student Tools

### Student Text

*Computer Service and Repair* presents the fundamentals of computer maintenance and repair as well as introductory networking theory and concepts to prepare students for the 220-1101 and 220-1102 CompTIA A+ Certification Exams.



### Lab Workbook

- Hands-on practice includes questions and activities.
- Projects offer students opportunities to work on various computer troubleshooting and administration challenges.

### Study Guide

- Practice exercises reinforce concepts and skills learned in the corresponding textbook chapters.
- A CompTIA A+ Reference Guide helps students study and prepare for the CompTIA A+ Exam.

### G-W Digital Companion

For digital users, e-flash cards and vocabulary exercises allow interaction with content to create opportunities to increase achievement.

### Online Learning Suite

- Online student text, study guide, and lab manual, along with rich supplemental content, bring digital learning to the classroom.
- All instructional materials are accessible at home, at school, or on the go.

## Instructor Tools

### LMS Integration

Integrate Goodheart-Willcox content within your Learning Management System for a seamless user experience for both you and your students. EduHub LMS-ready content in Common Cartridge® format facilitates single sign-on integration and gives you control of student enrollment and data. With a Common Cartridge integration, you can access the LMS features and tools you are accustomed to using and G-W course resources in one convenient location—your LMS.

G-W Common Cartridge provides a complete learning package for you and your students. The included digital resources help your students remain engaged and learn effectively:

- **Digital Textbook**
- Online **Lab Manual content**
- Online **Study Guide content**
- **Drill and Practice** vocabulary activities

When you incorporate G-W content into your courses via Common Cartridge, you have the flexibility to customize and structure the content to meet the educational needs of your students. You may also choose to add your own content to the course.

For instructors, the Common Cartridge includes the Online Instructor Resources. QTI® question banks are available within the Online Instructor Resources for import into your LMS. These prebuilt assessments help you measure student knowledge and track results in your LMS gradebook. Questions and tests can be customized to meet your assessment needs.

### Online Instructor Resources

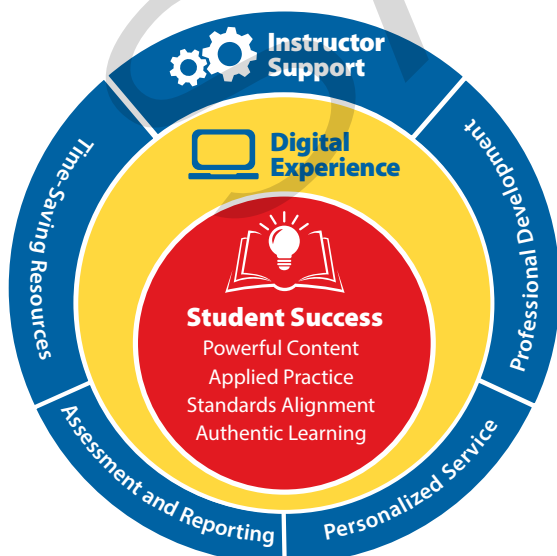
- The **Instructor Resources** provide instructors with time-saving preparation tools such as answer keys, editable lesson plans, and other teaching aids.
- **Instructor's Presentations for PowerPoint®** are fully customizable, richly illustrated slides that help you teach and visually reinforce the key concepts from each chapter.
- Administer and manage assessments to meet your classroom needs using **Assessment Software with Question Banks**, which include hundreds of matching, completion, multiple choice, and short answer questions to assess student knowledge of the content in each chapter.

See [www.g-w.com/computer-service-repair-2025](http://www.g-w.com/computer-service-repair-2025) for a list of all available resources.

### Professional Development

- Expert content specialists
- Research-based pedagogy and instructional practices
- Options for virtual and in-person Professional Development

# G-W EduHub®



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